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MINERALS YEARBOOK

1951

Prepared by the staff of the
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UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON : 1954

For sale by the Superintendent of Documents, U. S. Government Printing Office
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FOREWORD

The year 1951 was one of generally accelerating activity in the minerals industries in the United States, notably in those concerned with strategic commodities. This growth was engendered by the rapidly expanding materiel needs of the free world in prosecuting its drive against aggression, particularly in Korea. This MINERALS YEARBOOK, the latest in an extended series of annual volumes, records the accomplishments of the minerals industries in that year. As such, I hope that the volume will serve well those in industry, in Government, and among the general public who have need for basic economic data on minerals. Such changes as have been made in this volume over previous editions were in line with the Bureau of Mines' continuing efforts to enhance the usability of its data through improvement of its methods of collection, processing, and presentation of data.

J. J. FORBES, *Director.*

PREFACE

The present format and content of the MINERALS YEARBOOK have developed over the years because of the ideas and efforts of many individuals, in industry, private organizations, and Government agencies—both State and Federal. Drawing upon these contributors, its preparation each year has involved continued efforts by the Bureau of Mines to improve both the quality and manner of presentation of the information incorporated into the volume. As a practicable matter, it has not always been possible to incorporate all appropriate suggestions outstanding into any volume. Further, some suggestions, while meritorious in themselves, could not be adopted because they were not in accordance with the general tenor of the Yearbook. Nevertheless, the Bureau of Mines hopes and urges that all users of the MINERALS YEARBOOK continue to send to the Bureau for consideration any and all suggestions they may have regarding improvement of these annual volumes.

Questionnaires answered by mineral producers and users are the source of most of the information herein. Other sources are the business press, trade associations, scientific journals, international organizations, and Government agencies. In particular, data on foreign trade are obtained from the United States Department of Commerce, and data on foreign production and developments largely through the United States Foreign Service.

The reader is reminded that the purpose of the MINERALS YEARBOOK is to provide a convenient and reasonably comprehensive reference summary for United States mineral activity in the subject year. It is not the source of prompt statistics from canvasses conducted by the Bureau of Mines. The first publication of Bureau statistics is generally a release issued before the individual chapter preprints. Such releases are available from the Publications Distribution Section, U. S. Bureau of Mines, 4800 Forbes Street, Pittsburgh 13, Pa. The individual MINERALS YEARBOOK chapter preprints, which are issued months before the entire volume, are sold for nominal amounts through the offices of the Superintendent of Documents. Bibliographic lists of such current releases are available in the monthly and annual supplements to the List of New Publications, Bureau of Mines, and in the Monthly Catalog of U. S. Government Publications, sold by the Superintendent of Documents, Government Printing Office.

Cooperating with the Bureau of Mines in the conduct of statistical canvasses in their respective States were the following State officials to whom grateful acknowledgment is made:

Alabama: Walter B. Jones, State geologist, Geological Survey of Alabama, University.
Alaska: Leo Saarela, commissioner of mines, Department of Mines, Juneau.
California: Olaf P. Jenkins, chief, Division of Mines, and State mineralogist, Department of Natural Resources, San Francisco.

Florida: Herman Gunter, director, Florida Geological Survey, Tallahassee.
Georgia: Garland Peyton, director, Department of Mines, Mining and Geology, Atlanta.
Illinois: M. M. Leighton, chief, Illinois State Geological Survey Division, Urbana.
Iowa: H. Garland Hershey, district and State geologist, Iowa Geological Survey, Iowa City.
Kansas: John C. Frye, executive director, and R. C. Moore, State geologist and director of research, State Geological Survey of Kansas, Lawrence.
Kentucky: Arthur C. McFarlan, director, and Daniel J. Jones, State geologist, Kentucky Geological Survey, University of Kentucky, Lexington.
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Virginia: William M. McGill, State geologist, Department of Conservation and Development, Geological Survey Division, Charlottesville.
Washington: Sheldon L. Glover, supervisor, Division of Mines and Geology, Olympia.
West Virginia: Paul H. Price, State geologist, West Virginia Geological and Economic Survey, Morgantown.
Wisconsin: E. F. Bean, State geologist, Wisconsin Geological and Natural History Survey, University of Wisconsin, Madison.

Advance planning for this edition was done by my predecessor, Leonard L. Fischman, who before his resignation from the Bureau in February 1953 edited a number of the chapters. His immediate assistant and mine was Robert E. Herman, who supervised the Yearbook staff in processing of manuscripts and who during the last year undertook some of the editorial functions. Yearbook staff members included Blanche G. Robertson, Ethel M. Tucker, Thelma K. Stewart, Robert V. Crosson, Janet B. Riddle, and Joseph G. Dubuque. In addition, special credit for staff work on this Yearbook should go to Sally S. Nishiyama, for her helpfulness in keeping the work in order and progressing. The manuscript was edited for style improvement, punctuation, and type specification by Mabel E. Winslow, Estelle R. Templeton, Hazel J. Stratton, and Betty Ruth Cattell of the Office of Mineral Reports. Shortly after the first of the manuscripts for this edition were submitted by the authors, Adelaide B. Palmer, who for a number of years had served in a highly commendable fashion as draftsman for the Yearbook as well as for other releases of the Bureau's Washington office, was forced by serious illness to go on extended leave and subsequently to retire. Her duties, which included not only

drafting many of the Yearbook charts but also seeing that the many additional charts prepared at the Bureau's Pittsburgh office under the supervision of Louis F. Perry (later Gene Nicolai) were completed in good order, were subsequently undertaken by Caroline G. Holcomb (on a temporary appointment) and then by Orrie E. Vigal.

All but two of the world production tables in this volume were prepared under the direct supervision of Mrs. Berenice B. Mitchell, of the Foreign Minerals Region. Among other Bureau of Mines statisticians and researchers who rendered substantial assistance to the authors of this volume were: In Washington, D. C.—Hope R. Anderson, Kathleen Joyce D'Amico, Elizabeth K. Elsner, Nina L. Jones, Naomi W. Kearney, James G. Kirby, Ann C. Mahoney, Elizabeth A. Miller, Zena M. Mohme, Robert C. Morris, Elizabeth J. Reid, Dora D. Springer, Mary E. Trought, and Virginia E. Wrenn. In Juneau, Alaska—Opal Y. Sharman. In Denver, Colo.—Stella K. Drake. In Minneapolis, Minn.—Eunice M. Clark, William V. Jokela, Luella Niemeyer, and Matthew G. Sikich. In Albany, Oreg.—Catherine M. Moll. In Pittsburgh, Pa.—Roy H. Davis. In Salt Lake City, Utah—Virginia C. Halverson.

PAUL W. MCGANN.

FEBRUARY 1954.

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PART I. GENERAL REVIEWS

Review of the Mineral Industries in 1951

By Paul W. McGann

GENERAL SUMMARY

THE MINERAL INDUSTRIES of the United States enjoyed a record year in 1951 as a result of the high level of employment and demand sustained by the Korean War and by the general progress of the economy. The aggregate value of mineral production increased over 1950 and was above the previous high. There was but little growth, however, in physical output of minerals during the year above the high level at which the year began. Nevertheless, physical production was 11 percent above the previous year and 6 percent above 1948, the previous peak year.

Consumption and imports of minerals for the year were also the highest in history. Petroleum consumption and imports reached new highs. Bituminous consumption increased 3 percent, but anthracite consumption continued to decrease. Minerals-manufacturing orders, sales, and inventories reached the highest values ever.

PRODUCTION

Value of Production.—The historic peak value of mineral-industry production was reached in 1951 for all major categories. The mine value of fuels produced was 13 percent higher than in 1950; other nonmetallic minerals 14 percent higher; and metals 24 percent. This gave a 14-percent increase for all minerals, 10 percent above 1948, the previous high.

The value of mineral production for 1947–51 is summarized in table 1. Detailed data may be found in the Statistical Summary chapter of this volume.

TABLE 1.—Value of mineral production in continental United States, 1947–51, by mineral group

[Millions of dollars]

Year	Nonmetallic			Metallic	Grand total
	Fuels	Other	Total		
1947	7,181	1,345	8,526	1,084	9,610
1948	9,495	1,559	11,054	1,219	12,273
1949	7,912	1,567	9,479	1,101	10,580
1950	8,681	1,823	10,504	1,351	11,855
1951	9,770	2,084	11,854	1,670	13,524

Volume of Production.—The high monthly production of minerals in 1951 continued at the rates set in the fall of 1950 and previously reached in 1948. The unique feature of 1951 was that these high rates were sustained throughout the entire year. There was not a significant rate of change during this "plateau" period, but a perceptible monthly increase of about ½ percent might be detected in the Federal Reserve adjusted index of mineral production. The only significant dip of adjusted monthly mineral production (5 percent) during the year was the result of the 21 percent July decline in bituminous-coal production, but recovery followed immediately in August. The most violent fluctuation in monthly production was suffered, as usual, by the anthracite industry, which had a 46-percent decrease in March. Other mineral industries enjoyed unusual stability, led by crude-petroleum and pig-iron production. Metallic mining (other than gold and silver) experienced only one unseasonable low period, about 9 percent lower in July and August, owing to declines in copper and zinc output. Smelting and refining of nonferrous metals also was lower by about 6 percent in terms of monthly output in August and September as a result of the short strike of the International Union of Mine, Mill, and Smelter Workers in these months. Gold and silver production declined throughout the year.

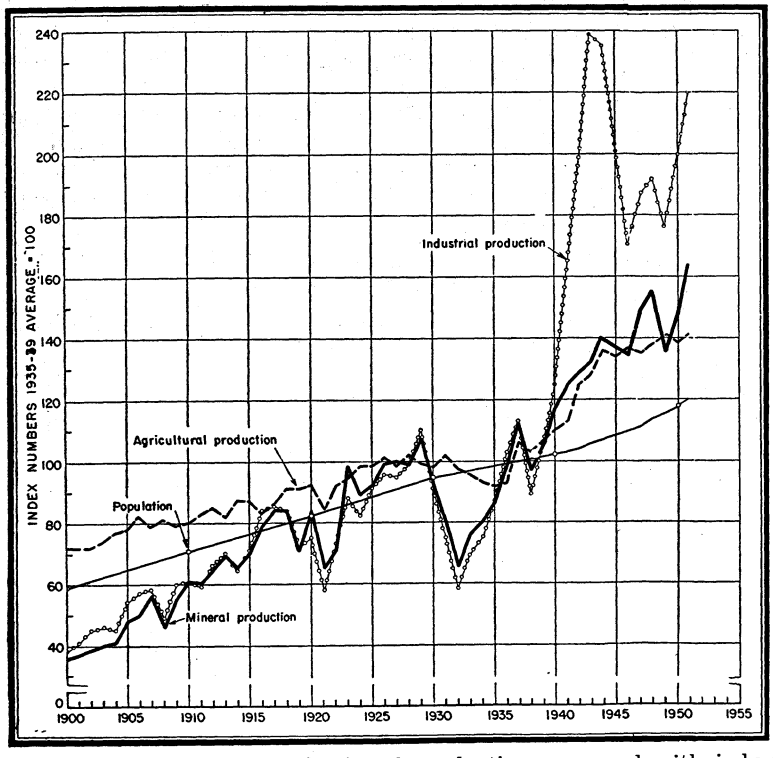

FIGURE 1.—Physical volume of mineral production compared with industrial production (manufactures and minerals), agricultural production, and population, 1900–51. Sources: Federal Reserve Board, U. S. Department of Agriculture, and Bureau of the Census.

The output of nonmetallic minerals increased throughout the year at about 1 percent per month. Cement, however, declined every month from March to October but recovered thereafter. Other nonmetallics, for which monthly or quarterly data are collected by the Bureau of Mines, however, increased steadily (gypsum, sulfur, lime, soda ash, glauber's salt, salt cake, and fluorspar).

The increase for all nonmetallic output over 1950 was 9 percent; for metals, 5 percent; bituminous coal, 3 percent; and crude petroleum, 14 percent. The decrease for anthracite was 3 percent.

Number, Size, and Age of Firms.—The gross number of mining firms remained constant at 34,100, although for the first two quarters it reached 34,200. This was the result of approximately 3,700 new businesses balancing 3,700 discontinued firms. These were the lowest turnover figures in the postwar era. There were 1,800 transfers of ownership of going concerns during the year, the lowest number since 1944.[1]

The number of active proprietors in mining industries also remained the same, 46,000, from 1950 to 1951, and was approximately constant within each major category: Metal, 9,000; nonmetallic, 7,000; anthracite, 2,000; bituminous, 6,000; and crude petroleum, 22,000. (These figures are greater than the number of firms, of course, because of partnerships.) Active proprietors are unimportant in mineral manufacturing.

The Bureau of the Census' annual survey of manufactures for 1951 in general shows minor changes in establishment size distributions of major mineral-manufacturing industries between 1950 and 1951 (*see* table 2).

Of the firms started in 1950, 63.6 percent lasted one year or more into 1951, and 47.6 percent of those started in 1949 lasted until 1951. These figures are about the same as for manufacturing and for all industries. A modified "life-expectancy table" for mining and quarrying firms is also about the same as for manufacturing and as for the average of all industries. (For example, the percentage of mining firms remaining in operation one additional year if 5.5 years of age is 88.4 percent.) The median age of mining firms is 5.1 years, higher than that of any other major industrial group except financial, insurance, and real estate, and is the highest since the data have been collected beginning in 1945. Mining and quarrying firms appear to gain life expectancy above the average business as they grow older. The cumulative age distribution curve begins at an average industry value at 0.5 year (84.4 percent being older), ranks fifth out of 8 major industrial groups at 2.5 years, and third at 4.5 years (behind wholesale and financial, insurance, and real estate). It gets closest to the leader (financial, etc.) and becomes second at 7.5 years, the last value tabulated, than it is at any value after 0.5 year. At that age, 42.8 percent survive (the next highest industrial group only has 36.9 percent survival).[2] This life-expectancy data seem to indicate that if mining "differs" from other industry because of exhaustibility of deposits, other factors seem to work more for reducing the life of firms in other lines of endeavor.

[1] Survey of Current Business, vol. 32, No. 6, June 1952, pp. 14-15.
[2] Survey of Current Business, vol. 32, No. 12, December 1952, pp. 14-17.

TABLE 2.—Size distribution of larger establishments within selected mineral manufacturing and related industries in the United States, 1950–51 [1]

Industry group number [2]	Industry	Number of employees [3]			
		250–499	500–999	1,000–2,499	2,500 and more
2911	Petroleum refining:				
	1951	44	30	22	12
	1950	50	24	21	12
2932	Byproduct coke ovens:				
	1951	31	16	5	1
	1950	29	19	2	2
3241	Cement, hydraulic:				
	1951	44	8	1	----
	1950	42	6	1	----
3275	Mineral wool:				
	1951	4	2	1	----
	1950	3	2	1	----
3331	Primary copper:				
	1951	8	6	4	----
	1950	7	5	5	----
3332	Primary lead:				
	1951	7	3	----	----
	1950	7	3	----	----
3333	Primary zinc:				
	1951	7	7	3	----
	1950	7	8	2	----
3334	Primary aluminum:				
	1951	2	3	6	----
	1950	2	5	4	----
3341	Secondary nonferrous metals:				
	1951	13	1	----	----
	1950	10	1	----	----
3531	Construction and mining machinery:				
	1951	44	20	21	1
	1950	26	19	15	----
3532	Oilfield machinery and tools:				
	1951	22	4	7	1
	1950	13	5	4	1

[1] Source: U. S. Department of Commerce, Bureau of the Census, Annual Survey of Manufactures, 1951: Washington, 1953, pp. 146–161.
[2] These are Standard Industrial Classification numbers.
[3] Figures for the size category 1–249 were withheld by the Bureau of the Census, because the estimates did not meet its publication standards, either on the basis of associated standard error of estimate or on the basis of consistency review.

CONSUMPTION AND STOCKS

Annual apparent consumption of most minerals increased over the previous year in 1951. Major exceptions were anthracite, copper, lead, zinc, chromite, molybdenum, tungsten, tin, cadmium, and sulfur. These exceptions were largely explained by increases of stocks of chromite, and sulfur, but decreased net imports was the cause for decreases in tungsten and lead. Anthracite consumption declined moderately.

Significant changes in stocks took place during 1951 only for manganese, cadmium, tungsten, tin, mercury, and platinum-group metals. All were net withdrawals except for cadmium and platinum-group metals.

There was no decrease in dependence upon imports for strategic minerals for which domestic supplies are inadequate or uneconomic. The decreases in net imports that took place resulted instead from temporary decreases in foreign supplies. The decline in mercury imports was largely responsible for the unusual increase in price (the 1951 annual average price was over two and one-half times that of 1950).

TABLE 3.—Apparent consumption of principal minerals in the United States, 1950–51

Commodity and unit of measurement	Apparent consumption		Primary and secondary production as a percent of apparent consumption [1]		Net imports [2] as a percent of apparent consumption [1]	
	1950	1951	1950	1951	1950	1951
Fuels:						
Coal:						
Anthracite—thousand short tons	39,915	37,068	110.4	115.2	−9.7	−16.0
Bituminous and lignite—do	460,428	473,280	112.1	112.7	−5.5	−12.0
Petroleum, crude—million barrels	2,118	2,388	93.2	94.1	6.6	6.2
Ferrous and ferroalloy metals:						
Iron ore—thousand gross (long) tons	105,489	116,406	92.9	10.1	5.5	5.0
Manganese—thousand short tons (Mn content)	1,205	1,283	15.5	14.6	81.5	75.8
Chromite—thousand short tons (gross weight)	1,453	1,403	[3]	.5	89.6	101.7
Cobalt—thousand pounds (Co content)	11,913	12,137	7.9	14.8	78.3	85.2
Molybdenum ore and concentrates—thousand pounds (Mo content)	37,081	34,398	76.8	112.9	−16.7	−10.8
Nickel—short tons (Ni content)	93,235	96,618	6.1	5.8	92.3	93.5
Tungsten ore and concentrates—short tons (W content)	9,916	6,678	20.0	44.3	81.4	47.7
Other metals:						
Copper—thousand short tons (Cu content)	2,002	1,775	86.1	93.8	8.9	6.2
Lead—thousand short tons (Pb content)	1,407	1,090	61.0	76.2	37.5	19.2
Zinc—thousand short tons (Zn content)	1,144	937	57.9	73.6	33.1	26.3
Aluminum—thousand short tons (Al content)	1,209	1,286	79.6	87.9	19.4	11.4
Tin, primary—long tons (Sn content)	112,478	73,196	[4] 29.4	[4] 43.5	73.4	37.6
Antimony—short tons (Sb content)	35,181	37,531	60.4	62.4	46.0	39.0
Cadmium—thousand pounds (Cd content)	9,502	7,172	96.7	115.9	2.9	−7.2
Magnesium—short tons (Mg content)	20,599	46,574	102.7	101.1	−2.7	−1.0
Mercury—76-pound flasks	45,503	60,359	10.0	12.1	122.3	78.9
Platinum-group metals—thousand troy ounces	503	565	19.1	15.9	75.1	92.4
Titanium concentrate: Ilmenite—thousand short tons (TiO_2 content)	374	385	63.9	70.9	34.8	29.4
Nonmetallic minerals:						
Asbestos—thousand short tons	727	797	5.8	6.5	94.2	93.5
Barite—do	754	914	91.9	92.6	7.8	5.8
Boron minerals and compounds—thousand short tons (gross weight)	505	650	128.3	132.8	−28.3	−32.8
Bromine and bromine in compounds—thousand pounds	97,739	126,978	100.8	102.0	−.8	−2.0
Clays—thousand short tons	39,304	43,243	100.2	100.4	−.2	−.4
Fluorspar, finished—short tons	433,971	525,836	65.3	64.9	37.8	34.3
Gypsum, crude—thousand short tons	11,388	12,089	71.9	71.7	28.1	28.3
Mica (except scrap)—thousand pounds	27,900	25,473	2.1	2.3	97.9	97.7
Phosphate rock—thousand long tons (P_2O_5 content)	2,758	3,103	129.3	111.4	−20.9	−16.3
Potash—thousand short tons (K_2O equivalent)	1,411	1,653	91.2	85.9	9.5	14.8
Salt, common—thousand short tons	16,447	19,772	101.1	102.2	−1.1	−2.2
Sulfur—thousand long tons (S content)	4,951	4,705	121.0	131.7	−30.0	−27.8
Talc and allied minerals—thousand short tons	619	638	99.7	100.3	.3	−.3

[1] Where, for either year, the sum of the percentages for production and imports for a particular mineral does not equal 100, the difference is due to changes in stocks.

[2] Minus sign denotes net exports. Imports calculated to include all sources of minerals, through the refined stage. Exports calculated to include only those shipments occurring before the point of consumption.

[3] Less than 0.05 percent.

[4] Domestic smelter production. Domestic mine production, virtually all from Alaska was 94 long tons in 1950 and 88 long tons in 1951.

TABLE 4.—Percentage distribution of imports of principal minerals consumed in the United States, 1950–51, by source of supply

Commodity and unit of measurement	Imports for consumption		Percent from—									
			Canada and Mexico		South and East Pacific[1]		Other Western Hemisphere		Other free world		U. S. S. R. bloc	
	1950	1951	1950	1951	1950	1951	1950	1951	1950	1951	1950	1951
Fuels:												
Coal:												
Anthracite—thousand short tons	18	27	1						99	100		
Bituminous and lignite—do	347	292	99	100				[2]	1	[2]		
Petroleum, crude—million barrels	174	177	6	7			71	70	23	23		
Ferrous and ferroalloy metals:												
Iron ore—thousand gross (long) tons	8,281	10,145	25	21	31	27	9	17	35	35		
Manganese—thousand short tons (Mn content)	987	977	4	10	[2]	1	10	11	82	78	4	[2]
Chromite—thousand short tons	1,304	1,429	[2]		5	5	8	6	81	89	6	
Cobalt—thousand pounds (Co content)	9,498	10,337	[2]	2					100	98		
Molybdenum ore and concentrate—thousand pounds (Mo content)	3	4							100	100		[2]
Nickel—short tons (Ni content)	89,200	94,576	95	95				[2]	5	5		
Tungsten ore and concentrates—short tons (W content)	8,074	3,188	1	2	18	30	5	14	30	54	46	[2]
Other metals:												
Copper—thousand short tons (Cu content)	322	242	18	12	73	88		[2]	9	[2]	[2]	
Lead—thousand short tons (Pb content)	532	210	62	50	21	27	1	1	16	22		
Zinc—thousand short tons (Zn content)	393	286	87	86	6	6	[2]	2	7	6	[2]	
Aluminum—thousand short tons (Al content)	256	162	65	73	[2]	[2]	[2]	[2]	35	27	[2]	
Tin—long tons (Sn content)	82,838	27,784			[2]	[2]			98	100	2	[2]
Antimony—short tons (Sb content)	16,333	14,818	38	42	40	37		[2]	21	21	1	[2]
Cadmium—thousand pounds (Cd content)	630	90	38	3	2	11			60	86		
Magnesium—short tons (Mg content)	25	108	100	100					[2]			
Mercury—76-pound flasks	56,080	47,860	6	12		[2]		[2]	94	88		
Platinum-group metals—thousand troy ounces	428	601	45	48			9	4	35	45	11	3
Titanium concentrate: Ilmenite—thousand short tons (TiO_2 content)	130	113	1	2	[2]	[2]		[2]	99	98		
Nonmetallic minerals:												
Asbestos—thousand short tons	705	762	96	96	[2]	[2]			4	4	[2]	[2]
Barite—do	59	53	81	100					19	[2]		
Boron minerals and compounds[3]—thousand short tons (gross weight)	[3]	[3]										
Bromine and bromine in compounds—thousand pounds	107	3	100		[2]	15			[2]	85		
Clays—thousand short tons	161	151	3	6	[2]	[2]	[2]		97	94	[2]	
Fluorspar, finished—short tons	164,634	181,275	53	47					47	53		
Gypsum, crude—thousand short tons	3,219	3,448	100	99			[2]	1	[2]		[2]	[2]
Mica (except scrap)—thousand pounds	27,657	25,277	1	2	[2]	[2]	9	11	90	87		[2]
Phosphate rock—thousand long tons (P_2O_5 content)	30	29		2			88		12	98		
Potash—thousand short tons (K_2O equivalent)	201	313	[2]		2	1			84	97	14	2
Salt, common—thousand short tons	8	4	54	100			46	[2]	[2]			
Sulfur—thousand long tons (S content)	[3]	2		17		15		67		1		
Talc and allied minerals—thousand short tons	23	21	17	19					83	81		

[1] West coast of South America (Salvador, Chile, Bolivia, Peru and Ecuador), Australia, New Zealand, and New Caledonia. [2] Less than 0.5 percent. [3] Negligible.

Orders, Sales, and Inventories.—Mineral-manufacturing industries enjoyed the highest sales, inventories, and orders in their history. New orders in the primary-metals industries and the annual accumulation of unfilled orders for 1951 were 16 and 26 percent, respectively, above the previous highs of 1950.[3]

Peak backlogs of unfilled orders accumulated in 1951. The year-end backlog was about 3.8 months' worth, about a 10-percent increase over that at the end of 1950. Although these backlog lengths were smaller than for most other durable-goods industries, they were well above those of nondurables. The monthly peak for new orders of primary-metals industries (adjusted for seasonal variation) was in October, but the second half of the year was about 12 percent below the first half. The monthly peak was in January for other durables and also for all nondurable-goods industries, and new orders for the former at the year end were being received at about a 30-percent lower rate, whereas new orders rate for nondurables declined only about one-half as much percentagewise. Unfilled orders were 27 percent higher at the year end for primary metals and 73 percent for all durables but fell 48 percent by December for nondurables from the March peak. Unfilled orders for primary metals were down 5 percent from their October peak, but December was the high for all durables.

Sales (seasonally adjusted) were at a peak in May for primary metals as was true for all manufacturing, all durable- and nondurable-manufacturing industries. Petroleum and coal products had adjusted sales peaks in October–November, when there was a secondary peak for primary metals and the other manufacturing groups.

Inventories (seasonally adjusted) were the highest on record and climbed almost every month of the year, finishing about one-sixth greater at year-end than at the beginning for both primary-metals and petroleum- and coal-products firms. This approximately equaled the increase for nondurable-manufacturing firms (17 percent) but was only half the increase in the durable-goods group of firms (36 percent).

Behavior of inventories of mineral-manufacturing establishments was very little different from those of firms discussed above. For petroleum- and coal-products establishments 1951 year-end inventories were 12 percent above 1950, and for primary metals, 14 percent. For all manufacturing establishments industry categories, the increase in inventories (25 percent) was slightly less than for firms. For all durable-goods industries establishments the increase was 39 percent.[4]

As might be expected, detailed industrial classifications of mineral-manufacturing establishments showed notably different changes in inventories between 1950 and 1951. Byproduct-coke-oven inventories declined 6 percent because of a 9-percent decrease in raw materials and goods in process inventories. Other decreases were primary copper, 18 percent; primary minor nonferrous metals, 7 percent; and secondary nonferrous metals, 3 percent. The decreases in primary copper and secondary nonferrous inventories were due to large declines in finished-goods inventories resulting from acute shortages in these areas; but the shortages also caused primary copper to suffer a substantial decline in raw materials and goods in process inventories.

[3] Survey of Current Business, vol. 32, 1952, various issues.
[4] U. S. Department of Commerce, Bureau of the Census, Annual Survey of Manufactures, 1951: Ser. MAS–51–2, Nov. 25, 1952, 11 pp.

INCOME AND INVESTMENTS

National Income Originated.—The increase for the mineral industries in national income originated during 1951 was greater than ever before,[5] exceeding that for 1948, the previous high. The percentage increase in business income before taxes was higher than the increase in wages and salaries and supplements thereto, except for anthracite and bituminous coal, where the business income declined from 1950.

The national income originated in mineral industries is potentially perhaps the best measure of their normal economic importance (although it might not be a good measure of their strategic nature). Unfortunately, national income originated is a curious hybrid estimate for the mining industries as such, consisting of labor income for mining establishments but business income only for firms classified as mostly mining. The disparity between firms and establishments in industrial classifications is greatest as regards mining industries because major establishments are owned by large, integrated firms ordinarily classified as manufacturing. The business income of these firms that derives from mining is almost never publicly segregated. (Thus it might be better to regard these national income data as integrated minerals-industry data if the manufacturing industries were classified in a way that clearly allowed this.) Anthracite mining is an exception, in that virtually all of its establishments are controlled by anthracite-mining firms.

Corrections of mining business income to allow for business income counted in manufacturing appear to be most necessary in the case of crude-petroleum production, nonmetallic minerals and bituminous coal—in that order. Despite sizable production of metallic ores by subsidiaries, the Department of Commerce business-income estimate does not seem to need correction for metal mining (or for anthracite). The corrections for 1951 are given in table 5. The corrections were made by using data from the Census of Mining Industries in 1939 in addition to the Commerce Department data of that and subsequent years. (These were checked against Bureau of Internal Revenue data where available.) The Census data essentially provide a value-added figure for all establishments in each industry from which business income for all establishments may be roughly estimated by subtracting wages and salaries (including supplements thereto) (from 1939 Census), estimated depreciation, and estimated business taxes (from Bureau of Internal Revenue and Commerce Department data). For purposes of this illustrative correction, other less important adjustments have been ignored because it is not pretended that the adjustments calculated are accurate enough to warrant further refinement.

Another interesting national income estimation is that which attempts to measure the amount of income originating in transportation and manufacturing industries devoted to production and distribution of refined mineral products. (In this comparison the correction of mining income will be ignored because the integrated manufacturing firms to which the correction would apply will be included in the total anyway.) Table 6 shows the national income

[5] Survey of Current Business, vol. 32, No. 7, July 1952, various refs.

TABLE 5.—Corrected national income originated in mining industries in the United States, 1951

[Millions of dollars]

Industry	Wages and salaries, supplements to wages and salaries and income of unincorporated enterprises [1]	Other national income [1]	Correction of other national income [2]	Total
Crude petroleum and natural gas	1,429	853	1,708	3,990
Nonmetallic mining and quarrying	401	159	60	620
Bituminous and other soft coal	1,672	182	46	1,900
Anthracite	264	20	----	284
Metal mining	455	396	----	851
Total	4,221	1,610	1,814	7,645
Uncorrected total	----	----	----	5,831
All industries total	----	----	----	277,554

[1] Survey of Current Business, vol. 32, No. 7, July 1952, pp. 18 and 19.
[2] *See* text.

originated according to the Commerce industrial classification, along with adjusted estimates of the national income originated in minerals industries, which account for nearly 6 percent of the national total in 1951.

TABLE 6.—National income originated within mineral industries in the United States in 1951

[Millions of dollars]

Industry	U. S. Department of Commerce classification of national income originated [1]	Percentage accounted for by crude and refined mineral products [2]	Mineral-industry portion
Mining	5,831	100	5,831
Products of petroleum and coal	4,122	90	3,710
Stone, clay, and glass products	3,117	30	935
Nonferrous metals and their products	3,172	40	1,269
Iron and steel and their products	12,385	5	619
Railroads	7,799	33	2,600
Water transportation	945	57	538
Pipeline transportation	297	100	297
Highway freight and warehousing	3,161	15	474
Total	----	----	16,273

[1] Survey of Current Business, vol. 32, No. 7, July 1952, p. 18.
[2] *See* text.

The adjustments for manufacturing are the fraction that the 1951 value added of mineral industries is of the whole manufacturing category of which they are a part, according to the Annual Survey of Manufactures.[6] The railroad adjustment is the 1951 sum of gross freight revenue from products of mines and minerals in manufacturing categories as a fraction of total gross freight revenue. A tonnage ratio was used for water transport, because of the almost complete lack of comparable economic data for water transport. The highway adjustment was a partly educated guess.

[6] U. S. Department of Commerce, Bureau of the Census, Annual Survey of Manufactures, 1951: Washington, 1953, various refs.

Business Income and Dividends.[7]—Mining corporations constituted the only major industrial group whose income after taxes rose from 1950 to 1951 (9 percent). Wartime corporate income-tax increases and price controls led to declines in annual corporate income after taxes in bituminous coal (4 percent), nonmetallic mineral mining (1 percent), the primary manufacturing of iron and steel (9 percent), and nonferrous metals (4 percent). None of these declines were as great percentagewise, however, as those for all industries (12 percent) or for all manufacturing (14 percent). These were overbalanced, on the other hand, by unusually large percentage increases in annual corporate income after taxes for metal mining (15 percent), crude petroleum production (12 percent), and petroleum refining and coal products (19 percent).

Large percentage increases in annual income before taxes were not enough to enable iron and steel (24 percent) and nonferrous metals (24 percent) to retain an increase after taxes. In crude-petroleum the percentage increase after taxes was substantial (12 percent) even though the increase before taxes was more modest (17 percent). This was largely due to the effects of percentage depletion allowances on crude petroleum.

All mining industries increased their 1951 dividends except anthracite. This was true also of the total of all industries, but manufacturing dividends generally were curtailed. Dividends of petroleum and coal products and nonferrous products were increased (21 and 12 percent, respectively), although iron and steel decreased slightly (2 percent).

Quarterly cash dividends publicly reported [8] rose throughout 1951 for mining firms as they did for all industry and for manufacturing firms. As usual, the seasonally high fourth quarter dividends for mining were about 50 percent above those in other quarters.[9]

Undistributed corporate income for mining firms in 1951 increased slightly, although it fell sharply for all manufacturing and all industries. Modest declines in undistributed income were observed for bituminous and nonmetallic mining and for iron and steel and nonferrous-products industries.

Quarterly corporate profits behaved differently for the major mineral-manufacturing industries, but dividends rose and current assets and liabilities increased for all.[10] Profits before taxes as a percentage of sales were well above the average of all manufacturing for petroleum refining and nonferrous metals and were somewhat below for other products of petroleum and coal. Profits after taxes as a percentage of stockholders' equity were also well above the manufacturing average for the first two and about equal to it for the latter group. For all manufacturing groups, profits fell during the year because of the effects of rising costs and price controls, which caused operating profits to decline, and because of 1951 corporate income taxes.

Investment.—Expenditures on new plant and equipment in 1951 by mining firms were 31 percent higher than in 1950. This increase

[7] Annual data discussed in this section are from Survey of Current Business, vol. 32, No. 7, July 1952, pp. 16-21.

[8] Work cited in footnote 3.

[9] Although some dividends are paid each month, the dividends from the last month in each quarter for mining firms is always about 10 times greater than the sum of the other two months. This discrepancy is much less for other industrial categories.

[10] Federal Trade Commission and Securities and Exchange Commission, Quarterly Financial Report, U. S. Manufacturing Corporations, 4th quarter 1951: Washington, 1952, 21 pp.

TABLE 7.—Components of national income originated in the mineral industries in the United States, 1949–51 [1]

[Millions of dollars]

Industry	National income originated, total	Wages and salaries	Supplements to wages and salaries	Income of unincorporated enterprises	Corporate income before taxes	Corporate income after taxes [2]	Corporate inventory valuation adjustment	Unincorporated inventory valuation adjustment	Net interest
Mining:									
Anthracite:									
1949	261	223	15	4	17	12	2		
1950	276	233	22	5	21	15	−4	−1	
1951	284	237	22	5	20	16			
Bituminous and other soft coal:									
1949	1,479	1,166	111	46	144	96	10	4	−2
1950	1,696	1,291	172	63	194	121	−14	−8	−2
1951	1,854	1,425	187	60	187	116	−1	−1	−3
Crude petroleum and natural gas:									
1949	1,820	929	45	139	631	482	34	11	31
1950	1,883	967	51	190	707	512	−50	−16	34
1951	2,282	1,128	62	239	826	572	−4	−3	34
Metal mining:									
1949	568	323	16	7	206	152	22	1	−7
1950	652	346	18	13	317	219	−32	−1	−9
1951	851	417	21	17	407	252	−3		−8
Nonmetallic mining and quarrying:									
1949	448	290	8	12	129	86	8	1	
1950	479	319	11	13	149	90	−12	−1	
1951	560	374	13	14	160	89	−1		
Total mining:									
1949	4,576	2,931	195	208	1,127	828	76	17	22
1950	4,986	3,156	274	284	1,388	957	−112	−27	23
1951	5,831	3,581	305	335	1,600	1,045	−9	−4	23
Mineral manufacturing:									
Products of petroleum and coal:									
1949	2,838	957	202	3	1,544	1,204	112		20
1950	3,247	998	226	5	2,095	1,514	−99		22
1951	4,122	1,130	252	5	2,745	1,802	−32		22
Iron and steel and their products:									
1949	7,629	5,630	286	59	1,682	998	−25	−1	−2
1950	10,100	6,645	526	95	2,944	1,557	−103	−3	−4
1951	12,385	8,208	574	109	3,645	1,423	−142	−4	−5
Nonferrous metals and their products:									
1949	2,138	1,386	66	29	467	271	179	11	
1950	2,483	1,634	92	47	915	499	−193	−12	
1951	3,172	1,912	110	54	1,137	478	−40	−1	

[1] Survey of Current Business, vol. 32, No. 7, July 1952, pp. 18–23.

[2] Not included in total.

was in keeping with that of all industry (24 percent) but less than for all manufacturing firms (45 percent). Mineral manufacturing showed especially great increases with nonferrous (131 percent) and iron and steel (100 percent). Petroleum and coal products were closer to all mining (32 percent). These investments were stimulated considerably by the accelerated tax-amortization allowances provided for war industries under the Defense Production Act.

Quarterly expenditures on plant and equipment by mining firms (adjusted for seasonality) showed a plateau over the second, third, and fourth quarters at an annual rate of $960 million (3 percent above the actual amount for the year). The unadjusted peak took place in the fourth quarter as did the adjusted peak for all industry. Quarterly expenditures of mineral-manufacturing industries on plant and equipment reached peaks (unadjusted for seasonality) in the fourth quarter 30 to 50 percent above the fourth quarter of 1950.[11]

The annual increases in expenditures on new plant and equipment for mineral-manufacturing establishments followed closely that for firms, as was true of all manufacturing industries. The increase for petroleum and coal products was 35 percent and for primary metals 105 percent. In primary metals, as for all manufacturing, the percentage increases in expenditures on new structures and additions to plant were twice as large as for new machinery and equipment, 161 and 87 percent, respectively. For petroleum and coal products the opposite was true (14 and 69 percent, respectively) because most of the investment was made as additions to old "establishments in operation" rather than new "establishments under construction." For petroleum and coal products only 0.1 percent of the investment was in new establishments, whereas for primary metals 16 percent was a much higher ratio than for any other major manufacturing category. The figure for all manufacturing was 7 percent, which was typical for other major manufacturing industries.

Certain more detailed mineral-manufacturing classifications showed quite large increases in these expenditures. For example, fertilizer-industries plant and equipment expenditures increased 111 percent over 1950; blast furnaces and steel mills, 113 percent; and primary nonferrous, 176 percent. A related industry of much interest to mining, the construction and mining machinery industry, increased its investment expenditure 207 percent over 1950.[12]

The above difference in fixed investment patterns between mineral manufacturing industries was largely due to the differing impacts of construction schedules covered by certificates of necessity for accelerated tax amortization of emergency facilities. For steel and related programs, about two-thirds of the fixed-asset investment in the fourth quarter of 1951 was under certificates of necessity; for nonferrous metals, seven-eighths; but for petroleum refining, only one-twentieth.[13]

The calculation of investment by firms generally leads to underestimation of investment of mining, transportation, and other facilities and overestimation of what are apparently manufacturing facilities because all the investment of integrated firms is generally

[11] Survey of Current Business, vol. 33, No. 4, April 1953, p. 9.
[12] U. S. Department of Commerce, Bureau of the Census, Annual Survey of Manufactures, 1951: Ser. MAS-51-1, Nov. 21, 1952, 11 pp.
[13] Defense Production Administration data on "value put in place" compared with data on expenditures for new plant and equipment.

counted as that of manufacturing firms. In the case of oil companies only 11 percent of the industry's $2,948 million domestic investment was in manufacturing (that is, refining and chemical plants), whereas 65 percent was in production of crude petroleum, 13 percent in transportation, and the remainder in other nonmanufacturing facilities.[14]

Expenditures on plant and equipment are by no means all of gross investment. In petroleum, working capital in the 30 largest companies increased $492 million through 1951.[15] For firms manufacturing coke and other products of petroleum and coal (but not for refining firms) the 1951 working capital increment of $30 million was 1.4 times greater than the net increase of other assets, and the increase in current assets of $56 million was 1.3 times the gross increase in fixed assets plus changes in other assets. The primary nonferrous firms show a different pattern of asset growth, dominated by fixed assets in 1951. The net increase in noncurrent assets was $371 million, 5.7 times the increase in net working capital, and the gross increase was $486 million, 1.3 times the increase in current assets.[16]

It is interesting to compare net and gross fixed investment in 1951. Depreciation and depletion as a percentage of the sum of depreciation and depletion plus the net increase in fixed assets during 1951 was 53 percent for petroleum-refining firms, 45 percent for coke and other petroleum and coal manufacturing, and 31 percent for primary nonferrous metals. For all manufacturing, the percentage was 42.

Tax Yields.—Federal corporate tax liability of mining firms rose 29 percent over 1950. This increase was slightly less than that of all industry (32 percent) and well below all manufacturing (40 percent).

Tax liabilities for mineral industries as a percentage of corporate income before taxes were much less than for other industries. For example, tax liability for all industries was 56 percent of the income before taxes; all manufacturing was 59 percent; iron and steel products, 61; nonferrous-metals-manufacturing firms, 58; and pipeline transportation, 58. On the other hand, crude petroleum was only 31 percent; metallic mining, 38; and nonmetallic mining, 44. The differences were no doubt largely due to the differing effects of percentage depletion allowances (and to a lesser extent, the effects of intangible drilling and development costs). Petroleum-refining firms, being largely integrated to include crude output, brought the percentage of manufacturing firms producing products of petroleum and coal down to 34 percent.[17]

The effects of percentage depletion on wholesale gasoline prices were counteracted by the Federal and State excise taxes, which produced more revenue than was applied for highway purposes. The Federal excise rose ½ cent per gallon to 2 cents during 1951. (The Federal gasoline excise should probably be included with other Federal excises on motor vehicles, parts, and tires when compared with Federal highway expenditures and with revenue-producing taxes on other modes of transportation such as railroads.) Federal gasoline

[14] American Petroleum Institute, Petroleum Facts and Figures Tenth Edition, 1952: New York, 1952, p. 235.
[15] Coqueron, Frederick G., Financial Analysis of 30 Oil Companies for 1951: Chase National Bank, July 1952, p. 19.
[16] Work cited in footnote 10.
[17] Work cited in footnote 5, p. 19.

excises produced about $570 million, and $455 million was spent on highways, leaving net revenue produced of about $115 million. About $270 million in State taxes in 1951 [18] was diverted to non-highway uses. These net revenue contributions of $385 million gasoline taxes approximately cancel the reduction in income tax borne by gasoline (estimated on a refinery value basis as a share of crude-oil final product). Thus, it might be said that the net effect of the tax systems is to provide encouragement through percentage depletion primarily to other oil products than gasoline, mainly diesel and distillate fuel oils, and residual fuel oil, and to natural gas (Federal lubricating-oil excises also approximately balanced estimated tax-relief effects of percentage depletion on these products in 1951). The stimulating effects of percentage depletion upon crude-petroleum production no doubt contributes somewhat to increased supplies of gasoline and lubricants, however, despite the depressing effects of net revenue-producing excises, because there has been a slight increase recently in the refinery yields of gasoline and lubricating oils in response to increased demands. Other qualifications to these propositions should be examined if the data are to be improved, for example, the extent to which highway expenditures can be considered net capital expenditures instead of current operating replacement. Another point to be studied is the behavior of the average for the industry of marginal effective income-tax rates for individual firms, especially during years of excess profits taxes, such as 1951.

LABOR

Wages.[19]—Wages and salaries received in mining industry firms were 13 percent above 1950; in petroleum- and coal-products industry, 13 percent; nonferrous metals and their products, 17 percent; and iron and steel, 24 percent. The increases inside the mining industries were equally uneven, ranging from 2 percent for anthracite to 21 percent for metal mining. Bituminous wage and salary payments increased 10 percent, and those of crude petroleum and nonmetallic minerals both rose 17 percent.

Percentage increases in supplements to wages and salaries were about one-fourth less than those of wages for each of the above minerals industries except crude-petroleum and nonferrous-metals firms, whose supplements each increased 20 percent over 1950.

In general, labor income increases were slightly less in minerals industries than for the rest of the economy. Salaries and wages for all industries increased 17 percent and supplements thereto 15 percent and for all manufacturing 18 and 16 percent, respectively.

Employment.—Annual average employment increased in all mining from 904,000 to 920,000, decrease in anthracite (8 percent) being overbalanced by increases in bituminous, metallic-mining firms, nonmetallic, and crude petroleum (1, 4, 8, and 3 percent). There has been an irregular downward trend in mining employment since World War I. Mineral-manufacturing employment had a significant net increase in 1951 as a result of increases in all major categories—7 percent in

[18] Duff, Dahl M., Gasoline Taxes: Oil and Gas Jour., vol. 51, No. 35, Jan. 5, 1953, pp. 33-34.
[19] Work cited in footnote 5, p. 18.

petroleum and coal products, 6 percent in blast furnaces and steel works, and 3 percent in primary nonferrous metals.

The increase in the annual average hid a decline throughout the year from 932,000 in January to 916,000 in December (July, the vacation month, was as low as 906,000). The high metals-mining annual employment was the result of a high plateau of monthly employment, but there were increases throughout the year for nonmetallic mining and crude petroleum, December being greater than January by 7 percent for both. Coal employment fell throughout the first half of the year to a stable low level the last half. Monthly patterns of production-worker employment were the same as for all employees. Mineral-manufacturing employment (both of all employees and of production workers) increased throughout the year with coke, petroleum refining, and blast furnaces and steel works gaining from January to December but primary nonferrous metals declined slightly.[20]

Unemployment in mining industries was 3.3 percent in 1951, nearly half that of 1950 and the lowest since the statistic has been estimated, beginning in 1946. In the fourth quarter a low of 1.5 percent was reached. The annual figure was slightly above that for all workers and equal to manufacturing. The fourth-quarter percentage was lower than that of any industrial group.[21]

Hours.[22]—The 1951 annual average of weekly hours worked increased over 1950 for all mining industries except anthracite mining. Bituminous and petroleum increases were small, but nonfuel mining increases were an hour or more. The highest annual average was 46 hours for copper mining, and the lowest 30 hours for anthracite. All other mining industries were between 39 to 43 hours, except bituminous at 35 hours and nonmetallic mining 45 hours.

The largest increase of average weekly hours during the year took place in iron mining, whose December average was 2.1 hours more than in January. Other minerals industries had increases of less than an hour over the year.

Average Earnings.—In 1951, there were significant increases in average annual earnings per full-time equivalent employee. The average for all mining rose 13 percent, which was better than in mineral manufacturing concerns because in both petroleum and coal products and in nonferrous metals the increase was only 8 percent; iron and steel's average rose 11 percent. The leader in mining was bituminous coal with 17 percent, followed by metal mining at 15 percent, both anthracite and nonmetallics with 10 percent, and crude petroleum at 8 percent. The average annual earnings for all industries and for all manufacturing increased only 8 and 9 percent, respectively.

The level of average annual earnings in mining was 20 percent above all industries and 8 percent above all manufacturing. In fact, the only major industry group above mining industries was transporta-

[20] U. S. Department of Labor, Monthly Labor Review, 1952, various issues.
[21] U. S. Department of Commerce, Bureau of the Census, Current Population Reports, Labor Force: Ser. P-50, No. 40, p. 10.
[22] Work cited in footnote 20.

tion, 3 percent above mining. The highest mineral industry was petroleum and coal manufactured products at $4,650 per year. All the other mineral categories were grouped between $3,841 and $4,162 annually, except anthracite and nonmetallics, with $3,435 and $3,596, respectively—both still well above all industry at $3,253. This no doubt depends in part upon the high degree of unionization of mineral industries and high proportion of skilled workers required.[23]

Average weekly earnings increased throughout the year for every mineral industry except anthracite, although somewhat irregularly for some industries because of variations in average weekly hours worked and sudden jumps in average hourly earnings as a result of industry-wide changes in union contracts.[24]

Average hourly earnings also increased during 1951 for all mineral industries. Copper mining had the smallest increase in average hourly earnings for the year, 6 percent, and iron ore the highest, 13 percent. The others all had 10- or 11-percent increases except crude petroleum, 7 percent. The range of increase in mineral manufacturing was less, from 8 percent for petroleum refining and cement to 11 percent for blast furnaces and steel works. Fertilizer, coke, and primary copper, lead, zinc, and aluminum all had 9 or 10 percent increases in the annual average. The big jumps in monthly figures took place in December (7 percent) for copper, lead, and zinc mining, smelting, and refining; February (about 10 percent) for anthracite and bituminous coal. Other increases were more gradual.[24]

Productivity.—Output per man-hour generally rose in coal and metal mining from 1950 to 1951. (No data were available for crude-petroleum production or nonmetallic mining.) Those increasing were bituminous coal and recoverable copper, each 1 percent, and anthracite and direct-shipping iron ore 8 percent. A decrease was experienced in labor productivity in terms of recoverable lead-zinc (5 percent) and primary refining of copper, lead, and zinc (7 percent). Mineral-manufacturing industries with increased output per man-hour were cement (6 percent), byproduct coke (2 percent), and beehive coke (9 percent). (For other mineral-manufacturing industries data were not available.)[25]

Health and Safety.—Disabling injuries in mining industries in 1951 declined as a portion of the total for all industrial groups from 3.69 percent in 1950 to 3.57 percent. Fatalities in mining industries rose, however, from 6.45 percent to 7.50 percent of those in all industries.[26] Fatality rates in mining rose largely because of the fatality-rate increase in coal mining—the result of an unusual number of major disasters. (Detailed discussion of health and safety statistics in mineral industries is found in the chapter on Employment and Injuries.)

[23] Work cited in footnote 5, p. 22.
[24] Work cited in footnote 20, p. 16.
[25] U. S. Department of Labor, Handbook of Labor Statistics: 1951 Suppl., pp. 53–55.
[26] Work cited in footnote 25, p. 57.

PRICES AND COSTS

Prices of minerals in the United States were quite stable during 1951 because of the effects of price control. The Bureau of Labor Statistics monthly wholesale indexes moved only a point or two during the year, but the annual averages were generally well above those for 1950. Both coal and gas, however, averaged only about 2 percent above 1950. Petroleum and products monthly indexes only increased 1 percent during the year but the annual average was 7 percent above that for 1950. Iron and steel products and nonferrous metals both fell a point or two from January to December but on an annual basis were 9 and 19 percent, respectively, above 1950. Clay and gypsum products were unchanged during the year but their annual averages were up 8 and 12 percent, respectively. Fertilizer materials climbed 4 percent during the year, but the annual average was only 5 percent over 1950.

Wholesale price indexes of materials and equipment cost items did not rise significantly. Lumber fell 4 percent from January to December, and construction machinery and equipment and industrial chemicals only rose 1 percent each. The first two averaged about 10 percent each above 1950 values, but industrial chemicals were 19 percent above 1950.[27]

The 6- to 13-percent increase in annual average hourly earnings in mining and mineral manufacturing industries from 1950 to 1951 was not matched by increases in annual productivity. Thus, it may be said that unit labor costs increased from 1 to 3 percent (which would be one-third of 1 percent to 1 percent of output prices). Fortunately for these industries, the average price increases from 1950 to 1951 were about 10 percent, so labor costs generally fell as a fraction of sales for the year. Within the year, however, average hourly earnings increased much more than prices (which had their big jump in the last quarter of 1950), so quarterly operating profits were seen to fall during the year. The experience for individual industries differed widely, however.

TABLE 8.—Relative labor cost in mineral industries in the United States, 1950–51, percentage change in annual averages

Industry	Percentage change in—			
	Average hourly earnings [1]	Price [2]	Output per man-hour [3]	Unit labor cost as a percent of price
Bituminous coal	10	2	1	6
Anthracite	12	7	8	−4
Iron ore	13	9	8	−4
Copper (recoverable) mining	6	[4] 14	[5] 1	−8
Lead-zinc mining	11	[4] 31	[5] −5	−11
Byproduct coke	9	5	2	3
Primary nonferrous	9	20	−7	−4
Cement	8	8	6	−10

[1] Bureau of Labor Statistics, Monthly Labor Review, vol. 74, No. 6, June 1952, table C-1.
[2] Unless otherwise indicated, derived from data given in the respective commodity chapters in this volume.
[3] Bureau of Labor Statistics, Handbook of Labor Statistics, 1951 Suppl., pp. 53–55.
[4] Engineering and Mining Journal, February 1953, vol. 154, No. 2, p. 87.
[5] Preliminary figure.

[27] U. S. Department of Commerce, Office of Business Economics, Business Statistics 1953 Biennial edition: Survey of Current Business Suppl., 1953, pp. 27–30.

TRANSPORTATION

Rail and water transportation of minerals and mineral products grew with general industrial activity. However, mineral-product tonnage fell as a fraction of the total tonnage of all products carried both in the case of rail and of water transportation (*see* table 9). In the case of rail transportation, the decline in proportion was due to the less than average increase in rail haulage of bituminous coal. Iron ore hauled by rail increased 20 percent, the same as the increase for all tonnage.

These transportation data do not agree exactly with that submitted to the Bureau of Mines by its respondents, shown in the various commodity chapters (cement, coal, coke, fluorspar, fuel briquets, iron ore, petroleum, sand and gravel, slag, and crushed stone) because of slightly different reporting concepts and item and respondent coverage.

TABLE 9.—Rail and water transport of mineral products in the United States, 1950–51, in millions of short tons

Commodity	Rail [1]		Water [2]	
	1950	1951	1950	1951
Coal:				
Bituminous	362	386	117	118
Anthracite	55	54	4	3
Coke and breeze	22	26	1	1
Crude petroleum	5	5	68	72
Gasoline	13	13	70	74
Distillate fuel oil	14	13	53	57
Residual fuel oil			40	39
Other petroleum	8	14	22	14
Total petroleum	40	45	253	256
Iron and manganese ore	105	126	82	94
Slag	7	8	-------	[3]
Iron and steel scrap	22	25	1	1
Limestone, crushed	18	21	23	26
Other metals, ores, and concentrates	63	19	10	1
Other nonmetallic minerals		54		5
Cement	29	30	3	3
Sand and gravel	56	60	54	62
Stone, crushed	45	55		
Phosphate rock	21	21	2	2
Sulfur	-------	5	3	3
Total mineral products	845	935	553	575
Grand total all products	1,233	1,477	651	692
Mineral products as percent of grand total	69	63	85	83

[1] Interstate Commerce Commission, Freight Commodity Statistics: 1950, 1951, Revenue Freight Originated.
[2] Department of the Army, Office of the Chief of Engineers, Water-Borne Commerce of the United States: 1950, 1951.
[3] Not available.

FOREIGN TRADE AND INVESTMENTS

Imports.—The value of mineral imports for 1951 rose only 6 percent above that of the previous year because of a 7-percent decline in metals imports. All other major mineral categories registered increases from 23 percent for crude nonmetallics to 6 percent for fuels. Fuels were 35 percent of mineral imports. Metals and their ores and concentrates comprised 48 percent, nonmetallics 10 percent (nearly all in crude form) and other mineral imports, 7 percent. (*See* table 8 in the Statistical Summary chapter.)

Declines in mica, tin, lead, zinc, and nonferrous scrap were to a large extent responsible for strategic shortages in 1951. These were extreme cases of a general pattern of increased demand and emergency hoarding in all countries. Imports swelled in the last half of 1950 after the Korean outbreak, but increased foreign consumption and substantially uncontrolled prices greatly reduced the flows to this country of the most strategic items. The 1951 decline in residual oils and the modest increase in crude imports resulted from the world petroleum crisis following the Abadan seizure, which reduced petroleum imports significantly in the third quarter as Venezuelan petroleum products were diverted to Europe.

Exports.—Fuels, as usual, had overwhelming importance among mineral exports in 1951, comprising 85 percent of the total value. Of the remainder, metals came to 6 percent, nonmetallic minerals 8 percent, and other, 1 percent. (*See* table 8 in the Statistical Summary chapter.)

The great increase over 1950, which raised mineral exports to seven-eighths the value of mineral imports, also was due to fuels exports, which increased 79 percent in value. Great percentage export value increases also took place in metals, crude metallic minerals, and nonmetallic manufactures (141, 55, and 47 percent, respectively), but crude nonmetallic exports increased little (11 percent).

Tariffs.[28]—*Escape-Clause Actions.*—Application for tariff relief under the "escape-clause" procedure outlined in Executive Order No. 10082 (1949) resulted in an adverse action for the lead industry. Escape-clause applications with respect to lead-bearing materials, lead, and lead scrap brought (early in 1950) by the Emergency Lead Committee, New York, and the New Mexico Miners and Prospectors Association, were dismissed by the Tariff Commission on January 25, 1951, after preliminary hearings.

In June 1951 the Trade Agreements Extension Act of 1951 was passed. This law, which basically extends the authority of the President to enter into trade agreements with other countries, now includes an escape clause and "peril-point" amendment. The peril-point amendment appeared originally in the Trade Agreements Extension Act of 1948 but was repealed, along with the entire act of 1948, by the Extension Act of 1949. Both the escape clause and the peril-point amendment provide industries with the opportunity to seek protection from injurious foreign competition. The peril point allows the industry to seek protection from any adverse change of rates as a result of impending negotiations, and the escape clause affords the industry the means of seeking relief as a result of a past tariff concession.

Congressional Actions.—The import duty on all scrap metal was suspended by the Congress for 1 year beginning June 30, 1951. Also, by act of Congress, effective April 1, 1951 (until February 15, 1953, or the end of the emergency period, whichever occurs first), the import duty on various copper items was suspended. This suspension of the duty on copper ores, concentrates, and articles containing copper was to remain in effect so long as the average monthly market price of copper was 24 cents or more per pound delivered Connecticut Valley. If the average domestic market price of electrolytic copper,

[28] This section was prepared by H. E. Striner, Bureau of Mines.

delivered Connecticut Valley, was below 24 cents per pound for 1 calendar month, the Tariff Commission within 15 days after the end of that month was to advise the President of this situation. The President then had to revoke the suspension by proclamation. This proclamation was to be issued not later than 20 days after the advising action by the Tariff Commission.

International Agreements.—Multilateral reciprocal tariff negotiations undertaken at Torquay, England, in September 1950 were completed in April 1951. These negotiations, conducted under the provisions of the General Agreement on Tariffs and Trade (usually referred to as GATT), resulted in tariff bindings and reductions on a number of mineral items by the United States. A list of these items includes various barium compounds, magnesium salts and compounds, all potash salts, sodium compounds, tellurium compounds, coal-tar compounds, cobalt compounds, iodine (resublimed), zinc, and lead ores, concentrates and compounds, magnesium and magnesium compounds, manganese, phosphorus, mineral-earth pigments, barites or lampblack, potassium compounds, strontium compounds, thorium compounds, tin compounds, magnesite, clay of various sorts, bentonite, feldspar, clays, silica, crude fluorspar containing over 97 percent of calcium fluoride, mica, talc, granite, pig iron, molybdenum, ferromanganese, manganese-silicon, various ferrous compounds, chrome, titanium, boron, vanadium, calcium metals, zirconium metals, aluminum metal and alloys, and bismuth.

Foreign Investment.—In 1951, net direct investment capital movements from the United States to other countries plus reinvested earnings and other changes (*see* table 10) increased the total investment abroad in mining and smelting 17 percent, in petroleum 9 percent, and in all industries 11 percent. The cumulative net mineral investment abroad remained at 38 percent of net investment abroad in all industries.

Net capital movements from the United States to other countries in 1951 for petroleum and mining and smelting fell 42 percent from 1950 and amounted to only 37 percent of such investment for all industries (in 1950 they had been 54 percent of the total). The total for all industries of such investment flows declined 15 percent compared with 1950. The major exceptions to this general decline were Brazil, Peru, and Chile, for which modest increases took place for mineral industries and for all industry.

Canada accounted for 133 percent of the net flow of United States investment abroad in petroleum ventures in 1951 and 36 percent of mining and smelting investment flows. Chile and Peru together accounted for another 54 percent of the latter flows. Of the areas of greatest cumulative net United States investment abroad in petroleum, Venezuela and the Middle East (25 and 20 percent, respectively), the former suffered a slight decline in 1951. On the other hand, the countries with the greatest cumulative net investment in mining and smelting, Chile and Canada (31 and 30 percent, respectively), each enjoyed increases in mining and smelting investment flow in 1951 and together accounted for 66 percent of the 1951 total.

TABLE 10.—Direct private investments of the United States in foreign mineral industries, 1950–51 [1]

[Millions of dollars, inflows (−)]

Country	Mining and smelting			Petroleum			All industries [2]		
	Book value, end of 1950	1951 changes		Book value, end of 1950	1951 changes		Book value, end of 1950	1951 changes	
		Net capital movements	Reinvested earnings and other changes [3]		Net capital movements	Reinvested earnings and other changes [3]		Net capital movements	Reinvested earnings and other changes [3]
Canada	334	36	30	418	124	20	3,579	240	153
Latin American Republics:									
Brazil	(4)	(4)	(4)	112	17	3	644	92	67
Chile	351	30	2	(4)	(4)	(4)	540	40	3
Colombia	(4)	(4)	(4)	112	4	(5)	193	11	3
Mexico	121	−5	11	13	−2	−1	415	24	33
Panama				181	−44	57	348	−38	63
Peru	55	24	34	(4)	(4)	(4)	145	17	36
Venezuela	(4)	(4)		857	−39	16	993	−16	19
Total [6]	628	60	48	1,408	−75	75	4,735	165	276
United Kingdom	3	(5)	(5)	123	18	13	847	18	96
Other Western European countries	18	(5)	2	301	19	37	873	44	101
Middle East [7]	11	(5)	(4)	681	44	46	719	64	49
All other countries	135	4	8	459	−37	29	1,035	−3	99
All areas, total	1,129	100	88	3,390	93	220	11,788	528	774

[1] Source: U. S. Department of Commerce, Office of Business Economics, Foreign Investments of the United States: Washington, 1953, 61 pp.; and records of Office of Business Economics.
[2] Includes industries not shown separately.
[3] "Other changes" consist of adjustments caused by revaluation of properties, transfer of assets from one country to another, profit or loss on liquidations, and other technical adjustments. The net of such changes in 1951 were as follows (in millions of dollars): Mining and smelting, all areas, 32 (Peru, 33; other Latin American Republics, −1; Western European countries, −1; all other countries, 1); Petroleum, all areas, 16 (Panama, −7; United Kingdom, 6; Other Western European countries, 11; Middle East and "all other countries," 6); All industries, all areas, 22 (Canada, −28; Panama, −7; Peru, 33; other Latin American Republics, 1; United Kingdom, 6; Other Western European countries, 10; Middle East and "all other countries," 7).
[4] Included in totals.
[5] Less than $500,000.
[6] Includes countries not shown separately above.
[7] Includes Aden, Bahrein Islands, Egypt, Iran, Iraq, Israel, Jordan, Kuwait (including neutral zone), Lebanon, Saudi Arabia (including neutral zone) and Syria.

The flow of gross petroleum capital expenditures for foreign facilities was 13 percent of domestic gross and was 250 percent of net petroleum investment abroad in 1951.[29] (Comparable gross figures for other mineral industries not available.) The flow of net investment abroad for all industries in 1951 was 2.6 percent of domestic net investment flow (which is computed by subtracting the sum of capital consumption allowances and private residential construction from gross private domestic investment).

Economic Cooperation Administration.—The Economic Cooperation Administration purchased $14.5 million worth of strategic minerals[30] for the National Stockpile during 1951, of which 92 percent was covered by counterpart funds. During the same period it committed $68.2 million for prospecting, developing, and expanding production

[29] Work cited in footnote 15, p. 20.
[30] Plus small amount of nonmineral products.

of strategic minerals in "ECA areas," raising the cumulative total to $109 million. Ninety percent of the 1951 total was from counterpart funds. The repayment of the total of these advances was to be made in minerals for the Stockpile, and usually options for additional Stockpile purchase were involved as well.[31]

The first contract guaranteeing the convertability of receipts from licensing patents, processes or techniques without an accompanying cash or "hard" investment (as provided for in the 1950 amendments to the Economic Cooperation Act) was made in the first quarter. Informational-media-receipts-convertability guarantees were continued and constituted an important contribution to technical assistance programs.

Mineral products constituted 20 percent of procurement authorizations for European countries in 1951, about 55 percent of which was for fuels. This equaled the value of 15 percent of United States coal exports during the year.

DEFENSE MOBILIZATION

Defense Production Act.—The Defense Production Act of 1950 was amended and renewed as Public Law 96, 82d Congress, on July 31, 1951. The same powers as the act originally contained were continued in essentially unmodified form as far as minerals expansion assistance was concerned, except that subsidy granting powers were clarified. A number of changes permitting adjustments of price ceilings were added, which liberalized that treatment, and provisions covering materials and equipment allocations to small businesses and other provisions covering small business problems had some impact on minerals firms. The administration continued to request review of price control sections of the act by Congress throughout the remainder of the year.

Defense Minerals Administration.—During 1951 the Defense Minerals Administration developed programs stating requirement needs and supply deficiencies of strategic minerals and instituted supply projects to make up the indicated shortages. DMA also contracted with private companies on a sharing basis to stimulate exploration designed to provide a long-run base of strategic minerals reserves. Maintenance of existing production was assisted by arranging priorities for scarce manpower, materials, and equipment needed to keep mines operating at maximum efficiency. Among the types of assistance recommended under provisions of the Defense Production Act to expand supply were accelerated tax amortization, conditional procurement contracts, fixed-price contracts, subsidies, loans, advances, loan guarantees, and access roads.

The agency recommended such projects to the Defense Production Administration for certification to the various operating agencies to carry out. Accelerated tax amortizations were certified to the Bureau of Internal Revenue. Loans were certified to the Reconstruction Finance Corporation for final development of terms. Procurement contracts and advances were certified to the General Services Administration for final negotiation, execution, and administration. Access roads were directly recommended to the Bureau of Public Roads for survey and construction.

[31] U. S. Department of Defense, Munitions Board, Stockpile Report to the Congress: July 23, 1951 and January 23, 1952.

During 1951 the budget estimates indicated that the gross commitments required under DMA programs would be over $6 billion, but it was obvious that the cost to the Government would never be more than a fraction of that amount. This led to an important development in Government accounting, estimation of the financing necessary to meet the expected cost of such assistance to the Government. When the budget was submitted under this concept, the "probable ultimate net cost," a prudently ample obligation limit requested for the fiscal year beginning in July 1951, was below the original $2 billion authorization limit of the Defense Production Act as amended.

Another section of DMA work considered to be to a large degree completed during 1951 was recommendation of accelerated tax-amortization projects. This was natural because of pressure for early construction starts under the program and the fact that the largest projects came in early.

Defense Materials Procurement Agency and Defense Minerals Exploration Administration.—On August 28, 1951, the President established the Defense Materials Procurement Agency and transferred the authority of the Secretary of the Interior for emergency mineral assistance responsibilities to the General Services Administrator under Executive Order 10281. The General Services Administrator delegated back to Interior (September 14) the exploration assistance responsibilities (and budgets), which were of a long-run rather than an emergency nature. To carry out these duties, the Secretary of the Interior organized the Defense Minerals Exploration Administration (November 20) with personnel transferred mostly from the DMA Production Expansion Division. The General Services Administrator, under Budget Bureau orders of determination and disposition, incorporated most of the other DMA personnel in the Defense Materials Procurement Agency on October 28 along with the minerals personnel of the ECA Materials Development Division in December.

With the assistance of the General Services Administration the DMPA carried out the functions previously performed by DMA (except the delegated exploration), that is, keeping minerals programs up to date and analyzing and negotiating domestic and foreign expansion assistance projects for recommendation to the Defense Production Administration.

The Defense Minerals Exploration Administration continued to carry out (as DMA previously did) the analysis of exploration proposals, and the negotiation and administration of exploration-expense-sharing contracts. Early in 1951, DMA had obtained approval of and issued Mineral Order 5, which listed three sharing exploration percentages (50, 75, and 90) under which strategic minerals were grouped and also specified other regulations and instructions, which were also subsequently followed by DMEA. By December 31 DMA and DMEA had received 1,174 applications for exploration assistance, executed 197 contracts, and otherwise disposed of 437 applications.

Price Controls.—Price control of minerals in the United States began with a series of industry meetings in January at which it was apparent that the prices of copper, lead, and zinc had already risen enough to sustain considerable pressure from increases in costs and foreign

metals prices. The latter, however, became especially bothersome through the year. Much of the industry felt that the New York futures market should be closed and all tariffs removed if the price were to hold. The market was closed.

Foreign prices of minerals continued to climb after United States prices were frozen until they were later frozen at higher levels or never even formally controlled. The Chilean Government was in no mood to be "regulated" by the Office of Price Stabilization when some copper was selling to certain Europeans at twice the United States ceiling. After Chilean price negotiations were settled, the United States agreed in May to establish an import price ceiling for copper 3 cents above the 24.5 cent domestic ceiling. Import declines of lead and zinc led to 2-cent increases in their ceiling prices in October.

Concern over supplies of ferroalloy metals led to an unusual price-control ceiling. In May domestic tungsten was guaranteed a $63-per-unit price for 4 years which was substantially higher than an adjusted freeze price would have been. This action was taken as an effort to afford sustained encouragement to the domestic industry. Price controls were dropped altogether, for example, on cobalt, columbium, titanium, and nickel in an effort to encourage increased supply.

Other Defense Organizations.—There were no other defense agency reorganizations of particular significance for minerals industries. The reorganizations in the Office of Defense Mobilization, Defense Production Administration, National Production Authority, and the Economic Stabilization Agency's suborganizations were all essentially internal adjustments to rapid, administrative expansion. An Executive order of January 3, 1951, transferred the coordinating authority in the materials field from the National Resources Planning Board to the Defense Production Administration. That Administration organized the interagency Vital Materials Coordinating Committee to perform the functions of coordinating expansions of supply, distribution of available quantities, and restrictions of nonessential uses. The Small Defense Plants Administration was under fire throughout 1951 but maintained its independence and enlarged its scope of function.

The Defense Solid Fuels Administration and the Petroleum Administration for Defense continued through 1951 with their operations, expanding rapidly at the same time, especially in the first half of the year. Their major assistance projects were for accelerated tax amortization and a heavy part of their workload was as a claimant agency for materials, manpower, and equipment for the industries within their scope.[32]

The Office of International Trade applied its export controls to all strategic minerals, for which there were several gradations of control from closed, quantitative, restrictive, to open end (which were freely licensed but watched closely).

National Strategic Stockpile.[33]—The accelerated activity connected with the National Strategic Stockpile initiated in 1950 was continued throughout 1951 to the extent allowed by supply conditions. Fifty-

[32] *See* Annual Reports of the Secretary of the Interior, 1951 and 1952, and press releases of the agencies.
[33] U. S. Department of Defense, Munitions Board, Stockpile Report to the Congress: January 23, 1952, and August 15, 1952.

four percent of the obligations incurred over the 5½ years of the Stockpile were incurred in 1951. Likewise, 41 percent of the cumulative expenditures up to December 31 took place in that one year. In November there were moderate increases in total obligational authority and cash appropriated to stay ahead of the 1951 program of incurring obligations.

Total Stockpile objectives were raised during 1951 from $8,870 million to $9,298 million, a net figure resulting from both increases and decreases. As a result of emergency shortages, the President authorized release of $40 million worth of aluminum, copper, and lead from the Stockpile inventory.

Specifications were revised for asbestos, bauxite, bismuth, cobalt, quartz crystals, fluorspar, graphite, iridium, kyanite and mullite, lead, platinum, and tungsten powder. The only reclassification of commodity during 1951 was the shift of iodine from Group II to Group I, indicating that purchases from general sources were to be reopened.

The Export-Import Bank established $38 million of credits abroad during 1951 to assist production of manganese and tungsten concentrates for the National Stockpile and had several millions more of credits under consideration at the year end for the same purpose.

The Commodity Credit Corporation through December 31, 1951 exchanged some of its agricultural commodities for $33 million worth of industrial diamonds, chromite, and manganese produced abroad, which were then purchased by General Services Administration for the Stockpile.

TECHNOLOGY

Mining.[34]—Improvements were made in mining technology in all fields of the mineral industries during 1951, but no outstanding innovations were reported.

In the bituminous-coal industry the trend was toward increased mechanization, with a resultant increase to 7.04 tons output per man-shift from 6.77 in 1950.

Experiments to adapt longwall mining to American conditions were begun at several bituminous-coal mines; European longwall machines were imported for the tests. The increasing scarcity of high-quality coking coals in the United States makes these experiments particularly important. Nearly half of our coking coal is now lost in mining; the success of the longwall mining experiments would lead to a substantial increase in the percentage of extraction.

A successful application of block caving was made in the anthracite mines; the tonnage per man-shift was increased several fold over conventional methods.

The practice of roof bolting was greatly extended both in coal and metal mines. Roof bolting permits freer use of mechanical equipment, which, in turn, increases the tons per man-shift.

In underground metal-mining, improvements were made in drilling and blasting practices. Jumbos and jackleg drill supports continued to replace drill columns. Improvements in tungsten carbide bits have permitted drilling a blast hole with a single piece of steel.

[34] This section was prepared by E. D. Gardner, chief mining engineer, Bureau of Mines.

This practice, together with jumbo-mounted drills, has reduced drilling costs. Millisecond blasting was introduced in some mines.

Diesel trucks continued to replace track haulage at mines where conditions favored the change. The use of belt haulage underground was extended. More tractor-mounted loading equipment, such as that used in surface excavations, also was introduced underground.

A successful experiment was made with hydraulic hoisting through pipes at one mine. A shaft was sunk through quicksand in the New Mexico potash field by the freezing method. This was the first successful application of freezing in shaft sinking in America—at least in the past 3 decades. Plans were drawn for longwall mining of potash at one mine, and pillar extraction was begun at two others.

The economic ratio of stripping to ore increased in all fields of mining so that some deep (over 350 feet) deposits that previously would have been exploited by underground mining were being mined as open pits.

Milling and Metallurgy.[35]—*Beneficiation.*—The most spectacular developments in mineral dressing have been in the taconite and other iron ores of the upper lakes area. As an instance, the Reserve Mining Co. let $75 million contracts for construction of a 2,500,000-ton-per-year concentrates plant at Beaver Bay, Minn. It began erecting a 300,000-ton-per-year pilot plant for magnetic concentration and pelletizing of concentrate. Oliver Mining Co., Erie Mining Co., and Pickands Mather & Co. were doing similar things. Cleveland Cliffs Iron Co. had put into commercial operation a Dutch State Mines "cyclone" plant for concentrating iron sands at the Buckeye mine of M. A. Hanna & Co., and another was started at the Holman mine.

Manganese ores of the Three Kids mine, near Las Vegas, Nev., were to be concentrated in a 1,000-ton-per-day concentrator under construction. The Bureau of Mines began constructing a pilot plant at Boulder City, Nev., for flotation and hydrometallurgical treatment of ore from the Artillery Peak mine in Arizona. Other concentrators for Cuyuna-range manganese slates and other low-grade ores were contemplated to produce concentrate between 20 and 30 per cent manganese that could then be treated by several hydrometallurgical processes.

The mill of Calera Mining Co. (Howe Sound) at the Blackbird mining district of Idaho began producing copper concentrate and cobalt concentrate from 1,000 tons of ore daily. The copper was to be smelted at Garfield and the cobalt recovered by a hydrometallurgical process in a plant under erection at Garfield, Utah. Cobalt-nickel-copper-iron sulfide middlings made by National Lead Co. at Fredericktown, Mo., during the milling of a lead ore are to be treated in a similar hydrometallurgical plant using the Chemico process. This was also to be done by the Lynn Lake mine of Sherritt-Gordon in Manitoba where a 50-ton-per-day-pilot-plant was in operation.

In milling the most expensive step—grinding—was being intensively improved and cheapened. Several installations of new high-speed, large-diameter rod mills had been breaking records.

In concentration the Humphreys spiral and the Dutch cyclone were becoming very popular and promising further developments in future years. Electrostatic separation of mixed concentrates made from

[35] This section was prepared by O. C. Ralston, chief metallurgist, Bureau of Mines.

placer and beach sands had won definite place in large mills in Florida and was included in the testing work done on many of the new complex ores under development.

The Mardun disintegrator, developed in a small desert plant of northern Arizona, was further developed at the Salt Lake Experiment Station of the Bureau of Mines. A mixture of strong and weak minerals is stirred in a rotating device of controllable speed at a rate that will reduce the soft mineral to dust and leave the strong mineral grains only slightly abraded. The original plant in Arizona treated a sandstone containing soft copper carbonates. The apparatus is simple and appears to offer great promise.

Metallurgy.—As mentioned above, hydrometallurgy as an adjunct to beneficiation is finding new fields. The Artillery Peak manganese dioxide ore is very fine grained, and flotation is successful only on the more granular material produced when the ore is ground. The tremendous reserves of siliceous manganese ores and the manganese slates of the Cuyuna range in Minnesota cannot be beneficiated to Metallurgical Grade but can be concentrated with acceptable recovery if 20 to 25 percent Mn concentrate is made. Then hydrometallurgy would take over.

Uranium is recovered by hydrometallurgical methods from most of the ores of the Colorado Plateau, and new proposals were under way for recovering the small amounts of uranium in gold ores and phosphate pebble, both of which are worked in such large tonnages that the total of available uranium in the lean material is not inconsiderable.

Titanium was a favorite research subject during the year, and organization of production went forward. The Titanium Metals Corp. of America, jointly owned by National Lead Co. and Allegheny Ludlum Steel Co., was awarded a contract for producing 10 tons of titanium sponge daily and began construction and operation. Du Pont de Nemours & Co. were also very active in production, but moved more slowly and cautiously. The Bureau of Mines continued improvements on the Kroll process used by both of the above, and the literature was replete with articles on the alloys of titanium and their properties and potential usefulness. The Van Arkle process of refining titanium by the tetraiodide process was intensively discussed, and the New Jersey Zinc Co. set up a small plant to produce highly refined titanium for the use of experimenters on alloys.

There was great interest in zirconium, also sparked by the Bureau of Mines, but the curtain of secrecy surrounding its use as a structural material in the raising of atomic power, hindered to some extent the free exchange of information about its extraction, refining, fabrication, and alloying. Recovery of the hafnium associated with zirconium also was begun.

Lead, zinc, and cadmium were recovered at higher rates than before.

The germanium content of zinc ores was under intense scrutiny, and the Eagle Picher Co. at Joplin, Mo., produced much of the metal used in transistors and other electronic tubes. Selenium for rectifiers was in short supply, and many were seeking a further supply. Utah was found to be the most important area for selenium supplies, and a considerable amount was noted in Mexico.

Fuels.[36]—*Synthetic Liquid Fuels.*—The first demonstration-scale Fischer-Tropsch (gas-synthesis) plant in this country to produce synthetic liquid fuels from coal was completed and tested by the Bureau of Mines in 1951. Technological advances were made in developing the coal-hydrogenation process, in producing more durable catalysts for this and the gas-synthesis process, in reducing oil-shale mining costs using Bureau-developed equipment and in retorting oil shale and refining shale oil to usable products. In laboratories, pilot plants, and demonstration-scale equipment the Bureau added much information for industry in evaluating synthetic fuels processes. Reduction of costs of producing synthesis gas was also achieved.

Petroleum.—There were no outstanding advances in petroleum technology; but in 1951 manufacture of "petrochemicals" increased markedly over 1950, and several units of the platforming process were started in operation.

Coal.—The Bureau of Mines conducted research to improve the safety and efficiency of coal mining by studies and tests of mechanical mining equipment for both bituminous coal and anthracite, including the introduction of a German coal planer to long-wall mining of thin-bed coal. Coal preparation and utilization research and developments included successful testing of a heavy-medium pilot plant to separate close-gravity fractions of coal and refuse, improvements in the Bureau-developed kerosine flotation process, preparation of ultraclean coal for electrodes, testing and developing special types of combustion equipment, study of factors affecting the quality of coke and the behavior of coal in coke ovens, and assistance in the design of the first commercial plant utilizing the Bureau-developed process of fluidized drying and carbonization of noncoking coals. The Bureau's research work on coal and synthetic liquid fuel from coal in 1951 was summarized in information circulars 7647 and 7663.[37]

Private Research.—The Research and Development Board of the Department of Defense had the Bureau of Labor Statistics prepare a report on private industrial research in 1951 based on a sample (which covered most of American industrial scientists) of 1,934 companies including 49 petroleum firms and 49 primary metals companies. The report showed that, out of 89,851 research engineers and scientists employed by all industries, 5.5 percent were employed by petroleum refining and 1.9 percent by primary metal industries in January 1952. The cost of research to petroleum refining in 1951 was $93 million, 5.2 percent of that for all industry, and primary metal industries spent $34 million. Only 3.1 percent of the expenditure by petroleum refining was financed by the Federal government, and 9.5 percent in primary metal industries—much lower than the 47.0 percent of all industries.[38]

[36] This section was prepared by the staff of the Fuels and Explosives Division of the Bureau of Mines.
[37] Brown, R. L., and Carman, E. P., Annual Report of Research and Technologic Work on Coal, Fiscal Year 1951: Bureau of Mines Inf. Circ. 7647, 1952, 81 pp. Brown, R. L., and Ode, W. H., Annual Report of Research and Technologic Work on Coal, Fiscal Year 1952: Bureau of Mines Inf. Circ. 7663, 1953, 67 pp.
[38] Department of Defense and Department of Labor, Industrial Research and Development, A Preliminary Report: January 1953, 42 pp.

WORLD REVIEW

World Production.—World production increased for virtually all major minerals from 1950 to 1951 and for many of them reached the highest level of annual ever attained.

Crude petroleum rose 13 percent, and lignite increased about 14 percent. Coal production increased only 5 percent. Inasmuch as coal constitutes about half the world energy sources (in terms of coal equivalents), the increase in world energy consumption was only 9 percent, a 7.5-percent-per-capita increase. The 8 largest European coal producing countries all registered modest output increases, but Western Germany production increased about 7 percent.

TABLE 11.—Comparison of world and United States production of principal minerals and metals, 1950–51

[Compiled by Berenice B. Mitchell, Pauline Roberts, and Helen Hunt]

Mineral	1950			1951		
	World	United States		World	United States	
	Thousand metric tons		Percent of world	Thousand metric tons		Percent of world
Fuels:						
Anthracite	140,000	39,986	29	145,700	38,709	27
Bituminous coal and lignite	1,665,000	468,387	28	1,769,300	484,130	27
Natural gas—million cubic meters	203,000	177,860	88	240,000	211,170	88
Petroleum, crude—thousand barrels	3,802,907	1,973,574	52	4,282,874	2,244,529	52
Nonmetallic minerals (other):						
Asbestos	1,300	38	3	1,400	47	3
Cement	131,500	39,273	30	147,200	42,548	29
Diamonds—thousand carats	15,250			17,000		
Fluorspar	789	274	35	957	315	33
Graphite [1]	135	5	4	160	6	4
Gypsum	22,700	7,432	33	24,500	7,861	32
Mica	104	63	61	101	65	64
Nitrogen, agricultural [1]—fiscal year	3,707	1,048	28	4,011	996	25
Phosphate rock	21,875	10,418	48	23,420	11,273	48
Potash—K_2O equivalent	4,400	1,168	27	4,800	1,288	27
Pyrites	11,600	946	8	12,600	1,034	8
Salt	48,000	15,086	31	53,500	18,331	34
Sulfur, native—thousand long tons	5,700	5,192	91	5,800	5,278	91
Metals, mine basis:						
Antimony [1]—Sb content	44	2	5	64	3	5
Bauxite	8,160	1,356	17	10,650	1,878	18
Chromite	2,300	[2]	[3]	2,800	6	[3]
Copper—Cu content	2,510	825	33	2,640	842	32
Gold—thousand troy oz. Au	32,500	2,289	7	33,500	1,895	6
Iron ore	247,000	99,619	40	293,000	118,375	40
Lead—Pb content	1,643	391	24	1,679	352	21
Manganese ore	5,800	122	2	6,500	92	1
Mercury—thousand flasks Hg	143	5	3	148	7	5
Nickel—Ni content	145	1	1	161	1	1
Platinum group thousand troy oz. Pt, Pd, etc.	600	38	6	675	37	5
Silver—thousand troy oz. Ag	198,600	42,309	21	198,600	39,907	20
Tin—thousand long tons Sn	169	[4]	[3]	169	[4]	[3]
Tungsten—60 percent WO_3	39	4	10	50	6	12
Zinc—Zn content	2,123	566	27	2,271	609	27
Metal, smelter basis:						
Aluminum	1,494	652	44	1,788	759	42
Copper	2,685	915	34	2,850	940	33
Iron, pig (including ferroalloys)	134,000	60,210	45	150,000	65,805	44
Lead	1,696	458	27	1,652	376	23
Magnesium	41	14	34	80	37	46
Tin—thousand long tons	178	33	19	171	32	19
Zinc	1,966	765	39	2,095	800	38

[1] Exclusive of U. S. S. R.
[2] 367 tons.
[3] Less than 0.5 percent.
[4] 1950, 94 long tons; 1951, 88 long tons.

Most nonmetallic minerals (other than fuels) had record years of output in 1951. This was also true of petroleum and natural gas. The only major metals, however, with a 1951 historical peak were iron ore, manganese, zinc, chrome, and antimony. (The greatest world production years for most other metals was 1943; 1941 for tin and mercury; 1940 for gold; and 1937 for silver.)[39]

World Prices and Stocks.—Coal prices rose substantially in a few countries from June 1950 to August 1951, Poland by 90 percent and Western Germany by 45 percent, but only small increases were realized in most countries because of price controls. Stocks of coal increased in most of the major producing countries but fell in France, Belgium and Japan.[40]

Petroleum-products prices also rose only moderately because output rose readily with demand.[41] Stocks were also able to rise during the year.[42] The largest price increases were those for fuel oils which rose an average of 15 percent above 1950.

World prices of native sulfur [43] continued to increase wildly where there was no price control, but pyrites prices rose less because of a greater relative increase in production (9 percent compared to 2 percent for native sulfur).

The London tin price rose to £1,615 in February and fell to £805 by August. Nevertheless, the sixth meeting of the International Tin Study Group held in Rome during September did not consider an international agreement in their discussions of long- and short-run cooperation.[44]

Aluminum prices rose only modestly in all countries under the moderating influence of large increases in output by the United States and Canada.[45] World trade in aluminum expanded along with the large increase in Canadian output, the world's largest exporter.[46]

Prices of iron ore, scrap and pig iron [47] rose considerably in all important countries but generally less than prices of nonferrous metals or ferroalloy metals. Scrap rose much more than iron ore or pig iron because its supply was less elastic.

International Cooperation.—Of all the intergovernmental cooperative efforts that affected minerals industries, the International Materials Conference was the most important. The foreign ministers of France, the United Kingdom, and the United States published a joint declaration on January 12, 1951, stating their agreement to propose international commodity groups to certain other governments. Four committees (out of seven created) covered minerals: The Copper, Zinc, and Lead Committee; the Manganese, Nickel, and Cobalt Committee; the Tungsten and Molybdenum Committee; and the Sulfur Committee. The countries that joined the original three on commodity committees were: The other members of the British Common-

[39] Statistical Office of the United Nations, Statistical Yearbook 1952: New York, 1952, various refs.
[40] United Nations, Review of International Commodity Statistics: 1951, pp. 14-15.
[41] Organisation for European Economic Cooperation, General Statistical Bulletin: 1952, various issues.
United Nations, Monthly Bulletin of Statistics: 1952, various issues.
International Monetary Fund, International Financial Statistics: 1951–52, various issues.
[42] Bureau of Mines, World Petroleum Statistics: 1952, various issues.
[43] Organisation for European Economic Cooperation, Chemical Products Committee, Sulphur; a study by the secretariat of the Chemical Products Committee: Paris, 1952, 62 pp.
[44] United Nations, Monthly Bulletin of Statistics: 1952, various issues.
International Monetary Fund, International Financial Statistics: 1951–52, various issues.
[45] Works cited in footnote 44.
[46] Organisation for European Economic Cooperation. Foreign Trade of Selected Commodities, January–December, 1951 and January–March 1952: Foreign Trade Statistical Bull., Series III, Paris, September 1952.
Works cited in footnotes 40 and 41.
[47] Works cited in footnote 41.

TABLE 12.—World prices of selected mineral products, 1951, by months, in United States dollars

[International Financial Statistics, International Monetary Fund]

Commodity and country	Percent of world exports or imports [1]	January	February	March	April	May	June	July	August	September	October	November	December
Copper (cents per pound): [2]													
Belgian Congo	(13)	----------	25.64	26.33	26.33	27.72	29.42	29.52	29.55	29.72	29.82	29.82	29.82
Canada	(8)	24.52	24.53	24.43	24.34	24.45	27.54	27.55	27.50	27.53	27.54	27.51	27.54
France	7	32.13	32.13	32.77	32.77	32.77	36.78	36.91	36.91	36.91	37.04	45.13	45.13
Italy	5	54.14	58.24	55.70	56.61	56.54	55.16	53.07	53.56	58.33	61.47	61.42	61.05
Netherlands	1	51.33	59.68	56.70	56.70	57.30	54.91	53.72	56.70	57.30	55.51	53.72	50.73
United Kingdom	29	25.25	25.25	25.25	26.25	27.25	29.25	29.25	29.25	28.81	28.37	28.37	28.37
United States	29	24.50	24.50	24.50	24.50	24.50	24.50	24.50	24.50	24.50	24.50	24.50	24.50
Lead (cents per pound): [3]													
Canada	(15)	16.98	17.02	16.98	16.83	16.94	17.04	17.05	17.00	17.00	17.93	18.68	19.01
France	6	21.04	21.04	21.04	21.04	21.04	21.04	21.11	21.11	25.79	26.69	26.69	26.69
Italy	2	21.55	22.32	21.55	21.05	20.72	20.87	20.87	20.94	21.55	21.77	21.64	21.50
United Kingdom	27	17.00	17.00	17.00	20.00	20.00	20.00	22.50	22.50	22.50	21.88	21.88	21.88
United States	38	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	19.00	19.00	19.00
Zinc (cents per pound): [4]													
Canada	(29)	18.43	18.51	18.41	18.28	18.35	18.47	18.48	18.45	18.47	19.54	20.45	30.81
France	9	22.87	22.87	22.87	22.87	24.82	24.82	24.91	26.86	26.86	29.57	29.57	29.57
Netherlands	2	28.65	29.24	29.24	29.24	28.64	29.24	29.24	30.48	30.48	31.69	32.52	32.52
United Kingdom	38	18.87	18.87	18.87	20.00	20.00	20.00	23.75	23.75	23.75	23.75	23.75	23.75
United States	19	18.22	18.22	18.22	18.25	18.25	18.25	18.25	18.26	18.29	20.29	20.29	20.29
Coal (dollars per short ton): [5]													
United States	(37)	8.74	8.97	8.98	8.94	9.09	9.09	9.01	9.12	9.23	9.25	9.26	9.26
Germany	(18)	14.89	14.89	14.89	14.89	14.89	14.89	14.89	14.89	14.89	14.89	14.89	14.89
United Kingdom	(9)	10.15	10.15	10.40	10.74	11.47	11.37	11.02	11.38	11.35	11.48	11.95	11.71
France (Domestic)	} 15	{ 9.80	9.80	9.80	11.09	11.09	11.09	11.35	11.35	13.63	13.67	13.67	13.67
France (British)	}	{ 26.06	26.06	26.06	28.70	28.70	28.70	31.48	31.48	36.21	36.33	36.33	36.33
Italy	6	19.60	24.68	23.95	26.13	26.13	26.13	26.13	26.13	26.13	25.40	25.40	25.40
Fuel oil (dollars per barrel): [6]													
United States	(19)	3.36	3.36	3.36	3.34	3.33	3.33	3.35	3.36	3.36	3.36	3.36	3.36
France	----------	5.23	5.51	5.69	5.69	5.69	6.02	5.26	5.12	5.05	5.19	5.34	5.34
Italy	----------	4.44	4.78	5.14	5.14	4.91	4.87	4.68	4.60	4.55	4.60	4.77	4.66
United Kingdom	11	6.25	6.12	6.62	5.83	5.02	5.44	5.48	5.64	5.64	(7)	(7)	(7)

[1] Figures in parentheses are exports; all other figures are imports.

[2] Belgian Congo: Electrolytic, Belgian market; Canada: Electrolytic, Montreal or Toronto; France: Electrolytic, at port; Italy: Wirebars, Milan; Netherlands: Remelted copper; United Kingdom: Electrolytic; United States: Domestic electrolytic, Connecticut Valley.

[3] Canada: Carlots, delivered Montreal or Toronto; France: C. i. f. at port; Italy: Milan; United Kingdom: Soft foreign, duty paid; United States: Average of daily prices of domestic desilverized pig lead, New York.

[4] Canada: Electrolytic, Grade A; France: Ingots, at port; Netherlands: Sheets; United Kingdom: g. o. b. foreign duty paid; United States: Domestic Prime Western, New York.

[5] United States: Average composite domestic prices of mine-run bituminous coal, at destination; Germany: Anthracite nut, free market; United Kingdom: Large steam and household coal, unit value of exports, f. o. b.; France (domestic): Bituminous, mine-run, Flenus, inclusive of taxes; France (British): Anthracite nut, imported, inclusive of taxes; Italy: Mine-run industrial, Genoa.

[6] United States: Gulf coast cargoes, domestic andexport prices from all Gulf ports, f. o. b. ship at Gulf; France: Light, price at port; Italy: Milan; United Kingdom: Gas and diesel.

[7] Not available.

wealth; all the other countries of Western Europe (except Ireland, Denmark, and Greece); and Japan, Mexico, Cuba, and all the South American countries (except Venezuela, Colombia, Ecuador, and Paraguay). Only Western Germany and Canada were on all the mineral committees, in addition to the original three nations. The committee membership included over 85 percent of the Free World production and consumption of the scarce minerals involved.

By the third quarter (July 1951), three months after beginning their work, the Tungsten-Molybdenum and Sulfur Committees had made recommendations for quarterly allocations of their commodities. By the fourth quarter, the other two mineral committees had agreed upon quarterly allocations of their minerals.[48]

The emergency allocations were designed to achieve an orderly and equitable distribution of available supplies, recognizing needs for defense, strategic stockpiling, and essential civilian consumption. The committees endeavored not to interfere with normal channels of trade and made no recommendations for allocation by source. The quotas were merely limits on exports and imports, which permitted countries, within those limits, to buy from or sell to any countries of the Free World. The methods of distribution and control of prices within a country were matters for determination by that country. Copper was the most widely restricted commodity and the first to receive attention by the Organization for European Cooperation. In September 1951, the OEEC adopted a list of 211 articles for which it was recommended that the use of copper, and alloys containing over 40 percent copper, should be prohibited. Most of the major consumers also imposed restrictions on the other allocated minerals.

Although the immediate direct effect on the United States minerals industries was not great, a very important long-run development in international cooperation was the signing on April 18, 1951, of the treaty constituting the European Coal and Steel Community, commonly known as the Schuman Plan (after Robert Schuman, Minister for Foreign Affairs for France). The parties to the treaty were France, the German Federal Republic, Italy, Belgium, the Netherlands, and Luxembourg. The major positive and direct effects of the treaty were removal of trade barriers among the party nations covering iron, ferroalloy and steel-mill products, their raw materials (except limestone), and fuels. Subsidies, restrictive practices, and discriminations were also to be eliminated, and it was the aim of the parties to achieve the lowest prices feasible.

[48] International Materials Conference, Report on Operations, February 26, 1951 to March 1, 1952: Washington, 1952, 91 pp.

Statistical Summary of Mineral Production

By Robert E. Herman [1]

INTRODUCTION

THIS CHAPTER, in line with corresponding chapters in earlier editions of the Minerals Yearbook, contains summary statistical data on mineral production in the United States. However, it also includes a table summarizing the foreign trade of the United States in minerals and mineral products (table 8); in Minerals Yearbooks for earlier years, a table of this nature has usually been carried in the Review of the Minerals Industries chapters.

PRODUCTION

The tables in this section summarize the statistics on mineral production in continental United States, that is, the 48 States and the District of Columbia (tables 1–3); in each of the individual States (tables 4 and 5); in the Territories of the United States (table 6); and in possessions and other areas administered by the United States (table 7).

Mineral production may be measured at any of several stages of extraction and processing; for example, see table 2 of the Copper chapter of this volume. However, the term "mineral production" usually refers to minerals in the form in which they are first extracted from the ground but customarily includes, for some minerals, the product of auxiliary processing operations at or near mines—such as sizing and cleaning, in the case of coal, and concentrating, in the case of metallic ores.

Because of inadequacies in the available statistics, some series deviate from the foregoing definition. In particular, the limestone, cement rock, and clay that are processed into cement are reflected in the series on cement rather than being included in their originally extracted form; similarly, limestone used for lime is reflected in the series on lime rather than that on stone. The quantities of gold, silver, copper, lead, zinc, and tin are recorded on a mine basis—that is, as the recoverable content of ore sold or treated; the values assigned to these quantities, however, are based on the average selling price of refined metal, not the mine value. Mercury is measured in the form of recovered metal and valued at the average New York price for metal.

A number of additional deficiencies in a previously maintained series (which covered the period 1880–1948) were eliminated with revisions

[1] Assisted by Blanche G. Robertson.

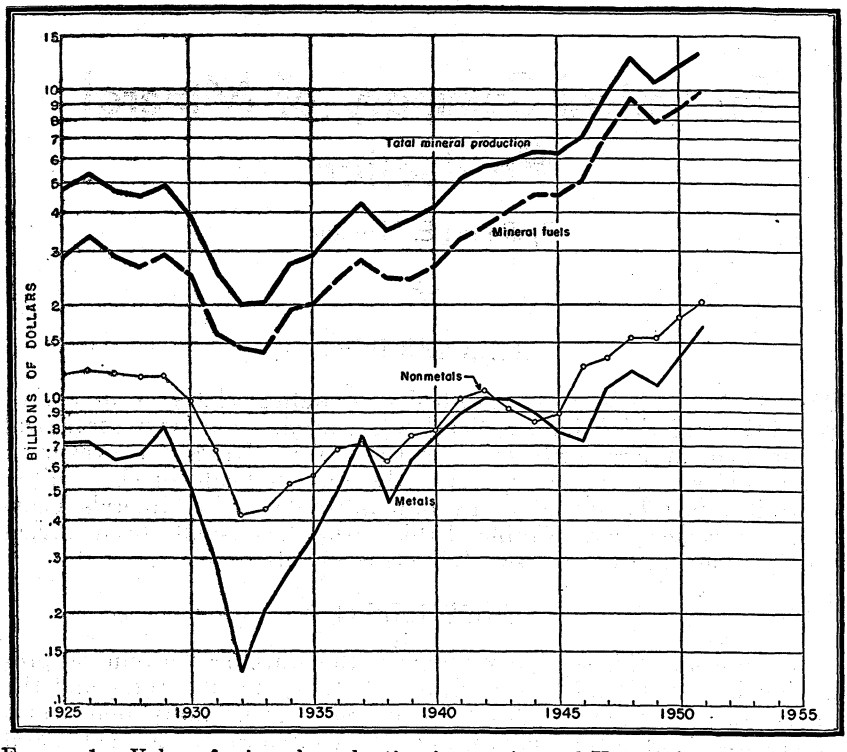

FIGURE 1.—Value of mineral production in continental United States, 1925–51.

that are described in the Statistical Summary chapter of Minerals Yearbook, 1949.

The weight or volume units shown are those customary in the particular industries producing the respective products. No adjustment has been made in the dollar values for changes in the purchasing power of the dollar.

TABLE 1.—Value of mineral production in continental United States, 1925–51, by mineral group [1]

[Millions of dollars]

Year	Nonmetallic			Metallic	Grand total	Year	Nonmetallic			Metallic	Grand total
	Fuels	Other	Total				Fuels	Other	Total		
1925	2,905	1,192	4,097	715	4,812	1939	2,420	757	3,177	631	3,808
1926	3,366	1,224	4,590	721	5,311	1940	2,659	787	3,446	752	4,198
1927	2,869	1,207	4,076	622	4,698	1941	3,224	993	4,217	890	5,107
1928	2,660	1,169	3,829	655	4,484	1942	3,563	1,061	4,624	999	5,623
1929	2,934	1,172	4,106	802	4,908	1943	4,023	921	4,944	987	5,931
1930	2,495	978	3,473	507	3,980	1944	4,568	842	5,410	900	6,310
1931	1,617	674	2,291	287	2,578	1945	4,563	894	5,457	774	6,231
1932	1,457	415	1,872	128	2,000	1946	5,084	1,249	6,333	729	7,062
1933	1,411	434	1,845	205	2,050	1947	7,181	1,345	8,526	1,084	9,610
1934	1,944	523	2,467	277	2,744	1948	9,495	1,559	11,054	1,219	12,273
1935	2,011	566	2,577	365	2,942	1949	7,912	1,567	9,479	1,101	10,580
1936	2,401	689	3,090	516	3,606	1950	8,681	1,823	10,504	1,351	11,855
1937	2,795	714	3,509	756	4,265	1951	9,770	2,084	11,854	1,670	13,524
1938	2,433	625	3,058	460	3,518						

[1] Data for 1925–46 are not strictly comparable with those for 1947–51, since for the earlier years the value of heavy clay products has not been replaced by the value of raw clays used in such products.

TABLE 2.—Mineral production in continental United States, 1948–51, by individual mineral [1]

Mineral	1948		1949		1950		1951	
	Quantity	Value (thousand dollars)	Quantity	Value (thousand dollars)	Quantity	Value (thousand dollars)	Quantity	Value (thousand dollars)
MINERAL FUELS								
Coal:								
Bituminous [2] ---- thousand short tons	596,024	2,983,465	434,342	2,126,226	512,529	2,489,229	529,880	2,614,219
Lignite ---- do	3,086	7,012	3,092	7,336	3,370	8,112	3,291	8,044
Pennsylvania anthracite ---- do	57,140	467,052	42,702	358,008	44,077	392,398	42,670	405,818
Natural gas ---- million cubic feet	5,148,020	333,173	5,419,736	344,034	6,282,060	408,521	7,457,359	542,964
Natural-gas liquids:								
Natural gasoline and cycle products ---- thousands of 42-gallon barrels	94,124	341,154	99,217	303,136	109,679	321,832	118,377	369,718
LP-gases ---- do	52,597	117,823	57,869	99,054	72,282	97,773	86,377	138,443
Petroleum (crude) ---- do	2,020,185	5,245,080	1,841,940	4,674,770	1,973,574	4,963,380	[3] 2,247,711	[3] 5,690,410
Total mineral fuels		9,495,000		7,912,000		8,681,000		9,770,000
NONMETALLIC MINERALS (EXCEPT FUELS)								
Abrasive stone: [4]								
Grindstones and pulpstones ---- short tons	7,954	405	4,507	247	4,468	233	5,571	316
Millstones	([5])	18	([5])	9	([5])	11	([5])	6
Pebbles (grinding) ---- short tons	4,026	102	2,374	64	1,923	53	3,062	84
Tube-mill liners (natural) ---- do	1,297	42	1,166	47	1,523	63	1,408	77
Asbestos ---- do	37,092	1,806	43,387	2,614	42,434	2,925	51,645	3,912
Asphalt and related bitumens (native):								
Bituminous limestone and sandstone ---- do	1,084,004	3,635	1,150,931	4,265	1,184,676	3,522	1,378,434	4,159
Gilsonite ---- do	52,122	1,391	51,462	1,304	66,186	1,774	65,521	1,895
Barite (crude) ---- do	799,848	6,693	717,313	5,642	695,414	6,194	860,669	7,968
Boron minerals ---- do	450,932	11,148	467,592	11,512	647,735	15,890	862,797	20,030
Bromine ---- thousand pounds	76,048	14,825	88,726	16,268	98,502	18,795	129,563	26,180
Calcium-magnesium chloride ---- short tons, 75-percent ($CaCl_2$, $MgCl_2$) basis	309,660	3,907	255,797	3,261	299,821	3,802	328,042	4,756
Carbon dioxide, natural (estimated) ---- thousand cubic feet	545,000	397	489,000	376	472,334	369	547,436	161
Cement ---- thousands of 376-pound barrels	205,239	446,465	207,142	475,074	228,788	537,652	240,330	611,751
Clays (including fuller's earth) [6] ---- thousand short tons	31,304	80,997	28,474	74,619	32,301	89,676	35,612	120,570
Emery ---- short tons	5,405	69	4,909	61	5,949	75	11,634	160
Feldspar (crude) ---- long tons	460,713	2,564	369,378	2,278	407,925	2,558	400,439	2,816
Fluorspar ---- short tons	331,749	11,227	236,704	8,267	301,510	10,620	347,024	14,370
Garnet (abrasive) ---- do	8,039	588	6,578	505	9,304	794	14,050	1,247
Gem stones (estimated)	([5])	450	([5])	450	([5])	450	([5])	450
Graphite ---- short tons	9,871	451	5,213	475	5,605	428	6,808	771
Gypsum (crude) ---- do	7,254,535	19,113	6,608,118	18,319	8,192,625	22,735	8,665,534	24,024
Helium (shipments, calendar years) ---- thousand cubic feet	50,915	610	51,501	689	80,889	1,028	108,970	1,387
Kyanite ---- short tons	14,552	527	12,115	403	([7])	([7])	([7])	([7])
Lime (open-market) ---- do	7,245,211	74,677	6,302,551	68,908	7,462,109	82,847	8,236,422	96,507
Lithium minerals ---- do	3,881	211	4,838	346	9,306	580	12,897	896

For footnotes, see end of table.

TABLE 2.—Mineral production in continental United States, 1948–51, by individual mineral [1]—Continued

Mineral	1948		1949		1950		1951	
	Quantity	Value (thousand dollars)	Quantity	Value (thousand dollars)	Quantity	Value (thousand dollars)	Quantity	Value (thousand dollars)
NONMETALLIC MINERALS (EXCEPT FUELS)—continued								
Magnesite (crude)—short tons	(7)	(7)	287,315	1,950	429,392	3,091	670,167	4,507
Magnesium compounds from sea water and brines (except for metal) short tons, MgO equivalent	91,700	6,918	63,000	5,033	89,300	7,283	106,414	8,996
Marl:								
Calcareous (except for cement)—short tons	114,759	146	166,800	232	347,843	246	269,955	234
Greensand—do	7,269	393	6,128	277	3,935	304	5,067	264
Mica:								
Scrap—do	52,157	1,092	32,856	796	69,320	1,743	71,871	1,884
Sheet—pounds	270,042	46	513,994	132	578,818	126	594,884	160
Olivine—short tons	4,766	86	3,528	57	[8] 4,103	[8] 59	8,816	135
Peat—do	129,581	930	129,532	1,020	130,723	1,143	194,416	1,489
Perlite—do	22,112	134	71,203	511	101,536	649	181,588	810
Phosphate rock—thousand long tons	8,669	50,502	8,987	51,415	10,254	59,028	11,095	66,158
Potassium salts—short tons, K_2O equivalent	1,143,339	35,999	1,120,653	35,106	[8] 1,276,164	[8] 39,774	1,408,408	44,789
Pumice and pumicite—short tons	607,646	2,501	716,742	2,369	719,356	2,661	749,192	2,740
Pyrites—long tons	928,531	3,950	888,388	3,904	931,163	4,059	1,017,769	4,656
Quartz from pegmatites and quartzite—short tons	161,861	751	107,552	475	160,508	707	281,047	1,165
Salt (common)—thousand short tons	16,388	54,220	15,560	53,549	16,616	59,774	20,196	69,616
Sand and gravel—do	318,070	252,244	315,895	245,661	367,304	292,559	394,629	329,982
Sand and sandstone (ground)—short tons	692,773	5,778	610,789	5,258	750,673	6,463	818,479	7,163
Slate—do	799,400	12,881	740,260	12,164	930,370	15,047	825,700	13,896
Sodium carbonate (natural)—do	[9] 288,769	[9] 6,623	[9] 200,496	[9] 4,164	351,075	7,544	350,688	8,368
Sodium sulfate (natural)—do	265,862	4,249	186,223	2,734	186,537	2,199	(7)	(7)
Stone [10]—thousand short tons	224,475	326,660	222,549	339,442	250,844	387,911	284,947	434,879
Sulfur:								
Ore for direct agricultural use—long tons	1,700	30	5,392	102	3,247	60	3,945	76
Frasch-process—do	4,978,912	89,600	4,789,311	86,208	5,504,714	104,000	4,988,101	107,300
Talc, pyrophyllite, and ground soapstone—short tons	518,746	8,265	461,896	7,523	620,750	10,621	636,068	11,323
Topaz (industrial)—do	200	4	(7)	(7)				
Tripoli—do	26,845	706	25,525	691	43,720	1,174	37,476	1,105
Vermiculite—do	138,635	1,387	168,819	1,686	208,096	2,122	209,008	2,094
Wollastonite—do	75	2	500	7	800	16	(7)	(7)
Undistributed: Andalusite (1948–49), aplite, brucite, diatomite, dumortierite (1949), espom salts from espomite (1949–51), iodine, quartz crystal (1950), sharpening stones, sodium carbonate (Wyoming 1948–49), and minerals whose value must be concealed for particular years (indicated in appropriate column by footnote reference 7)		10,549		8,105		9,824		15,892
Total nonmetallic minerals (except fuels)		1,559,000		1,567,000		1,823,000		2,084,000

METALS								
Antimony ore and concentrate	short tons, gross weight	16,171	4,349	5,186	1,134	6,888	1,443	9,100	(11)
Bauxite	long tons, dried equivalent	1,457,148	8,697	1,148,792	6,778	1,334,527	7,693	1,848,676	12,478
Beryllium concentrate	short tons, gross weight	99	27	[8] 475	[8] 152	559	171	484	161
Chromite	do	3,619	(11)	433	12	404	(11)	7,056	554
Cobalt (content of ore)	pounds	580,703	(11)	673,773	(11)	660,025	(11)	755,631	(11)
Columbium (niobium) concentrate	pounds, gross weight	100	(11)	(12)	(12)	(12)	(12)	(12)	(12)
Copper (recoverable content of ores, etc.)	short tons	834,797	362,302	752,746	296,582	909,337	378,284	928,329	449,311
Gold (recoverable content of ores, etc.)	troy ounces	1,765,862	61,805	1,762,367	61,683	2,104,959	73,674	1,741,026	60,936
Iron ore, usable (excluding byproduct iron sinter)	thousand long tons, gross weight	100,275	391,230	84,174	377,637	97,151	483,358	115,622	629,837
Lead (recoverable content of ores, etc.)	short tons	390,147	139,673	409,857	129,515	430,678	116,283	388,143	134,298
Manganese ore (35 percent or more Mn)	short tons, gross weight	131,100	4,390	126,135	5,179	134,451	6,230	105,007	6,045
Manganiferous ore (5 to 35 percent Mn)	do	1,340,565	(11)	1,078,395	4,040	1,087,597	4,609	1,223,964	5,386
Manganiferous residuum	do	291,383	(11)	158,902	(11)	183,842	(11)	267,751	(11)
Mercury	76-pound flasks	14,288	1,093	9,830	781	4,535	368	7,293	1,532
Molybdenum (content of ore and concentrate)	thousand pounds	29,669	20,418	23,280	19,332	44,544	37,729	37,955	36,177
Silver (recoverable content of ores, etc.)	thousand troy ounces	38,029	34,418	34,639	31,350	42,406	38,380	39,734	35,961
Tantalum concentrate	pounds, gross weight	500	(11)	[8] [12] 1,020	[8] [12] 2	[12] 1,000	[8] [12] 2	[12] 925	[12] 2
Tin (content of ore and concentrate)	long tons	(13)	(11)	17	37	15	31	19	56
Titanium concentrate:									
Ilmenite	short tons, gross weight	381,508	5,794	389,234	6,212	[8] 452,370	5,607	510,840	7,689
Rutile	do	9,907	647	10,559	490	(11)	(11)	(11)	(11)
Tungsten concentrate	short tons, 60-percent WO_3 basis	4,033	6,355	2,765	4,377	4,807	8,157	6,265	22,937
Zinc (recoverable content of ores, etc.)	short tons	629,955	167,974	593,201	148,913	623,369	178,667	681,188	249,331
Undistributed: Magnesium chloride for magnesium metal, platinum-group metals (crude), vanadium, zirconium concentrate, and minerals whose value must be concealed for particular years (indicated in appropriate column by footnote reference 11)			10,466		6,671		10,216		17,755
Total metals			1,219,000		1,101,000		1,351,000		1,670,000
Grand total mineral production			12,273,000		10,580,000		11,855,000		13,524,000

[1] Production as measured by mine shipments or mine sales (including consumption by producers), except that fuels and the following additional minerals are strictly production: Gypsum, iodine, magnesite, pyrites, bauxite, and mercury. Excludes uranium ores and monazite.

[2] Includes small quantity of anthracite mined in States other than Pennsylvania.

[3] Final figure. Supersedes preliminary figure given in commodity chapter.

[4] Excludes sharpening stones, value for which is included with "Nonmetallic minerals, undistributed."

[5] Weight not recorded.

[6] Excludes clays sold or used for cement as follows: 1948—6,362,000 short tons, $4,320,000; 1949—6,676,000 tons, $4,573,000; 1950—7,080,000 tons, $5,574,000; 1951—7,804,000 tons, $8,052,000.

[7] Value included with "Nonmetallic minerals, undistributed."

[8] Revised figure.

[9] Excludes production from Wyoming, value for which is included with "Nonmetallic minerals, undistributed."

[10] Excludes abrasive stone, bituminous limestone, bituminous sandstone, and ground soapstone, all included elsewhere in table. Also excludes limestone for cement and lime.

[11] Value included with "Metals, undistributed."

[12] Columbite and tantalite production not differentiated and given under tantalum concentrate.

[13] Less than 0.5 ton.

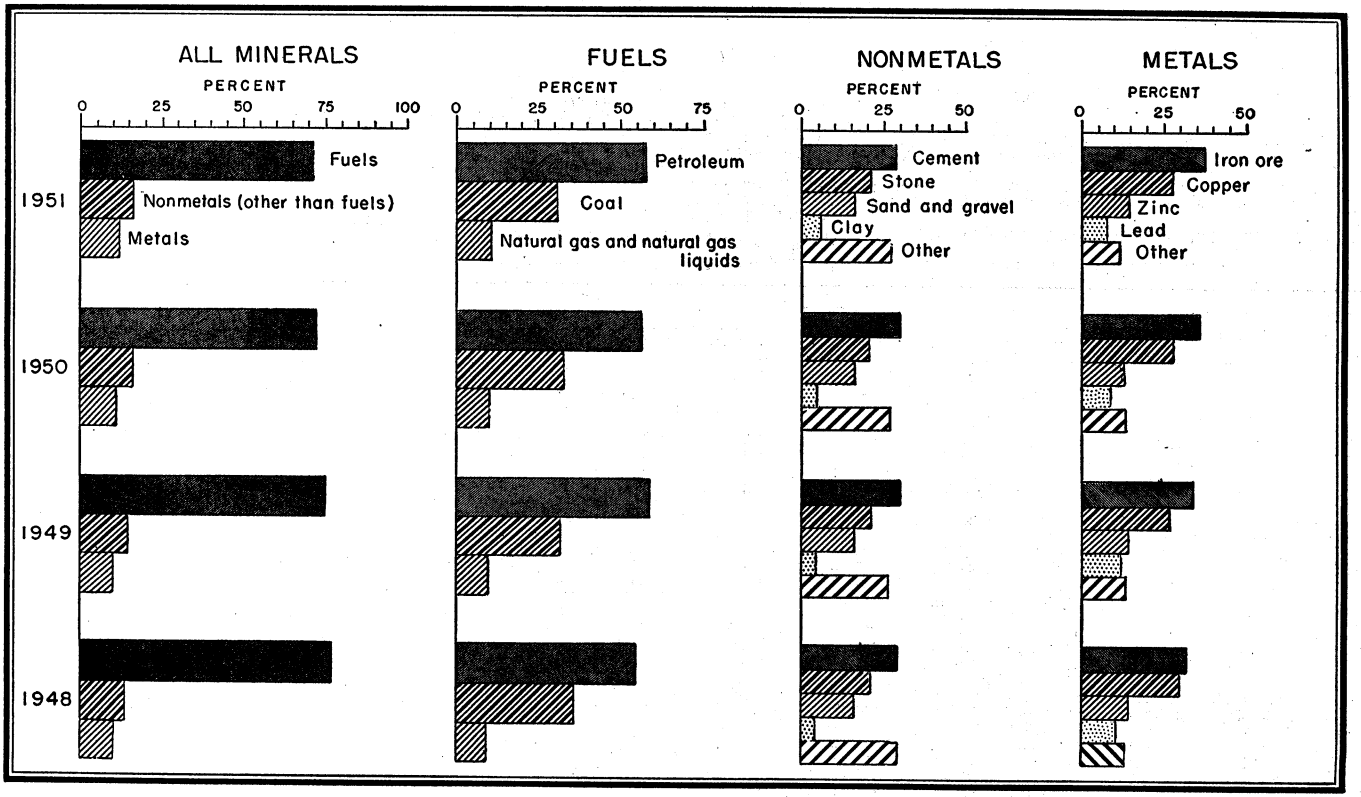

FIGURE 2.—Value of mineral production in continental United States, 1948–51, by mineral group and by mineral, in percent.

TABLE 3.—Minerals produced in continental United States and principal producing States in 1951

Rank in value	Mineral	Principal producing States	
		In order of quantity	In order of value
	Abrasive stone:		
67	Grindstones and pulpstones	Ohio, West Virginia, Washington	Rank same as for quantity.
82	Millstones	Not available	North Carolina.
75	Pebbles (grinding)	Wisconsin, Minnesota, Texas, North Carolina	Minnesota, Wisconsin, Texas, North Carolina.
78	Sharpening stones	Arkansas, Indiana, New Hampshire, Ohio	Arkansas, New Hampshire, Indiana, Ohio.
76	Tube-mill liners (natural)	Minnesota, North Carolina, Wisconsin	Rank same as for quantity.
49	Antimony ores and concentrates	Idaho, Nevada, Washington, Montana	Idaho, Washington, Nevada, Montana.
66	Aplite	Virginia	Rank same as for quantity.
42	Asbestos	Vermont, Arizona, Georgia, North Carolina	Do.
36	Asphalt (native)	Texas, Alabama, Oklahoma, Kentucky	Texas, Utah, Alabama, Kentucky.
32	Barite (crude)	Arkansas, Missouri, Nevada, Georgia	Arkansas, Missouri, Georgia, Nevada.
27	Bauxite	Arkansas, Alabama, Georgia	Rank same as for quantity.
70	Beryllium concentrates	New Mexico, South Dakota, Colorado, New Hampshire	Do.
24	Boron minerals	California	Do.
21	Bromine	Texas, Michigan, California, West Virginia	Michigan, Texas, California, West Virginia.
74	Brucite	Nevada	Rank same as for quantity.
39	Calcium-magnesium chloride	Michigan, West Virginia, California, Ohio	Michigan, California, West Virginia, Ohio.
71	Carbon dioxide (natural)	New Mexico, California, Utah, Oregon	New Mexico, California, Oregon, Washington.
4	Cement	Pennsylvania, California, Texas, New York	Rank same as for quantity.
62	Chromite	California, Oregon	Do.
12	Clays	Ohio, Pennsylvania, Georgia, California	Georgia, Pennsylvania, Ohio, Missouri.
2	Coal:		
	Bituminous	West Virginia, Pennsylvania, Kentucky, Illinois	Rank same as for quantity.
	Lignite	North Dakota, Montana, South Dakota, California	Do.
	Pennsylvania anthracite	Pennsylvania	Do.
65	Cobalt (in ores, etc.)	Pennsylvania	Do.
7	Copper (in ores, etc.)	Arizona, Utah, New Mexico, Montana	Do.
29	Diatomite	California, Nevada, Oregon	Do.
72	Emery	New York	Do.
83	Epsomite	Washington	Do.
44	Feldspar (crude)	North Carolina, Colorado, South Dakota, New Hampshire	North Carolina, New Hampshire, South Dakota, Colorado.
25	Fluorspar	Illinois, Kentucky, New Mexico, Colorado	Rank same as for quantity.
55	Garnet (abrasive)	New York, Idaho, Florida	Do.
64	Gem stones	Not available	Oregon, California, Texas, Washington.
17	Gold (in ores, etc.)	South Dakota, Utah, California, Nevada	Rank same as for quantity.
61	Graphite:		
	Amorphous	Rhode Island	Do.
	Crystalline	Texas, Alabama	Do.
22	Gypsum (crude)	Michigan, New York, Texas, Iowa	Do.
53	Helium	Texas, Kansas	Do.
52	Iodine	California	Do.
3	Iron ore (usable)	Minnesota, Michigan, Alabama, Utah	Minnesota, Michigan, New York, Alabama.
59	Kyanite	Virginia, South Carolina	Rank same as for quantity.
11	Lead (in ores, etc.)	Missouri, Idaho, Utah, Colorado	Do.
14	Lime (open-market)	Ohio, Pennsylvania, Missouri, Illinois	Do.
58	Lithium minerals	South Dakota, California, North Carolina, Arizona	Do.
41	Magnesite (crude)	Washington, Nevada, California	Do.
35	Magnesium chloride (for magnesium metal)	Texas	Do.
30	Magnesium compounds from sea water and brines (except for metal).	California, Michigan, New Jersey	Michigan, California, New Jersey.

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TABLE 3.—Minerals produced in continental United States and principal producing States in 1951—Continued

Rank in value	Mineral	Principal producing States	
		In order of quantity	In order of value
37	Manganese ore	Montana, Arkansas, Nevada, New Mexico	Rank same as for quantity.
38	Manganiferous ore	Minnesota, New Mexico, Montana, Arkansas	Do.
46	Manganiferous residuum	New Jersey	Do.
	Marl:		
69	Calcareous	Michigan, Virginia, Wisconsin, Indiana	Michigan, Virginia, New York, Nevada.
68	Greensand	New Jersey	Rank same as for quantity.
50	Mercury	California, Nevada, Oregon, Idaho	Do.
48	Mica	North Carolina, New Hampshire, Georgia, Maine	North Carolina, Georgia, Pennsylvania, Arizona.
	Scrap	North Carolina, Georgia, South Dakota, Pennsylvania	Do.
	Sheet	North Carolina, Virginia, New Hampshire, Georgia	Rank same as for quantity.
19	Molybdenum (in ores and concentrates)	Colorado, Utah, Arizona, New Mexico	Do.
5	Natural gas	Texas, Louisiana, California, Oklahoma	Texas, California, Louisiana, Pennsylvania.
6	Natural gas liquids:		
	Natural gasoline and cycle products	Texas, California, Louisiana, Oklahoma	Rank same as for quantity.
	L-P gases	Texas, California, Oklahoma, Louisiana	Texas, California, Louisiana, Oklahoma.
73	Olivine	North Carolina, Washington	Rank same as for quantity.
51	Peat	Washington, New Jersey, Florida, Ohio	Michigan, Ohio, New Jersey, Florida.
60	Perlite (crude)	Nevada, New Mexico, Colorado, Oregon	Nevada, New Mexico, Colorado, California.
1	Petroleum (crude)	Texas, California, Louisiana, Oklahoma	Rank same as for quantity.
16	Phosphate rock	Florida, Tennessee, Idaho, Montana	Florida, Tennessee, Montana, Idaho.
80	Platinum-group metals (crude)	California	Rank same as for quantity.
18	Potassium salts	New Mexico, California, Utah, Michigan	Do.
45	Pumice and pumicite	California, New Mexico, Idaho, Colorado	California, New Mexico, Oregon, Idaho.
40	Pyrites	Tennessee, California, Virginia, Montana	Rank same as for quantity.
56	Quartz from pegmatites and quartzite	Washington, California, North Carolina, Connecticut	Do.
15	Salt (common)	Michigan, New York, Ohio, Louisiana	Michigan, New York, Louisiana, Kansas.
9	Sand and gravel	California, Michigan, New York, Illinois	California, Pennsylvania, Ohio, Michigan.
34	Sand and sandstone (ground)	Illinois, New Jersey, West Virginia, Ohio	Illinois, West Virginia, New Jersey, Ohio.
20	Silver (in ores, etc.)	Idaho, Utah, Montana, Arizona	Rank same as for quantity.
26	Slate	Pennsylvania, Vermont, New York, Georgia	Pennsylvania, Vermont, New York, Virginia.
31	Sodium carbonate (natural)	California, Wyoming	Rank same as for quantity.
43	Sodium sulfate (natural)	California, Texas, Wyoming	Do.
8	Stone	Pennsylvania, Ohio, Michigan, Illinois	Pennsylvania, Ohio, New York, Indiana.
13	Sulfur (Frasch-process)	Texas, Louisiana	Rank same as for quantity.
77	Sulfur ore for direct agricultural use	Nevada, California, Wyoming	Do.
28	Talc, pyrophyllite and ground soapstone	New York, California, North Carolina, Vermont	Do.
79	Tin (in ores and concentrates)	Colorado, North Carolina	Do.
	Titanium concentrates:		
33	Ilmenite	New York, Florida, Virginia, North Carolina	Do.
63	Rutile	Florida	Do.
57	Tripoli	Illinois, Missouri, Pennsylvania	Missouri, Illinois, Pennsylvania.
23	Tungsten concentrates	California, Nevada, North Carolina, Idaho	Rank same as for quantity.
47	Vermiculite	Montana, South Carolina, North Carolina, Wyoming	Do.
81	Wollastonite	New York	Do.
10	Zinc (in ores, etc.)	Montana, Idaho, New Jersey, Colorado	Do.
54	Zirconium concentrates	Florida	Do.

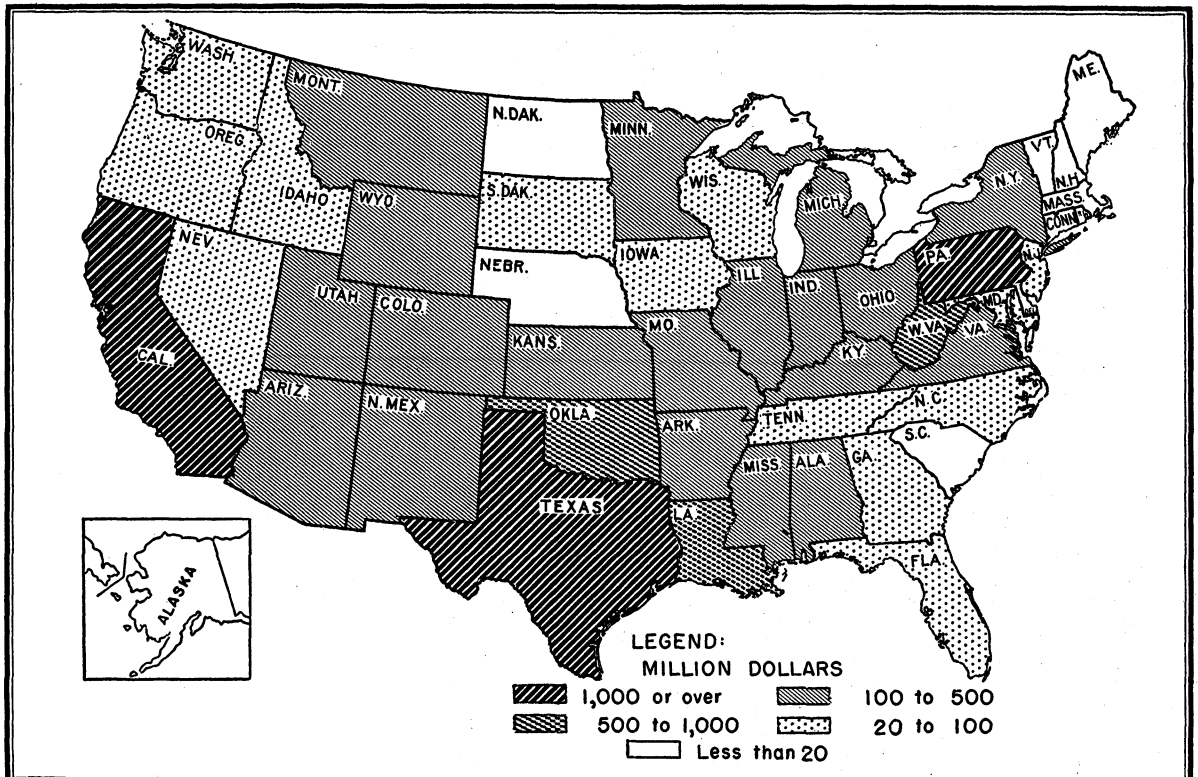

FIGURE 3.—Value of mineral production in continental United States and Alaska, 1951, by States.

TABLE 4.—Value of mineral production in continental United States, 1948–51, by States, in thousands of dollars, and principal minerals produced in 1951

State	1948	1949	1950	1951			
				Value	Rank	Percent of U. S. total	Principal minerals in order of value
Alabama	183,797	143,905	158,975	164,279	20	1.22	Coal, iron ore, cement, stone.
Arizona	200,382	181,094	207,406	243,887	15	1.80	Copper, zinc, lead, silver.
Arkansas	122,089	109,523	118,642	118,693	24	.88	Petroleum, bauxite, coal, natural-gas liquids.
California	1,146,410	1,075,612	1,056,047	1,209,428	3	8.94	Petroleum, natural gas, natural-gas liquids, cement.
Colorado	128,861	[1] 139,873	[1] 154,898	179,434	18	1.33	Petroleum, molybdenum, coal, zinc.
Connecticut	4,484	4,887	5,675	6,299	45	.05	Stone, sand and gravel, lime, clays.
Delaware	403	335	522	644	48	(2)	Sand and gravel, stone, clays.
District of Columbia	64	63	60	82	49	(2)	Clays.
Florida	53,654	55,018	67,717	78,548	28	.58	Phosphate rock, stone, cement, sand and gravel
Georgia	36,103	35,508	44,157	48,509	32	.36	Clays, stone, cement, iron ore.
Idaho	79,128	64,292	79,077	82,793	27	.61	Zinc, lead, silver, sand and gravel.
Illinois	521,038	[1] 449,893	488,144	489,933	7	3.62	Coal, petroleum, stone, cement.
Indiana	161,950	141,025	166,632	174,389	19	1.29	Coal, petroleum, cement, stone.
Iowa	35,955	37,458	41,773	47,706	34	.35	Cement, stone, coal, sand and gravel.
Kansas	361,160	337,162	368,614	400,087	10	2.96	Petroleum, natural gas, cement, zinc.
Kentucky	504,080	372,229	459,956	442,264	8	3.27	Coal, petroleum, natural gas, stone.
Louisiana	604,198	631,813	693,607	787,678	5	5.82	Petroleum, natural-gas liquids, natural gas, sulfur.
Maine	8,094	6,742	7,461	8,516	44	.06	Cement, stone, sand and gravel, slate.
Maryland	25,002	20,461	22,725	26,027	38	.19	Sand and gravel, stone, cement, coal.
Massachusetts	12,583	12,449	16,014	16,951	41	.13	Stone, sand and gravel, lime, clays.
Michigan	202,885	201,260	[1] 229,941	257,939	12	1.91	Iron ore, petroleum, cement, salt.
Minnesota	267,248	257,540	331,567	433,098	9	3.20	Iron ore, sand and gravel, stone, manganiferous ore.
Mississippi	119,317	103,711	102,945	103,030	25	.76	Petroleum, natural gas, clays, natural-gas liquids.
Missouri	108,291	111,293	113,191	135,246	22	1.00	Lead, cement, stone, coal.
Montana	103,841	98,070	103,389	126,166	23	.93	Zinc, copper, petroleum, lead.
Nebraska	8,385	10,102	14,022	18,469	40	.14	Cement, petroleum, sand and gravel, stone.
Nevada	42,503	[1] 37,373	48,499	57,626	30	.43	Copper, zinc, tungsten, gold.
New Hampshire	1,331	[1] 1,389	1,711	1,296	46	.01	Sand and gravel, feldspar, stone, clays.
New Jersey	44,388	38,584	46,391	59,024	29	.44	Zinc, stone, sand and gravel, iron ore.
New Mexico	220,080	198,825	210,294	256,304	14	1.90	Petroleum, potassium salts, copper, zinc.

New York	143,623	138,493	156,529	188,256	17	1.39	Iron ore, cement, stone, sand and gravel.
North Carolina	18,231	19,755	[1] 26,338	29,648	36	.22	Stone, sand and gravel, tungsten, clays.
North Dakota	8,478	8,818	9,614	10,246	43	.08	Coal (lignite), sand and gravel, stone, petroleum.
Ohio	284,816	242,080	274,572	302,613	11	2.24	Coal, stone, cement, lime.
Oklahoma	506,846	484,264	527,095	607,485	6	4.49	Petroleum, natural-gas liquids, natural gas, zinc.
Oregon	23,923	21,845	21,542	28,401	37	.21	Stone, sand and gravel, cement, diatomite.
Pennsylvania	1,386,960	1,035,970	1,186,212	1,289,226	2	9.53	Coal, cement, petroleum, stone.
Rhode Island	1,450	929	1,425	1,278	47	.01	Stone, sand and gravel, graphite.
South Carolina	8,885	9,026	11,394	11,284	42	.08	Clays, stone, cement, vermiculite.
South Dakota	24,327	[1] 26,746	32,716	29,658	35	.22	Gold, stone, clays, sand and gravel.
Tennessee	93,599	77,333	89,694	99,854	26	.74	Coal, cement, stone, zinc.
Texas	2,830,283	2,379,793	2,673,950	3,268,555	1	24.17	Petroleum, natural-gas liquids, natural gas, sulfur.
Utah	204,459	177,825	229,956	257,144	13	1.90	Copper, coal, lead, gold.
Vermont	15,999	17,384	18,563	18,535	39	.14	Stone, slate, asbestos, copper.
Virginia	143,333	116,408	137,806	161,251	21	1.19	Coal, stone, cement, sand and gravel.
Washington	48,928	40,863	49,055	54,552	31	.40	Cement, sand and gravel, zinc, coal.
West Virginia	1,012,402	718,119	829,624	941,723	4	6.96	Coal, natural gas, petroleum, natural-gas liquids.
Wisconsin	37,108	35,878	41,693	48,348	33	.36	Stone, sand and gravel, iron ore, zinc.
Wyoming	172,004	150,998	177,577	201,834	16	1.49	Petroleum, coal, clays, natural gas.
Total	12,273,000	10,580,000	11,855,000	13,524,000	--------	100.00	Petroleum, coal, iron ore, cement.

[1] Revised figure.
[2] Less than 0.005 percent.

TABLE 5.—Mineral production in continental United States, 1948–51, by State and individual mineral

[Products listed under any State following the State total are not included with the figures for mineral production, but are shown for informational purposes only]

ALABAMA

Mineral	1948		1949		1950		1951	
	Quantity	Value (thousand dollars)	Quantity	Value (thousand dollars)	Quantity	Value (thousand dollars)	Quantity	Value (thousand dollars)
Cement [1] thousands of 376-pound barrels	9, 949	20, 140	9, 394	20, 321	10, 575	23, 176	10, 587	24, 523
Clays (except for cement) thousand short tons	956	1, 076	857	934	993	1, 045	919	1, 367
Coal do	18, 801	115, 535	12, 934	79, 188	14, 422	88, 343	13, 597	82, 466
Iron ore (usable) thousand long tons, gross weight	8, 024	32, 544	7, 314	27, 553	7, 402	28, 933	8, 182	34, 800
Lime (open-market) short tons	388, 197	3, 275	359, 446	3, 203	389, 071	3, 578	455, 953	4, 396
Manganese ore (35 percent or more Mn) short tons, gross weight					138	[2]		
Natural gas million cubic feet					2	[3]	1	[3]
Peat short tons	2, 034	12						
Petroleum (crude) thousands of 42-gallon barrels	466	[2]	462	[2]	735	[2]	[4] 1, 020	[2]
Sand and gravel thousand short tons	3, 619	2, 406	3, 297	2, 268	3, 616	2, 464	3, 536	2, 807
Stone (except for cement and lime) do	2, 476	4, 482	2, 637	6, 040	2, 588	6, 038	2, 818	7, 255
Undistributed: Native asphalt, bauxite, puzzolan cement, graphite, and minerals whose value must be concealed for particular years (indicated in appropriate column by footnote reference 2)		4, 327		4, 398		5, 398		6, 665
Total Alabama		183, 797		143, 905		158, 975		164, 279
Clays sold or used for cement thousand short tons	304	184	328	202	357	268	351	351
Coke do	6, 015	57, 612	5, 161	55, 493	5, 833	64, 332	6, 291	75, 125
Ferroalloys short tons	129, 615	16, 817	99, 268	14, 276	165, 002	23, 403	154, 540	22, 940
Iron, pig thousand short tons	3, 981	145, 359	3, 665	131, 162	4, 307	167, 984	4, 384	192, 359

ARIZONA

Clays thousand short tons	178	326	190	433	224	512	227	472
Coal do	5	24	5	23	4	27	5	30
Copper (recoverable content of ores, etc.) short tons	375, 121	162, 803	359, 010	141, 450	403, 301	167, 773	415, 870	201, 281
Fluorspar do	1, 271	[2]	846	[2]	952	[2]	1, 623	[2]
Gold (recoverable content of ores, etc.) troy ounces	109, 487	3, 832	108, 993	3, 815	118, 313	4, 141	116, 093	4, 063
Lead (recoverable content of ores, etc.) do	29, 899	10, 704	33, 568	10, 607	26, 383	7, 123	17, 394	6, 018
Lime (open-market) do	54, 608	763	43, 529	608	51, 530	718	54, 023	773
Manganese ore (35 percent or more Mn) short tons, gross weight	240	[2]	223	[2]	222	[2]	173	[2]
Manganiferous ore (5 to 35 percent Mn) do							224	[2]

Molybdenum (content of ore and concentrate)—thousand pounds	(2)	(2)	(2)	(2)	(2)	(2)	1,173	1,102
Perlite (crude)—short tons	(2)	(2)	519	3	1,923	11	(2)	(2)
Sand and gravel—thousand short tons	2,014	1,799	1,512	971	2,499	1,590	2,691	2,203
Silver (recoverable content of ores, etc.)—thousand troy ounces	4,838	4,379	4,971	4,499	5,325	4,820	5,121	4,635
Stone (except limestone for cement and lime)—thousand short tons	308	263	356	203	228	140	309	354
Tungsten concentrate—short tons, 60-percent WO_3 basis	23	30	(5)	(2)	1	(2)	11	37
Zinc (recoverable content of ores, etc.)—short tons	54,478	14,491	70,658	17,523	60,480	17,176	52,999	19,292
Undistributed: Asbestos, barite, beryllium concentrate (1949–51), cement (1949–51), feldspar, gem stones, gypsum, lithium minerals (1951), mercury (1951), mica (1949–51), pumice (1949 and 1951), quartz, vanadium, and minerals whose value must be concealed for particular years (indicated in appropriate column by footnote reference 2)		968		959		3,375		3,627
Total Arizona		200,382		181,094		207,406		243,887

ARKANSAS

Barite (crude)—short tons	362,470	2,900	363,382	2,907	343,168	3,089	407,085	3,766
Bauxite—long tons, dried equivalent	1,395,341	8,299	1,094,924	6,434	1,307,335	7,532	1,815,274	12,260
Clays (except for cement)—thousand short tons	441	1,076	434	1,067	461	996	483	1,199
Coal—do	1,662	12,879	962	7,535	1,169	8,883	1,107	8,686
Gem stones and industrial diamonds—carats	(6)	(6)	6 246	6 1				
Iron ore (usable)—thousand long tons, gross weight					1	(2)	1	(2)
Lead (recoverable content of ores, etc.)—short tons	22	8	1	(3)	9	2	33	11
Manganese ore (35 percent or more Mn)—short tons, gross weight	212	(2)	2,851	(2)	1,224	(2)	3,718	(2)
Manganiferous ore (5 to 35 percent Mn)—do	1,165	(2)	5,555	(2)	6,359	(2)	1,429	(2)
Natural gas—million cubic feet	53,946	2,422	47,788	1,912	48,047	1,682	44,656	1,786
Natural-gas liquids:								
Natural gasoline—thousands of 42-gallon barrels	1,388	5,454	1,427	4,080	1,395	3,926	1,386	4,247
LP-gases—do	871	2,021	853	1,492	938	1,197	962	1,606
Petroleum (crude)—do	31,682	78,570	29,986	74,360	31,108	76,530	4 29,798	4 73,900
Sand and gravel—thousand short tons	7 2,545	7 2,079	7 2,507	7 2,129	4,118	3,447	3,869	3,569
Slate—short tons	(2)	(2)	(2)	(2)	(2)	(2)	27,080	174
Stone (except limestone for cement and lime)—thousand short tons	1,379	1,884	8 1,279	8 2,247	3,953	7,419	2,536	3,216
Zinc (recoverable content of ores, etc.)—short tons	31	8	1	(3)	8	2	50	18
Undistributed: Abrasive stones, cement, gypsum, lime, noncommercial sand and gravel (1948–49), slate, stone (unclassified 1949), and minerals whose value must be concealed for particular years (indicated in appropriate column by footnote reference 2)		4,489		5,359		3,937		4,255
Total Arkansas		122,089		109,523		118,642		118,693
Clays sold or used for cement—thousand short tons	27	20	18	14	14	11	8	8

For footnotes, see end of table.

TABLE 5.—Mineral production in continental United States, 1948–51, by State and individual mineral—Continued

CALIFORNIA

Mineral	1948		1949		1950		1951	
	Quantity	Value (thousand dollars)	Quantity	Value (thousand dollars)	Quantity	Value (thousand dollars)	Quantity	Value (thousand dollars)
Antimony ore and concentrate—short tons, gross weight	5	2						
Boron minerals—short tons	450, 932	11, 148	467, 592	11, 512	647, 735	15, 890	862, 797	20, 030
Calcium-magnesium chloride—short tons, 75-percent (Ca, Mg) Cl_2 basis	10, 009	168	11, 166	204	(2)	(2)	(2)	(2)
Carbon dioxide, natural (estimated)—thousand cubic feet	(2)	(2)	(2)	(2)	200, 000	200	(2)	(2)
Cement—thousands of 376-pound barrels	24, 163	57, 742	23, 202	57, 464	26, 685	65, 259	28, 956	77, 754
Chromite—short tons, gross weight	274	(2)	433	12	404	(2)	6, 302	491
Clays (except for cement)—thousand short tons	1, 758	3, 252	1, 391	2, 744	1, 455	2, 905	1, 615	3, 757
Fuller's earth—do	(2)	(2)						
Coal (lignite)—do	1	15	4	39	(2)	(2)	4	38
Copper (recoverable content of ores, etc.)—short tons	481	209	649	256	646	269	921	446
Gold (recoverable content of ores, etc.)—troy ounces	421, 473	14, 752	417, 231	14, 603	412, 118	14, 424	339, 732	11, 891
Gypsum (crude)—short tons	962, 038	2, 354	753, 581	1, 853	962, 373	2, 463	1, 092, 883	2, 603
Iron ore (usable)—thousand long tons, gross weight	346	(2)	584	(2)	849	(2)	1, 183	(2)
Lead (recoverable content of ores, etc.)—short tons	9, 110	3, 261	10, 318	3, 261	15, 831	4, 274	13, 967	4, 833
Lime (open-market)—do	179, 257	3, 027	153, 483	2, 516	171, 440	2, 723	203, 344	3, 367
Magnesium compounds from sea water and bitterns (partly estimated) short tons, MgO equivalent	38, 500	2, 549	27, 600	1, 770	(2)	(2)	(2)	(2)
Manganese ore (35 percent or more Mn)—short tons, gross weight			280	(2)	37	(2)		
Manganiferous ore (5 to 35 percent Mn)—do			386	(2)	640	6		
Mercury—76-pound flasks	11, 188	856	4, 493	357	3, 850	313	4, 282	900
Natural gas—million cubic feet	570, 954	64, 803	550, 903	64, 731	558, 398	66, 449	566, 751	82, 745
Natural-gas liquids:								
Natural gasoline and cycle products—thousands of 42-gallon barrels	20, 118	62, 834	20, 568	67, 407	21, 247	65, 527	21, 132	65, 923
LP-gases—do	6, 431	16, 527	6, 585	19, 553	7, 081	14, 497	8, 401	15, 528
Peat—short tons	6, 942	33	5, 670	35	6, 399	37	6, 432	42
Perlite—do	(2)	(2)	4, 043	27	(2)	(2)	(2)	(2)
Petroleum (crude)—thousands of 42-gallon barrels	340, 074	822, 980	332, 942	752, 450	327, 607	707, 630	4 354, 561	4 797, 760
Pumice and pumicite—short tons	196, 934	1, 110	149, 878	800	157, 497	971	264, 411	1, 229
Salt (common)—thousand short tons	914	3, 928	965	4, 110	868	3, 817	1, 276	5, 262
Sand and gravel—do	33, 787	30, 593	36, 280	30, 199	41, 894	35, 548	46, 928	41, 280
Silver (recoverable content of ores, etc.)—thousand troy ounces	725	656	784	709	1, 072	970	1, 145	1, 036
Sodium carbonate (natural)—short tons	288, 769	6, 623	200, 496	4, 164	(2)	(2)	(2)	(2)
Stone (except limestone for cement and lime)—thousand short tons	5 11, 936	5 13, 155	11, 374	12, 594	11, 765	13, 998	12, 537	14, 715
Sulfur ore for direct agricultural use—long tons	(2)	(2)	1, 302	26	1, 463	28	(2)	(2)
Talc, pyrophyllite, and ground soapstone—short tons	98, 681	1, 774	83, 359	1, 434	109, 747	2, 069	126, 784	2, 270
Tungsten concentrate—short tons, 60-percent WO_3 basis	1, 767	(2)	952	(2)	2, 025	3, 392	3, 007	11, 557
Zinc (recoverable content of ores, etc.)—short tons	5, 325	1, 416	7, 209	1, 788	7, 551	2, 144	9, 602	3, 495

Undistributed: Abrasive stones (1948–49), asbestos, barite, bromine, diatomite, feldspar, gem stones, iodine, lithium minerals, magnesite, molybdenum, platinum-group metals (crude), potassium salts, pyrites, quartz, ground sand and sandstone, slate, sodium sulfate, stone (dimension basalt 1948), titanium concentrate (1948–49), and minerals whose value must be concealed for particular years (indicated in appropriate column by footnote reference 2)		20,643		18,994		30,244		40,476
Total California		1,146,410		1,075,612		1,056,047		1,209,428
Clays sold or used for cement	thousand short tons	916	561	839	504	830	623	975	975
Coke	do	297	(9)	347	(9)	513	(9)	568	(9)
Iron, pig	do	375	(9)	494	(9)	667	(9)	920	(9)
COLORADO									
Beryllium concentrate	short tons, gross weight	(2)	(2)	[10] 144	[10] 43	97	30	97	32
Carbon dioxide, natural (estimated)	thousand cubic feet	16,000	6	8,000	3				
Clays (except for cement)	thousand short tons	299	488	255	499	310	619	443	958
Coal	do	5,631	27,826	4,636	23,735	4,259	21,669	4,103	21,165
Copper (recoverable content of ores, etc.)	short tons	2,298	997	2,403	947	3,141	1,307	3,212	1,555
Feldspar (crude)	long tons	62,497	253	60,966	341	59,457	329	50,451	283
Fluorspar	short tons	27,698	831	22,324	763	18,489	654	20,661	820
Gold (recoverable content of ores, etc.)	troy ounces	154,802	5,418	102,618	3,592	130,390	4,564	116,503	4,078
Gypsum (crude)	short tons	(2)	(2)	(2)	(2)	62,150	184	(2)	(2)
Lead (recoverable content of ores, etc.)	do	25,143	9,001	26,853	8,486	27,007	7,292	30,336	10,496
Mica (scrap)	do	5,907	53	4,168	60	1,467	27	(2)	(2)
Molybdenum (content of ore and concentrate)	thousand pounds	12,630	(2)	10,483	(2)	24,090	(2)	(2)	(2)
Natural gas	million cubic feet	8,967	539	8,490	443	11,168	436	14,128	608
Natural-gas liquids:									
Natural gasoline	thousands of 42-gallon barrels	28	120	152	463	217	584	(2)	(2)
LP-gases	do	5	12	189	281	169	289	(2)	(2)
Peat	short tons	(2)	(2)	2,800	24	3,210	28	2,241	20
Perlite (crude)	do	3,000	21	12,729	89	13,691	96	(2)	(2)
Petroleum (crude)	thousands of 42-gallon barrels	17,862	45,730	23,587	60,150	23,303	59,420	[4] 27,823	[4] 70,670
Pyrites	long tons	(2)	(2)	13,877	50	(2)	(2)	(2)	(2)
Sand and gravel	thousand short tons	4,906	2,658	4,751	2,965	5,154	3,940	6,917	4,452
Silver (recoverable content of ores, etc.)	thousand troy ounces	3,011	2,725	2,895	2,620	3,492	3,161	2,788	2,523
Stone (except limestone for cement and lime)	thousand short tons	2,195	2,491	[8] 1,817	[8] 2,804	[8] 1,680	[8] 2,776	1,470	2,334
Tin (content of ore and concentrate)	long tons			17	37	15	31	18	54
Tungsten concentrate	short tons, 60-percent WO_3 basis	208	337	222	(2)	196	302	336	1,093
Zinc (recoverable content of ores, etc.)	short tons	45,164	12,014	47,703	11,830	45,776	13,000	55,714	20,280
Undistributed: Cement, gem stones, lime (1948–49), pumice and pumicite (1950 and 1951), stone (dimension, unclassified, 1949–50), sulfur ore (1948–50), vanadium, vermiculite (1949–50), other minerals, and minerals whose value must be concealed for particular years (indicated in appropriate column by footnote reference 2)			17,341		[10] 19,648		[10] 34,160		38,013
Total Colorado			128,861		[10] 139,873		[10] 154,898		179,434
Clays sold or used for cement	thousand short tons	160	120	215	161	192	144	214	214
Coke	do	977	(9)	730	(9)	805	(9)	996	(9)

For footnotes, see end of table.

TABLE 5.—Mineral production in continental United States, 1948–51, by State and individual mineral—Continued

CONNECTICUT

Mineral	1948		1949		1950		1951	
	Quantity	Value (thousand dollars)	Quantity	Value (thousand dollars)	Quantity	Value (thousand dollars)	Quantity	Value (thousand dollars)
Clays thousand short tons	315	230	289	217	292	236	276	253
Feldspar (crude) long tons	12,110	79	12,659	95	13,580	102	13,811	107
Peat short tons	4,332	24	5,974	33	6,294	35	5,586	34
Quartz from pegmatites and quartzite do			16,225	97	27,560	167	29,273	176
Sand and gravel thousand short tons	2,577	1,488	2,648	1,587	2,998	1,862	3,108	1,761
Stone (except limestone for lime) do	1,525	2,283	1,696	2,461	1,861	2,789	2,278	3,360
Undistributed: Nonmetallic minerals		380		397		484		608
Total Connecticut		4,484		4,887		5,675		6,299

DELAWARE

Clays thousand short tons	(2)	(2)	33	46	41	40	36	35
Sand and gravel do	(2)	(2)	234	197	368	292	655	364
Stone do	36	90	37	92	77	190	99	245
Undistributed: Minerals whose value must be concealed for particular years (indicated in appropriate column by footnote reference 2)		313						
Total Delaware		403		335		522		644

FLORIDA

Clays (including fuller's earth)[11] thousand short tons	(2)	(2)	96	1,447	127	1,955	133	2,289
Natural gas million cubic feet	27	1	39	2	8	(3)	10	1
Peat short tons	24,750	56	11,800	69	23,022	151	25,748	161
Petroleum (crude) thousands of 42-gallon barrels	290	(2)	441	(2)	487	(2)	[4] 596	(2)
Phosphate rock thousand long tons	6,539	37,733	6,816	37,858	8,086	45,378	8,497	50,263
Sand and gravel thousand short tons	2,312	2,433	2,244	1,880	2,794	2,807	4,419	4,301
Stone (except limestone for cement and lime) do	[8] 4,155	[8] 5,116	4,215	4,748	5,313	6,885	8,033	9,420
Undistributed: Cement, abrasive garnet (1951), lime, calcareous marl (1949), stone (unclassified, 1948), titanium concentrate, zirconium concentrate, and minerals whose value must be concealed for particular years (indicated in appropriate column by footnote reference 2)		8,315		9,014		10,541		12,113
Total Florida		53,654		55,018		67,717		78,548
Clays sold or used for cement thousand short tons	49	37	80	40	84	63	70	70

GEORGIA

Barite (crude) short tons	62,781	655	50,267	465	(2)	(2)	(2)	(2)
Clays (except for cement) thousand short tons	2,125	15,378	1,983	16,653	2,325	20,938	2,528	23,090
Fuller's earth do	(2)	(2)						
Coal do	20	124	17	98	(2)	(2)	(2)	(2)
Gold (recoverable content of ores, etc.) troy ounces	19	1	18	1			3	(3)
Iron ore (usable) thousand long tons, gross weight	274	747	[22]9	693	202	677	358	1,339
Lime (open-market) short tons	6,141	58	7,028	67	11,998	122	10,616	105
Mica (scrap) do	785	15	(2)	(2)	(2)	(2)	(2)	(2)
Peat do	2,500	50	1,870	56	1,750	41	2,250	41
Sand and gravel thousand short tons	986	720	[7] 984	[7] 758	[7] 1,212	[7] 937	1,226	1,042
Sand and sandstone (ground) short tons	1,909	17	771	8	1,176	12	1,874	19
Silver (recoverable content of ores, etc.) thousand troy ounces	[12]	(3)						
Stone (except limestone for cement and lime) thousand short tons	3,631	10,801	[8] 4,156	[8] 8,428	[8] 6,145	[8] 11,917	6,026	15,768
Talc short tons	53,602	625	49,338	580	70,749	774	77,895	823
Undistributed: Asbestos, bauxite, cement, feldspar, kyanite (1948–49), mica sheet, sand and gravel (noncommercial, 1949–50), slate, stone (marble and dimension, unclassified, 1949–50), and minerals whose value must be concealed for particular years (indicated in appropriate column by footnote reference 2)		6,912		7,701		8,739		6,282
Total Georgia		36,103		35,508		44,157		48,509
Clays sold or used for cement thousand short tons	91	94	75	111	84	90	75	110

For footnotes, see end of table.

TABLE 5.—Mineral production in continental United States, 1948–51, by State and individual mineral—Continued

IDAHO

Mineral	1948		1949		1950		1951	
	Quantity	Value (thousand dollars)	Quantity	Value (thousand dollars)	Quantity	Value (thousand dollars)	Quantity	Value (thousand dollars)
Antimony ore and concentrate—short tons, gross weight	15,941	4,295	4,838	1,053	6,868	(2)	8,805	(2)
Clays (except for cement)—thousand short tons	26	27	25	31	26	31	28	43
Coal—do			3	25				
Copper (recoverable content of ores, etc.)—short tons	1,624	705	1,438	566	2,107	876	2,160	1,045
Gold (recoverable content of ores, etc.)—troy ounces	58,454	2,046	77,829	2,724	79,652	2,788	45,064	1,577
Gypsum, crude—short tons							65	(3)
Lead (recoverable content of ores, etc.)—do	88,544	31,699	79,299	25,058	100,025	27,007	76,713	26,543
Mercury—76-pound flasks	543	41					357	75
Phosphate rock—thousand long tons	431	2,094	(2)	(2)	(2)	(2)	694	1,748
Pumice and pumicite—short tons	79,426	94	71,373	105	93,990	121	83,528	133
Sand and gravel—thousand short tons	3,671	2,552	3,271	2,287	4,282	3,044	4,057	2,971
Sand and sandstone (ground)—short tons					3,700	29	11,968	108
Silver (recoverable content of ores, etc.)—thousand troy ounces	11,449	10,362	10,049	9,095	16,095	14,567	14,753	13,352
Stone (except limestone for cement)—thousand short tons	1,081	1,004	1,441	1,879	[8] 644	[8] 861	1,457	1,811
Tungsten concentrate—short tons, 60-percent WO_3 basis	86	(2)	66	(2)	222	(2)	377	1,403
Zinc (recoverable content of ores, etc.)—short tons	86,267	22,947	76,555	18,986	87,890	24,961	78,121	28,436
Undistributed: Barite (1949–51), cement, fluorspar (1951), abrasive garnet, stone (crushed sandstone and limestone, 1950), titanium concentrate (1951), vanadium, and minerals whose value must be concealed for particular years (indicated in appropriate column by footnote reference 2)		1,262		2,483		4,792		3,548
Total Idaho		79,128		64,292		79,077		82,793
Clays sold or used for cement—thousand short tons	8	6						

ILLINOIS

Cement—thousands of 376-pound barrels	7,573	15,201	7,977	16,646	7,858	16,920	8,377	19,853
Clays (including fuller's earth)[11]—thousand short tons	2,289	3,300	1,957	2,707	2,302	3,243	2,400	3,837
Coal—do	65,342	253,633	47,208	190,863	56,291	228,138	54,200	220,548
Fluorspar—short tons	172,561	6,322	120,881	4,622	154,623	6,111	204,328	9,295
Lead (recoverable content of ores, etc.)—do	3,695	1,323	3,824	1,208	2,729	737	3,160	1,093
Lime (open-market)—do	283,090	3,000	276,161	3,198	367,485	4,465	462,690	5,878
Marl, calcareous (except for cement)—do	2,025	1						

Natural gas	million cubic feet	14,062	1,735	12,391	1,398	13,285	1,342	11,425	1,748
Natural-gas liquids:									
Natural gasoline	thousands of 42-gallon barrels	1,085	5,575	905	3,533	989	3,019	(2)	(2)
LP-gases	do	2,454	7,851	2,313	4,941	2,118	3,436	2,071	4,727
Petroleum (crude)	do	64,808	179,520	64,501	178,670	62,028	171,820	[4] 60,243	[4] 166,870
Sand and gravel	thousand short tons	17,400	15,102	17,128	14,781	18,695	16,532	20,131	19,146
Sand and sandstone (ground)	short tons	232,971	1,943	217,577	1,887	263,122	2,278	262,488	2,300
Silver (recoverable content of ores, etc.)	thousand troy ounces	4	4	3	3	2	2	3	3
Stone (except limestone for cement and lime)	thousand short tons	[8] 18,533	[8] 22,823	17,054	20,682	17,911	21,970	19,299	23,475
Zinc (recoverable content of ores, etc.)	short tons	12,980	3,453	18,157	4,503	26,982	7,663	21,776	7,926
Undistributed: Peat, stone (sandstone, 1948), tripoli and minerals whose value must be concealed for particular years (indicated in appropriate column by footnote reference 2)			252		[10] 251		468		3,234
Total Illinois			521,038		[10] 449,893		488,144		489,933
Clays sold or used for cement	thousand short tons	237	172	236	171	216	163	189	189
Coke	do	3,675	54,397	3,196	52,258	3,591	58,141	3,686	62,053
Iron, pig	do	5,503	196,587	4,904	204,468	6,039	258,242	6,593	306,764
Sulfuric acid (from zinc smelting)	short tons, 100-percent basis	116,773	1,649	71,700	1,094	118,434	1,715	127,918	2,055
INDIANA									
Clays (except for cement)	thousand short tons	963	1,095	1,023	1,198	1,159	1,396	1,267	1,657
Coal	do	23,849	96,303	16,550	66,988	19,957	79,302	19,451	78,617
Marl, calcareous (except for cement)	short tons	15,839	17	44,026	50	20,380	14	12,960	18
Natural gas	million cubic feet	553	54	334	25	956	67	845	83
Peat	short tons	2,288	12	7,949	28	5,793	19	5,699	23
Petroleum (crude)	thousands of 42-gallon barrels	6,974	19,320	9,696	26,860	10,699	29,530	[4] 11,100	[4] 30,530
Pyrites	long tons	470	2	559	2	(2)	(2)	(2)	(2)
Sand and gravel	thousand short tons	9,439	7,092	8,887	6,695	9,723	7,516	11,031	8,764
Stone (except limestone for cement and lime)	do	[8] 6,574	[8] 14,989	[8] 6,332	[8] 15,228	6,995	20,686	[8] 8,642	[8] 23,730
Undistributed: Abrasive stones, cement, lime, and stone (sandstone, 1948–49; dimension sandstone, 1951), and minerals whose value must be concealed for particular years (indicated in appropriate column by footnote reference 2)			23,066		23,951		28,102		30,967
Total Indiana			161,950		141,025		166,632		174,389
Clays sold or used for cement	thousand short tons	247	191	273	204	253	210	258	257
Coke	do	8,584	125,355	7,533	122,528	8,256	138,881	8,844	156,205
Iron, pig	do	6,496	245,946	6,028	248,700	7,013	297,569	7,700	358,744

For footnotes, see end of table.

TABLE 5.—Mineral production in continental United States, 1948–51, by State and individual mineral—Continued

IOWA

Mineral	1948		1949		1950		1951	
	Quantity	Value (thousand dollars)	Quantity	Value (thousand dollars)	Quantity	Value (thousand dollars)	Quantity	Value (thousand dollars)
Cement thousands of 376-pound barrels	6,836	14,424	6,655	14,602	7,232	16,158	8,025	19,800
Clays (except for cement) thousand short tons	626	663	572	629	579	645	577	720
Coal do	1,670	7,020	1,724	6,912	1,891	6,977	1,630	6,110
Gypsum (crude) short tons	729,880	1,754	858,464	2,188	981,647	2,508	1,127,705	2,881
Peat do	(2)	(2)	(2)	(2)	3,000	19	13,545	108
Sand and gravel thousand short tons	8,040	3,729	7,978	4,447	8,995	4,796	9,943	5,917
Stone (except limestone for cement) do	6,388	8,333	6,831	8,663	8,425	10,668	9,261	12,170
Undistributed		32		17		2		
Total Iowa		35,955		37,458		41,773		47,706
Clays sold or used for cement thousand short tons	267	138	266	138	283	213	339	342

KANSAS

Cement [13] thousands of 376-pound barrels	7,931	16,188	7,641	16,880	8,759	19,400	8,164	19,413
Clays (except for cement) thousand short tons	289	240	302	260	352	321	373	370
Coal do	2,538	9,654	2,031	7,968	2,125	8,234	1,961	7,734
Helium (shipments, calendar years) thousand cubic feet							26,280	327
Lead (recoverable content of ores, etc.) short tons	8,386	3,002	9,772	3,088	9,487	2,561	8,947	3,096
Natural gas million cubic feet	245,189	12,235	294,078	15,910	364,024	24,026	417,538	33,821
Natural-gas liquids:								
Natural gasoline thousands of 42-gallon barrels	1,847	6,561	1,880	4,772	2,572	6,146	2,645	6,931
LP-gases do	714	1,716	768	1,164	1,115	1,487	1,621	2,445
Petroleum (crude) do	110,908	288,360	101,868	262,820	107,586	276,500	[4] 114,522	[4] 294,320
Salt (common) thousand short tons	832	4,961	832	5,218	846	5,915	901	6,640
Sand and gravel do	5,083	2,749	6,187	3,328	9,781	6,782	7,677	4,747
Stone (except limestone for cement) do	5,316	5,481	[5] 5,978	[5] 7,952	7,630	8,920	7,192	9,059
Zinc (recoverable content of ores, etc.) short tons	35,577	9,464	29,433	7,300	27,176	7,718	28,904	10,521
Undistributed: Natural cement, gypsum, pumice and pumicite, and stone (dimension sandstone, 1949)		549		502		604		663
Total Kansas		361,160		337,162		368,614		400,087
Clays sold or used for cement thousand short tons	298	205	311	214	374	280	359	359

KENTUCKY

Clays (except for cement)	thousand short tons	748	3,483	571	2,903	661	3,553	817	5,210
Coal	do	82,084	444,359	62,583	315,472	78,496	393,637	74,972	366,687
Fluorspar	short tons	84,889	2,663	63,438	2,018	80,137	2,555	68,635	2,335
Lead (recoverable content of ores, etc.)	do	216	77	187	59	66	18	107	37
Natural gas	million cubic feet	70,095	12,897	51,851	9,888	73,316	14,443	76,097	16,513
Natural-gas liquids:									
Natural gasoline	thousands of 42-gallon barrels	239	938	202	595	244	687	265	799
LP-gases	do	1,327	1,683	1,419	1,591	1,535	1,658	1,901	2,129
Petroleum (crude)	do	8,801	24,380	8,803	24,300	10,381	28,650	[4] 11,622	[4] 32,190
Sand and gravel	thousand short tons	2,067	2,069	2,376	2,169	2,383	2,263	2,802	2,435
Stone (except limestone for cement)	do	6,155	7,598	7,100	8,586	[5] 7,417	[5] 8,866	7,049	8,610
Zinc (recoverable content of ores, etc.)	short tons	639	170	935	232	731	207	3,457	1,258
Undistributed: Native asphalt, cement, and stone (crushed sandstone, 1950)			3,763		4,416		3,419		4,061
Total Kentucky			504,080		372,229		459,956		442,264
Clays sold or used for cement	thousand short tons	54	27	53	26	58	43	63	64
Iron, pig	do	799	(9)	627	(9)	754	(9)	766	(9)

LOUISIANA

Clays (except for cement)	thousand short tons	158	127	134	107	209	185	153	153
Natural gas	million cubic feet	686,061	26,482	732,845	32,025	831,771	44,084	1,054,199	61,143
Natural-gas liquids:									
Natural gasoline and cycle products	thousands of 42-gallon barrels	12,562	46,553	13,936	45,259	14,603	44,548	15,643	49,202
LP-gases	do	4,339	11,346	5,318	9,573	6,165	7,991	6,839	15,374
Petroleum crude	do	181,458	485,950	190,826	507,730	208,965	554,520	[4] 232,281	[4] 614,680
Salt (common)	thousand short tons	2,223	6,445	2,030	5,838	2,279	6,903	2,737	7,662
Sand and gravel	do	[7] 4,319	[7] 5,204	[7] 5,050	[7] 6,107	5,505	6,310	6,384	7,420
Sulfur (Frasch-process)	long tons	1,005,711	18,100	1,111,115	20,000	1,256,026	23,700	1,152,821	25,400
Undistributed: Cement, gypsum (1950–51), noncommercial sand and gravel (1948–49), and stone (except limestone for cement, 1948–50)			3,991		5,174		5,366		6,644
Total Louisiana			604,198		631,813		693,607		787,678
Clays sold or used for cement	thousand short tons	91	68	116	87	118	88	154	154

For footnotes, see end of table.

TABLE 5.—Mineral production in continental United States, 1948–51, by State and individual mineral—Continued

MAINE

Mineral	1948		1949		1950		1951	
	Quantity	Value (thousand dollars)	Quantity	Value (thousand dollars)	Quantity	Value (thousand dollars)	Quantity	Value (thousand dollars)
Cement—thousands of 376-pound barrels	1,176	2,755	1,057	2,526	1,127	2,705	(2)	(2)
Clays—thousand short tons	27	24	28	25	32	26	22	22
Columbium (niobium) concentrate—pounds, gross weight	100	(2)					(14)	(14)
Feldspar (crude)—long tons	18,774	130	18,286	130	17,487	125	19,273	155
Mica, scrap—short tons	(2)	(2)	45	1	23	1	(2)	(2)
Peat—do	1,100	30	3,312	79	2,912	62	1,805	37
Sand and gravel—thousand short tons	[7] 496	[7] 287	4,605	1,394	4,897	1,726	5,367	1,817
Stone (except limestone for cement and lime)—do	289	2,021	259	2,026	[8] 310	[8] 2,214	645	2,582
Undistributed: Beryllium concentrate, gem stones, lime, lithium minerals (1948 and 1950), mica (sheet, 1950–51), quartz from pegmatites and quartzite (1950), sand and gravel (noncommercial, 1948), slate, stone (crushed sandstone, 1950), and minerals whose value must be concealed for particular years (indicated in appropriate column by footnote reference 2)		2,847		561		602		3,903
Total Maine		8,094		6,742		7,461		8,516

MARYLAND

Clays (except for cement)—thousand short tons	521	920	586	923	676	1,158	698	1,355
Coal—do	1,661	8,734	668	3,505	648	3,135	589	2,781
Gold (recoverable content of ores, etc)—troy ounces					20	1	1	(3)
Lime (open-market)—short tons	69,032	655	64,299	618	64,687	692	67,684	722
Natural gas—million cubic feet					373	74	3,422	684
Sand and gravel—thousand short tons	5,834	6,158	[7] 4,777	[7] 6,029	[7] 5,864	[7] 7,790	7,054	8,171
Slate—short tons	(2)	(2)	(2)	(2)	(2)	(2)	67,770	431
Stone (except limestone for cement and lime)—thousand short tons	1,874	3,115	[8] 1,790	[8] 3,036	1,976	3,459	3,181	5,983
Undistributed: Cement, potassium salts, quartz (1948–49), noncommercial sand and gravel (1949–50), stone (dimension granite, 1949), and talc and ground soapstone		5,420		6,350		6,416		5,900
Total Maryland		25,002		20,461		22,725		26,027
Clays sold or used for cement—thousand short tons	69	52	67	50	66	49	59	59
Coke—do	2,148	(9)	2,040	(9)	2,367	(9)	2,855	(9)
Iron, pig—do	2,806	(9)	2,932	(9)	3,525	(9)	3,657	(9)

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MASSACHUSETTS

Clays	thousand short tons	137	113	156	136	155	139	150	168
Lime (open-market)	short tons	112,271	1,302	107,931	1,360	139,357	1,831	143,316	1,930
Peat	do	441	6	595	7	650	7	(2)	(2)
Quartz from pegmatites and quartzite	do	792	7	577	4	2,145	24	2,186	17
Sand and gravel	thousand short tons	5,500	4,418	5,505	4,379	7,111	5,431	7,232	5,593
Sand and sandstone (ground)	short tons	2,150	14	1,514	10	1,829	10	(2)	(2)
Stone (except limestone for lime)	thousand short tons	[8] 2,367	[8] 6,593	2,291	6,553	[8] 3,284	[8] 8,485	[8] 3,226	[8] 9,172
Undistributed			130				87		71
Total Massachusetts			12,583		12,449		16,014		16,951
Coke	thousand short tons	1,057	(9)	891	(9)	855	(9)	1,109	(9)
Iron, pig	do	141	(9)	125	(9)	182	(9)	182	(9)

MICHIGAN

Bromine	thousand pounds	17,666	5,436	28,035	7,023	(2)	(2)	(2)	(2)
Cement	thousands of 376-pound barrels	11,117	23,533	12,748	28,823	12,854	29,620	14,113	35,121
Clays (except for cement)	thousand short tons	407	372	369	333	416	381	391	462
Coal	do	13	90	11	116	12	116	7	75
Copper (recoverable content of ores, etc.)	short tons	27,777	12,055	19,506	7,686	25,608	10,653	24,979	12,090
Gypsum (crude)	do	1,309,331	3,618	1,264,511	3,470	1,474,210	4,091	1,566,276	4,403
Iron ore (usable)	thousand long tons, gross weight	12,896	53,247	10,993	55,237	12,821	72,359	13,612	81,766
Magnesium compounds from well brines (partly estimated)	short tons, MgO equivalent	34,500	3,577	23,700	2,719	34,000	3,871	45,692	5,011
Manganiferous ore (5 to 35 percent Mn)	short tons, gross weight					117,619	(2)		
Marl, calcareous (except for cement)	short tons			1,500	2	218,429	122	178,010	97
Natural gas	million cubic feet	14,981	2,195	14,753	2,242	11,250	1,485	11,194	1,657
Natural-gas liquids:									
Natural gasoline	thousands of 42-gallon barrels	60	246	86	196	79	161	(2)	(2)
LP-gases	do	1	3						
Peat	short tons	12,425	154	(2)	(2)	12,750	174	20,180	320
Petroleum (crude)	thousands of 42-gallon barrels	16,871	48,250	16,517	45,420	15,826	42,730	[4] 13,927	[4] 37,880
Salt (common)	thousand short tons	4,388	16,266	4,064	16,109	4,447	18,179	5,138	21,221
Sand and gravel	do	20,671	14,072	20,476	13,993	24,557	16,699	27,541	20,977
Stone (except limestone for cement and lime)	thousand short tons	[8] 19,704	[8] 14,620	16,547	13,387	19,096	15,391	20,852	17,515
Undistributed: Calcium-magnesium chloride, lime, potassium salts, ground sand and sandstone (1951), stone (basalt, 1948), and minerals whose value must be concealed for particular years (indicated in appropriate column by footnote reference 2)			5,151		4,504		[10] 13,909		19,344
Total Michigan			202,885		201,260		[10] 229,941		257,939
Clays sold or used for cement	thousand short tons	901	613	993	678	1,012	759	1,120	1,120
Coke	do	2,850	39,638	2,484	34,773	2,731	39,192	2,920	44,321
Iron, pig	do	1,535	(9)	1,542	(9)	2,157	(9)	2,164	(9)

For footnotes, see end of table.

TABLE 5.—Mineral production in continental United States, 1948–51, by State and individual mineral—Continued

MINNESOTA

Mineral	1948		1949		1950		1951	
	Quantity	Value (thousand dollars)	Quantity	Value (thousand dollars)	Quantity	Value (thousand dollars)	Quantity	Value (thousand dollars)
Clays—thousand short tons	133	152	134	153	129	151	130	188
Gem stones (estimated)	(15)	5	(15)	5				
Iron ore (usable)—thousand long tons, gross weight	67,923	249,523	55,944	239,859	64,539	311,716	78,165	411,469
Manganiferous ore (5 to 35 percent Mn)—short tons, gross weight	1,198,523	(2)	990,202	(2)	869,838	(2)	1,132,250	(2)
Marl, calcareous (except for cement)—short tons	11,262	9	8,840	7	19,375	8	2,925	2
Peat—do	3,000	13	12,820	54	400	13		
Sand and gravel—thousand short tons	13,723	4,819	12,935	4,904	15,473	5,903	17,229	6,009
Stone (except limestone for cement and lime)—do	1,805	5,091	1,879	5,279	[8] 1,953	[8] 5,334	[8] 1,906	[8] 5,613
Undistributed: Abrasive stones, cement, lime, stone (crushed sandstone, 1950–51), and minerals whose value must be concealed for particular years (indicated in appropriate column by footnote reference 2)		7,636		7,279		8,442		9,817
Total Minnesota		267,248		257,540		331,567		433,098
Coke—thousand short tons	846	12,426	782	12,694	834	13,030	972	16,143
Iron, pig—do	557	(9)	455	(9)	652	(9)	696	(9)

MISSISSIPPI

Clays—thousand short tons	453	1,416	508	1,654	562	2,184	673	4,250
Fuller's earth—do	(9)							
Natural gas—million cubic feet	59,899	3,336	68,062	4,199	114,153	7,192	158,845	10,007
Natural-gas liquids:								
Natural gasoline and cycle products—thousands of 42-gallon barrels	692	1,815	776	2,264	780	2,274	729	2,503
LP-gases—do	432	922	495	572	532	864	473	852
Petroleum (crude)—do	45,761	110,280	37,966	93,400	38,236	88,330	[4] 37,039	[4] 82,970
Sand and gravel—thousand short tons	2,879	1,520	[7] 1,943	[7] 1,330	2,764	1,986	3,012	2,279
Stone—do	24	28	(2)	(2)	100	115	171	169
Undistributed: Sand and gravel (noncommercial 1949), and minerals whose value must be concealed for particular years (indicated in appropriate column by footnote reference 2)				292				
Total Mississippi		119,317		103,711		102,945		103,030

Barite (crude) short tons	278,071	2,414	186,891	1,498	212,736	1,924	281,895	2,697
Cement thousands of 376-pound barrels	8,428	17,911	8,519	19,348	9,780	22,751	10,217	25,760
Clays (except for cement) thousand short tons	1,801	5,061	1,469	3,963	1,533	4,329	1,904	10,098
Coal do	4,022	15,688	3,647	14,919	2,963	12,369	3,269	13,405
Copper (recoverable content of ores, etc.) short tons	2,370	1,029	3,670	1,446	2,982	1,240	2,422	1,172
Iron ore (usable) thousand long tons, gross weight	165	(2)	145	(2)	194	(2)	172	(2)
Lead (recoverable content of ores, etc.) short tons	102,288	36,619	127,522	40,297	134,626	36,349	123,702	42,801
Lime (open-market) do	1,009,993	8,999	878,561	8,035	1,035,176	9,448	1,122,299	11,286
Natural gas million cubic feet	27	5	24	4	21	3	14	2
Petroleum (crude) thousands of 42-gallon barrels	31	(2)	49	(2)	32	(2)	[4] 24	(2)
Sand and gravel thousand short tons	4,887	4,198	5,194	4,347	6,232	5,268	6,810	5,970
Silver (recoverable content of ores, etc.) thousand troy ounces	114	103	123	112	236	214	184	167
Stone (except limestone for cement and lime) thousand short tons	[3] 9,021	[3] 12,320	9,563	13,969	10,300	14,407	11,294	15,255
Tripoli short tons	(2)	(2)	15,888	506	(2)	(2)	(2)	(2)
Tungsten concentrate short tons, 60-percent WO_3 basis	4	(2)	2	(2)	(5)	(2)		
Zinc (recoverable content of ores, etc.) short tons	6,463	1,719	5,911	1,466	8,189	2,326	11,476	4,177
Undistributed: Native asphalt, ground sand and sandstone, stone (sandstone, 1948), and minerals whose value must be concealed for particular years (indicated in appropriate column by footnote reference 2)		2,225		1,383		2,563		2,456
Total Missouri		108,291		111,293		113,191		135,246
Clays sold or used for cement thousand short tons	334	249	352	251	414	327	451	460

For footnotes, see end of table.

TABLE 5.—Mineral production in continental United States, 1948–51, by State and individual mineral—Continued

MONTANA

Mineral	1948		1949		1950		1951	
	Quantity	Value (thousand dollars)	Quantity	Value (thousand dollars)	Quantity	Value (thousand dollars)	Quantity	Value (thousand dollars)
Antimony ore and concentrate—short tons, gross weight							29	(2)
Clays—thousand short tons	55	150	54	124	38	38	39	42
Coal:								
Bituminous—do	2,860	6,306	2,721	6,161	2,468	5,686	2,310	6,039
Lignite—do	38	124	45	151	52	175	35	123
Copper (recoverable content of ores, etc.)—short tons	58,252	25,281	56,611	22,305	54,478	22,663	57,406	27,785
Fluorspar—do	318	(2)	422	(2)	41	(2)		
Gold (recoverable content of ores, etc.)—troy ounces	73,091	2,558	52,724	1,845	51,764	1,812	30,502	1,068
Lead (recoverable content of ores, etc.)—short tons	18,411	6,591	17,996	5,687	19,617	5,297	21,302	7,370
Manganese ore (35 percent or more Mn)—short tons, gross weight	130,184	4,362	122,382	5,068	131,201	(2)	100,562	(2)
Manganiferous ore (5 to 35 percent Mn)—do	4,135	(2)	5,517	(2)	6,810	(2)	7,598	(2)
Natural gas—million cubic feet	36,551	1,696	35,291	1,962	39,186	2,077	36,424	2,003
Natural-gas liquids:								
Natural gasoline—thousands of 42-gallon barrels	81	370	86	210	98	350	113	392
LP-gases—do	120	350	144	431	153	450	164	481
Petroleum (crude)—do	9,382	24,210	9,118	23,520	8,109	20,430	[4] 8,958	[4] 22,130
Phosphate—thousand long tons	249	1,720	355	2,574	210	1,496	304	2,353
Sand and gravel—thousand short tons	7,384	3,257	6,682	3,366	9,044	5,140	9,583	6,202
Silver (recoverable content of ores, etc.)—thousand troy ounces	6,931	6,273	6,327	5,726	6,591	5,965	6,394	5,787
Stone (except limestone for cement and lime)—thousand short tons	615	613	[5] 603	[5] 564	919	949	872	986
Tungsten concentrate—short tons, 60-percent WO_3 basis	28	(2)	9	(2)			1	3
Zinc (recoverable content of ores, etc.)—short tons	59,095	15,719	54,195	13,440	67,678	19,221	85,551	31,141
Undistributed: Barite (1951), cement, gem stones, gypsum, lime, pumice and pumicite (1948 and 1950–51), pyrites, sodium sulfate (1951), stone (basalt and unclassified, 1949), talc, vermiculite, and minerals whose value must be concealed for particular years (indicated in appropriate column by footnote reference 2)		4,261		4,936		11,640		12,261
Total Montana		103,841		98,070		103,389		126,166

NEBRASKA

Clays (except for cement)	thousand short tons	105	99	87	85	100	109	86	87
Natural gas	million cubic feet					17	2	3,895	499
Petroleum (crude)	thousands of 42-gallon barrels	215	520	330	730	1,547	3,300	[4] 2,558	[4] 5,960
Pumice and pumicite	short tons	4,000	34	4,622	40	(2)	(2)	(2)	(2)
Sand and gravel	thousand short tons	4,726	2,933	5,115	2,912	5,078	3,168	4,969	3,477
Stone (except limestone for cement)	do	366	707	[3] 505	[3] 841	737	1,042	943	1,438
Undistributed: Nonmetallic minerals, and minerals whose value must be concealed for particular years (indicated in appropriate column by footnote reference 2)			4,092		5,494		6,401		7,008
Total Nebraska			8,385		10,102		14,022		18,469
Clays sold or used for cement	thousand short tons	54	31	47	29	54	40	30	29

NEVADA

Antimony ore and concentrate	short tons, gross weight	225	53	280	77	20	(2)	156	(2)
Barite (crude)	short tons	(2)	(2)	70,576	417	47,608	269	63,201	387
Clays (including fuller's earth)	thousand short tons	(2)	(2)	(2)	(2)	(2)	(2)	3	33
Copper (recoverable content of ores, etc.)	short tons	45,242	19,635	38,058	14,995	52,569	21,869	56,474	27,333
Fluorspar	do	9,615	(2)	5,847	(2)	7,577	(2)	(2)	(2)
Gold (recoverable content of ores, etc.)	troy ounces	111,532	3,904	130,399	4,564	178,447	6,246	121,036	4,236
Gypsum (crude)	short tons	519,552	1,222	495,229	1,348	604,604	1,614	643,637	1,812
Iron ore (usable)	thousand long tons, gross weight	9	(2)	3	(2)	5	(2)	299	898
Lead (recoverable content of ores, etc.)	short tons	9,777	3,500	10,626	3,358	9,408	2,540	7,148	2,473
Manganese ore (35 percent or more Mn)	short tons, gross weight							328	(2)
Manganiferous ore (5 to 35 percent Mn)	do	8,707	(2)	4,964	53	8,942	102	1,250	(2)
Mercury	76-pound flasks	1,206	92	4,170	331	680	55	1,400	294
Sand and gravel	thousand short tons	2,249	2,018	1,347	1,212	2,617	2,253	2,617	2,658
Silver (recoverable content of ores, etc.)	thousand troy ounces	1,790	1,620	1,800	1,629	1,537	1,391	982	889
Stone (except limestone for lime)	thousand short tons	555	681	519	669	[3] 274	[3] 270	835	960
Sulfur ore for direct agricultural use	long tons	358	7	860	15	867	15	(2)	(2)
Talc and pinite	short tons	8,019	108	8,837	147	8,581	171	6,919	153
Tungsten concentrate	short tons, 60-percent WO_3 basis	949	(2)	740	(2)	1,123	(2)	1,482	4,780
Zinc (recoverable content of ores, etc.)	short tons	20,288	5,396	20,443	5,070	21,606	6,136	17,443	6,349
Undistributed: Andalusite (1948–49), brucite, diatomite, dumortierite (1949), gem stones (1948–49), lime, magnesite, calcareous marl, molybdenum, perlite, pumice and pumicite (1949–51), salt, stone (crushed limestone, 1950), and minerals whose value must be concealed for particular years (indicated in appropriate column by footnote reference 2)			4,267		[10] 3,488		5,568		4,371
Total Nevada			42,503		[10] 37,373		48,499		57,626

For footnotes, see end of table.

TABLE 5.—Mineral production in continental United States, 1948–51, by State and individual mineral—Continued

NEW HAMPSHIRE

Mineral	1948		1949		1950		1951	
	Quantity	Value (thousand dollars)	Quantity	Value (thousand dollars)	Quantity	Value (thousand dollars)	Quantity	Value (thousand dollars)
Beryllium concentrate—short tons, gross weight	(2)	(2)	(2)	(2)	106	40	50	16
Clays—thousand short tons	25	19	26	20	23	17	29	29
Peat—short tons			15	(3)				
Sand and gravel—thousand short tons	2,482	651	[16] 2,001	[16] 237	[16] 1,713	[16] 226	2,260	518
Stone—do	88	314	7	381	[8] 16	[8] 384	[8] 62	[8] 350
Undistributed: Abrasive stones, feldspar, mica, sand and gravel (commercial, 1949–50), stone (crushed unclassified, 1950 crushed granite, 1951), and minerals whose value must be concealed for particular years (indicated in appropriate column by footnote reference 2)		347		[10] 751		1,044		383
Total New Hampshire		1,331		[10] 1,389		1,711		1,296

NEW JERSEY

Clays—thousand short tons	600	1,571	537	1,314	602	1,278	683	2,107
Iron ore (usable)—thousand long tons, gross weight	436	3,740	448	4,469	588	5,652	658	7,811
Manganiferous residuum—short tons, gross weight	291,383	(2)	158,902	(2)	183,842	(2)	267,751	(2)
Marl (greensand)—short tons	7,269	393	6,128	276	3,935	304	5,067	264
Peat—do	23,102	163	25,500	181	26,466	186	27,678	213
Sand and gravel—thousand short tons	[7] 6,325	[7] 7,490	[7] 5,555	[7] 6,982	[7] 7,620	[7] 8,636	6,652	9,106
Sand and sandstone (ground)—short tons	116,832	782	107,946	755	131,744	937	144,098	1,054
Stone (except limestone for lime)—thousand short tons	3,591	6,376	4,071	7,897	[8] 4,672	[8] 9,119	6,457	10,988
Zinc (recoverable content of ore, etc.) [17]—short tons	76,332	20,710	50,984	14,443	55,029	17,259	62,917	24,280
Undistributed: Lime, magnesium compounds, noncommercial sand and gravel (1948–50), stone (crushed unclassified, 1950), and minerals whose value must be concealed for particular years (indicated in appropriate column by footnote reference 2)		3,163		2,267		3,020		3,201
Total New Jersey		44,388		38,584		46,391		59,024
Coke—thousand short tons	1,411	(9)	1,345	(9)	1,481	(9)	1,539	(9)

Beryllium concentrate—short tons, gross weight			8	(2)	(2)	(2)	141	47
Carbon dioxide, natural (estimated)—thousand cubic feet	73,000	29	87,000	35	68,000	27	(2)	(2)
Clays—thousand short tons	50	63	98	69	63	78	76	149
Coal—do	1,364	6,947	1,004	5,227	727	3,917	783	4,502
Copper (recoverable content of ores, etc.)—short tons	74,687	32,414	55,388	21,823	66,300	27,581	73,558	35,602
Fluorspar—do	24,968	912	12,844	446	20,036	742	24,402	1,163
Gold (recoverable content of ores, etc.)—troy ounces	3,414	119	3,249	114	3,414	119	3,959	139
Iron ore (usable)—thousand long tons, gross weight					14	(2)	32	(2)
Lead (recoverable content of ores, etc.)—short tons	7,653	2,740	4,652	1,470	4,150	1,121	5,846	2,023
Manganese ore (35 percent or more Mn)—short tons, gross weight					1,320	(2)	226	(2)
Manganiferous ore (5 to 35 percent Mn)—do	122,879	(2)	65,511	(2)	74,348	(2)	79,844	(2)
Natural gas—million cubic feet	194,749	5,258	204,961	5,985	212,909	6,387	300,169	11,406
Natural-gas liquids:								
Natural gasoline—thousands of 42-gallon barrels	2,382	9,111	2,733	7,728	3,021	8,898	3,307	10,507
LP-gases—do	721	1,358	1,292	1,462	1,998	2,061	2,281	3,170
Petroleum (crude)—do	47,969	117,520	47,645	116,250	47,367	115,100	[4] 52,719	[4] 129,160
Potassium salts—short tons, K_2O equivalent	967,945	29,177	932,497	27,950	1,072,772	31,944	1,217,617	37,210
Pumice and pumicite—short tons	177,630	813	351,368	1,026	351,642	1,110	245,564	884
Sand and gravel—thousand short tons	[7] 717	[7] 573	883	611	938	923	1,080	1,088
Silver (recoverable content of ores, etc.)—thousand troy ounces	538	487	381	345	339	306	443	401
Stone—thousand short tons	531	294	138	106	365	244	1,023	592
Zinc (recoverable content of ores, etc.)—short tons	41,502	11,040	29,346	7,278	29,263	8,311	45,419	16,533
Undistributed: Barite (1949–51), gem stones, gypsum (1948–49), lithium minerals (1950), mica (1948 and 1950), molybdenum, perlite, salt, sand and gravel (noncommercial, 1948), vanadium (1948 and 1950–51), and minerals whose value must be concealed for particular years (indicated in appropriate column by footnote reference 2)		1,225		900		1,425		1,728
Total New Mexico		220,080		198,825		210,294		256,304

For footnotes, see end of table.

TABLE 5.—Mineral production in continental United States, 1948–51, by State and individual mineral—Continued

NEW YORK

Mineral	1948		1949		1950		1951	
	Quantity	Value (thousand dollars)	Quantity	Value (thousand dollars)	Quantity	Value (thousand dollars)	Quantity	Value (thousand dollars)
Cement [13]—thousands of 376-pound barrels	12,299	26,071	12,680	28,484	13,271	30,895	13,863	34,687
Clays (except for cement)—thousand short tons	1,162	928	977	769	1,154	939	1,224	1,298
Emery—short tons	5,405	69	4,909	61	5,949	75	11,634	160
Gypsum (crude)—do	1,228,358	3,295	916,117	2,805	1,280,100	3,876	1,259,484	4,011
Iron ore (usable)—thousand long tons, gross weight	2,932	24,385	2,345	22,185	2,917	27,915	3,650	39,819
Lead (recoverable content of ores, etc.)—short tons	1,231	441	1,317	416	1,484	401	1,500	519
Marl, calcareous (except for cement)—do			550	3	(2)	(2)	(2)	(2)
Natural gas—million cubic feet	4,705	1,040	3,693	907	3,336	837	3,214	807
Natural gasoline—thousands of 42-gallon barrels	(18)	1	(18)	1			(18)	(3)
Petroleum (crude)—do	4,621	22,830	4,425	15,750	4,143	15,660	[4] 4,254	[4] 17,990
Salt (common)—thousand short tons	3,066	13,057	2,952	12,710	2,807	14,405	3,519	16,553
Sand and gravel—do	16,369	13,382	18,543	15,117	21,778	18,075	21,009	19,285
Silver (recoverable content of ores, etc.)—thousand troy ounces	19	17	18	17	33	30	48	43
Slate—short tons	125,520	1,533	122,180	1,617	151,160	2,055	126,270	1,465
Stone (except limestone for cement and lime)—thousand short tons	12,688	17,261	13,022	18,160	13,122	19,729	15,559	24,326
Talc—short tons	119,716	2,614	115,636	2,659	163,974	4,040	152,652	4,171
Wollastonite—do	75	2	500	7	800	16	(2)	(2)
Zinc (recoverable content of ores, etc.)—do	34,566	9,195	37,973	9,417	38,321	10,883	40,051	14,579
Undistributed: Abrasive stones (1948), natural cement, feldspar (1948–49), abrasive garnet, lime, mica sheet (1950), pyrites, titanium concentrate, and minerals whose value must be concealed for particular years (indicated in appropriate column by footnote reference 2)		7,502		7,408		6,698		8,543
Total New York		143,623		138,493		156,529		188,256
Clays sold or used for cement—thousand short tons	303	201	308	205	289	217	335	335
Coke—do	5,687	72,757	5,165	69,074	5,412	73,460	5,611	80,327
Ferroalloys—short tons	365,067	66,186	(9)	(9)	(9)	(9)	320,721	81,690
Iron, pig—thousand short tons	3,744	122,441	3,244	142,108	4,222	180,158	4,542	218,059

NORTH CAROLINA

Clays	thousand short tons	1,205	1,436	1,181	1,336	1,437	1,767	1,462	2,177
Coal	do			14	104	(2)	(2)	(2)	(2)
Feldspar (crude)	long tons	201,774	1,117	160,916	974	183,027	1,107	166,361	1,230
Gold (recoverable content of ores, etc.)	troy ounces			13	1				
Mica:									
Scrap	short tons	44,428	992	24,801	640	48,193	1,281	52,550	1,442
Sheet	pounds	257,926	45	470,072	121	483,736	102	464,949	127
Olivine	short tons	3,926	(2)	2,458	(2)	[10] 4,063	(2)	(2)	(2)
Sand and gravel	thousand short tons	4,837	3,522	5,093	3,553	8,352	5,465	7,656	4,436
Stone	do	5,237	7,714	6,225	10,078	7,712	11,895	[8] 8,613	[8] 13,293
Talc, pyrophyllite, and ground soapstone	short tons	104,052	1,456	86,208	1,345	116,895	1,855	113,950	1,983
Tin	long tons							1	2
Titanium concentrate (ilmenite)	short tons, gross weight	28,790	(2)	31,714	(2)	[10] 25,842	(2)	(2)	(2)
Tungsten concentrate	short tons, 60-percent WO_3 basis	965	(2)	770	(2)	1,240	(2)	1,041	(2)
Vermiculite	short tons	(2)	(2)	(2)	(2)	2,366	67	(2)	(2)
Undistributed: Abrasive stones, asbestos (1948 and 1950–51), beryllium concentrate (1949 and 1951), lithium minerals (1951), quartz, ground sand and sandstone (1950), stone (dimension marble, 1951), and minerals whose value must be concealed for particular years (indicated in appropriate column by footnote reference 2)			1,949		1,603		[10] 2,799		4,958
Total North Carolina			18,231		19,755		[10] 26,338		29,648

NORTH DAKOTA

Clays	thousand short tons	(2)	(2)	(2)	(2)	(2)	(2)	18	35
Coal (lignite)	do	2,961	6,730	2,967	7,004	3,261	7,758	3,224	7,784
Natural gas	million cubic feet	643	19	533	27	608	31	456	24
Petroleum (crude)	thousands of 42-gallon barrels							25	(2)
Sand and gravel	thousand short tons	5,245	1,713	4,371	1,638	4,271	1,660	4,573	2,140
Stone	do	(2)	(2)	(2)	(2)	193	136	281	213
Undistributed: Nonmetallic minerals, and minerals whose value must be concealed for particular years (indicated in appropriate column by footnote reference 2)			16		149		29		50
Total North Dakota			8,478		8,818		9,614		10,246

For footnotes, see end of table.

TABLE 5.—Mineral production in continental United States, 1948–51, by State and individual mineral—Continued

OHIO

Mineral	1948		1949		1950		1951	
	Quantity	Value (thousand dollars)	Quantity	Value (thousand dollars)	Quantity	Value (thousand dollars)	Quantity	Value (thousand dollars)
Cement—thousands of 376-pound barrels	10,020	20,497	10,157	22,389	10,512	24,013	11,872	29,499
Clays (except for cement)—thousand short tons	4,525	8,024	4,044	7,448	4,498	8,695	5,147	13,224
Coal—do	38,708	155,129	30,961	123,053	37,761	143,853	37,949	146,678
Lime (open-market)—short tons	1,936,211	21,473	1,712,248	20,321	2,142,344	26,273	2,289,473	29,046
Natural gas—million cubic feet	65,619	12,901	46,512	8,991	43,163	8,374	38,879	7,854
Natural-gas liquids:								
Natural gasoline—thousands of 42-gallon barrels	145	629	123	432	103	344	107	399
LP-gases—do	5	11						
Peat—short tons	19,207	162	20,372	181	22,145	245	21,378	262
Petroleum (crude)—thousands of 42-gallon barrels	3,600	15,190	3,483	10,200	3,383	10,250	[4] 3,140	[4] 9,580
Salt (common)—thousand short tons	2,753	5,884	2,196	5,135	2,515	5,492	3,112	5,849
Sand and gravel—do	15,509	15,150	14,956	14,429	15,664	16,209	19,431	21,395
Stone (except limestone for cement and lime)—do	29,275	27,552	[3] 19,364	[3] 27,419	20,466	28,629	[3] 25,190	[3] 36,436
Undistributed: Abrasive stones, bromine (1950–51), calcium-magnesium chloride, gypsum, ground sand and sandstone, and stone (crushed unclassified, 1949 and 1951)		2,214		2,082		2,195		2,391
Total Ohio		284,816		242,080		274,572		302,613
Clays sold or used for cement—thousand short tons	438	234	466	250	480	360	540	540
Coke—do	10,562	128,844	8,911	111,443	10,314	130,017	11,151	146,141
Ferroalloys—short tons	259,271	21,853	195,905	18,725	284,229	28,632	322,618	41,312
Iron, pig—thousand short tons	12,367	469,654	10,524	430,628	12,521	530,708	13,726	626,822

OKLAHOMA

Clays (except for cement)	thousand short tons	254	227	244	222	316	313	345	356
Coal	do	3,462	16,619	3,022	15,242	2,679	14,567	2,223	13,873
Lead (recoverable content of ores, etc.)	short tons	16,918	6,057	19,858	6,275	20,724	5,596	16,575	5,735
Natural gas	million cubic feet	480,573	23,356	435,262	20,327	482,360	23,636	538,756	28,554
Natural-gas liquids:									
Natural gasoline	thousands of 42-gallon barrels	6,498	26,143	6,855	20,360	7,980	21,579	9,458	27,498
LP-gases	do	4,680	10,963	5,630	8,408	6,753	8,393	8,084	12,436
Petroleum (crude)	do	154,455	398,490	151,660	388,250	164,599	423,020	[4] 186,869	[4] 480,250
Sand and gravel	thousand short tons	2,005	1,088	2,921	1,526	3,287	2,357	3,183	2,322
Stone (except limestone for cement and lime)	do	4,028	4,141	4,342	4,028	5,022	4,848	6,967	6,918
Zinc (recoverable content of ores, etc.)	short tons	43,821	11,656	44,033	10,920	46,739	13,274	53,450	19,456
Undistributed: Native asphalt, cement, gypsum, lime, pumice and pumicite (1948–50), salt, and ground sand and sandstone (1949–51)			8,106		8,706		9,512		10,087
Total Oklahoma			506,846		484,264		527,095		607,485
Clays sold or used for cement	thousand short tons	256	163	236	152	240	180	206	206

OREGON

Antimony ore and concentrate	short tons, gross weight			54	3			
Carbon dioxide, natural (estimated)	thousand cubic feet	[19]	50	[19]	50	[2]	[2]	[2]	[2]
Chromite	short tons, gross weight	3,345	[2]					754	63
Clays (except for cement)	thousand short tons	111	82	109	90	112	91	95	105
Coal	do					1	8		
Copper (recoverable content of ores, etc.)	short tons	2	1	20	8	19	8	11	5
Gold (recoverable content of ores, etc.)	troy ounces	14,611	511	16,226	568	11,058	387	7,927	277
Lead (recoverable content of ores, etc.)	short tons	7	3	12	4	17	5	2	1
Mercury	76-pound flasks	1,351	103	1,167	93	5	[3]	1,177	247
Perlite (crude)	short tons	7,937	44	[2]	[2]	17,397	70	[2]	[2]
Pumice and pumicite	do	106,277	307	104,475	273	79,653	321	47,026	137
Sand and gravel	thousand short tons	8,385	10,629	7,135	7,682	8,200	8,168	10,504	9,117
Silver (recoverable content of ores, etc.)	thousand troy ounces	14	12	12	11	14	12	6	6
Stone (except limestone for cement and lime)	thousand short tons	3,682	5,734	[8] 4,397	[8] 6,479	[8] 3,837	[8] 5,559	8,722	10,831
Tungsten concentrate	short tons, 60-percent WO_3 basis			3	[2]			1	3
Zinc (recoverable content of ores, etc.)	short tons			6	1	21	6	3	1
Undistributed: Asbestos (1949–51), cement, diatomite, gem stones, lime (1950–51), quartz, stone (dimension granite, 1949; dimension and crushed granite, 1950), and minerals whose value must be concealed for particular years (indicated in appropriate column by footnote reference 2)			6,447		6,583		6,907		7,608
Total Oregon			23,923		21,845		21,542		28,401
Clays sold or used for cement	thousand short tons	61	46	55	41	51	38	57	57

For footnotes, see end of table.

TABLE 5.—Mineral production in continental United States, 1948–51, by State and individual mineral—Continued

PENNSYLVANIA

Mineral	1948		1949		1950		1951	
	Quantity	Value (thousand dollars)	Quantity	Value (thousand dollars)	Quantity	Value (thousand dollars)	Quantity	Value (thousand dollars)
Cement—thousands of 376-pound barrels	38,256	81,639	36,905	84,839	39,451	94,604	41,560	107,036
Clays (except for cement)—thousand short tons	3,451	8,605	3,155	7,527	3,301	8,479	3,993	13,664
Coal:								
Anthracite—do	57,140	467,052	42,702	358,008	44,077	392,398	42,670	405,818
Bituminous—do	134,542	664,724	89,215	446,774	105,870	529,462	108,164	572,194
Cobalt (content of ore)—pounds	580,703	(2)	673,773	(2)	660,025	(2)	755,631	(2)
Gold (recoverable content of ores, etc.)—troy ounces	2,200	77	1,645	57	1,764	62	2,179	76
Iron ore (usable)—thousand long tons, gross weight	1,122	9,041	953	9,324	1,116	11,626	1,215	13,864
Lime (open-market)—short tons	1,085,807	11,320	911,065	10,191	1,086,451	12,663	1,181,100	14,260
Natural gas—million cubic feet	87,578	21,124	84,739	21,727	91,137	23,058	128,715	35,654
Natural-gas liquids:								
Natural gasoline—thousands of 42-gallon barrels	269	1,116	228	683	232	702	192	656
LP-gases—do	22	67	17	45	14	55	18	71
Peat—short tons	(2)	(2)	6,663	30	(2)	(2)	8,591	46
Petroleum (crude)—thousands of 42-gallon barrels	12,667	62,830	11,374	40,600	11,859	45,300	[4] 11,345	[4] 48,220
Sand and gravel—thousand short tons	12,423	15,304	11,699	14,398	13,858	17,172	15,737	21,488
Silver (recoverable content of ores, etc.)—thousand troy ounces	14	12	11	10	11	9	14	12
Slate—short tons	269,120	5,351	228,170	4,579	285,120	5,546	268,830	5,689
Stone (except limestone for cement and lime)—thousand short tons	23,172	35,189	21,226	34,856	25,493	42,206	[5] 27,400	[5] 46,669
Tripoli (rottenstone)—short tons	(2)	(2)	452	10	(2)	(2)	(2)	(2)
Undistributed: Copper, mica (1949–51), potassium salts (1949), pyrites, ground sand and sandstone, stone (dimension unclassified, 1951), and minerals whose value must be concealed for particular years (indicated in appropriate column by footnote reference 2)		3,509		2,312		2,870		3,809
Total Pennsylvania		1,386,960		1,035,970		1,186,212		1,289,226
Clays sold or used for cement—thousand short tons	158	251	156	300	181	337	238	424
Coke—do	22,384	257,034	17,667	216,206	21,526	269,222	23,647	308,788
Ferroalloys—short tons	618,677	101,136	464,564	84,953	586,805	128,259	688,823	149,295
Iron, pig—thousand short tons	17,750	651,137	14,894	641,033	18,300	788,497	20,206	951,282
Sulfuric acid (from zinc smelting)—short tons, 100-percent basis	238,125	3,363	229,819	3,506	308,718	4,472	317,064	5,095

RHODE ISLAND

Sand and gravel	thousand short tons	633	729	398	379	580	580	535	577
Stone	do	107	537	[8] 75	[8] 451	239	798	239	652
Undistributed: Nonmetallic minerals			184		99		47		49
Total Rhode Island			1,450		929		1,425		1,278

SOUTH CAROLINA

Clays (except for cement)	thousand short tons	706	3,712	664	3,796	955	4,996	902	4,689
Sand and gravel	do	403	199	[7] 287	[7] 145	348	167	320	139
Stone	do	2,444	4,543	[8] 2,441	[8] 3,629	[8] 2,558	[8] 3,836	[8] 2,829	[8] 3,690
Topaz (industrial)	short tons	200	4	[2]	[2]				
Undistributed: Barite (1949–51), cement (1949–51), kyanite, sand and gravel (noncommercial, 1949), stone (crushed, unclassified, 1949–50, dimension granite, 1951), vermiculite, and minerals whose value must be concealed for particular years (indicated in appropriate column by footnote reference 2)			427		1,456		2,395		2,766
Total South Carolina			8,885		9,026		11,394		11,284
Clays sold or used for cement	thousand short tons	4	2	35	18	41	31	47	47

SOUTH DAKOTA

Beryllium concentrate	short tons, gross weight	45	[2]	[10] 139	[10] 40	96	30	138	46
Clays (except for cement)	thousand short tons	169	1,715	151	1,530	206	2,208	255	2,923
Coal (lignite)	do	29	86	26	92	[2]	[2]	28	99
Feldspar (crude)	long tons	54,037	271	32,272	157	43,875	249	48,559	291
Gold (recoverable content of ores, etc.)	troy ounces	377,850	13,225	464,650	16,263	567,996	19,880	468,101	16,034
Lead (recoverable content of ores, etc.)	short tons	16	6	4	1			2	1
Mica:									
Scrap	do	988	29	1,125	31	1,902	25	2,292	43
Sheet	pounds			8,367	3	13,018	2		
Natural gas	million cubic feet	2	[3]	1	[3]			7	[3]
Sand and gravel	thousand short tons	4,687	3,247	5,457	2,315	5,392	2,751	5,037	2,502
Silver (recoverable content of ores, etc.)	thousand troy ounces	95	86	109	99	142	128	140	126
Stone (except limestone for cement and lime)	thousand short tons	763	3,911	[8] 1,024	[8] 4,473	[8] 1,206	[8] 4,861	1,263	4,660
Tantalum concentrate	pounds, gross weight	500	[2]					[14]	[14]
Zinc (recoverable content of ores, etc.)	short tons	29	8						
Undistributed: Cement, gypsum (1948), lime, lithium minerals, quartz (1948), stone (crushed granite, 1949; crushed unclassified, 1950), tin (1948), and minerals whose value must be concealed for particular years (indicated in appropriate column by footnote reference 2)			1,743		1,742		2,582		2,933
Total South Dakota			24,327		[10] 26,746		32,716		29,658
Clays sold or used for cement	thousand short tons	58	43	37	28	90	67	[9]	[9]

For footnotes, see end of table.

TABLE 5.—Mineral production in continental United States, 1948–51, by State and individual mineral—Continued

TENNESSEE

Mineral	1948		1949		1950		1951	
	Quantity	Value (thousand dollars)	Quantity	Value (thousand dollars)	Quantity	Value (thousand dollars)	Quantity	Value (thousand dollars)
Barite (crude)—short tons	25,818	275	13,376	137	(2)	(2)	(2)	(2)
Cement—thousands of 376-pound barrels	6,775	13,667	5,993	12,858	6,663	14,683	7,163	17,203
Clays (except for cement)—thousand short tons	701	2,502	624	2,399	787	3,094	821	2,957
Fuller's earth—do	(2)	(2)						
Coal—do	6,483	37,232	4,172	21,895	5,070	27,360	5,401	26,956
Fluorspar—short tons							140	(2)
Gold (recoverable content of ores, etc.)—troy ounces	156	6	171	6	160	6	108	4
Iron ore (usable)—thousand long tons, gross weight							36	142
Lead (recoverable content of ores, etc.)—short tons			257	81	113	31	14	5
Lime (open-market)—do	163,098	1,443	117,053	1,108	98,232	958	108,970	1,098
Manganese ore (35 percent or more Mn)—short tons, gross weight	37	(2)	175	(2)	133	(2)		
Natural gas—million cubic feet	127	12	83	8	132	13	132	12
Petroleum (crude)—thousands of 42-gallon barrels	19	(2)	18	(2)	12	(2)	4 14	(2)
Phosphate rock—thousand long tons	1,308	8,231	1,342	9,066	1,384	10,028	1,420	10,605
Sand and gravel—thousand short tons	3,817	4,148	4,056	4,054	4,153	4,411	4,645	5,187
Silver (recoverable content of ores, etc.)—thousand troy ounces	40	36	42	38	40	36	25	23
Stone (except limestone for cement and lime)—thousand short tons	8,011	12,933	8 7,614	8 13,027	7,979	13,802	8 8,839	8 14,766
Zinc (recoverable content of ores, etc.)—short tons	29,524	7,853	29,788	7,387	35,326	10,033	38,639	14,065
Undistributed: Copper, pyrites, quartz (1948), stone (crushed sandstone, 1949, dimension sandstone, 1951), and minerals whose value must be concealed for particular years (indicated in appropriate column by footnote reference 2)		5,261		5,269		5,239		6,831
Total Tennessee		93,599		77,333		89,694		99,854
Clays sold or used for cement—thousand short tons	294	201	284	203	314	236	340	339
Coke—do	251	(9)	213	(9)	244	(9)	252	(9)
Ferroalloys—short tons	144,599	11,072	53,756	3,924	93,482	7,659	(9)	(9)

Abrasive stone: Pebbles, grinding—short tons	(2)	(2)	226	3	343	5	350	5
Cement—thousands of 376-pound barrels	13,787	30,353	14,742	33,409	17,282	39,678	17,643	42,649
Clays (including fuller's earth)[11]—thousand short tons	1,293	3,121	1,235	3,002	1,454	3,577	1,544	4,272
Coal (lignite)—do	57	58	49	50	18	30		
Copper (recoverable content of ores, etc.)—short tons	23	10	24	9	2	1	1	(3)
Fluorspar—do	906	(2)	1,770	(2)	719	(2)		
Gold (recoverable content of ores, etc.)—troy ounces	57	2	40	1	49	2	32	1
Gyspum (crude)—short tons	893,704	2,143	843,292	2,179	1,076,251	2,772	1,136,824	2,988
Helium (shipments, calendar years)—thousand cubic feet	50,915	610	51,501	689	80,889	1,028	82,690	1,060
Iron ore (usable)—thousand long tons, gross weight	746	(2)	569	(2)	1,189	(2)	1,053	(2)
Lead (recoverable content of ores, etc.)—short tons	170	61	132	42	129	35	43	15
Lime (open-market)—do	168,738	1,584	173,724	1,739	216,439	2,074	279,957	2,532
Natural gas—million cubic feet	2,289,923	103,505	2,588,921	118,832	3,126,402	146,941	3,781,136	204,181
Natural-gas liquids:								
Natural gasoline and cycle products—thousands of 42-gallon barrels	44,634	164,948	47,327	138,924	54,007	156,786	59,907	189,973
LP-gases—do	27,482	57,770	29,704	45,108	39,643	50,266	48,624	71,943
Peat—short tons	1,334	19	1,531	12	977	10	1,238	11
Petroleum (crude)—thousands of 42-gallon barrels	903,498	2,357,400	744,834	1,932,050	829,874	2,147,160	[4] 1,010,270	[4] 2,610,790
Salt (common)—thousand short tons	1,354	1,712	1,641	2,420	1,852	2,847	2,401	4,000
Sand and gravel—do	15,138	12,811	14,998	13,468	17,972	15,708	18,488	15,651
Silver (recoverable content of ores, etc.)—thousand troy ounces	3	3	3	2	2	2	1	1
Stone (except limestone for cement and lime)—thousand short tons	[5] 3,844	[5] 4,659	4,158	5,290	[5] 4,893	[5] 5,580	[5] 7,351	[5] 7,626
Sulfur (Frasch-process)—long tons	3,973,201	71,500	3,678,196	66,208	4,248,688	80,300	3,835,280	81,900
Zinc (recoverable content of ores, etc.)—short tons							24	9
Undistributed: Native asphalt, bromine, feldspar (1949–51), gem stones, graphite, magnesite (1949), magnesium chloride (for metal), magnesium compounds (except for metal, 1948–49), mercury (1951), pumice and pumicite, ground sand and sandstone (1948), ground soapstone, sodium sulfate, stone (basalt, 1948; crushed basalt and dimension granite, 1950–51), sulfur ore (1948), and minerals whose value must be concealed for particular years (indicated in appropriate column by footnote reference 2)		18,014		16,356		19,148		28,948
Total Texas		2,830,283		2,379,793		2,673,950		3,268,555
Clays sold or used for cement—thousand short tons	390	222	496	278	585	439	673	673
Coke—do	644	(9)	497	(9)	686	(9)	756	(9)
Magnesium metal—short tons	8,489	3,480	12,977	5,321	15,726	8,879	(9)	(9)

For footnotes, see end of table.

TABLE 5.—Mineral production in continental United States, 1948–51, by State and individual mineral—Continued

UTAH

Mineral	1948		1949		1950		1951	
	Quantity	Value (thousand dollars)	Quantity	Value (thousand dollars)	Quantity	Value (thousand dollars)	Quantity	Value (thousand dollars)
Asphalt and related bitumens, native: Gilsonite—short tons	52,122	1,391	51,462	1,304	66,186	1,774	65,521	1,895
Carbon dioxide, natural (estimated)—thousand cubic feet	156,000	62	94,000	38	104,334	42	97,436	10
Clays (except for cement)—thousand short tons	131	245	222	624	294	930	285	1,269
Fuller's earth—do	(2)	(2)						
Coal—do	6,813	31,062	6,160	29,357	6,670	32,050	6,136	32,653
Copper (recoverable content of ores, etc.)—short tons	227,007	98,521	197,245	77,715	278,630	115,910	271,086	131,206
Fluorspar—do	9,523	195	8,332	180	18,936	338	17,827	398
Gold (recoverable content of ores, etc.)—troy ounces	368,422	12,895	314,058	10,992	457,551	16,014	432,216	15,128
Iron ore (usable)—thousand long tons, gross weight	3,233	3,926	2,699	4,404	3,111	5,747	4,637	10,142
Lead (recoverable content of ores, etc.)—short tons	55,950	20,030	53,072	16,771	44,753	12,083	50,451	17,456
Lime (open-market)—do	40,635	353	36,082	356	49,419	457	(2)	(2)
Manganese ore (35 percent or more Mn)—short tons, gross weight					120	(2)		
Manganiferous ore (5 to 35 percent Mn)—do	2,694	(2)	4,981	40	3,041	(2)	1,369	(2)
Natural gas—million cubic feet	6,610	397	6,126	368	3,950	237	3,733	246
Natural gasoline—thousands of 42-gallon barrels	14	61	10	36	6	20	(2)	(2)
Perlite (crude)—short tons	414	2	731	3	2,585	13	3,422	16
Petroleum (crude)—thousands of 42-gallon barrels	16	(2)	637	(2)	1,228	(2)	4 1,305	(2)
Phosphate rock—thousand long tons	(2)	(2)			(2)	(2)	1	3
Pumice and pumicite—short tons	7,618	30	(2)	(2)	8,719	11	9,422	12
Salt (common)—thousand short tons	114	430	79	387	117	512	131	570
Sand and gravel—do	2,278	1,369	2,332	1,553	3,435	2,252	2,971	2,269
Silver (recoverable content of ores, etc.)—thousand troy ounces	8,045	7,281	6,725	6,086	7,084	6,411	7,311	6,617
Stone (except limestone for cement and lime)—thousand short tons	280	478	283	427	929	881	1,227	1,291
Tungsten concentrate—short tons, 60-percent WO_3 basis	3	(2)	1	(2)			(5)	1
Zinc (recoverable content of ores, etc.)—short tons	41,490	11,036	40,670	10,086	31,678	8,997	34,317	12,491
Undistributed: Native asphalt (bituminous sandstone), cement, diatomite (1950), gem stones (1948–49), gypsum, molybdenum, potassium salts, quartz crystal (1950), vanadium, and minerals whose value must be concealed for particular years (indicated in appropriate column by footnote reference 2)		14,695		17,098		25,277		23,471
Total Utah		204,459		177,825		229,956		257,144
Clays sold or used for cement—thousand short tons	37	28	30	22	9	7	9	9
Coke—do	1,247	(6)	1,035	(6)	1,226	(6)	1,328	(6)

VERMONT

Gold (recoverable content of ores, etc.)—troy ounces	104	4	120	4	146	5	156	5
Lime (open-market)—short tons	22,743	308	28,914	356	32,843	416	32,179	433
Sand and gravel—thousand short tons	732	619	1,582	729	1,041	662	966	647
Silver (recoverable content of ores, etc.)—thousand troy ounces	25	22	27	25	28	25	41	37
Slate—short tons	192,940	3,632	184,040	3,624	238,740	4,472	(2)	(2)
Stone (except limestone for lime)—thousand short tons	395	7,992	442	8,276	447	8,039	451	7,254
Talc—short tons	70,922	1,015	64,508	788	72,135	906	78,694	999
Undistributed: Asbestos, clays, copper, and minerals whose value must be concealed for particular years (indicated in appropriate column by footnote reference 2)		2,407		3,582		4,038		9,160
Total Vermont		15,999		17,384		18,563		18,535

VIRGINIA

Clays (except for cement)—thousand short tons	444	427	449	404	546	520	544	594
Coal—do	17,999	108,094	14,584	82,367	17,667	96,965	21,400	115,978
Feldspar (crude)—long tons	34,770	232	33,936	234	26,879	188	30,979	232
Iron ore (usable)—thousand long tons, gross weight	3	(2)	4	(2)	5	(2)	7	(2)
Lead (recoverable content of ores, etc.)—short tons	4,703	1,684	3,313	1,047	3,254	878	1,508	522
Lime (open-market)—do	382,734	3,271	349,132	3,214	428,339	3,862	452,680	4,552
Manganese ore (35 percent or more Mn)—short tons, gross weight	427	(2)	224	(2)	56	(2)		
Manganiferous ore (5 to 35 percent Mn)—do	2,462	(2)	1,279	(2)				
Marl, calcareous (except for cement)—short tons	53,597	65	62,482	117	52,181	54	(2)	(2)
Natural gas—million cubic feet	74	7	65	5	46	4	64	10
Petroleum (crude)—thousands of 42-gallon barrels	33	(2)	43	(2)	21	(2)	4 12	(2)
Sand and gravel—thousand short tons	4,099	3,838	4,413	4,049	4,374	4,145	5,773	5,750
Stone (except limestone for cement and lime)—do	7,367	12,157	7,510	12,443	9,273	16,435	9,277	16,621
Zinc (recoverable content of ores, etc.)—short tons	15,882	4,225	13,166	3,265	12,396	3,520	7,332	2,669
Undistributed: Abrasive stone (millstones 1948–50), aplite, cement, gypsum, kyanite, mica (1949–51), phosphate rock (1949), pyrites, salt, ground sand and sandstone, slate, talc and ground soapstone, titanium concentrate, and minerals whose value must be concealed for particular years (indicated in appropriate column by footnote reference 2)		9,333		9,263		11,235		14,323
Total Virginia		143,333		116,408		137,806		161,251
Clays sold or used for cement—thousand short tons	74	44	92	52	135	102	231	231
Coke—do	201	2,887	158	2,300	198	2,931	287	4,454

For footnotes, see end of table.

302512—64——6

TABLE 5.—Mineral production in continental United States, 1948–51, by State and individual mineral—Continued

WASHINGTON

Mineral	1948		1949		1950		1951	
	Quantity	Value (thousand dollars)	Quantity	Value (thousand dollars)	Quantity	Value (thousand dollars)	Quantity	Value (thousand dollars)
Abrasive stone:								
Pebbles (grinding) ---------- short tons	(2)	(2)	20	(3)	25	(3)	28	(3)
Pulpstones ---------- do	33	2	28	2	33	2	22	2
Antimony ore and concentrate ---------- short tons, gross weight			14	1			110	(2)
Carbon dioxide, natural (estimated) ---------- thousand cubic feet	(19)	50	(19)	50	(2)	(2)	(2)	(2)
Cement ---------- thousands of 376-pound barrels	(2)	(2)	(2)	(2)	(2)	(2)	5,371	15,984
Clays (except for cement) ---------- thousand short tons	234	262	220	267	217	252	205	286
Coal ---------- do	1,220	7,892	899	6,029	874	5,829	857	6,031
Copper (recoverable content of ores, etc.) ---------- short tons	5,665	2,459	5,275	2,078	5,057	2,104	4,089	1,979
Gold (recoverable content of ores, etc.) ---------- troy ounces	70,075	2,453	71,994	2,520	92,117	3,224	67,405	2,359
Iron ore (usable) ---------- thousand long tons, gross weight	5	(2)						
Lead (recoverable content of ores, etc.) ---------- short tons	7,147	2,559	6,417	2,628	10,334	2,790	8,002	2,769
Olivine ---------- do	840	(2)	1,070	(2)	40	(2)	(2)	(2)
Peat ---------- do	(2)	(2)	(2)	(2)			45,304	99
Pumice and pumicite ---------- do	26,675	48	8,610	18	11,013	23	5,105	11
Sand and gravel ---------- thousand short tons	9,267	6,657	9,216	6,391	10,606	7,435	10,547	7,596
Sand and sandstone (ground) ---------- short tons	6,682	34	(2)	(2)	(2)	(2)	(2)	(2)
Silver (recoverable content of ores, etc.) ---------- thousand troy ounces	376	340	358	324	364	329	335	303
Stone (except limestone for cement and lime) ---------- thousand short tons	5,230	6,382	[8] 3,689	[8] 4,106	4,931	5,735	5,030	5,664
Tungsten concentrate ---------- short tons, 60-percent WO_3 basis							9	33
Zinc (recoverable content of ores, etc.) ---------- short tons	12,638	3,362	10,740	2,664	14,807	4,205	18,189	6,621
Undistributed: Diatomite (1948–50), epsom salts made from epsomite (1949–51), gem stones, gypsum (1950–51), lime, magnesite, quartz, ground sand and sandstone (1951), stone (dimension, unclassified, 1949), talc, and minerals whose value must be concealed for particular years (indicated in appropriate column by footnote reference 2) ----------		16,428		14,385		17,127		4,815
Total Washington ----------		48,928		40,863		49,055		54,552
Aluminum ---------- short tons	232,067	67,411	238,812	76,164	267,107	87,812	285,855	103,542
Clays sold or used for cement ---------- thousand short tons	57	32	59	35	67	50	81	81

WEST VIRGINIA

Clays (except for cement)	thousand short tons	539	938	478	759	570	925	993	2, 184
Coal	do	168, 862	933, 606	122, 611	649, 697	144, 116	754, 370	163, 310	853, 894
Lime (open-market)	short tons	490, 803	4, 610	350, 311	3, 535	(2)	(2)	(2)	(2)
Natural gas	million cubic feet	203, 681	34, 035	181, 176	29, 296	189, 980	31, 917	191, 146	35, 553
Natural-gas liquids:									
Natural gasoline	thousands of 42-gallon barrels	1, 228	4, 866	997	2, 945	1, 048	2, 899	1, 107	3, 337
LP-gases	do	2, 409	3, 675	2, 763	3, 591	3, 575	4, 195	3, 844	5, 568
Petroleum (crude)	do	2, 692	12, 810	2, 839	8, 770	2, 808	9, 350	[4] 2, 757	[4] 10, 370
Salt (common)	thousand short tons	247	1, 198	356	1, 289	368	1, 239	379	1, 315
Sand and gravel	do	3, 974	6, 307	[7] 3, 285	[7] 5, 491	3, 613	6, 241	4, 735	8, 314
Stone (except limestone for cement and lime)	do	4, 930	5, 803	4, 855	6, 960	[8] 5, 368	[8] 7, 826	5, 754	[8] 8, 473
Undistributed: Abrasive stones, bromine, calcium-magnesium chloride, cement, calcareous marl, sand and gravel (noncommercial, 1949), ground sand and sandstone, stone (dimension limestone, 1950–51), and minerals whose value must be concealed for particular years (indicated in appropriate column by footnote reference 2)			4, 554		5, 786		10, 662		12, 715
Total West Virginia			1, 012, 402		718, 119		829, 624		941, 723
Clays sold or used for cement	thousand short tons	52	39	77	58	105	79	111	111
Coke	do	3, 651	37, 892	3, 360	36, 906	3, 691	40, 765	4, 262	50, 824

WISCONSIN

Abrasive stone: Pebbles, grinding	short tons	(2)	(2)	(2)	(2)	530	11	1, 327	26
Clays (except for cement)	thousand short tons	84	68	80	65	80	70	48	48
Iron ore (usable)	thousand long tons, gross weight	1, 469	(2)	1, 406	(2)	1, 702	(2)	1, 745	(2)
Lead (recoverable content of ores, etc.)	short tons	861	308	857	271	532	144	1, 391	481
Lime (open-market)	do	107, 648	1, 229	107, 339	1, 255	124, 530	1, 448	124, 852	1, 562
Marl, calcareous (except for cement)	do	10, 293	7	18, 533	10	22, 025	14	20, 625	13
Peat	do	(2)	(2)	(2)	(2)	2, 293	9	(2)	(2)
Sand and gravel	thousand short tons	18, 613	11, 370	17, 023	10, 457	19, 117	11, 959	19, 392	12, 392
Stone (except limestone for cement and lime)	do	[8] 7, 224	[8] 12, 581	7, 327	13. 636	7, 000	14, 495	7, 609	14, 672
Zinc (recoverable content of ores, etc.)	short tons	7, 864	2, 092	5, 295	1, 313	5, 722	1, 625	15, 754	5, 734
Undistributed: Abrasive stone (tube-mill liners), cement, pyrites (1948), quartz (1948–49 and 1951), ground sand and sandstone, stone (basalt, 1948), and minerals whose value must be concealed for particular years (indicated in appropriate column by footnote reference 2)			9, 453		8, 871		11, 918		13, 420
Total Wisconsin			37, 108		35, 878		41, 693		48, 348
Clays sold or used for cement	thousand short tons	71	46	79	51	82	62	94	94

For footnotes, see end of table.

TABLE 5.—Mineral production in continental United States, 1948–51, by State and individual mineral—Continued

WYOMING

Mineral	1948		1949		1950		1951	
	Quantity	Value (thousand dollars)	Quantity	Value (thousand dollars)	Quantity	Value (thousand dollars)	Quantity	Value (thousand dollars)
Clays (except for cement)—thousand short tons	401	3,692	370	3,567	413	4,102	483	5,995
Coal—do	6,412	23,985	6,001	22,972	6,348	24,049	6,430	26,938
Feldspar (crude)—long tons	16,760	78	[2]	[2]				
Gem stones (estimated)	[15]	[2]	[15]	20	[15]	[2]	[15]	[2]
Gold (recoverable content of ores, etc.)—troy ounces	115	4	389	14			9	[3]
Iron ore (usable)—thousand long tons, gross weight	690	[2]	540	[2]	492	[2]	617	[2]
Natural gas—million cubic feet	52,424	3,119	50,815	2,820	62,062	3,724	71,508	5,363
Natural-gas liquids:								
Natural gasoline—thousands of 42-gallon barrels	854	3,813	926	3,248	1,058	3,382	1,176	3,511
LP-gases—do	584	1,548	379	842	493	934	784	1,634
Petroleum (crude)—do	55,032	128,230	47,890	109,190	61,631	133,120	[4] 68,929	[4] 148,200
Phosphate rock—thousand long tons	139	695	[2]	[2]	[2]	[2]	179	1,186
Pumice—short tons					1,460	6	1,867	9
Sand and gravel—thousand short tons	2,022	1,508	2,352	1,913	1,938	1,251	2,347	1,731
Silver (recoverable content of ores, etc.)—thousand troy ounces	[12]	[3]	[12]	[3]			[12]	[3]
Stone (except limestone for cement)—thousand short tons	964	1,266	1,803	2,227	1,841	2,214	1,646	1,857
Sulfur ore for direct agricultural use—long tons			3,112	57	[2]	[2]	[2]	[2]
Undistributed: Cement, gypsum, sodium carbonate and sulfate, vermiculite (1948 and 1950–51), and minerals whose value must be concealed for particular years (indicated in appropriate column by footnote reference 2)		4,066		4,128		4,795		5,410
Total Wyoming		172,004		150,998		177,577		201,834

[1] Excludes puzzolan cement, value for which is included with "Undistributed."
[2] Value included with "Undistributed."
[3] Less than $500.
[4] Final figure. Supersedes preliminary figure given in commodity chapter.
[5] Less than 0.5 ton.
[6] Sales in 1948 included with 1949.
[7] "Commercial." Value of "Noncommercial" included with "Undistributed."
[8] Excludes certain stone, value for which is included with "Undistributed."
[9] Figure withheld to avoid disclosure of individual company operations.
[10] Revised figure.
[11] Except clays sold or used for cement.
[12] Less than 500 troy ounces.
[13] Excludes natural cement, value for which is included with "Undistributed."
[14] Columbite and tantalite production not differentiated; value included with "Undistributed."
[15] Weight not recorded.
[16] "Noncommercial." Value of "Commercial" included with "Undistributed."
[17] Value reported for zinc in New Jersey is estimated smelting value of recoverable zinc content of ore after freight, haulage, smelting, and manufacturing charges are added.
[18] Less than 500 barrels.
[19] Quantity not available.

TABLE 6.—Mineral production in Territories of the United States, 1948–51, by individual mineral

Territory and mineral	1948		1949		1950		1951	
	Quantity	Value (thousand dollars)	Quantity	Value (thousand dollars)	Quantity	Value (thousand dollars)	Quantity	Value (thousand dollars)
Alaska:								
Antimony ore and concentrate—short tons, gross weight	68	29	74	31			301	(1)
Coal—thousand short tons	408	2,789	434	3,309	412	3,033	494	3,767
Copper (recoverable content of ores, etc.)—short tons	16	7	4	2	6	2	1	(2)
Gold (recoverable content of ores, etc.)—troy ounces	248,395	8,694	229,416	8,030	289,272	10,125	239,637	8,388
Lead (recoverable content of ores, etc.)—short tons	329	118	51	16	149	40	21	7
Mercury—76-pound flasks	100	8	100	8				
Sand and gravel—thousand short tons	(1)	(1)	(1)	(1)	3,050	2,377	6,888	3,739
Silver (recoverable content of ores, etc.)—thousand troy ounces	67	61	36	33	53	48	33	30
Stone—thousand short tons	41	54	(1)	(1)	(1)	(1)	(1)	(1)
Tin (content of ore and concentrate)—long tons	5	(1)	51	115	79	170	69	197
Tungsten concentrate—short tons, 60-percent WO_3 basis					13	(1)	10	(1)
Zinc (recoverable content of ores, etc.)—short tons	22	6	2	(2)	6	2	1	(2)
Undistributed: Clays (1948), platinum-group metals (crude), pumice (1948 and 1951), and minerals whose value must be concealed for particular years (indicated in appropriate column by footnote reference 1)		1,258		4,005		2,055		3,441
Total Alaska		13,024		15,549		17,852		19,569
Hawaii:								
Lime (open-market)—short tons	8,767	237	8,404	227	8,141	220	8,740	236
Sand and gravel—thousand short tons	(1)	(1)					3	5
Stone—do	[3] 838	[3] 1,917	[3] 654	[3] 718	696	1,555	[3] 650	[3] 1,338
Undistributed: Other nonmetallic minerals		17		43				147
Total Hawaii		2,171		988		1,775		1,726
Total Territories		15,195		16,537		19,627		21,295

[1] Value included with "Undistributed."
[2] Less than $500.
[3] Excludes certain stone value for which is included with "Undistributed."

TABLE 7.—Mineral production in possessions and other areas administered by the United States, 1948–51, by individual mineral

Area and mineral	1948		1949		1950		1951	
	Quantity	Value (thousand dollars)	Quantity	Value (thousand dollars)	Quantity	Value (thousand dollars)	Quantity	Value (thousand dollars)
Canal Zone:								
Sand and gravel [1 2] thousand short tons	55	[3] 82	39	[3] 58	22	15	32	26
Stone (crushed) [1 2] do	179	[3] 268	109	[3] 164	53	83	60	112
Total Canal Zone		350		222		98		138
Guam: Stone [1 4] thousand short tons	1,537	3,073	2,605	5,209	[2] 1,528	[2 3] 3,055	720	[3] 1,440
Puerto Rico:								
Cement thousands of 376-pound barrels	2,440	6,947	2,171	6,109	3,187	8,299	4,298	11,252
Iron ore (usable) thousand long tons, gross weight							39	226
Lime (open-market) short tons	([5])	([5])	7,347	184	8,166	181	10,350	192
Salt (common) thousand short tons	15	112	13	77	14	137	11	119
Sand and gravel do	([5])	([5])	([5])	([5])	101	104	100	100
Stone do	[6] 159	[6] 312	[6] 520	[6] 827	[6] 250	[6] 575	284	614
Undistributed: Other nonmetallic minerals and minerals whose value must be concealed for particular years (indicated in appropriate column by footnote reference 5)		280		139		1		
Total Puerto Rico		7,651		7,336		9,297		12,503
Trust Territory of the Pacific Islands (Angaur Island):								
Phosphate rock (exports) thousand long tons	76	380	155	747	[2] 135	[2] 672	[2] 144	[2] 742
Virgin Islands: Stone (crushed) [1 2] thousand short tons	[7] 9	[3 7] 14	[7] 10	[3 7] 16	[7] 3	[3 7] 4	11	32
Total		11,468		13,530		13,126		14,855

[1] Quantities are estimated short-ton equivalents of cubic yards reported.
[2] Data for fiscal years ended June 30.
[3] Estimate.
[4] Distribution by years estimated for 1948–49 from reported totals and a partial breakdown.
[5] Value included with "Undistributed."
[6] Excludes certain stone value for which is included with "Undistributed."
[7] St. Croix Island only. Data for St. Thomas Island not available.

FOREIGN TRADE

TABLE 8.—Value of minerals and mineral products imported and exported by the United States, 1949–51, by commodity group and commodity, in thousands of dollars [1]

[U. S. Department of Commerce]

SITC No.	Group and commodity	Imports for consumption [2]			Domestic exports [3]		
		1949	1950	1951	1949	1950	1951
	CRUDE NONMETALLIC MINERALS (EXCEPT FUELS)						
	Fertilizer materials:						
271-02	Sodium nitrate	26,006	22,302	27,025			
271-03	Phosphates, crude	822	1,114	1,380	11,405	14,874	14,750
271-04	Potash salts, crude				672	646	579
	Total fertilizer materials	26,828	23,416	28,405	12,077	15,520	15,329
272-01	Asphalt, natural	88	136	112	823	911	1,278
272-02	Sand, including ground quartz	298	292	409			
272-03	Gravel and crushed stone	27	31	33			
272-04	China clay or kaolin	1,157	1,619	1,581	363	509	671
	Other clays	324	382	440	4,433	4,489	6,773
272-05	Salt	61	59	47	3,353	1,776	3,617
272-06	Sulfur	6	6	158	32,173	33,200	33,593
272-07	Abrasives, natural (including industrial diamonds): [4]						
	Diamond bort	17,335	35,012	45,824	2,404	2,493	3,176
	Other	760	787	1,542			
272-08	Building and dimension stone, crude	939	919	1,252	523	379	585
272-11	Plaster rock and gypsum, crude and ground	2,708	3,272	3,564	423	525	609
	Other stone for industrial purposes, including limestone	595	755	1,153			
272-12	Asbestos, crude, washed or ground:						
	Chrysotile, crude	6,742	5,968	6,620	1,742	1,682	479
	Blue crocidolite, crude						
	Amosite, crude						
	Fiber	14,476	21,232	28,843	1,877	1,965	2,738
	Other under 15 percent foreign material	12,722	20,042	23,058			
	Total asbestos	33,940	47,242	58,521	3,619	3,647	3,217
272-13	Mica, unmanufactured (including scrap):						
	Mica waste	22	59	93	43	99	94
	Phlogopite mica, untrimmed and block	97	52	74			
	Muscovite block	1,477	2,035	2,814			
	Mica films, not cut or stamped to dimensions	733	1,562	3,343			
	Mica splittings, not cut or stamped to dimensions	16,177	18,337	14,039			
	Other	680	1,389	1,735			
	Total mica	19,186	23,434	22,098	43	99	94
272-14	Feldspar	108	84	147			
	Fluorspar	1,549	2,580	4,110	39	33	67
	Cryolite	1,312	978	2,190	78	405	317
272-15	Magnesite, crude		[5]		1,231	831	2,348
272-16	Graphite, natural:						
	Amorphous, natural	954	1,335	1,561	67	86	76
	Crystalline, flake	277	725	1,413	91	87	120
	Other	27	8	29			
	Total graphite	1,258	2,068	3,003	158	173	196
272-19	Other nonmetallic minerals (except fuels):						
	Brazilian pebble, unmanufactured	1,462	763	2,089	5	3	16
	Kyanite, sillimanite, etc	325	588	808	47	36	44
	Talc, steatite or soapstone, and French chalk	577	692	694	440	561	645
	Other	1,774	3,279	3,895			
	Total crude nonmetallic minerals (except fuels)	112,617	148,394	182,075	62,232	65,590	72,575

For footnotes, see end of table.

TABLE 8.—Value of minerals and mineral products imported and exported by the United States, 1949–51, by commodity group and commodity, in thousands of dollars [1]—Continued

SITC No.	Group and commodity	Imports for consumption [2]			Domestic exports [3]		
		1949	1950	1951	1949	1950	1951
	CRUDE METALLIC MINERALS [6]						
281–01	Iron ore (including concentrates)	36,735	43,764	59,662	14,654	15,717	30,622
282–01	Iron and steel scrap	29,938	18,488	15,020	7,343	6,014	9,094
	Nonferrous base metal ores, concentrates, and scrap:						
283–01	Copper	49,305	36,695	48,712	79	223	174
283–04	Lead	34,526	21,178	8,657	330	31	171
283–05	Zinc	16,008	25,351	35,223	478	265	793
283–03	Bauxite and other aluminum ores and concentrates	16,353	15,719	17,863	513	1,156	2,168
283–06	Tin	78,176	47,224	82,425			
283–07	Manganese	26,798	42,267	46,583	354	458	466
283–02	Nickel	4,598	7,610	5,561	4	2	2
283–08	Chromium	24,200	23,214	25,506	74	63	144
283–11	Tungsten	6,390	15,013	17,440	85	16	
283–19	Beryl	858	1,182	1,367	2	1	1
	Ilmenite	2,479	1,199	1,323	143	57	63
	Rutile	180	150	491			
	Columbium ore or concentrate	562	753	1,349	12	49	
	Antimony	2,488	1,841	4,622	11	1	5
	Cobalt ore and concentrates	2,011	2,062	2,707		(5)	
	Molybdenum			3	4,624	5,454	3,735
	Other base metal ores and concentrates	1,155	1,583	1,563	1,248	66	102
284–01	Aluminum scrap	10,543	14,150	6,377	51	93	179
	Old and scrap copper	2,437	13,036	5,291	2,976	3,268	3,834
	Old brass and bronze and clippings	5,542	8,121	2,096	4,674	2,654	2,091
	Lead reclaimed, scrap, etc	4,004	4,004	2,105	192	183	142
	Tin scrap, dross, skimming, residues	24	153	67	2,122	740	2,215
	Zinc scrap, dross, skimming	559	677	284	486	861	1,272
	Cadmium flue dust	1,596	1,433	2,261	(5)		10
	Nickel alloys and scrap				2,882	2,806	4,783
	Other nonferrous scrap	285	261	1,599			
285–02	Platinum-group metals	6,247	9,105	13,535	2	(5)	118
	Total crude metallic minerals	363,997	356,233	409,692	43,339	40,178	62,184
	FUELS AND RELATED MATERIALS						
	Coal and coke:						
311–01	Coal (including lignite):						
	Bituminous coal and shale	1,700	1,542	1,286	232,393	206,545	496,944
	Lignite, slack and culm	668	827	733			
	Anthracite		255	394	64,786	62,502	89,112
	Total	2,368	2,624	2,413	297,179	269,047	586,056
311–02	Coke	3,976	5,297	1,932	8,323	6,159	17,715
311–03	Briquets	3	2	1	2,438	2,617	2,390
	Total coal and coke	6,347	7,923	4,346	307,940	277,823	606,161
312–01	Petroleum, crude: [7]						
	Gasoline, natural				17,465	3,581	6,964
	Crude petroleum	340,658	367,024	375,188	98,425	102,717	81,767
	Oil unfinished for further processing	3,091	8,226	4,713	102	445	1,056
	Crude oil topped	4,359	4,114	5,583		9	
	Total petroleum crude	348,108	379,364	385,484	115,992	106,752	89,787
	Petroleum products:						
313–01	Motor fuel:						
	Aviation, under 100 octane				5,491	1,545	8,128
	Aviation, 100 octane and over	146	1,089	2,400	47,820	32,290	65,952
	Other				99,557	62,104	103,450
	Total	146	1,089	2,400	152,868	[8]95,939	177,530
313–02	Kerosine	(5)	740	1	7,001	5,375	24,479

For footnotes, see end of table.

TABLE 8.—Value of minerals and mineral products imported and exported by the United States, 1949–51, by commodity group and commodity, in thousands of dollars [1]—Continued

SITC No.	Group and commodity	Imports for consumption [2]			Domestic exports [3]		
		1949	1950	1951	1949	1950	1951
	FUELS AND RELATED MATERIALS—continued						
	Petroleum products—Con.						
313-03	Gas oil, diesel oil, and other fuel oils:						
	Gas oil (inc. Diesel) and distillate fuel oil	2,991	4,144	6,743	33,183	33,178	71,063
	Gas oil for vessels and aircraft	1,709	1,992	1,544			
	Fuel oil, residual	81,722	161,084	148,140	14,102	18,111	47,841
	Fuel oil, residual, for vessels and aircraft	40,472	36,423	51,637			
	Total	126,894	203,643	208,064	47,285	51,289	118,904
313-04	Lubricating oils and greases	5	14	8	180,318	184,124	280,202
313-05	Mineral jelly and waxes (including petrolatum)	330	496	1,184	22,985	24,475	37,278
313-09	Other [9]	2,929	5,135	8,496	30,518	24,037	44,635
	Total petroleum products	130,304	211,117	220,153	440,975	385,239	683,028
314-01	Natural gas			(5)	1,986	2,323	2,264
	Coal, oil, and gas chemicals:						
521-01	Mineral tar	3	144	88	1,756	739	1,080
521-02	Tar oils and other crude chemicals from coal, petroleum, or natural gas:						
	Dead or creosote oil	5,493	6,413	8,143	175	80	104
	Benzene or benzol	643	6,570	25,115	299	254	113
	Other	3,183	4,953	9,774	1,590	963	2,583
	Total	9,319	17,936	43,032	2,064	1,297	2,800
	Total fuels and related materials	494,081	616,484	653,103	870,713	774,173	1,385,120
	NONMETALLIC MINERAL MANUFACTURES (EXCEPT CHEMICALS)						
	Building materials (other than clay and glass):						
661-01	Lime	581	548	577	937	826	1,158
661-02	Cement	336	3,614	3,198	15,961	7,275	9,964
661-03	Building and dimension stone (worked)	435	903	1,648	437	338	271
	Other (except glassware and pottery): [10]						
663-01	Grinding and polishing wheels and stones	70	149	335	4,570	4,252	6,544
663-02	Abrasive cloths and papers and similar articles	88	193	141	3,880	4,065	8,257
663-03	Asbestos manufactures (except building materials)	36	63	58	6,285	6,137	11,340
663-04	Mica manufactures [11]	131	224	416	634	761	1,008
663-05	Carbon and graphite products, except crucibles [12]	314	546	753	8,279	6,597	8,160
663-06	Other nonmetallic minerals, worked or manufactured (except ceramics)	379	652	931	11,330	11,312	14,303
663-07	Refractory products other than construction materials [13]	10	8	10	2,768	3,002	4,510
663-09	Other ceramics (except glassware and pottery)	34	282	379	578	560	609
	Total "Other"	1,062	2,117	3,023	38,324	36,686	54,731
	Total nonmetallic mineral manufactures (except chemicals)	2,414	7,182	8,446	55,659	45,125	66,124

For footnotes, see end of table.

TABLE 8.—Value of minerals and mineral products imported and exported by the United States, 1949–51, by commodity group and commodity, in thousands of dollars [1]—Continued

SITC No.	Group and commodity	Imports for consumption [2]			Domestic exports [3]		
		1949	1950	1951	1949	1950	1951
	PLATINUM, GEMS, AND JEWELRY						
671-02	Platinum-group metals, crude and partly wrought:						
	Platinum, bar, ingot, sheet, etc.[14]	2,306	8,020	14,320	1,380	994	835
	Palladium	1,593	2,863	4,796			
	Rhodium	873	1,413	2,196			
	Ruthenium	210	433	442	1,742	1,506	2,007
	Other	626	1,201	1,011			
	Total platinum-group metals	5,608	13,930	22,765	3,122	2,500	2,842
	Gem stones: [15]						
672-01	Precious and semiprecious stones uncut:						
	Diamonds, rough or uncut	28,247	44,776	48,705	139	90	29
	Other	493	497	247	(16)	(16)	(16)
	Total	28,740	45,273	48,952	139	90	29
672-02	Precious and semiprecious stones cut but not set:						
	Diamonds	41,428	58,525	61,858	835	1,951	1,920
	Other	3,181	3,615	3,928	479	585	365
	Total	44,609	62,140	65,786	1,314	2,536	2,285
673-01	Jewelry and precious or semiprecious materials	553	988	1,598	23,944	12,063	13,931
	Total platinum, gems, and jewelry	79,510	122,331	139,101	28,519	17,189	19,087
	METALS (UNWROUGHT)[17]						
	Iron and steel:						
681-01	Pig iron and sponge iron	5,012	26,806	51,086	3,354	322	352
681-02	Ferroalloys:						
	Ferromanganese	11,305	16,027	20,106	1,360	140	207
	Ferrochromium	1,280	4,530	6,123	943	134	97
	Ferrosilicon	255	798	2,533	436	242	388
	Ferrotungsten	31	1,079	3,535	861	409	1,007
	Other	108	668	355	1,440	2,076	3,876
	Total	12,979	23,102	32,652	5,040	3,001	5,575
682-01	Copper:						
	Unrefined copper	55,488	53,252	88,508	(18)	(18)	(18)
	Other	1,168	1,441	68	348	203	1,299
	Total copper	56,656	54,693	88,576	348	203	1,299
685-01	Lead	83,239	110,707	68,996	835	1,311	1,233
686-01	Zinc	29,345	38,822	31,163	18,819	4,034	15,984
684-01	Aluminum	21,569	48,367	41,395	3,170	259	433
687-01	Tin (including solder)	134,108	155,324	75,099	177	595	763
683-01	Nickel	54,816	58,761	81,534	960	414	377
689-01	Cobalt metal	8,999	11,131	16,792	56	82	64
	Mercury (or quicksilver)	6,762	2,694	6,586	54	38	58
	Antimony as needle, regulus or metal	1,285	2,213	1,786	337	86	146
	Bismuth	834	1,287	1,003	357	387	376
	Cadmium	303	1,590	344	1,270	806	2,208
	Cerium	1	3	5	261	213	374
	Other metals and alloys	1,811	4,148	6,585	2,819	2,089	4,111
	Total metals	417,719	539,648	503,602	37,857	13,840	33,353
	Grand total, mineral and mineral products	1,470,338	1,790,272	1,896,019	1,098,319	956,095	1,638,443

For footnotes, see page 81.

[1] The grouping of commodities is based upon the Standard International Trade Classification (United Nations) and a tentative conversion by the Bureau of the Census of United States import and export classifications to SITC categories. Data were compiled by the Office of Chief Economist, Bureau of Mines, from copies of unpublished tabulations on the foregoing basis supplied to the United Nations by the Bureau of the Census. As could be expected, individual commodities and groupings shown or omitted will not in all cases be in accordance with usual Bureau of Mines practice as followed in individual commodity chapters of this Minerals Yearbook. In some few cases, values for the same commodity will differ from those in the corresponding chapter because of reclassifications, exclusions or other reasons usually explained by footnotes in the chapter.

[2] Includes items entered for direct consumption, items withdrawn from bonded warehouse for consumption, and ores, etc., smelted and refined under bond at the time the refined product is withdrawn either for domestic consumption or for export.

[3] Includes both products mined in the United States and foreign mineral products which have been smelted, refined, manufactured, or otherwise processed in the United States.

[4] Does not duplicate items included in 672–01.

[5] Less than $500.

[6] Exclusive of silver and gold.

[7] Including natural gasoline and unfinished oils for further refining.

[8] This figure is about $4 million too low because of unrecorded omissions of certain classes of aviation gasoline.

[9] Pitch resin petroleum, asphalt, petroleum coke. Also includes miscellaneous byproducts of coal, lignite, petroleum, and oil shale, except chemicals.

[10] Includes no gypsum products.

[11] Builtup mica products and articles made from sheet mica and builtup mica.

[12] Includes lighting carbons, electrodes, carbon brushes, and brush stock and battery carbons.

[13] Includes retorts, crucibles, mufflers, nozzles, plugs, supports, tubes, pipes, sheets and rods.

[14] Does not include platinum allied metals and alloys.

[15] Does not duplicate items included in 272–07.

[16] Included in "cut but not set, other."

[17] Includes alloys.

[18] Not separately recorded. Included in 283–01 (*see* Crude metallic minerals).

Employment and Injuries in the Mineral Industries[1]

By Seth T. Reese

GENERAL SUMMARY

THE AVERAGE number of men working daily in the mineral industries declined 2 percent in 1951 to 702,715. However, mineral plants were active an average of 239 days, 18 more than in 1950. This increased plant activity produced a 5-percent gain in the total man-hours worked. The average employee in the industries in 1951 worked a 7.90-hour shift, unchanged from 1950. The average hours of work during the year at mineral plants was 1,889, or 139 more than during 1950. Increased average plant activity in 1951 was noted in each of the major branches of the mineral industries, except at metallurgical plants. The greatest increase in operations was in the coal industry, in which work stoppages were not as extensive as in 1950. There were slight increases in operating activity at metal and nonmetal mines, quarries, and coke plants.

The injury experience at operations in the mineral industries improved only slightly in 1951. A total of 974 fatalities, 131 more than in 1950, occurred at a frequency of 0.73 per million man-hour of exposure. This represented a 9-percent increase from the corresponding rate in 1950. An estimated total of 54,538 nonfatal injuries occurred at the rate of 41.09 per million man-hours in 1951. Although this was an increase of over 2 percent in number of injuries, the rate of occurrence was nearly 3 percent lower than the corresponding rate in 1950, due entirely to the 5-percent gain in total man-hours of worktime.

There were 5 major disasters (a single accident in which 5 or more men are killed) in the mineral industries during 1951. Four of them occurred at bituminous-coal mines and caused a loss of 152 men. The other disaster, at an anthracite mine, killed 5 men. This record of disasters was the worst since 1947 when, in 6 disasters, 179 men lost their lives. In 1951, 119 men were killed by an explosion in the Orient No. 2 mine at West Frankfort, Ill. This loss of life was larger than in the Centralia-mine explosion in the same State in 1947 and the most severe disaster since 1928, when an explosion at the Mather mine in western Pennsylvania killed 195 men.

Fatality experience improved at nonmetal mines, coke plants, and metallurgical plants. Not only were there substantial improvements in the rates, but also the number of fatalities was reduced appreciably. However, in the coal industry, at metal mines, and at quarries more men were killed and the rates of injury occurrence were higher in 1951 than in 1950.

The rates of nonfatal-injury frequency were better than in 1950 in the coal and metal industries, although the number of lost-time injuries increased. This was possible because of the increased man-

[1] Data on the oil and gas industries are treated separately in the last section of this chapter. Data on sand and gravel and clay industries and on iron-smelting and steel industries are excluded from this chapter.

hours of worktime. At coke plants the number of injuries and the rate of frequency were less than in the previous year. At nonmetal mines, quarries, and metallurgical plants increases in number of injuries were accompanied by increases in rates of frequency.

Work Stoppages.—According to the Bureau of Labor Statistics there were 650 work stoppages in the mineral industries during 1951. Of these, 549 at bituminous-coal mines caused a loss of 887,000 man-days, 30 at anthracite mines resulted in a loss of 81,000 man-days, 24 at nonmetal mines and quarries caused a loss of 53,000 man-days, and 23 at metal mines caused a loss of 269,000 man-days. The 12 stoppages at cement mills, 8 at petroleum refineries, and 4 at coke plants caused an additional loss of 60,000 man-days. Although there were 119 more work stoppages among the mineral industries in 1951 than in 1950 they lasted a shorter time. The total of 1,350,000 man-days of work idleness in the minerals industries in 1951 was one-eighth of the total loss caused by work stoppages in 1950.

Average Earnings.—Average hourly and weekly earnings increased in each of the mineral industries for which data are published by the Bureau of Labor Statistics, as shown in table 2.

Labor Turn-Over.—Labor turn-over in the mineral industries for which data were published by the Bureau of Labor Statistics followed the same pattern in 1951 as in 1950, with the highest in metal mining and the lowest in petroleum refining. The separation rates were lower than the accession rates in 1951 in each of the mineral industries, except anthracite and bituminous-coal mining. The accession rates in the anthracite industry and the separation rates in the petroleum-refining industry remained unchanged during 1950 and 1951.

NATIONAL SAFETY COMPETITION

Safety competitions, sponsored and conducted annually by the Bureau of Mines, have proved effective in promoting accident-prevention work in the minerals industry of the country. An encouraging number of the 751 mineral plants enrolled in the National Safety Competition and the National Sand and Gravel Safety Competition made outstanding safety records in 1951. Of the operations enrolled in these 2 contests, 228 (30 percent) attained injury-free records. Aggregate worktime at these injury-free plants was almost 22 million man-hours. In addition, the Bureau of Mines conducts four other competitions sponsored annually by National associations connected with the minerals industry. These associations are: National Sand and Gravel, National Lime, National Slag, and National Crushed Stone. In these contests of the 256 plants enrolled in 1951, 82 (32 percent) had injury-free records during an aggregate worktime of about 7 million man-hours.

Trophy awards for the best safety records in each of the six groups of the National Safety Competition were made to the following:

Anthracite Underground Mines.—No. 5 Hill mine, Ploskonka Coal Co., Archbald, Pa.

Bituminous-Coal Underground Mines.—Reliance No. 7 mine, Union Pacific Coal Co., Reliance, Wyo.

Metal Underground Mines.—Soudan underground mines, Oliver Iron Division of United States Steel Co., Soudan, Minn.

Nonmetal Underground Mines.—Retsof mine, International Salt Co., Inc., Retsof, N. Y.

Open-Pit Mines.—Mountain Iron open-pit mine, Oliver Iron Mining Division of United States Steel Co., Mountain Iron, Minn.

Quarries.—Port Inland quarry, Inland Lime & Stone Co., Gulliver, Mich.

TABLE 1.—Salient statistics of employment and injury experience in mineral industries in the United States, 1947–51, by industry group

	1947	1948	1949	1950	1951 [1]
Average number of men working daily: [2]					
Coal mines	490,356	507,333	485,306	483,239	453,600
Metal mines	71,228	71,436	71,664	68,292	72,600
Nonmetal mines (except stone quarries)	12,176	11,950	12,077	11,977	12,800
Stone quarries	75,245	77,344	82,209	85,730	88,200
Coke plants	23,705	25,157	24,471	24,347	25,715
Metallurgical plants	49,082	47,768	47,663	46,277	49,800
Total	721,792	740,988	723,390	719,862	702,715
Average number of active mine-days: [3]					
Coal mines	239	227	170	189	210
Metal mines	275	282	252	271	279
Nonmetal mines (except stone quarries)	292	287	277	293	294
Stone quarries	279	284	275	272	276
Coke plants	350	350	321	341	344
Metallurgical plants	313	317	294	314	310
Total	256	249	205	221	239
Man-days worked, in thousands: [4]					
Coal mines	117,312	115,083	82,437	91,231	95,411
Metal mines	19,567	20,124	18,067	18,522	20,223
Nonmetal mines (except stone quarries)	3,555	3,432	3,340	3,512	3,757
Stone quarries	20,996	21,993	22,569	23,346	24,339
Coke plants	8,293	8,798	7,860	8,292	8,834
Metallurgical plants	15,353	15,121	14,031	14,539	15,444
Total	185,076	184,551	148,304	159,443	168,008
Man-hours worked, in thousands: [4]					
Coal mines	949,540	898,231	642,476	711,390	742,360
Metal mines	157,024	161,516	144,368	147,765	161,780
Nonmetal mines (except stone quarries)	28,809	27,784	26,948	28,456	30,170
Stone quarries	171,979	179,111	182,258	189,535	198,760
Coke plants	66,119	70,021	62,446	65,861	70,190
Metallurgical plants	122,630	121,028	112,095	116,430	124,090
Total	1,496,101	1,457,691	1,170,591	1,259,436	1,327,350
Number of injuries:					
Fatal:					
Coal mines	1,158	999	585	643	785
Metal mines	126	104	69	84	96
Nonmetal mines (except stone quarries)	12	15	10	19	15
Stone quarries	75	75	66	54	58
Coke plants	15	20	7	14	10
Metallurgical plants	21	14	23	29	10
Total	1,407	1,227	760	843	974
Nonfatal:					
Coal mines	57,660	53,472	35,405	37,264	37,640
Metal mines	8,293	7,631	6,940	6,611	6,930
Nonmetal mines (except stone quarries)	1,308	1,176	1,125	1,238	1,385
Stone quarries	5,504	4,994	4,826	4,762	5,010
Coke plants	926	917	713	780	768
Metallurgical plants	3,228	2,749	2,567	2,574	2,805
Total	76,919	70,939	51,576	53,229	54,538
Injury rates per million man-hours:					
Fatal:					
Coal mines	1.22	1.11	.91	.90	1.06
Metal mines	.80	.64	.48	.57	.59
Nonmetal mines (except stone quarries)	.42	.54	.37	.67	.50
Stone quarries	.44	.42	.36	.28	.29
Coke plants	.23	.29	.11	.21	.14
Metallurgical plants	.17	.12	.21	.25	.08
Total	.94	.84	.65	.67	.73
Nonfatal:					
Coal mines	60.72	59.53	55.11	52.38	50.70
Metal mines	52.81	47.25	48.07	44.74	42.84
Nonmetal mines (except stone quarries)	45.40	42.33	41.75	43.51	45.91
Stone quarries	32.00	27.88	26.48	25.12	25.21
Coke plants	14.01	13.10	11.42	11.84	10.94
Metallurgical plants	26.32	22.71	22.90	22.11	22.60
Total	51.41	48.67	44.06	42.26	41.09

[1] Preliminary figures based on an average of 80 percent coverage.
[2] Average number of men at work each day mine was active. Because absenteeism and labor turnover are taken into consideration, this number is lower than number of men available for work, as measured by a count of names on payroll.
[3] Average in which operating time of each mine is weighted by average number of workers in mine.
[4] Totals of man-days and man-hours are additions of rounded subtotals and may differ slightly from totals obtained before rounding.

TABLE 2.—Work stoppages, average earnings, and labor turn-over in certain mineral industries in the United States, 1948–51

[Bureau of Labor Statistics]

Industry and year	Work stoppages [1]		Average earnings [2]		Labor-turnover rates [3]	
	Number	Man-days lost (thousands)	Weekly	Hourly	Accession	Separation
Coal mining:						
Anthracite:						
1948	26	274	$66.57	$1.809	1.7	1.9
1949	34	1,400	56.78	1.880	1.5	2.1
1950	41	80	63.24	1.970	1.8	1.8
1951	30	81	66.60	2.198	1.8	2.3
Bituminous:						
1948	561	9,560	72.12	1.898	3.3	3.1
1949	421	16,700	63.28	1.941	2.0	2.9
1950	430	9,320	70.35	2.010	[4] 2.0	[4] [6] 2.4
1951	549	887	77.86	2.212	1.9	2.6
Metal mining:						
Total:						
1948	11	473	60.80	1.434	4.7	4.5
1949	9	970	61.55	1.505	3.8	4.5
1950	14	235	65.58	1.554	4.6	[6] 4.0
1951	23	269	74.60	1.711	5.3	4.9
Iron:						
1948	[5]	[5]	58.32	1.412	3.1	2.9
1949	[5]	[5]	58.91	1.484	2.1	2.2
1950	[5]	[5]	61.96	1.515	2.7	[6] 2.3
1951	[5]	[5]	72.63	1.709	2.7	2.5
Copper:						
1948	[5]	[5]	65.81	1.456	5.9	5.5
1949	[5]	[5]	63.96	1.512	4.8	5.3
1950	[5]	[5]	72.05	1.601	5.1	[6] 4.3
1951	[5]	[5]	78.19	1.696	5.1	4.8
Lead-zinc:						
1948	[5]	[5]	61.37	1.486	6.4	6.0
1949	[5]	[5]	64.79	1.565	3.9	5.5
1950	[5]	[5]	66.64	1.602	4.3	[6] 3.8
1951	[5]	[5]	76.20	1.772	5.3	4.8
Nonmetal mining and quarrying:						
1948	16	57	55.31	1.243	[5]	[5]
1949	17	166	56.38	1.302	[5]	[5]
1950	22	64	59.88	1.361	[5]	[5]
1951	24	53	67.19	1.493	[5]	[5]
Cement:						
1948	4	37	54.76	1.307	3.7	3.4
1949	3	37	57.49	1.382	1.7	1.8
1950	12	57	60.13	1.442	2.2	[6] 2.0
1951	12	12	65.17	1.559	2.9	2.7
Coke and byproducts:						
1948	3	11	58.56	1.475	[5]	[5]
1949	3	31	61.07	1.554	[5]	[5]
1950	2	2	62.85	1.583	[5]	[5]
1951	4	11	69.47	1.741	[5]	[5]
Petroleum refining:						
1948	6	728	72.06	1.788	1.1	.9
1949	6	39	75.33	1.874	.4	1.0
1950	10	638	77.93	1.929	.8	.8
1951	8	37	84.70	2.031	1.2	.8

[1] Number of stoppages beginning during each year and man-days of work lost from only these stoppages during the year.

[2] Monthly averages for production and related workers only; data cover both full- and part-time employees who worked during, or received pay for, the pay period ended nearest the 15th of the month.

[3] Monthly averages expressed as the number per 100 employees. Accessions are additions to the work force, whether new or rehired employees; separations are terminations of employment, including quits, discharges, lay-offs, and military and miscellaneous separations. Data for metal mining, cement, and petroleum refining for 1950 and 1951 are not comparable with preceding years, owing to changes in industry classification by the Department of Labor.

[4] An 11-month average owing to strike during February.

[5] Figure not available.

[6] Revised figure.

TABLE 3.—Employment and injury experience of the mineral industries of the United States, 1931–51

Year	Men working daily	Average active days	Man-days worked	Man-hours worked	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Fatal	Nonfatal
1931	784,347	188	147,602,799	1,288,135,808	1,707	94,021	1.33	72.99
1932	671,343	165	110,655,616	962,924,915	1,368	66,028	1.42	68.57
1933	677,722	181	122,787,658	1,058,245,650	1,242	70,158	1.17	66.30
1934	739,817	195	144,566,133	1,167,723,543	1,429	79,211	1.22	67.83
1935	783,139	195	152,354,170	1,215,316,764	1,495	80,070	1.23	65.88
1936	824,514	216	177,920,334	1,426,233,543	1,686	90,608	1.18	63.53
1937	859,951	217	186,790,283	1,482,241,908	1,759	94,466	1.19	63.73
1938	774,894	187	145,056,875	1,144,137,296	1,369	69,940	1.20	61.13
1939	788,925	202	159,388,490	1,251,169,210	1,334	73,253	1.07	58.55
1940	801,926	219	175,663,792	1,385,128,234	1,716	80,856	1.24	58.37
1941	835,095	234	195,425,228	1,541,335,277	1,621	87,911	1.05	57.04
1942	802,640	260	208,739,906	1,653,284,620	1,862	91,675	1.13	55.45
1943	747,486	277	207,350,643	1,668,340,394	1,799	88,449	1.08	53.02
1944	676,938	287	194,512,359	1,618,479,042	1,571	83,451	.97	51.56
1945	637,220	271	172,672,431	1,437,533,530	1,270	73,411	.88	51.07
1946	676,254	240	162,630,674	1,354,822,190	1,167	72,805	.86	53.74
1947	721,792	256	185,076,018	1,496,101,097	1,407	76,919	.94	51.41
1948	740,988	249	184,551,937	1,457,690,518	1,227	70,939	.84	48.67
1949	723,390	205	148,304,347	1,170,590,880	760	51,576	.65	44.06
1950	719,862	221	159,443,478	1,259,436,140	843	53,229	.67	42.26
1951 (preliminary)[1]	702,715	239	168,008,329	1,327,350,493	974	54,538	.73	41.09

[1] Includes preliminary data except coke, which is final.

COAL MINES

Fatality experience at coal mines during 1951 was appreciably worse than that in 1950, and the rate of occurrence of fatalities was higher than in any year since 1948. The increase in the fatality record resulted entirely from the large number of men killed in mine disasters. However, nonfatal-injury experience continued to improve, and the rate of occurrence of nonfatal injuries in 1951 was lower than in any year since 1930, when these data became available. A total of 785 men was killed in the coal-mining industry during 1951, at a frequency rate of 1.06 per million man-hours. The rate of occurrence was 18 percent higher than the record low rate of 0.90 in 1950. Similarly, on a tonnage basis the fatality rate advanced to 1.36 per million tons mined in 1951 or appreciably above that of 1.14 in 1950. Failure to control the explosion hazard through safe ventilation practices, effective rock-dust controls, and adequate rock dusting ruined what could have been a relatively favorable fatality record. In 1951, 162 or 21 percent of the total fatalities occurred in major and local explosions of gas or dust.

Conversely to the fatality record, the nonfatal-injury experience in 1951 was a 3-percent improvement over the former low record in 1950. This improvement in 1951 continued the persistent year-to-year betterment in safety that has prevailed since 1946. Alhough the number of nonfatal injuries increased 376 to a total of 37,640 in 1951, the rate of occurrence of these injuries was 50.70 per million man-hours of exposure—a slight improvement over the corresponding rate of 52.38 in 1950. The lower rate in 1951 resulted from the greater total time of exposure of the men to the hazards of mining than in 1950. The

average number of men working daily decreased in 1951, but man-days and man-hours of work were appreciably higher than in 1950 owing to an increase in worktime. Coal mines were active an average of 210 days (21 more than in 1950). The average length of shift was 7.78 hours, and the total worktime per man-year was 1,637 hours (165 hours more than in 1950).

Bituminous-Coal Mines.—The average number of men working daily in bituminous-coal mines decreased to 384,300, a 6-percent reduction compared with the daily working force in 1950. Results of a monthly canvass of bituminous-coal operations showed a regular month-to-month downtrend in employment from 404,700 in January to 373,400 in December. Although the labor force was not as great as in 1950, man-hours of worktime rose to 635.4 million, an increase of 7 percent over the total worktime in 1950. The increased worktime resulted from a 14-percent increase in the average number of days operations were active. The average miner in 1951 worked a 7.86-hour shift for 210 active days compared with a shift of 7.88 hours for 185 days in 1950. The average worker at bituminous-coal mines had a total work-year of 1,653 hours (197 hours more than in 1950). The decrease in the average number of men to 384,300 in 1951 from 408,623 in 1950 was not reflected in the production at bituminous-coal operations. The production increased 3 percent to a total of 533,665,000 tons.

The fatality experience at bituminous-coal mines in 1951 was less favorable than in 1950. In all, 685 men were killed at bituminous-coal mines in 1951, an increase of 135 over the 1950 total of 550. These fatalities occurred at rates of 1.08 per million man-hours and 1.28 per million tons of coal mined, both well above the corresponding rates of 0.92 and 1.06 for the industry in 1950. Although both the number and frequency rates of fatalities were appreciably higher than in 1950, they were better than in any year, except 1949 and 1950, since collection of complete fatality statistics was begun in 1910.

The 685 fatalities were distributed among the following types of operations in 1951: 621 in underground workings, 35 on the surface, and 29 in stripping operations. In underground workings, falls of roof and face caused 312 deaths, explosions (major and local) of gas or dust 153, haulage 103, machinery and electricity 19 each, explosives 7, and miscellaneous 8.

Nonfatal-injury experience was also less favorable at bituminous-coal mines in 1951 than in 1950. The 30,525 disabling injuries for the year represented an 8-percent increase over the previous year's total of 28,390 injuries. The nonfatal-injury rates in 1951 were 48.04 per million man-hours and 57.20 per million tons, both rates less favorable than the respective rates of 47.73 and 54.82 in 1950.

Anthracite Mines.—The average number of men working daily at anthracite operations decreased from 74,616 men in 1950 to 69,300 in 1951, and worktime declined 8 percent to 106.9 million man-hours. The average employee in 1951 worked a 7.35-hour shift and performed 1,543 hours of work (19 hours less than in 1950).

The fatality experience at anthracite mines was less favorable in 1951 than in 1950. In all, 100 men lost their lives in the anthracite industry, or 7 more than in the previous year. These fatalities occurred at frequency rates of 0.94 per million man-hours and 2.34 per million tons. Comparable data for 1950 were 93 men killed at frequency rates of 0.80 per million man-hours and 2.09 per million tons. The

100 fatalities at anthracite mines occurred as follows: 89 in underground workings, 8 on the surface, and 3 in stripping operations. Falls of roof and face killed 51 men (57 percent of the total) in underground workings in 1951. In 1950 this type of accident resulted in 58 fatalities (74 percent of the underground total). Haulage accidents were responsible for 10 more fatalities in 1951 than in 1950, and an explosion of gas at an anthracite mine, resulting in the death of 5 men, increased the toll from this type of accident to 9 or 4 more than in 1950. This disaster in 1951 was the first one in the anthracite industry since 1947. The disaster record of this industry has been good in recent years, as 10 of the past 13 years have been disaster-free.

There were 7,115 lost-time injuries in the industry in 1951 (20 percent less than in 1950, when 8,874 disabling injuries were reported). The fewer number of injuries in 1951 resulted in a sharp reduction in the frequency rates—66.55 per million man-hours compared with 76.14 for 1950—continuing the downward trend that has persisted each year since 1946. The frequency rate per million tons of coal mined in 1951 was 166.74, and in 1950 it was 199.75.

TABLE 4.—Employment and injury experience at coal mines in the United States, 1947–51

Industry and year	Men working daily	Average active mine-days	Man-days worked	Man-hours worked	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Fatal	Non-fatal
Bituminous-coal mines: [1]								
1947	411,845	236	97,105,260	803,016,338	985	46,025	1.23	57.32
1948	429,378	220	94,574,820	747,685,733	862	42,078	1.15	56.28
1949	409,431	165	67,551,942	533,165,522	494	27,548	.93	51.67
1950	408,623	185	75,509,974	594,835,875	550	28,390	.92	47.73
1951 (preliminary)	384,300	210	80,860,000	635,440,000	685	30,525	1.08	48.04
Pennsylvania anthracite mines:								
1947	78,511	257	20,206,753	146,523,360	173	11,635	1.18	79.41
1948	77,955	263	20,508,227	150,544,968	137	11,394	.91	75.69
1949	75,875	196	14,885,115	109,310,226	91	7,857	.83	71.88
1950	74,616	211	15,721,460	116,553,682	93	8,874	.80	76.14
1951 (preliminary)	69,300	210	14,551,000	106,920,000	100	7,115	.94	66.55
Total coal mines:								
1947	490,356	239	117,312,013	949,539,698	1,158	57,660	1.22	60.72
1948	507,333	227	115,083,047	898,230,721	999	53,472	1.11	59.53
1949	485,306	170	82,437,057	642,475,748	585	35,405	.91	55.11
1950	483,239	189	91,231,434	711,389,557	643	37,264	.90	52.38
1951 (preliminary)	453,600	210	95,411,000	742,360,000	785	37,640	1.06	50.70

[1] Includes lignite.

METAL MINES

Injury experience at metal mines in 1951 improved slightly. The total injury-frequency rate of 43.43 injuries (fatal and nonfatal) per million man-hours was 4 percent lower than the comparable rate of 45.31 for 1950. However, this improvement was due entirely to a lower nonfatal rate, for the fatality experience at metal mines in 1951 was slightly higher than in the previous year.

The daily average number of men working increased 6 percent to a total of 72,600; these men worked almost 162 million hours, or 9 percent more than in 1950.

Iron Mines.—The average number of men at work daily at iron mines increased to 30,200 in 1951. The mines were worked an average of 279 days, compared with 268 days in 1950. Each worker averaged 2,239 hours (93 more than during 1950). Total man-hours rose to 67.6 million—a 14-percent increase over 1950. The number of fatalities and nonfatal injuries increased to 34 and 1,275, respectively, from 23 and 1,126 in 1950. The fatality frequency rate of 0.50 per million man-hours was less favorable than the 0.39 rate for 1950; however, the nonfatal-injury frequency rate of 18.85 was slightly better than the corresponding rate in 1950.

TABLE 5.—Employment and injury experience at metal mines in the United States, 1947–51, by industry group

Industry and year	Men working daily	Average active mine-days	Man-days worked	Man-hours worked	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Fatal	Non-fatal
Iron mines:								
1947	26,478	273	7,238,851	58,157,587	36	1,403	0.62	24.12
1948	27,116	287	7,786,361	62,468,142	34	1,440	.54	23.05
1949	27,792	249	6,907,048	55,422,388	21	1,158	.38	20.89
1950	27,686	268	7,407,111	59,406,348	23	1,126	.39	18.95
1951 (preliminary)	30,200	279	8,413,000	67,630,000	34	1,275	.50	18.85
Copper mines:								
1947	15,654	305	4,782,153	38,263,818	32	1,655	.84	43.25
1948	16,280	305	4,959,483	39,684,197	31	1,572	.78	39.61
1949	16,027	271	4,341,202	34,729,944	13	1,190	.37	34.26
1950	15,383	305	4,688,299	37,345,430	17	1,176	.46	31.49
1951 (preliminary)	16,100	305	4,908,000	39,260,000	22	1,305	.56	33.24
Lead-zinc mines:								
1947	16,628	268	4,457,549	35,618,006	33	3,221	.93	90.43
1948	16,113	264	4,255,190	34,034,255	22	3,050	.65	89.62
1949	16,333	243	3,971,971	31,738,565	24	2,810	.76	88.54
1950	14,038	257	3,612,051	28,878,165	28	2,411	.97	83.49
1951 (preliminary)	15,000	272	4,078,000	32,490,000	15	2,685	.46	82.64
Gold-silver lode mines:								
1947	5,537	255	1,414,106	11,063,328	14	1,192	1.27	107.74
1948	5,276	273	1,442,554	11,328,421	13	986	1.15	87.04
1949	5,309	258	1,369,960	10,651,525	9	1,190	.84	111.72
1950	5,112	261	1,333,387	10,328,735	10	1,270	.97	122.96
1951 (preliminary)	4,400	258	1,137,000	8,850,000	16	885	1.81	100.00
Gold placers:								
1947	3,920	212	830,710	7,166,257	3	230	.42	32.09
1948	3,772	230	867,709	7,423,065	1	180	.13	24.25
1949	3,523	216	760,202	6,087,196	--------	187	--------	30.72
1950	3,457	218	753,922	6,037,624	--------	184	--------	30.48
1951 (preliminary)	3,500	210	734,000	5,950,000	2	185	.34	31.09
Miscellaneous: [1]								
1947	3,011	280	843,616	6,755,376	8	592	1.18	87.63
1948	2,879	282	813,035	6,578,055	3	403	.46	61.26
1949	2,680	267	716,405	5,738,514	2	405	.35	70.58
1950	2,616	278	727,325	5,768,379	6	444	1.04	76.97
1951 (preliminary)	3,400	280	953,000	7,600,000	7	595	.92	78.29
Total:								
1947	71,228	275	19,566,985	157,024,372	126	8,293	.80	52.81
1948	71,436	282	20,124,332	161,516,135	104	7,631	.64	47.25
1949	71,664	252	18,066,788	144,368,132	69	6,940	.48	48.07
1950	68,292	271	18,522,095	147,764,681	84	6,611	.57	44.74
1951 (preliminary)	72,600	279	20,223,000	161,780,000	96	6,930	.59	42.84

[1] Includes antimony, bauxite, chromite, cobalt, manganese, mercury, molybdenum, pyrite, titanium tungsten, and vanadium-uranium mines.

Copper Mines.—The number of men working daily at copper mines rose in 1951 to 16,100. Total man-hours at all copper mines were a little more than 5 percent greater than in 1950. In 1951 the average manshift was 8.00 hours, and the average workyear per man was 2,439 hours or virtually equal to the previous year's average figure. The number of days worked was identical—305. The safety record at copper mines in 1951 was less favorable than in 1950. The 22 fatalities in 1951 (5 more than in 1950) occurred at a rate of 0.56 per million man-hours, or at a 22 percent higher rate than in the previous year. Nonfatal injuries totaled 1,305 for the year, at a frequency of 33.24 injuries per million man-hours. The corresponding rate in 1950 was 31.49.

Lead-Zinc Mines.—The daily average number of workers in 1951 at lead-zinc operations (15,000) was 7 percent greater than in 1950. Similarly, total man-hours worked at these plants were higher for the year, and the average number of days worked increased 15. Each worker averaged a shift of 7.97 hours and accumulated 2,166 hours for the year (109 more than in 1950). Fatality experience at lead-zinc mines in 1951 was considerably more favorable than in 1950. Likewise, the nonfatal injury rate improved, but to a smaller extent. The 15 fatalities (13 less than in 1950) occurred at a frequency rate of 0.46 per million man-hours and the 2,685 lost-time injuries at a rate of 82.64. The respective rates for the previous year were 0.97 and 83.49.

Gold-Silver Lode Mines.—The average number of men working at gold-silver lode mines totaled 4,400, a loss of 14 percent compared with 1950. Three fewer days were worked in 1951, and the total of 8.9 million man-hours of worktime was 14 percent lower than that during 1950. The average worker had a 7.78-hour shift and accumulated a total of 2,011 hours for the year (9 hours less than in 1950). Fatality experience at gold-silver lode mines was considerably worse than in 1950, a year when the record at these mines was not favorable. The 16 fatalities, compared with 10 in 1950, caused a fatality rate of 1.81 per million man-hours. Nonfatal injuries totaled 885, a decrease of 385 under the 1950 total number. They occurred at a rate of 100.00 injuries per million man-hours, a considerable improvement over the rate of 122.96 for 1950 but still the highest in the mineral industries in 1951.

Gold Placer Mines.—In 1951, an average of 3,500 men was working daily at gold placers—about the same as in 1950. Total man-hours of worktime decreased slightly because these operations working 8 days less than in 1950. The average worker increased his hours per day of work to 8.11 but had 46 fewer hours in total for the year's work. The injury experience at gold placer operations was less favorable in 1951 than in 1950. The 2 deaths during the year occurred at a rate of 0.34 per million man-hours. No one was killed in 1950. The number of nonfatal injuries (185 or 1 more than the previous year) occurred at a rate of 31.09 per million man-hours. The corresponding rate for 1950 was 30.48.

Miscellaneous Metal Mines.—The average daily number of workers, (3,400) was 30 percent greater than in 1950 at mines in this group. This division included plants producing antimony, bauxite, chromite, cobalt, manganese, mercury, molybdenum, pyrite, titanium, tungsten, and vanadium-uranium. The man-hours of worktime also increased 32 percent to a total of 7.6 million, and the average employee worked 2,235 hours during the year (30 more than during 1950). The safety record at mines in this group showed no improvement in 1951 as compared with 1950. Although the fatality frequency rate was somewhat lower, the nonfatal rate increased. The combined rate (fatal and nonfatal) in 1951 was 79.21, while in 1950 it was 78.01.

NONMETAL MINES (EXCEPT STONE QUARRIES)

This group includes barite, feldspar, fluorspar, gypsum, magnesite, mica, phosphate rock, rock salt, sulfur, and miscellaneous nonmetallic mineral operations. The average of 12,800 men at work daily was slightly higher than the total for 1950. These mines worked an average of 294 days, 1 more than in 1950, for a total of 30.2 million man-hours, 6 percent more than in 1950. The average employee did not work as many hours during the year, as his workday was 0.07 hour shorter than in 1950. The overall injury experience at nonmetal operations was not as good as in 1950. The 15 fatalities (4 less than the previous year's total) occurred at the rate of 0.50 per million man-hours. This betterment was offset by increased nonfatal injuries, which occurred at a rate of 45.91 per million man-hours. The corresponding rate for 1950 was 43.51.

TABLE 6.—Employment and injury experience at nonmetal mines (except stone quarries) in the United States, 1947–51 [1]

Year	Men working daily	Average active mine-days	Man-days worked	Man-hours worked	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Fatal	Non-fatal
1947	12,176	292	3,554,901	28,809,150	12	1,308	0.42	45.40
1948	11,950	287	3,432,304	27,784,119	15	1,176	.54	42.33
1949	12,077	277	3,340,482	26,948,124	10	1,125	.37	41.75
1950	11,977	293	3,512,094	28,455,936	19	1,238	.67	43.51
1951 (preliminary)	12,800	294	3,757,000	30,170,000	15	1,385	.50	45.91

[1] Includes barite, feldspar, fluorspar, gypsum, magnesite, mica, phosphate rock, rock salt, sulfur, and miscellaneous nonmetallic-mineral mines.

STONE QUARRIES

Injury experience in the quarrying industries in 1951 was less favorable, and the rates of occurrence of both fatal and nonfatal injuries increased over 1950. However, these increases were slight. The 1951 combined injury rate (fatal and nonfatal) per million man-hours was 25.50 as against 25.40 for the preceding year. Operating activity in each of the quarrying industries increased, and man-hours of worktime rose 5 percent over 1950. The average number of men working daily increased from 85,730 to 88,200—almost 3 percent. The average length of shift (8.17 hours) and the average number of hours worked per man (2,254) were slightly higher than in 1950.

TABLE 7.—Employment and injury experience at stone quarries in the United States, 1947–51, by industry group

Industry and year	Men working daily	Average active mine-days	Man-days worked	Man-hours worked	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Fatal	Non-fatal
Cement: [1]								
1947	28,184	315	8,883,904	70,756,640	26	820	0.37	11.59
1948	28,278	328	9,270,125	73,778,909	24	786	.33	10.65
1949	28,824	327	9,411,961	73,540,505	18	597	.24	8.12
1950	29,003	324	9,383,895	73,758,750	17	548	.23	7.43
1951 (preliminary)	29,000	327	9,483,000	75,690,000	14	515	.18	6.80
Limestone:								
1947	21,177	246	5,218,930	44,209,247	24	1,921	.54	43.45
1948	22,335	244	5,445,881	45,665,097	26	1,703	.57	37.29
1949	25,710	232	5,954,282	49,828,625	27	1,829	.54	36.71
1950	28,588	232	6,621,221	55,337,191	22	1,922	.40	34.73
1951 (preliminary)	29,500	236	6,961,000	59,570,000	25	2,125	.42	35.67
Lime: [1]								
1947	9,254	291	2,690,488	21,669,032	6	1,022	.28	47.16
1948	9,459	304	2,878,887	22,867,674	9	931	.39	40.71
1949	9,138	297	2,709,511	21,344,370	8	798	.37	37.39
1950	8,837	295	2,607,969	20,970,469	6	677	.29	32.28
1951 (preliminary)	9,600	296	2,842,000	22,060,000	8	605	.36	27.43
Marble:								
1947	3,165	262	830,620	6,833,627	2	200	.29	29.27
1948	2,747	266	730,699	5,876,884	1	167	.17	28.42
1949	2,815	255	719,207	5,962,020	-------	227	-------	38.07
1950	2,600	246	640,281	5,330,295	3	168	.56	31.52
1951 (preliminary)	2,700	254	685,000	5,750,000	-------	180	-------	31.30
Granite:								
1947	5,726	253	1,451,371	12,003,295	4	652	.33	54.32
1948	5,818	256	1,490,656	12,467,119	6	590	.48	47.32
1949	6,972	247	1,719,109	14,216,896	5	574	.35	40.37
1950	7,400	249	1,842,512	15,237,563	2	587	.13	38.52
1951 (preliminary)	7,600	259	1,969,000	15,910,000	7	600	.44	37.71
Traprock:								
1947	2,470	242	597,234	5,080,337	3	261	.59	51.37
1948	2,505	238	594,938	5,064,034	4	257	.79	50.75
1949	2,815	230	647,414	5,503,529	3	240	.55	43.61
1950	3,066	225	691,022	5,829,466	2	292	.34	50.09
1951 (preliminary)	3,200	238	763,000	6,280,000	2	400	.32	63.69
Slate:								
1947	1,740	267	465,449	4,174,220	3	243	.72	58.21
1948	1,952	262	512,126	4,511,472	3	188	.66	41.67
1949	1,820	260	472,868	4,061,750	3	217	.74	53.43
1950	2,032	268	544,213	4,633,830	1	203	.22	43.81
1951 (preliminary)	2,200	272	599,000	5,020,000	-------	220	-------	43.82
Sandstone:								
1947	3,529	243	858,419	7,252,419	7	385	.97	53.09
1948	4,250	252	1,070,005	8,879,320	2	372	.23	41.90
1949	4,115	227	934,969	7,800,638	2	344	.26	44.10
1950	4,204	242	1,015,370	8,437,247	1	365	.12	43.26
1951 (preliminary)	4,400	236	1,037,000	8,480,000	2	365	.24	43.04
Total:								
1947	75,245	279	20,996,415	171,978,817	75	5,504	.44	32.00
1948	77,344	284	21,993,317	179,110,509	75	4,994	.42	27.88
1949	82,209	275	22,569,321	182,258,333	66	4,826	.36	26.48
1950	85,730	272	23,346,483	189,534,811	54	4,762	.28	25.12
1951 (preliminary)	88,200	276	24,339,000	198,760,000	58	5,010	.29	25.21

[1] Includes burning or calcining and other mill operations.

Cement Mills and Associated Quarries.—The average number of men working daily at cement mills and associated quarries during 1951 was virtually identical with that in 1950. The 29,000 men worked an average of 327 days. The average worker had a shift of 7.98 hours and a workyear of 2,610 man-hours. Total man-hours of worktime in the industry increased by 1.9 million. The injury experience at cement operations improved in 1951. Decreases in the number of injuries, coupled with an increase in man-hours of worktime, were reflected in substantial decreases in the fatal and nonfatal frequency rates of 22 percent and 9 percent, respectively.

Limestone Quarries.—An average of 29,500 men worked daily at limestone quarries in 1951, a gain of almost 1,000 over 1950. These quarries worked 236 days during the year and reported 8.56 hours as an average length of shift. The total man-hours of worktime increased 8 percent to 59.6 million man-hours. At limestone operations the rates of frequency of both fatal and nonfatal injuries increased in 1951 over 1950, despite the 8-percent increase in man-hours of worktime.

Lime Plants.—The average number of men working at lime plants and associated quarries increased 9 percent to 9,600 in 1951. The average length of shift of 7.76 and the average number of 2,298 hours worked per man during the year were lower than in 1950. As the lime industry had 8 fatalities during the year, compared with 6 in 1950, the fatality rate rose to 0.36 per million man-hours. However, the nonfatal rate fell to 27.43 owing to an 11-percent decrease in the number of lost-time injuries.

Marble Quarries.—The total of 2,700 men working daily at marble operations was a gain of 100 over 1950. This increase in men working, together with a longer workyear for each worker, resulted in a higher total man-hours of worktime for the industry. There were no fatalities at marble operations in 1951, but 180 lost-time injuries were reported (12 more than in 1950). However, due to the increased worktime, the nonfatal injury rate improved slightly over the previous year.

Granite Quarries.—In 1951 the average number of men working at granite quarries rose to 7,600, and the number of days worked averaged 259 (10 more than in the preceding year). Total worktime was 4 percent higher in 1950. In 1951 the average granite employee had a shift of 8.08 hours and a workyear of 2,093 hours, 34 more than in 1950. Fatality experience at granite operations was considerably less favorable than in 1950. The 7 fatalities occurred at the rate of 0.44 per million man-hours, which was higher than the 0.13 rate for the preceding year. Although there were 13 more nonfatal injuries at granite quarries, the nonfatal rate of 37.71 was slightly less than the previous year's rate, due to the 4-percent increase in the total man-hours worked.

Traprock Quarries.—On the average, at traprock quarries in 1951, a total of 3,200 men, worked 238 days—13 more than in 1950. The aggregate of 6.3 million man-hours of work at these quarries was 8 percent higher than the corresponding total for 1950. The average shift was 8.23 hours, and each worker averaged a workyear of 1,963 hours (62 hours more than in 1950). From an overall standpoint, the safety record at traprock quarries was less favorable in 1951 than in 1950. The 2 fatalities at these operations occurred at a rate of 0.32 per million man-hours and the 400 nonfatal injuries at a rate of 63.69. The combined rate (fatal and nonfatal) of 64.01 was 27 percent higher than the same rate for 1950.

Slate Quarries.—At slate quarries the average number of men working increased to 2,200, while the average number of days worked rose to 272, 4 more than in 1950. Worktime increased 8 percent to a total of 5.0 million man-hours. On the average, each worker had a 2,282-hour workyear and an 8.38-hour shift. There were no fatalities at slate operations in 1951, but there were 220 nonfatal injuries (17 more than in 1950). The nonfatal injury rate of 43.82 per

million man-hours was virtually identical to the 1950 rate. The 8-percent increase in man-hours of worktime was responsible for keeping this rate in line with that of the previous year.

Sandstone Quarries.—The average number of men working daily at sandstone quarries increased to 4,400, who averaged 236 working days during the year, 6 less than in 1950. The aggregate of 8.5 million man-hours was slightly higher than the total for 1950. The average employee worked an 8.18-hour shift and had a 1,927-hour workyear (80 less than in 1950). Injury experience at sandstone operations was slightly better in 1951 than in 1950. The 2 fatalities in 1951 occurred at a frequency rate of 0.24 or double that of the previous year; but the decrease in the nonfatal frequency rate was sufficient to reduce the 1951 combined rate below that of 1950.

COKE PLANTS

The average number of men working at coke plants rose to 25,715, who averaged 344 active working days during the year. Man-hours of worktime at coke plants increased 7 percent over that in 1950 to slightly over 70 million. Fatality experience improved sharply; the rate of deaths per million man-hours was 33 percent lower than the 1950 rate. The nonfatal injury frequency rate dropped from 11.84 in 1950 to 10.94 in 1951. The average employee at coke plants worked a 7.95-hour shift to accumulate a workyear of 2,730 hours, 25 more than in 1950.

Byproduct-Coke Plants.—The number of men working at byproduct-coke plants increased to a daily average of 22,058, while active days averaged 363. Worktime totaled 64.1 million hours, 6 percent higher than in 1950. The average worker had an 8.01-hour shift and a 2,906-man-hour workyear. The 9 fatalities in 1951 were 4 less than in 1950, and these occurred at a rate of 0.14 per million man-hours, or 33 percent under the previous year's rate. The total of 533 nonfatal injuries in 1951 had a frequency of 8.31 compared with 8.52 in 1950.

TABLE 8.—Employment and injury experience at coke plants in the United States, 1947–51

Type and year	Men working daily	Average active plant-days	Man-days worked	Man-hours worked	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Fatal	Non-fatal
Byproduct ovens:								
1947	20,778	362	7,526,622	60,271,826	11	701	0.18	11.63
1948	21,877	364	7,964,283	63,788,327	17	676	.27	10.60
1949	21,141	349	7,373,684	58,822,239	7	581	.12	9.88
1950	20,942	362	7,577,665	60,593,087	13	516	.21	8.52
1951	22,058	363	8,000,833	64,102,990	9	533	.14	8.31
Beehive ovens:								
1947	2,927	262	766,542	5,846,933	4	225	.68	38.48
1948	3,280	254	833,606	6,233,002	3	241	.48	38.67
1949	3,330	146	486,497	3,623,543	-------	132	-------	36.43
1950	3,405	210	714,470	5,267,918	1	264	.19	50.11
1951	3,657	228	833,496	6,087,503	1	235	.16	38.60
Total:								
1947	23,705	350	8,293,164	66,118,759	15	926	.23	14.01
1948	25,157	350	8,797,889	70,021,329	20	917	.29	13.10
1949	24,471	321	7,860,181	62,445,782	7	713	.11	11.42
1950	24,347	341	8,292,135	65,861,005	14	780	.21	11.84
1951	25,715	344	8,834,329	70,190,493	10	768	.14	10.94

Beehive-Coke Plants.—The average number of men working daily at beehive plants advanced to 3,657 in 1951, and the plants were active 18 days more than in 1950, increasing the total man-hours of work to almost 16 percent above the preceding year. In 1951 the average employee had a 7.3-hour shift and worked 1,665 hours (118 more than in 1950). The lone fatality in 1951 occurred at a rate of 0.16 per million man-hours, slightly lower than the rate in 1950. The total of 235 nonfatal injuries had a frequency of 38.60 per million man-hours or a decline of 23 percent under the 1950 rate.

METALLURGICAL PLANTS

Injury experience at metallurgical plants was slightly less favorable in 1951 than in 1950. Although the number of fatalities was reduced one-third, the number of nonfatal injuries increased almost 9 percent above that in 1950. The combined frequency rate of injuries (fatal and nonfatal) in 1951 was 22.69 and the corresponding rate in 1950 22.36. The average number of men working daily rose to 49,800, and the total worktime was 7 percent greater than in 1950.

Ore-Dressing Plants and Auxiliary Works.—Plants or mills in this group are those in which ores of all metals are processed by various methods of treatment. The average number of men working in all metal mills in 1951 increased 7 percent to a total of 16,000, owing to increases in each group. This increase, accompanied by an increase in hours per shift, resulted in a gain of almost 9 percent in man-hours of worktime. The average employee in 1951 worked an 8.08-hour shift and 2,361 hours during the year (33 more than in 1950). The overall injury experience at metal mills was slightly more favorable than in 1950. As there were 4 fewer fatalities, the rate dropped from 0.20 to 0.08, but this betterment was almost offset by 65 more nonfatal injuries. The frequency rate of lost-time injuries was just slightly better than in 1950 and resulted from the increase in man-hours of worktime. Fatality experience was improved in copper and iron mills, and, except in lead-zinc mills, the nonfatal injury experience was better in each group. At lead-zinc operations the frequency of disabling injuries increased from 31.29 to 38.75 per million man-hours in 1951.

Nonferrous Reduction Plants and Refineries.—This group of plants is engaged in the primary extraction of nonferrous metals from ores and concentrates and includes smelters, refineries, roasting, electrolytic, and all other nonferrous metal reducing or refining plants. Iron and steel plants are not included.

The average number of men working in each division of plants in this classification increased in 1951 except at lead plants, where the average was 1 percent lower than in 1950. For the group, the average number of men working increased 8 percent in 1951, but man-hours

of worktime were not increased in this proportion as 6 fewer days were worked. The average shift was 8.02 hours and the worktime per man-year 2,554 hours in 1951 (52 less than in 1950). The overall safety record at plants in this classification was less favorable than in 1950. There were 15 fewer fatalities, and the frequency rate of fatalities was a 70-percent improvement over the 1950 rate. However, the nonfatal injury rate rose from 21.92 to 22.65 in 1951. The poorest showing in safety was at miscellaneous metal smelters where the combined frequency rate of injuries (fatal and nonfatal) increased 30 percent. The greatest improvement was made in the lead group through a 16-percent reduction in rate of occurrence.

TABLE 9.—Employment and injury experience at ore-dressing plants in the United States, 1947–51, by industry group [1]

Industry and year	Men working daily	Average active mill days	Man-days worked	Man-hours worked	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Fatal	Non-fatal
Copper:								
1947	5,846	323	1,887,600	15,100,609	2	288	0.13	19.07
1948	6,308	317	1,998,932	15,998,431	4	289	.25	18.06
1949	6,582	294	1,937,717	15,526,435	3	233	.19	15.01
1950	5,828	337	1,966,475	15,731,325	2	243	.13	15.45
1951 (preliminary)	6,200	333	2,062,000	16,530,000	--	250	--	15.12
Lead-zinc:								
1947	4,384	264	1,158,113	9,291,639	2	270	.22	29.06
1948	3,998	263	1,050,895	8,430,578	3	237	.36	28.11
1949	4,018	241	968,005	7,747,429	1	220	.13	28.40
1950	3,489	259	903,009	7,223,114	2	226	.28	31.29
1951 (preliminary)	3,600	263	948,000	7,870,000	1	305	.13	38.75
Iron:								
1947	3,343	245	820,014	6,662,689	2	86	.30	12.91
1948	3,259	267	870,632	7,040,488	--	101	--	14.35
1949	3,701	215	794,121	6,446,190	3	96	.47	14.89
1950	3,401	239	814,406	6,568,250	3	74	.46	11.27
1951 (preliminary)	3,700	251	927,000	7,490,000	--	70	--	9.35
Gold-silver:								
1947	1,107	282	312,564	2,450,112	1	138	.41	56.32
1948	919	287	263,644	2,064,381	1	106	.48	51.35
1949	935	288	269,389	2,106,362	--	83	--	39.40
1950	769	285	219,266	1,707,555	--	75	--	43.92
1951 (preliminary)	800	266	213,000	1,650,000	1	50	.61	30.30
Miscellaneous metals: [2]								
1947	1,257	269	338,547	2,707,720	--	89	--	32.87
1948	1,150	280	321,751	2,570,479	1	101	.39	39.29
1949	1,452	270	391,600	3,147,204	--	166	--	52.75
1950	1,469	303	444,660	3,584,752	--	167	--	46.59
1951 (preliminary)	1,700	310	527,000	4,240,000	1	175	.24	41.27
Total:								
1947	15,937	283	4,516,838	36,212,769	7	871	.19	24.05
1948	15,634	288	4,505,854	36,104,357	9	834	.25	23.10
1949	16,688	261	4,360,832	34,973,620	7	798	.20	22.82
1950	14,956	291	4,347,816	34,814,996	7	785	.20	22.55
1951 (preliminary)	16,000	292	4,677,000	37,780,000	3	850	.08	22.50

[1] Includes crushers, grinders, washers, ore concentration, sintering, cyaniding, leaching, and all other metallic ore-dressing plants and auxiliary works.
[2] Includes antimony, bauxite, mercury, manganese, tungsten, chromite, vanadium, molybdenum, and other metals.

TABLE 10.—Employment and injury experience at primary nonferrous reduction and refinery plants in the United States, 1947–51, by industry group [1]

Industry and year	Men working daily	Average active smelter-days	Man-days worked	Man-hours worked	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Fatal	Non-fatal
Copper:								
1947	12,393	322	3,992,485	31,938,431	7	726	0.22	22.73
1948	12,419	326	4,053,333	32,495,627	2	592	.06	18.22
1949	11,626	305	3,549,484	28,395,270	8	511	.28	18.00
1950	11,756	323	3,799,981	30,401,750	7	521	.23	17.14
1951 (preliminary)	12,600	319	4,016,000	32,130,000	3	535	.09	16.65
Lead:								
1947	3,679	331	1,219,309	9,750,024	4	197	.41	20.21
1948	4,037	323	1,302,463	10,419,706	1	188	.10	18.04
1949	4,045	306	1,239,792	9,918,334	2	164	.20	16.54
1950	3,946	305	1,202,755	9,606,222	4	166	.42	17.28
1951 (preliminary)	3,900	303	1,182,000	9,460,000	1	140	.11	14.80
Zinc:								
1947	10,484	345	3,616,035	28,667,924	1	994	.03	34.67
1948	9,843	342	3,367,815	26,875,360	1	843	.04	31.37
1949	9,573	318	3,044,234	24,118,138	5	791	.21	32.80
1950	9,106	350	3,187,484	25,314,896	9	779	.36	30.77
1951 (preliminary)	9,200	352	3,237,000	25,770,000	2	790	.08	30.66
Miscellaneous metals: [2]								
1947	6,589	305	2,007,873	16,061,153	2	440	.12	27.40
1948	5,835	324	1,891,583	15,132,655	1	292	.07	19.30
1949	5,731	320	1,836,176	14,689,399	1	303	.07	20.63
1950	6,513	307	2,001,201	16,292,286	2	323	.12	19.83
1951 (preliminary)	8,100	288	2,332,000	18,950,000	1	490	.05	25.86
Total:								
1947	33,145	327	10,835,702	86,417,532	14	2,357	.16	27.27
1948	32,134	330	10,615,194	84,923,348	5	1,915	.06	22.55
1949	30,975	312	9,669,686	77,121,141	16	1,769	.21	22.94
1950	31,321	325	10,191,421	81,615,154	22	1,789	.27	21.92
1951 (preliminary)	33,800	319	10,767,000	86,310,000	7	1,955	.08	22.65

[1] Includes smelters, refineries, roasting, electrolytic, retort, and all other nonferrous metal reducing or refining plants.
[2] Includes mercury, antimony, tin, and magnesium plants.

OIL AND GAS INDUSTRIES

This chapter is the first on Employment and Injuries to give data on the oil and gas industries. However, data for these industries have not been combined with those for the group of extractive industries, designated as "the mineral industries," covered in other sections of this chapter and to which coverage was restricted in earlier chapters.

It is believed that the statistics given herein present a reasonably comprehensive picture of injury and employment experience in the oil and gas industries, because in the canvasses fairly adequate coverage has been obtained of medium- and small-size operating companies and of oil and gas contractors, and especially good coverage obtained of the large companies. It is hoped that in 1952 and subsequent years the coverage will be expanded, especially of the medium- and small-size companies. It is estimated that, exclusive of marketing and inland water transportation, for which coverages are least satisfactory, the data cover the greater part of the oil and gas industries.

The safety record of the oil and gas industries in the United States was less favorable in 1951 than in 1950. There were 142 fatalities compared with 109 the year before. The fatality rate of 0.12 per million man-hours was a 20-percent increase over the corresponding

rate for the preceding year. Nonfatal injuries increased from 13,500 in 1950 to 15,130 in 1951, and the rate of frequency increased from 12.48 to 13.18. The 6-percent increase in the man-hours of worktime in 1951 over 1950 did not offset the 12-percent increase in the total number of injuries. The average worker accumulated 2,129 hours during the year, 40 more than in 1950.

TABLE 11.—Employment and injury experience in the oil and gas industries in the United States, 1949–51, by department

Department and year	Average number of men working daily	Man-hours worked	Number of injuries		Injury rates per million man-hours	
			Fatal	Nonfatal	Fatal	Nonfatal
Exploration:						
1949	10,906	23,800,551	9	314	0.38	13.19
1950	10,188	22,036,726	1	258	.05	11.71
1951	16,504	35,386,307	4	783	.11	22.13
Drilling:						
1949	18,862	37,258,977	17	3,122	.46	83.79
1950	22,118	41,853,377	24	2,628	.57	62.79
1951	22,538	39,044,160	20	3,077	.51	78.81
Production:						
1949	82,512	174,561,117	26	2,855	.15	16.36
1950	82,785	170,219,493	25	2,478	.15	14.56
1951	76,903	159,281,511	27	2,344	.17	14.72
Natural gasoline:						
1949	12,642	26,115,636	7	303	.27	11.60
1950	11,252	23,247,988	2	226	.09	9.72
1951	11,266	23,368,626	5	221	.21	9.46
Pipeline (oil):						
1949	31,419	66,059,616	6	739	.09	11.19
1950	29,715	61,713,601	6	695	.10	11.26
1951	31,187	64,618,061	9	597	.14	9.24
Pipeline (gas):						
1949	25,391	52,749,701	9	696	.17	13.19
1950	32,288	67,627,315	8	1,053	.12	15.57
1951	34,805	75,960,733	10	1,453	.13	19.13
Marine transportation (ocean and coastwise):						
1949	9,410	27,471,926	1	525	.04	19.11
1950	6,982	25,409,055	4	362	.16	14.25
1951	6,997	24,983,717	2	431	.08	17.25
Marine transportation (inland waters):						
1949	2,399	6,475,930	5	116	.77	17.91
1950	1,880	5,716,485	2	87	.35	15.22
1951	1,940	5,932,786	1	98	.17	16.52
Refining:						
1949	147,339	300,554,602	44	2,482	.15	8.26
1950	141,831	288,222,716	14	2,212	.05	7.67
1951	138,487	315,255,015	41	2,287	.13	7.25
Marketing:						
1949	126,251	273,188,843	11	2,849	.04	10.43
1950	125,892	269,123,845	15	2,900	.06	10.78
1951	134,842	277,238,228	14	2,993	.05	10.80
Miscellaneous:						
1949	32,139	65,884,950	2	237	.03	3.60
1950	33,623	67,888,043	2	289	.03	4.26
1951	40,187	79,449,699	4	396	.05	4.98
Office:						
1949	12,679	23,988,668	1	38	.04	1.58
1950	12,300	24,919,800	2	35	.08	1.40
1951	15,559	31,829,996	4	34	.13	1.07
Not classified:						
1949	4,991	7,716,769	----------	57	----------	7.39
1950	6,933	13,540,149	4	277	.30	20.46
1951	7,880	15,555,120	1	416	.06	26.74
Total:						
1949	516,940	1,085,827,286	138	14,333	.13	13.20
1950	517,787	1,081,518,593	109	13,500	.10	12.48
1951	539,095	1,147,903,959	142	15,130	.12	13.18

Fuels and Energy

By Orris C. Herfindahl and Herbert E. Striner

GENERAL SUMMARY

LONG-TERM trends in the growth and relative importance of primary fuels and energy continued in 1951. Petroleum and natural gas continued their relative growth at the expense of bituminous and anthracite. Water power as a source of electrical energy also fell relative to the other sources of energy.

The long-term movements in the production of primary fuels and energy are shown in table 1 and figure 1. Although bituminous coal surpassed its previous 1918 peak in several years during and after World War II, annual production since 1948 has been below the 1918 peak. Anthracite production has been declining steadily since its World War I peak. In contrast, crude petroleum and natural gas have in-

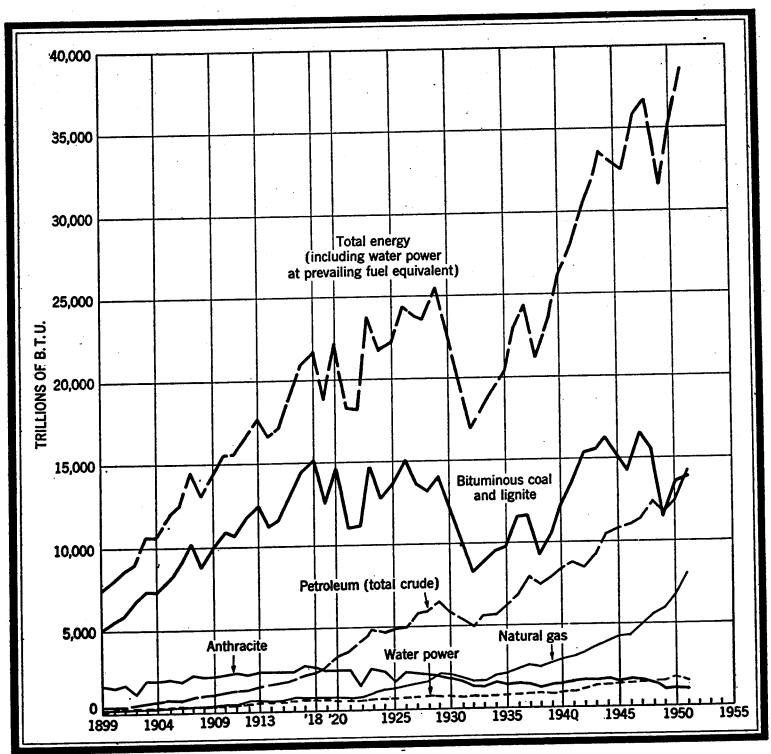

FIGURE 1.—Annual supply of energy from mineral fuels and water power in the United States, 1899–1951.

creased rather steadily over the whole period since the beginning of the century. Growth of natural-gas use has been especially rapid in recent years. The relative importance of these primary sources of energy is shown for selected years in table 2 and figure 2.

TABLE 1.—Annual supply of energy from primary mineral fuels and water power in the United States, 1900–51, in trillions of British thermal units [1]

Year	Pennsylvania anthracite	Bituminous coal and lignite	Total coal	Petroleum (crude)		Natural gas (marketed production)	Total petroleum and natural gas	Total mineral fuels	Water power [2]	Grand total
				Domestic production	Imports					
1900	1,457	5,563	7,020	369	----------	254	623	7,643	250	7,893
1905	1,973	8,255	10,228	781	----------	377	1,158	11,386	386	11,772
1910	2,146	10,928	13,074	1,215	3	547	1,765	14,839	539	15,378
1911	2,298	10,635	12,933	1,279	8	551	1,838	14,771	565	15,336
1912	2,143	11,793	13,936	1,293	40	604	1,937	15,873	585	16,458
1913	2,325	12,535	14,860	1,441	98	626	2,165	17,025	609	17,634
1914	2,307	11,075	13,382	1,541	98	636	2,275	15,657	636	16,293
1915	2,260	11,597	13,857	1,630	105	676	2,411	16,268	659	16,927
1916	2,224	13,166	15,390	1,744	121	810	2,675	18,065	681	18,746
1917	2,530	14,457	16,987	1,945	175	855	2,975	19,962	700	20,662
1918	2,510	15,180	17,690	2,064	219	775	3,058	20,748	701	21,449
1919	2,238	12,206	14,444	2,195	306	802	3,303	17,747	718	18,465
1920	2,276	14,899	17,175	2,569	616	858	4,043	21,218	738	21,956
1921	2,298	10,897	13,195	2,739	727	712	4,178	17,373	620	17,993
1922	1,389	11,063	12,452	3,234	738	820	4,792	17,244	643	17,887
1923	2,371	14,792	17,163	4,248	476	1,083	5,807	22,970	685	23,655
1924	2,233	12,672	14,905	4,141	451	1,228	5,820	20,725	648	21,373
1925	1,570	13,625	15,195	4,430	359	1,278	6,067	21,262	668	21,930
1926	2,145	15,022	17,167	4,471	350	1,411	6,232	23,399	728	24,127
1927	2,034	13,565	15,599	5,227	339	1,553	7,119	22,718	776	23,494
1928	1,914	13,120	15,034	5,229	463	1,686	7,378	22,412	854	23,266
1929	1,875	14,017	15,892	5,842	458	2,062	8,362	24,254	816	25,070
1930	1,762	12,249	14,011	5,208	360	2,089	7,657	21,668	752	22,420
1931	1,515	10,011	11,526	4,936	274	1,813	7,023	18,549	668	19,217
1932	1,266	8,114	9,380	4,554	259	1,673	6,486	15,866	713	16,579
1933	1,258	8,741	9,999	5,253	185	1,672	7,110	17,109	711	17,820
1934	1,452	9,415	10,867	5,267	206	1,904	7,377	18,244	698	18,942
1935	1,325	9,756	11,081	5,780	187	2,060	8,027	19,108	806	19,914
1936	1,386	11,504	12,890	6,378	187	2,330	8,895	21,785	812	22,597
1937	1,317	11,673	12,990	7,419	159	2,588	10,166	23,156	871	24,027
1938	1,171	9,132	10,303	7,043	153	2,468	9,664	19,967	866	20,833
1939	1,308	10,345	11,653	7,337	192	2,663	10,192	21,845	838	22,683
1940	1,308	12,072	13,380	7,849	247	2,860	10,956	24,336	880	25,216
1941	1,432	13,471	14,903	8,133	294	3,024	11,451	26,354	934	27,288
1942	1,532	15,267	16,799	8,043	71	3,282	11,396	28,195	1,136	29,331
1943	1,540	15,463	17,003	8,733	80	3,671	12,484	29,487	1,304	30,791
1944	1,618	16,233	17,851	9,732	260	3,989	13,981	31,832	1,344	33,176
1945	1,395	15,134	16,529	9,939	429	4,213	14,581	31,110	1,442	32,552
1946	1,537	13,989	15,526	10,057	517	4,333	14,907	30,433	1,406	31,839
1947	1,453	16,522	17,975	10,771	576	4,926	16,273	34,248	1,426	35,674
1948	1,451	15,707	17,158	11,717	746	5,534	17,997	35,155	1,481	36,636
1949	1,085	11,472	12,557	10,683	897	5,827	17,407	29,964	1,539	31,503
1950	1,120	13,527	14,647	11,449	1,009	6,753	19,211	33,856	1,573	35,431
1951 [3]	1,084	13,982	15,066	13,018	1,029	8,016	22,065	37,130	1,559	38,690

[1] The unit heat values employed are: Anthracite, 12,700 B. t. u. per pound; bituminous coal and lignite, 13,100 B. t. u. per pound; petroleum, 5,800.000 B. t. u. per barrel; natural gas, 1,075 B. t. u. per cubic foot. Water power includes installations owned by manufacturing plants and mines, as well as Government- and privately-owned public utilities. The fuel equivalent of water power is calculated from the kilowatt hours of power produced wherever available as it is true of all public-utility plants since 1919. Otherwise, the fuel equivalent is calculated from the reported horsepower of installed water wheels, assuming a capacity factor of 20 percent for factories and mines and of 40 percent for public utilities.

Not all imports of energy and energy materials are included. The most important omission is petroleum products other than crude oil. A small portion of mineral fuels (roughly 3 percent) is used for purposes other than the production of energy.

[2] Fuel equivalent calculated by assuming the average central-station practice for each of the years for which data are available.

[3] Preliminary figures.

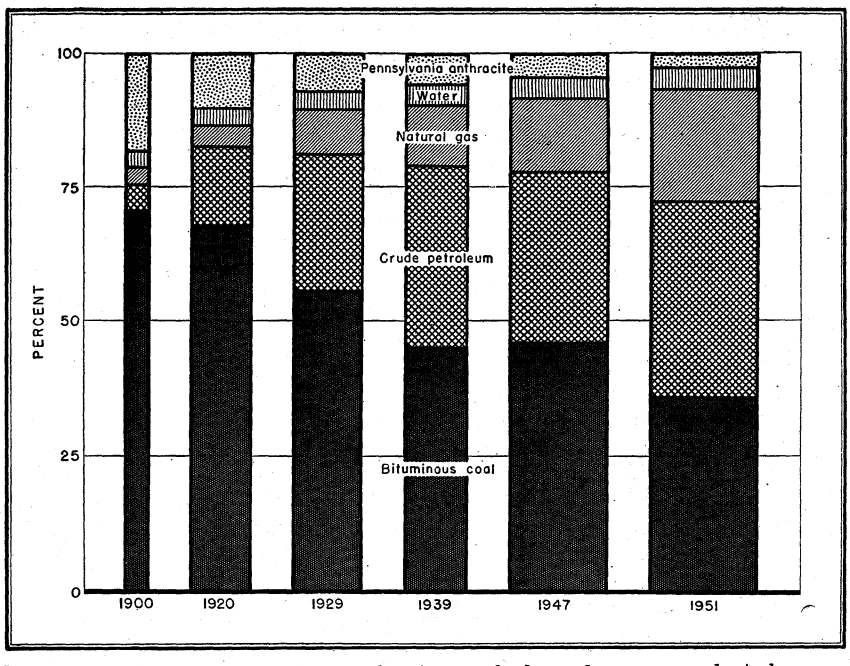

FIGURE 2.—Relative importance of primary fuels and energy, selected years, 1900–1951.

TABLE 2.—Relative importance of primary sources of energy in the United States, selected years from 1900 to 1951, in percent [1]

Fuel	1900	1920	1929	1939	1947	1950	1951
Bituminous coal	70.5	67.8	55.9	45.6	46.3	38.2	36.1
Crude petroleum	4.7	14.5	25.1	33.2	31.8	35.1	36.4
Natural gas	3.2	3.9	8.2	11.7	13.8	19.1	20.7
Water power	3.2	3.4	3.3	3.7	4.0	4.4	4.0
Pennsylvania anthracite	18.4	10.4	7.5	5.8	4.1	3.2	2.8
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

[1] Percentages based upon figures given in table 1.

In interpreting the long-term movements in these data there are several important qualifications. First, the data are in terms of B. t. u. (British thermal unit) content; however, work delivered by these fuels will not be in proportion to their B. t. u. contents because the efficiency with which fuels are utilized varies among fuels and also among different uses of the same fuel. This means that the gross changes in B. t. u. content of production may not closely reflect changes in work performed. Also, it must be remembered that for many uses the user is interested in more than just the quantity of heat that he can get out of a fuel. In the case of household space heating, he is interested as well in "clean" heat. The vehicle owner is not only interested in the quantity of energy and cleanliness of the fuel but also the rapidity with which the energy output can be changed and in low-cost vehicle maintenance.

The factors behind the various rates of growth in the production of primary fuels and energy are numerous, but perhaps the three most important are changes in the relative prices of the different fuels, differential rates of growth in noncompeting demands, and changes in the overall efficiency with which the different fuels are utilized. In connection with efficiency of fuel utilization, the crucial factor is the overall cost (not fuel cost) per unit of output, which in many applications will mean cost per B. t. u. output. If a fuel is cheap enough, it may pay to use it even though a large percentage of the contained B. t. u.'s is "wasted" in producing usable heat.

USE OF FUELS AND ENERGY

Data are not available for tracing detailed short-run changes in the use of fuels and energy. Data have been assembled for 1929 and 1947, however, and show long-run changes in fuel utilization in considerable detail (*see* tables 3–9).

A small portion of the output of primary fuels—about 2 percent—is consumed in the production of these fuels. Natural-gas producers are the heaviest consumers of their own outputs as shown in the following table:

Self-consumption of fuels and energy as a percentage of production in the United States, 1947 [1]

[Based on B. t. u. content

Bituminous coal	0. 4
Anthracite	3. 3
Crude petroleum	1. 4
Natural gas [2]	10. 8
Hydroelectric power	--
Wood and waste	--
All	2. 3

[1] Percentage figures derived from Lyon, W. H., and Colby, D. S., Production, Consumption, and Use of Fuels and Electric Energy in the United States in 1929, 1939, and 1947: Bureau of Mines Rept. of Investigations 4805, 1951, p. 12.
[2] Does not include loss.

After accounting for self-consumption, the most important primary fuels and energy then available are bituminous coal, crude petroleum, and natural gas. The percentage distribution of the net outputs of primary fuels and energy industries, based on B. t. u. content, is shown in columns A of table 3 for 1929 and 1947.

To a large extent, primary fuels are changed in form before use by the non-energy-producing sectors of the economy. For example, crude oil is not consumed in these sectors until converted into more convenient forms. Much of the coal output is converted into electrical energy. These and other changes in the form of primary fuels in turn require energy, with the result that in 1947 only 86 percent of the net output of primary fuels and energy was available to the non-energy-producing sectors of the economy—not counting the fuel energy consumed in transporting fuel from sources to use locations.

Large changes have taken place in the forms in which fuels and primary energy are consumed outside the energy-producing industries (*see* table 3). In 1929, 61 percent of the B. t. u. consumption outside the energy-producing industries was made up of primary fuel or energy.

TABLE 3.—Primary and secondary fuels and energy available to non-energy-producing sectors of the United States economy, 1929 and 1947, by sources, in percent of total [1]

[Based on B. t. u. content with electric energy at central-station fuel-consumption rate]

Source of fuel and energy	1929 (A) Primary fuels and energy available after self-consumption	1929 (B) Primary and secondary fuels and energy available to nonenergy sectors	1947 (A) Primary fuels and energy available after self-consumption	1947 (B) Primary and secondary fuels and energy available to nonenergy sectors
Primary fuels and energy:				
Bituminous coal	55.4	44.2	45.6	30.3
Anthracite	7.0	7.2	3.9	3.4
Crude petroleum	23.9	[2]	31.2	
Natural gas	7.1	5.5	13.0	9.8
Hydroelectric energy:				
Utility	2.8		3.7	
Industrial	.4	.4	.2	.2
Wood and waste	3.4	3.8	2.4	2.7
Total primary	100.0	61.1	100.0	46.4
Secondary fuels and energy:				
Briquets and packaged fuel		0.1		0.2
Coking:				
Coke		6.8		5.9
Crude light oil		[2]		.1
Coal tar		.6		.4
Byproduct gas		1.2		1.0
Total coking		8.6		7.4
Other manufactured gas		0.7		0.6
Net blast-furnace gas		[2]		−0.1
Refinery products:				
Liquefied petroleum and refinery gases		[2]		0.6
Still gas				.1
Motor fuels		8.8		13.4
Distillate oils:				
Kerosine		.9		1.9
Diesel and other		9.6		5.4
Residual oil		.1		8.1
Petroleum coke		1.3		.1
Nonfuel products				2.0
Total refinery products		20.7		31.6
Utility electric energy		8.8		13.9
Grand total		100.0		100.0

[1] Columns A show primary fuels and energy available after accounting for imports, exports, self-consumption, and changes in stocks.

Columns B show all fuels and energy available to nonenergy sectors after accounting for imports, exports, consumption in primary and secondary energy-producing industries, and changes in stocks of energy-producing industries.

These distributions are derived from Lyon, W. H., and Colby, D. S., Production Consumption, and Use of Fuels and Electric Energy in the United States in 1929, 1939, and 1947: Bureau of Mines Rept. of Investigations 4805, 1951, 90 pp.

[2] Less than 0.05 percent.

By 1947 the movement to secondary forms of fuels and energy had reduced this to 46 percent. The main factors in this shift were the increased reliance on refinery products instead of coal and a relative increase in the use of electric energy. Refinery products provided 21 percent of the energy consumed by nonenergy sectors in 1929, but by 1947 this percentage had risen to 32. Bituminous coal provided 44 percent of the energy consumed by nonenergy sectors in

1929, but by 1947 this percentage had dropped to 30 percent of the total.

In contrast with the changes that have occurred in the relative importance of the types of fuels and energy used by the non-energy-producing sector, the distribution of energy use was much the same in both 1929 and 1947 in its broader aspects (*see* table 4). Manufacturing industries consumed about 28 percent of the total, with transportation and domestic-commercial taking about a third each. Within manufacturing, the iron and steel industry was by far the biggest user.

TABLE 4.—Fuels and energy used by nonenergy-producing industries in the United States, 1929 and 1947, by industries, in percent of total [1]

[Based on B. t. u. content, with electric energy at central station fuel-consumption rate]

Industry	1929	1947 [2]	Industry	1929	1947 [2]
Manufacturing industries:			Transportation industries:		
Iron and steel	10.3	9.3	Railroads	19.1	12.3
Chemicals and allied products	2.3	3.3	Highway	7.9	11.4
Stone, clay, and glass products	3.8	2.9	Pipeline and utility system usage and losses	2.2	2.9
Food and kindred products	2.5	2.3	Bunkers (foreign trade only)	3.0	2.5
Paper and allied products	1.8	2.1	Nonhighway:		
Nonferrous metals	.7	1.4	Civilian aviation	(3)	.2
Textile mill products	1.6	1.3	Other	1.2	1.4
Fabricated metal products	1.0	.6			
Other manufacturing industries	4.2	4.2	Total	33.4	30.7
Total	28.2	27.4	Army, Navy, and Coast Guard	.2	.9
Nonfuel mines and quarries	1.1	.7	Domestic and commercial	31.2	33.7
			Nonfuel use	2.9	4.3
			Miscellaneous	3.0	2.3
			Grand total	100.0	100.0

[1] Derived from source cited in footnote 1, table 3.
[2] Does not include a small quantity of liquefied gases and motor fuel used by manufacturing industries and mines and quarries (0.2 percent of total); also some liquefied petroleum gases used for highway and nonhighway transportation purposes (0.03 percent of total).
[3] Less than 0.05 percent.

Within these categories, however, were wide differences in rates of growth of energy use. Energy use in the chemicals, paper, and nonferrous metals industries grew relative to the total. Consumption of energy by railroads fell from 19 to 12 percent of the total from 1929 to 1947, but highway consumption (autos and trucks) rose from 8 to 11 percent.

Within industries, important shifts in the sources of fuel and energy took place from 1929 to 1947. Manufacturing as a whole shifted from bituminous coal to utility electric energy, distillate and residual oil, and natural gas (*see* table 5). The same relative movements took place in iron and steel. In chemicals and allied products, however, both coal and utility electric energy lost ground, especially to natural gas.

Similar shifts from solid fuels took place for railroads and domestic and commercial users. Railroads moved from coal to oils, whereas domestic and commercial users moved to natural gas, oil, and electric energy (*see* tables 6 and 7). Residential use and commercial space heating exhibited a great shift from solid fuels between 1935 and 1950 (*see* table 8). This movement continued from 1950 to 1951. In 1950 solid fuels provided 48 percent of these requirements, but only 43 percent in 1951.

TABLE 5.—Fuel and energy used by selected manufacturing industries in the United States, 1929 and 1947, by sources, in percent of total [1]

Source of fuel and energy	All manufacturing [2]		Iron and steel		Chemicals and allied products		Stone, clay and glass products		Food and kindred products		Nonferrous metals	
	1929	1947	1929	1947	1929	1947	1929	1947	1929	1947	1929	1947
Bituminous coal	46.1	31.3	27.1	11.2	53.7	45.3	68.5	48.9	57.4	46.0	35.6	12.8
Utility electric energy	12.3	18.8	3.5	8.9	29.7	19.3	7.3	11.0	16.4	20.0	16.7	52.7
Coke	20.1	20.2	50.4	55.4	1.3	5.4	.5	1.1	2.9	.7	3.3	4.2
Distillate and residual fuel oil	7.7	11.8	6.8	12.0	8.5	9.8	6.0	9.9	8.7	13.0	14.8	10.0
Natural gas	4.9	11.0	2.7	5.4	2.5	16.0	15.1	26.5	6.6	16.3	12.1	16.4
Manufactured gas	2.8	2.7	6.7	5.9	.2	1.0	.2	1.5	.8	1.2	1.0	1.0
Anthracite	3.6	2.1	.7	.6	4.1	3.2	2.4	1.1	7.1	2.8	16.5	2.9
Wood and waste	1.7	1.2	.2	[3]	------	------	------	------	------	------	------	------
Motor fuel	.1	.7	[3]	------	[3]	------	[3]	------	.1	------	[3]	------
Coal tar	.7	.2	1.9	.6	------	------	------	------	------	------	------	------
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

[1] Based on B. t. u. content. Derived from source cited in footnote 1, table 3.
[2] Includes industries not shown separately.
[3] Less than 0.05 percent.

TABLE 6.—Fuel and energy used by railroads in the United States, 1929 and 1947, by sources, in percent of total [1]

Source of fuel and energy	1929	1947
Bituminous coal	84.9	78.2
Anthracite	2.4	.6
Motor fuel (nondiesel)	.1	.1
Diesel oil	11.8	3.2
Other distillate		.5
Residual oil		16.2
Electric energy	.6	1.2
Other	.2	------
Total	100.0	100.0

[1] Based on B. t. u. content. Derived from source cited in footnote 1, table 3.

TABLE 7.—Fuel and energy used for domestic and commercial purposes in the United States, 1929 and 1947, by sources, in percent of total [1]

Source of fuel and energy	1929	1947
Bituminous coal	44.9	35.1
Anthracite	18.3	8.1
Natural gas	5.4	11.0
Wood and waste	10.5	7.0
Briquets and packaged fuels	.4	.7
Coke	3.5	1.1
Manufactured gas	3.3	2.1
Liquefied gases	------	1.1
Kerosine	2.9	4.9
Distillate and residual oil	2.4	13.1
Electric energy	8.4	15.8
Total	100.0	100.0

[1] Based on B. t. u. content. Derived from source cited in footnote 1, table 3.

TABLE 8.—Relative amounts of fuels and power consumed in all residential uses and commercial space heating in the United States, 1935, 1946, 1950, and 1951, in percent of total [1]

Type of fuel or energy	1935	1946	1950	1951
Liquid	9.6	19.1	26.2	28.2
Gaseous fuel	9.4	15.4	22.7	25.5
Solid fuel	80.1	63.6	48.2	43.0
Electricity	.9	1.9	2.9	3.3
Total	100.0	100.0	100.0	100.0

[1] These distributions are based on physical state at point of combustion. The data are from Coumbe, A. T., and Avery, I. F., Fuels Consumed for Residential and Commercial Space Heating, 1935-51; Bureau of Mines Inf. Circ. 7657, 1953, 10 pp.

TABLE 9.—Distribution of selected fuels and energy to nonenergy producing industries in the United States, 1929 and 1947, in percent of total [1]

Industry	Bituminous coal		Natural gas		Distillate and residual oils		Utility electric energy	
	1929	1947	1929	1947	1929	1947	1929	1947
Manufacturing industries:								
Food and kindred products	3.2	3.5	3.0	3.8	2.1	1.9	4.6	3.3
Textile mill products	2.0	1.7	.2	.2	1.7	1.4	4.5	3.2
Paper and allied products	2.7	3.8	1.1	2.4	.9	1.5	3.3	2.3
Chemicals and allied products	2.8	5.0	1.0	5.5	1.8	2.1	7.6	4.6
Stone, clay, and glass	5.8	4.6	10.4	7.9	2.1	1.9	3.2	2.3
Iron and steel	6.4	3.4	5.2	5.1	6.6	7.3	4.2	6.0
Nonferrous metals	.6	.6	1.6	2.4	1.0	.9	1.4	5.5
Fabricated-metal products	.9	.6	1.2	.7	1.4	.7	2.4	1.5
Other manufacturing	5.0	5.2	1.6	2.9	3.1	3.2	8.3	8.7
Total	29.4	28.4	25.3	30.9	20.7	20.9	39.5	37.4
Nonfuel mines and quarries	1.1	0.5	2.2	1.2	1.1	0.6	3.2	2.1
Transportation:								
Pipeline and utility system usage and losses			3.4	4.4		.7	18.8	15.2
Railroads	36.8	31.6	.5		21.3	15.8	1.3	1.0
Bunkers (foreign trade only)	1.1	.5			24.0	15.2		
Nonhighway						1.0	6.7	1.8
Highway								
Total	37.9	32.1	3.9	4.4	45.3	32.7	26.8	18.0
Army, Navy, and Coast Guard					1.7	3.2		
Domestic and commerical	31.6	39.0	30.9	37.8	15.9	39.3	29.6	38.5
Nonfuel use			22.4	17.4				
Miscellaneous			15.3	8.3	15.3	3.3	.9	4.0
Grand total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

[1] Based on B. t. u. content. Derived from source quoted in footnote 1, table 3.

In table 9, which shows a detailed breakdown of the percent distribution of selected fuels and energy to nonenergy-producing industries during 1929 and 1947, it is possible to compare the relative importance in 1947 of the markets for each of the fuels as against the relative importance of these same markets for the specific fuels in 1929.

FUEL EFFICIENCY

It has already been emphasized that a decisive criterion in selecting a fuel is its cost per unit of useful output. Cost per contained B. t. u. is not necessarily decisive and may be higher for the fuel actually selected than for those rejected. Cost per contained B. t. u. can be offset by more efficient utilization or cheaper burning equipment.

Cost of fuel per unit of useful output is not completely decisive because it is only a part of the total cost of obtained useful energy flow. The complete and relevant cost concept also must include labor and equipment costs. Even with these qualifications, however, fuel efficiency is an important element of overall energy cost. Because of this, data on fuel efficiency do serve as useful indicators of changes in energy cost, although the correspondence is not perfect.

Electric Generating Stations.—The long-run trends of fuel consumed per kilowatt hour in electric generating stations have been very similar for coal, oil, and gas. Data for 1920–51 are shown in table 10. The percentage by which fuel consumption declined per year was quite rapid in the early years following 1920. The rate of decline gradually slowed until the 1930's, when there were very few gains. Consumption of coal declined slightly during the late thirties and early forties.

TABLE 10.—Average consumption of coal, oil and gas per kilowatt-hour in electric generating stations in the United States, 1920–51 [1]

Year	Coal (pounds)	Oil (gallons)	Gas (thousand cubic feet)	Year	Coal (pounds)	Oil (gallons)	Gas (thousand cubic feet)
1920	3.0	0.254	36.9	1936	1.44	.118	17.1
1921	2.7	.220	31.0	1937	1.44	.118	17.1
1922	2.5	.209	31.2	1938	1.40	.113	17.1
1923	2.4	.195	29.3	1939	1.38	.099	16.3
1924	2.2	.182	26.3	1940	1.34	.111	16.5
1925	2.0	.164	23.9	1941	1.34	.112	16.8
1926	1.9	.157	22.9	1942	1.30	.114	16.7
1927	1.82	.153	21.5	1943	1.30	.111	17.0
1928	1.73	.143	20.8	1944	1.29	.108	16.6
1929	1.66	.137	19.7	1945	1.30	.109	16.6
1930	1.60	.132	19.0	1946	1.29	.108	16.3
1931	1.52	.128	18.0	1947	1.31	.113	16.1
1932	1.49	.123	17.6	1948	1.30	.107	15.9
1933	1.46	.122	17.3	1949	1.24	.098	14.9
1934	1.45	.120	17.2	1950	1.19	.094	14.1
1935	1.44	.118	17.0	1951	1.14	.094	13.5

[1] Derived from Federal Power Commission, Consumption of Fuel for Production of Electrical Energy 1951: Report S–100, Washington, D. C., pp. 4, 6, and 9.

Since 1948 the fuel efficiency of all three fuels has improved. In interpreting these declines in fuel consumption, it should be remembered that the United States average reflects the efficiency of equipment installed in earlier as well as recent years. Hence, fuel-consumption statistics will fully reflect technological advance only after a substantial lag. (There is also an element of equipment utilization that is difficult to segregate.)

Railroads.—Fuel-consumption data for railroads are available for a much shorter period than for electric generating stations. Available data are presented in table 11.

During the period covered in table 11, there were no persistent trends in thermal fuel efficiency for each of the fuels shown. The trend has, of course, been to replace coal and fuel oil with diesel oil as the chief energy fuel in the railroad industry. The reasons for this shift include lower fuel costs and greater economies in operation. In 1951 the costs of the coal, fuel oil, and diesel oil per thousand gross ton-miles of freight service were 28, 37, and 15 cents, respectively.

TABLE 11.—Average consumption of diesel oil, fuel oil, and coal on United States railroads per 1,000 gross ton-miles of road freight service, including locomotives and tenders, 1936–51 [1]

Year	Fuel oil (gallons)	Coal (pounds)	Year	Diesel oil [2] (gallons)	Fuel oil (gallons)	Coal (pounds)
1936	8.63	121	1944	1.7	8.15	119
1937	8.65	118	1945	1.7	8.27	123
1938	8.41	117	1946	1.6	8.46	124
1939	8.23	115	1947	1.6	8.26	123
1940	8.16	115	1948	1.6	8.21	124
1941	8.10	113	1949	1.6	8.54	122
1942	8.23	113	1950	1.6	8.80	120
1943	8.31	117	1951	1.6	8.63	118

[1] Interstate Commerce Commission, Bureau of Transport Economics and Statistics, Fuel and Power Statistics of Class I Steam Railways in the United States (Statements No. M-230).
[2] Consumption prior to 1944 was relatively minor.

FOREIGN TRADE

The export and import data shown in tables 12–18 serve to illustrate several major points of interest. These points involve the shifts over time in international trade patterns and the shift of the United States from a net importer position to a net exporter position, or vice versa, in the case of certain fuels.

TABLE 12.—Fuel imported for consumption in the United States, 1939, and 1945–51 [1]

[U. S. Department of Commerce]

Fuel	1939	1945	1946	1947	1948	1949	1950	1951
Petroleum products (million barrels):								
Crude petroleum	28.6	74.0	87.5	99.3	128.6	154.8	172.7	177.5
Residual fuel oil [2]	2.2	27.7	22.9	32.8	29.9	52.8	99.3	88.2
Gas oil and finished distillate oil	.2	19.9	8.2	3.7	2.3	1.7	2.0	2.3
Total	31.0	121.6	118.6	135.8	160.8	209.3	274.0	268.0
Bituminous coal [3] (thousand net tons)	355.1	467.5	434.7	290.1	291.3	315.0	346.7	291.5

[1] Imports of fuels other than those shown have been minor.
[2] Excluding fuel oil for vessels and aircraft.
[3] Includes slack, culm, and lignite.

TABLE 13.—Fuel exported from the United States, 1939 and 1945–51 [1]

[U. S. Department of Commerce]

Fuel	1939	1945	1946	1947	1948	1949	1950	1951
Petroleum products (million barrels):								
Crude petroleum	72.1	35.4	42.6	45.9	39.7	33.1	34.8	28.6
Residual fuel oil	15.0	7.2	5.8	8.1	9.3	8.5	11.9	24.1
Gas oil and finished distillate oil	30.6	31.7	27.2	26.0	18.5	10.0	10.5	19.9
Total	117.7	74.3	75.6	80.0	67.5	51.6	57.2	72.6
Natural gas (trillion cubic feet)	------	13.2	13.3	8.0	5.6	5.2	23.5	19.6
Bituminous coal (million net tons) [2]	11.6	28.0	41.2	68.7	45.9	27.8	25.5	56.7

[1] Not including shipments to United States Territories.
[2] Excludes fuel or bunker coal loaded on vessels engaged in foreign trade.

The effects of World War II and the war in Korea were reflected in the abnormal coal exports of bituminous coal to Europe. After World War II, when European coal production was still in the process of regaining prewar levels, coal exports from this country to the Netherlands, Belgium, France, and Italy increased sharply over the prewar levels. Similarly, the heightened industrial activity resulting from war in Korea increased coal exports to Europe after these exports had returned to a more normal level during 1949–50.

The defense and increased industrial activity that followed the outbreak of war in Korea also resulted in a rise in United States exports of gas oil and distillate fuel oil. Most of the increase in exports went to Canada, the United Kingdom, Sweden, Mexico, and the Netherlands Antilles.

TABLE 14.—Bituminous coal exported from the United States, 1939 and 1945–51, by major country of destination, in thousands of net tons [1]

[U. S. Department of Commerce]

Country	1939	1945	1946	1947	1948	1949	1950	1951
Argentina	232	314	487	1,114	827	31	97	1,632
Austria				122	58			929
Belgium-Luxembourg		437	888	3,364	631		50	1,495
Brazil	425	665	1,083	1,468	959	682	1,055	1,027
Canada	9,975	21,586	21,880	25,848	25,843	15,982	[2] 23,009	[2] 22,823
Denmark	3	199	1,060	2,378	52			1,076
France		624	5,092	12,467	8,459	3,639	11	4,305
Germany				43	71		31	6,047
Italy	39	1,112	4,688	8,780	4,696	3,912	115	5,086
Japan					689	1,355	147	1,569
Netherlands		434	1,607	2,691	771	311	34	3,369
Norway	42	354	744	739			6	992
Sweden	26	134	861	2,074	587	437	141	942
Switzerland	25	99	308	683	421	187	196	1,062
United Kingdom				675			104	1,302
All other	823	1,998	2,510	6,221	1,866	1,306	472	3,070
Total	11,590	27,956	41,208	68,667	45,930	27,842	25,468	56,726

[1] Excludes fuel or bunker coal loaded on vessels engaged in foreign trade.
[2] Includes Newfoundland and Labrador.

The data dealing with crude petroleum and residual fuel oil imports and exports strikingly illustrate the shift in the United States import-export position in these fuels. During the period 1939 through 1951 the United States changed from a net exporter of crude petroleum and residual fuel oil to a net importer of these two major petroleum items. During this same period the Middle East and Venezuela grew considerably in importance as areas of supply for crude and residual, whereas Mexico and Colombia diminished in importance.

Though the United States imports only negligible quantities of natural gas, as of 1951, United States exports of natural gas to Canada and Mexico have grown in importance.

TABLE 15.—Residual fuel oil imported for consumption in the United States, 1939 and 1945–51, by major country, in thousands of barrels [1]

[U. S. Department of Commerce]

Country	1939	1945	1946	1947	1948	1949	1950	1951
Netherlands Antilles	2,112	27,195	21,597	28,896	27,166	47,348	74,136	65,839
Saudi Arabia		1		1,521	793	4	157	
Trinidad and Tobago	59	120	9	30	118	710	2,003	1,600
Venezuela		190	416	609	111	3,813	21,531	20,380
All other	42	209	882	1,727	1,749	907	1,515	336
Total	2,213	27,715	22,904	32,783	29,937	52,782	99,342	88,155

[1] Excluding fuel oil for vessels and aircraft.

TABLE 16.—Residual fuel oil exported from the United States, 1939 and 1945–51, by major country of destination, in thousands of barrels

[U. S. Department of Commerce]

Country	1939	1945	1946	1947	1948	1949	1950	1951
Australia				(1)	(1)			1,803
Canada	611	728	1,924	2,407	3,767	2,819	4,498	5,761
Chile	1,903		90	348	109	935	1,965	1,961
Italy	1,402					1		
Japan	3,889				131	301	71	3,991
Mexico	351	585	837	1,342	1,285	1,360	2,171	2,328
Philippines	812			104	142	298	7	735
United Kingdom	279	4,360		409	5		74	1,109
All other	5,725	1,482	2,963	3,478	3,904	2,834	3,099	6,435
Total	14,972	7,155	5,814	8,081	9,343	8,548	11,885	24,123

[1] Less than 500 barrels.

TABLE 17.—Crude petroleum imported for consumption in the United States, 1939 and 1945–51, by major country, in thousands of barrels

[U. S. Department of Commerce]

Country	1939	1945	1946	1947	1948	1949	1950	1951
British Malaya								3,543
Canada		25		112	1	(1)	5	473
Colombia	1,166	8,389	10,068	11,679	8,649	11,425	15,699	16,684
Kuwait			115	229	7,430	23,075	26,163	21,648
Mexico	1,688	2,477	2,961	5,808	4,060	4,250	9,493	12,889
Saudi Arabia	1			391	10,695	12,460	13,973	16,161
Venezuela	25,645	63,112	74,362	81,096	93,748	101,825	106,948	105,856
All other	62	1	1		4,004	1,789	455	220
Total	28,562	74,004	87,507	99,315	128,587	154,824	172,736	177,474

[1] Less than 500 barrels.

TABLE 18.—Crude petroleum exported from the United States, 1939 and 1945–51, by major country of destination, in thousands of barrels

[U. S. Department of Commerce]

Country	1939	1945	1946	1947	1948	1949	1950	1951
Argentina	2,125	70	724	1,052	1,417	242	661	1,356
Canada	28,121	32,841	36,595	39,058	33,298	29,996	30,708	21,172
Cuba	1,141	824	1,158	1,354	1,498	1,759	1,829	2,167
Japan	16,086						334	2,403
All other	24,591	1,618	4,097	4,892	3,524	1,071	1,292	1,505
Total	72,064	35,353	42,574	46,356	39,737	33,068	34,824	28,603

PART II. COMMODITY REVIEWS

Abrasive Materials

By Henry P. Chandler and A. L. Marks

GENERAL SUMMARY

INCREASED production was reported in nearly all branches of the abrasive industry during 1951, and new records were established in the output of the following natural abrasives: Quartz, ground sand and sandstone, pumice and pumicite, garnet, and emery. In the artificial abrasive field record production was made of silicon carbide and metallic abrasives, and aluminum oxide production almost equaled the record output of 1943.

Imports of industrial diamonds increased 9 percent by weight and 26 percent in total value over the 1950 figures. Corundum imports during 1951 increased 38 percent in tonnage and 40 percent in value over the preceding year.

TABLE 1.—Salient statistics of the abrasives industry in the United States, 1950–51

	1950		1951		Percent of change	
	Short tons	Value	Short tons	Value	Short tons	Value
Natural abrasives (domestic) sold or used by producers:						
Diatomite	[1]	[1]	[1]	[1]		
Tripoli	43,720	$1,173,647	37,476	$1,105,135	−14	−6
Quartz	160,508	706,724	281,047	1,165,370	+75	+65
Ground sand and sandstone	750,673	6,462,503	818,479	7,163,343	+9	+11
Grindstones	4,435	230,462	5,549	313,901	+25	+36
Pulpstones	33	2,100	22	1,970	−33	−6
Millstones	[2]	11,300	[2]	6,000		−47
Tube-mill liners	1,523	62,535	1,408	77,027	−8	+23
Grinding pebbles	1,923	53,007	3,062	84,306	+59	+59
Pumice and pumicite	719,356	2,661,052	749,942	2,752,907	+4	+3
Garnet	9,304	793,558	14,050	1,246,947	+51	+57
Emery	5,949	75,308	11,634	160,212	+96	+113
Artificial abrasives:						
Silicon carbide—production [3]	65,004	7,303,671	100,498	11,734,812	+55	+61
Aluminum oxide—production [3]	140,352	11,958,035	216,329	21,444,343	+54	+79
Metallic abrasives (steel shot and grit)—shipments	144,333	11,699,764	165,138	17,923,301	+14	+53
Foreign trade (natural and artificial abrasives):						
Imports		[4] 48,801,998		65,487,548		+34
Exports		[4] 16,175,052		25,157,033		+56

[1] Average annual figure for 1949–51 was 274,070 short tons valued at $7,577,119; annual data not published separately in this case to avoid disclosing individual company operations.
[2] Tonnage not recorded.
[3] Includes Canadian production.
[4] Revised figure.

This chapter includes data for most materials used for abrasive purposes, but certain clays, carbides, oxides, and other substances noted in the Miscellaneous Mineral-Abrasive Materials section are not covered. Certain abrasive products for which figures are given also have important nonabrasive uses.

NATURAL SILICA ABRASIVES

Diatomite.—The production of diatomite continued to increase during 1951. To avoid disclosing individual company operations, the Bureau of Mines, in this case, does not publish the annual data separately; however, the average production for 1949–51 was 274,000 short tons, valued at $7,577,000. This compares with an average of 214,000 short tons valued at $4,307,000 for 1945–47, an increase of 28 percent in tonnage and 76 percent in value.

During 1951 diatomite was produced for sale in three States—California, Nevada, and Oregon. Production in Washington was temporarily suspended.

The principal uses of diatomite in 1951 were: Filtration, 54 percent; fillers, 27 percent; insulation, 12 percent; abrasives, 2 percent; and other uses, 5 percent.

It was reported that two companies producing diatomite in California increased their productive capacity.[1] A description of current mining and processing methods in California appeared in a mining publication.[2]

As quoted in E&MJ Metal and Mineral Markets, prices of diatomite during 1951 continued unchanged from the previous year as follows (per ton, crude, in bulk, dried, nominal): Nevada, f. o. b. mill, 98- to 100-mesh, $25; low-temperature insulation, $25; high-temperature insulation, $40; fine abrasive, 2 to 3 cents a pound (bags extra); California, filtration grades, $20 to $50 f. o. b. mill.

The Geological Surveys of Queensland, Australia, and Nova Scotia, Canada, described newly developed deposits of diatomite in those Provinces,[3] and an occurrence of diatomite in India was the subject of a consular report.[4]

Tripoli.—The sales of tripoli, amorphous silica, and rottenstone totaled 37,476 short tons valued at $1,105,000, a decrease of 14 percent in tonnage and 6 percent in value from the 1950 figures. These commodities were produced in Illinois, Missouri, and Pennsylvania.

The quantity of tripoli used as an abrasive decreased 20 percent in 1951 from 1950. The other uses—for fillers, foundry facing, etc.—increased slightly.

Companies producing tripoli, amorphous silica, and rottenstone in 1951 were: Ozark Minerals Co., Cairo, Ill. (amorphous silica); Tamms Industries, Inc., 228 North LaSalle St., Chicago 1, Ill. (amorphous silica); American Tripoli Corp., Seneca, Mo. (tripoli); Penn Paint & Filler Co., Antes Fort, Pa. (rottenstone); and Keystone Filler & Mfg. Co., Muncy, Pa. (rottenstone).

Quotations on tripoli in E&MJ Metal and Mineral Markets remained unchanged from 1950, as follows (per short ton, paper bags, minimum carlot 30 tons, f. o. b. Missouri): Once-ground through 40-mesh, rose and cream, $30; double-ground through 110-mesh, rose and cream, $32; air-floated through 200-mesh, $35.

[1] Oil, Paint & Drug Reporter, Diatomite Shortage to Be Eased by New Johns-Manville Output: Vol. 160, No. 9, Aug. 27, 1951, p. 83; Wall Street Journal, vol. 138, No. 81, Oct. 5, 1951, p. 10; Pit and Quarry, vol. 43, No. 11, May 1951, p. 71.

[2] Mining Magazine, vol. 84, No. 1, January 1951, p. 28.

[3] Queensland Government Mining Journal, West Haldon Diatomite Deposit: Vol. 51, No. 590, Dec. 20, 1950, pp. 984–986. Diatomite—Black Duck Creek—Gatton: Vol. 52, No. 597, July 20, 1951, pp. 353–358. Foran, M. R., Nova Scotia Diatomite: Canadian Min. and Met. Bull., vol. 44, No. 472, August 1951, pp. 538–545.

[4] Deimel, H. L., American consulate general, Madras, India, Dispatch 322, New Delhi, India, Aug. 8, 1951, 2 pp.

TABLE 2.—Tripoli [1] sold or used by producers in the United States, 1947–51, by uses [2]

Year	Abrasives		Filler		Other, including foundry facings		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1947	29,866	$654,232	2,573	$47,640	2,139	$49,550	34,578	$751,422
1948	22,193	606,402	2,723	45,000	1,929	54,121	26,845	705,523
1949	20,972	587,241	2,820	53,938	1,733	49,385	25,525	690,564
1950	34,865	968,497	6,744	147,379	2,111	57,771	43,720	1,173,647
1951	28,000	869,000	7,000	155,000	2,476	81,135	37,476	1,105,135

[1] Including amorphous silica and Pennsylvania rottenstone.
[2] Partly estimated.

Quartz.—Total sales of crude, crushed, and ground quartz from pegmatite veins or dikes and from quartzite in 1951 increased 75 percent in tonnage and 65 percent in value compared with 1950. The principal uses for which the reported tonnage was consumed included glass and ferrosilicon, with smaller quantities for abrasives, filters, pottery, tile, and miscellaneous. Sales of crude quartz declined from 1950, but sales of crushed and of ground quartz increased substantially. These data do not include the sales of quartzite to cement mills and certain sales of quartz or quartzite for use in the manufacture of ferrosilicon.

The average value of the quartz reported in this section was $4.15 per ton in 1951, compared with $4.40 in 1950 and $4.42 in 1949.

TABLE 3.—Quartz (crude, crushed, and ground) sold or used by producers in the United States, 1947–51 [1]

Year	Crude		Crushed		Ground [2]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1947	21,940	$118,231	62,169	$170,254	17,208	$136,040	101,317	$424,525
1948	41,081	250,184	104,496	374,781	16,284	125,702	161,861	750,667
1949	15,816	74,562	72,432	257,213	19,304	143,716	107,552	475,491
1950	11,062	52,591	117,499	430,256	31,947	223,877	160,508	706,724
1951	8,236	23,098	237,806	890,918	35,005	251,354	281,047	1,165,370

[1] Does not include sales of quartzite to cement mills or certain sales of quartz or quartzite for use in the manufacture of ferrosilicon.
[2] To avoid duplication, the ground material shown here is only that ground by the original producers of the crude quartz or by grinders who purchase from small miners not reporting their production.

The combined production of quartz in California and Oregon in 1951 showed a substantial increase over 1950, both in tonnage and value.

A discovery of a quartz deposit of excellent quality in Utah was reported,[5] and significant developments in quartz-crystal synthesis were recorded during 1951.[6]

Ground Sand and Sandstone.—Sales of ground sand and sandstone in 1951 increased 9 percent in tonnage and 11 percent in value over 1950. The average value per ton in 1951 was $8.75, compared with

[5] Chemical and Engineering News, vol. 29, No. 40, Oct. 1, 1951, p. 4053; Oil, Paint and Drug Reporter, vol. 160, No. 14, Oct. 1, 1951, p. 44; Rock Products, vol. 54, No. 11, November 1951, p. 56.
[6] Foose, Richard M., Industrial Minerals Have Boom Year in Construction Materials—Quartz Crystal: Min. Eng., vol. 190, No. 2, February 1951, p. 132.

$8.61 in 1950 and 1949. Illinois, the State producing the largest tonnage, accounted for 32 percent of the total, its output declining slightly in tonnage, but increasing a little in value over the preceding year. New Jersey, which ranks second as a producer, with 18 percent of the total, reported small increases both in tonnage and value over 1950. Idaho showed a relatively large increase in tonnage and value, but little change was noted in the other producing States.

TABLE 4.—Quartz (crude, crushed, and ground) sold or used by producers in the United States, 1949–51, by States [1]

State	1949		1950		1951	
	Short tons	Value	Short tons	Value	Short tons	Value
Arizona, California, Oregon, Washington	51,185	$212,114	[2] 89,290	[2] $318,720	193,444	$747,161
Connecticut	16,225	97,350	27,560	166,810	31,459	193,127
Massachusetts	577	4,265	2,145	23,646		
Other States [3]	39,565	161,762	41,513	197,548	56,144	225,082
Total	107,552	475,491	160,508	706,724	281,047	1,165,370

[1] Does not include sales of quartzite to cement mills or certain sales of quartz or quartzite for use in the manufacture of ferrosilicon. To avoid duplication, the ground material included is only that ground by the original producers of the crude quartz or by grinders who purchase from small miners not reporting their production.
[2] Arizona included with "Other States" to avoid disclosure of individual company operations.
[3] Arizona (1950), Maine (1950–51), Maryland (1949), North Carolina, and Wisconsin (1949, 1951).

TABLE 5.—Ground sand and sandstone sold or used by producers in the United States, 1946–51

Year	Short tons	Value	Year	Short tons	Value
1946	575,888	$4,125,398	1949	610,789	$5,258,464
1947	644,508	5,154,264	1950	750,673	6,462,503
1948	692,773	5,778,277	1951	818,479	7,163,343

TABLE 6.—Ground sand and sandstone sold or used by producers in the United States, 1949–51, by States

State	1949		1950		1951	
	Short tons	Value	Short tons	Value	Short tons	Value
Georgia	771	$7,712	1,176	$11,760	1,874	$18,740
Idaho			3,700	29,600	11,968	107,738
Illinois	217,577	1,887,144	263,122	2,278,237	262,488	2,300,102
Massachusetts	1,514	9,650	1,829	9,882	(1)	(1)
New Jersey	107,946	755,215	131,744	936,817	144,098	1,053,991
Ohio, Virginia, and West Virginia	192,134	1,776,717	218,281	2,002,703	249,345	2,305,825
Other States [2]	90,847	822,026	130,821	1,193,504	148,706	1,376,947
Total	610,789	5,258,464	750,673	6,462,503	818,479	7,163,343

[1] Included with "Other States" to avoid disclosure of individual company operations.
[2] California, Massachusetts (1951), Michigan (1951), Missouri, North Carolina (1950), Oklahoma, Pennsylvania, Washington, and Wisconsin.

The pottery, porcelain, and tile industries were the largest consumers of ground sand and sandstone, using 41 percent of the specified total, followed by abrasive industries—chiefly cleansing and scouring

compounds (23 percent), foundries (14 percent), fillers (12 percent), enamel (4 percent), and all other uses (6 percent). The distribution by uses in 1951 was based on reports from companies accounting for 85 percent of the total sales.

TABLE 7.—Ground sand and sandstone sold or used by producers in the United States in 1951, by uses

Use	Short tons	Value	
		Total	Average per ton
Abrasive:			
Cleansing and scouring compound	147,218	$1,237,136	$8.40
Other	9,884	87,640	8.87
Enamel	30,870	247,349	8.01
Filler	83,912	638,290	7.61
Filter	2,980	26,800	8.99
Foundry	97,809	791,542	8.09
Glass	8,910	70,652	7.93
Pottery, porcelain, and tile	287,273	2,766,668	9.63
Other uses [1]	28,378	228,630	8.06
Use reported, total	697,234	6,094,707	8.74
Use unspecified	121,245	1,068,636	8.81
Grand total	818,479	7,163,343	8.75

[1] Include paint, plaster, roofing, and siding.

Abrasive Sands.—Considerable tonnages of natural sands with a high silica content are sold for abrasive purposes, such as glass grinding, stone polishing, and sand blasting. Sales of these sands in 1951 totaled 1,476,912 short tons valued at $3,111,649, compared with 1,299,760 tons valued at $2,670,791 in 1950. The 1951 figures include 549,955 short tons of blast sand valued at $1,875,775, compared with 470,717 short tons valued at $1,463,623 in 1950. The quantity and value of these sands are included in the figures given in the Sand and Gravel chapter of this volume where detailed data regarding tonnages produced in each State appear.

SPECIAL SILICA-STONE PRODUCTS

Grindstones and Pulpstones.—Sales of grindstones in 1951 increased 25 percent in tonnage and 36 percent in value over 1950, but the sales of pulpstones declined in both quantity and value. Ohio and West Virginia were the only States reporting the manufacture of grindstones, and pulpstones were produced only in Washington.

TABLE 8.—Grindstones and pulpstones sold by producers in the United States, 1947–51

Year	Grindstones		Pulpstones		
	Short tons	Value	Quantity		Value
			Pieces	Equivalent short tons	
1947	10,620	$476,811	24	76	$4,976
1948	7,921	402,667	12	33	2,100
1949	4,479	244,704	7	28	1,975
1950	4,435	230,462	12	33	2,100
1951	5,549	313,901	6	22	1,970

Oilstones and Other Sharpening Stones.—Output of natural sharpening stones increased during 1951. The Bureau of Mines is not at liberty to publish the exact figures because of the small number of producers. Producing States in 1951 were: Arkansas—oilstones and whetstones; Indiana—whetstones, hones and rubbing stones; New Hampshire—scythestones; Ohio—rubbing stones (holystones).

Millstones.—Only one company, in North Carolina (Rowan County) reported production of millstones in the United States during 1951, and no chasers were manufactured.

TABLE 9.—Value of millstones and chasers sold by producers in the United States, 1946–51 [1]

Year	Number of producers	Value	Year	Number of producers	Value
1946	4	$14,780	1949	2	$9,400
1947	4	23,189	1950	2	11,300
1948	3	17,733	1951	1	6,000

[1] Produced in New York (1946–48 only), North Carolina, and Virginia (except 1951).

Grinding Pebbles and Tube-Mill Liners.—The combined output of grinding pebbles and tube-mill liners in 1951 increased 30 percent in tonnage and 40 percent in value over the previous year. Grinding pebble production was reported from the following States: Minnesota, Wisconsin, Texas, North Carolina, and Washington; and tube-mill liners from Minnesota, Wisconsin, and North Carolina.

TABLE 10.—Grinding pebbles and tube-mill liners sold or used by producers in the United States, 1947–51

Year	Grinding pebbles		Tube-mill liners		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1947	5,860	$122,883	1,496	$40,303	7,356	$163,186
1948	4,026	101,583	1,297	41,555	5,323	143,138
1949	2,374	64,038	1,166	47,093	3,540	111,131
1950	1,923	53,007	1,523	62,535	3,446	115,542
1951	3,062	84,306	1,408	77,027	4,470	161,333

NATURAL SILICATE ABRASIVES

Pumice and Pumicite.—Production of pumice and pumicite (volcanic ash) in 1951 increased 4 percent in tonnage and 3 percent in value over 1950. Its principal use as in prior years was as aggregate in lightweight concrete.

TABLE 11.—Pumice and pumicite sold or used by producers in the United States,[1] 1946–51

Year	Short tons	Value	Year	Short tons	Value
1946	319,883	$1,585,753	1949	716,742	$2,369,082
1947	442,552	2,021,880	1950	719,356	2,661,052
1948	607,746	2,501,906	1951	749,942	2,752,907

[1] Includes Alaska.

TABLE 12.—Pumice and pumicite sold or used by producers in the United States, 1949–51, by States

State	1949		1950		1951	
	Short tons	Value	Short tons	Value	Short tons	Value
California	149,878	$799,602	157,497	$970,826	264,411	$1,228,569
Idaho	71,373	105,360	93,990	121,044	83,528	133,192
Nebraska	4,622	40,000	(1)	(1)	(1)	(1)
New Mexico	351,368	1,026,479	351,642	1,109,883	245,564	884,311
Oregon	104,475	273,427	79,653	320,530	47,026	137,136
Utah	(1)	(1)	8,719	10,891	9,422	11,478
Washington	8,610	18,221	11,013	22,672	5,105	10,832
Wyoming			1,460	6,353	1,867	9,141
Other States [2]	26,416	105,993	15,382	98,853	93,019	338,248
Total	716,742	2,369,082	719,356	2,661,052	749,942	2,752,907

[1] Included with "Other States" to avoid disclosure of individual company operations.
[2] Alaska (1951), Arizona (1949 and 1951), Colorado (1950–51), Kansas, Montana (1950–51), Nebraska (1950–51), Nevada (1950–51), Oklahoma (1949–50), Texas, and Utah (1949).

Pumice and pumicite production was reported from 14 States and Alaska, the largest producer being California, with New Mexico second. The largest increase was reported from California, whereas marked declines in production were noted in New Mexico and Oregon.

Average values per ton at the mine were as follows: 1951, $3.67; 1950, $3.70; 1949, $3.31; 1948, $4.12.

TABLE 13.—Pumice and pumicite sold or used by producers in the United States, 1949–51, by uses [1]

Use	1949		1950		1951	
	Short tons	Value	Short tons	Value	Short tons	Value
Abrasive:						
Cleansing and scouring compounds and hand soaps	15,926	$188,823	15,362	$198,053	8,205	$124,314
Other abrasive uses	8,077	320,017	12,214	410,243	4,485	318,013
Acoustic plaster	10,018	182,990	6,662	151,766	3,761	112,518
Concrete admixture and concrete aggregate	672,592	1,559,587	672,125	1,750,269	720,170	1,988,204
Other uses [2]	10,129	117,665	12,993	150,721	13,321	209,858
Total	716,742	2,369,082	719,356	2,661,052	749,942	2,752,907

[1] Includes Alaska.
[2] Insecticide, insulation, brick manufacture, filtration, solvents, roads (surfacing and ice control), absorbents, soil conditioner, and miscellaneous uses.

The tonnage of pumice and pumicite used for concrete admixture and concrete aggregate increased 7 percent in quantity and 14 percent in value over the preceding year. The pumice used for abrasive purposes in 1951 was less than one-half the amount so used in 1950. As an admixture in acoustic plaster its use also declined, but for minor industrial uses the tonnage increased slightly. These minor uses included insecticides, insulation, brick manufacture, filtration, solvents, roads (surfacing and ice control), absorbents, soil conditioning, and other miscellaneous applications. (*See* fig. 1.)

As reported in Oil, Paint and Drug Reporter, quotations on domestic and imported pumice in 1951 showed but little change over the previous year, and were as follows: Domestic coarse-ground (sizes 0, ½,

1, 1½, 2, and 3)—in bags, ton lots, New York, 3⅝ to 4½ cents a pound, smaller lots, 3⅞ to 4½ cents; imported—Italian, silk-screened, fine, in bags, ton lots, 4 cents a pound; coarse, 6½ cents; sun-dried—fine or coarse in bags, ton lots, 2½ cents; pumice—in barrels, ½ cent a pound higher. The E&MJ Metal and Mineral Markets quoted per pound, f. o. b. New York or Chicago, in barrels, powdered, 3 to 5 cents; lump, 6 to 8 cents.

The use of pumice imported from Europe in the manufacture of masonry units was described.[7] The enactment of legislation to make available pumicite (volcanic ash) from portions of the Katmai National Monument in Alaska as a source of needed building material was considered.[8] New types of lightweight masonry units using pumice were described in a booklet.[9] The pumice industry in Oregon was the subject of an article in a technical magazine.[10]

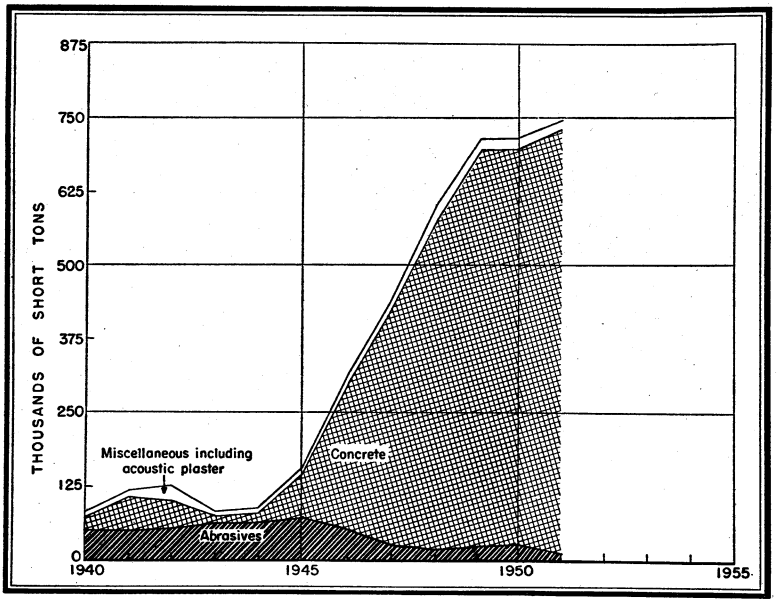

FIGURE 1.—Pumice and pumicite sold or used in the United States, 1940–1951, by uses.

Garnet.—Garnet production in 1951 was 14,050 short tons valued at $1,247,000, an increase of 51 percent in tonnage and 57 percent in value over 1950. This was the largest annual production of garnet on record. Sales of the fine sizes of garnet to the optical and other industries for glass and metal polishing increased during the year. Use of the coarser sizes of garnet for sand blasting also increased. Garnet production in Idaho gained substantially. The largest commercial use for garnet continued to be for the manufacture of garnet-coated abrasive papers and cloths. A description of the new equipment for

[7] Persons, Hubert C., Pumice Block for New England Market: Concrete Prod., vol. 54, No. 11, November 1951, pp. 128–129.
[8] 82d Congress, 2d Sess., House of Representatives, Report 1384, to accompany H. R. 4794.
[9] Wagner, W. C., Gay, W. E., and Dexter, H. R., Pumice as an Aggregate for lightweight Structural Concrete: Univ. of New Mexico Publications in Eng., No. 5. University Press, 39 pp.
[10] Utley, Harry F., The Oregon Pumice Industry: Pit and Quarry, vol. 43, No. 7, January 1951, pp. 89–90.

garnet production at the Barton mines, North Creek, N. Y., appeared in a trade publication.[11]

A description of the industrial uses of garnet appeared in a trade journal. Production methods were described, and it was suggested that if the price were reduced uses would increase considerably.[12]

TABLE 14.—Abrasive garnet sold or used by producers in the United States, 1946–51

Year	Short tons	Value	Year	Short tons	Value
1946	7,743	$570,186	1949	6,578	$505,231
1947	8,722	614,071	1950	9,304	793,558
1948	8,039	587,797	1951	14,050	1,246,947

As quoted in E&MJ Metal and Mineral Markets, the price of New York Adirondack garnet concentrate in grain form during 1951 was $93 a short ton.

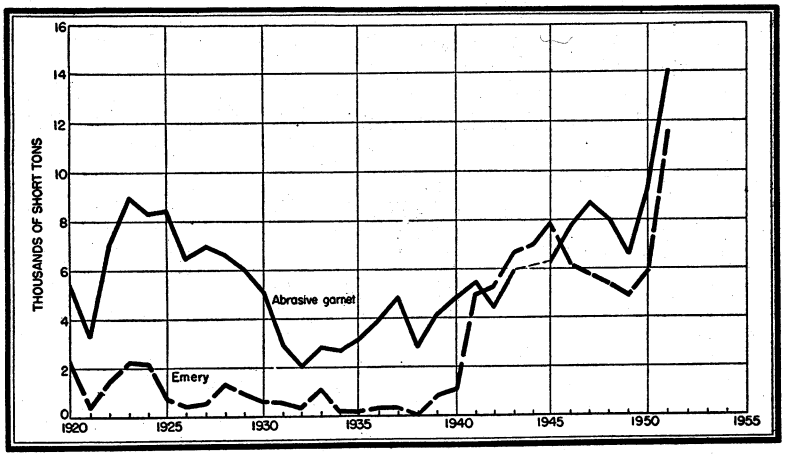

FIGURE 2.—Abrasive garnet and domestic emery sold or used by producers in the United States, 1920–51.

NATURAL ALUMINA ABRASIVES

Corundum.—During 1951 the Union of South Africa produced about 5,000 short tons of corundum concentrates, of which 4,893 short tons, valued at $273,095, was imported into the United States compared with 3,543 short tons valued at $194,427 during the previous year. Neither the United States nor Canada had produced corundum in recent years. The American Abrasive Co. of Westfield, Mass., continued to be the only importer. An article commenting on the corundum supply and the uses of corundum appeared in a trade journal.[13]

[11] Pit and Quarry, Barton Mines Corp. Orders New Equipment: Vol. 44, No. 2, August 1951, p. 57.
[12] Mine & Quarry Eng., vol. 17, No. 8, August 1951, pp. 273–275.
[13] Foose, Richard M., Industrial Minerals Have Boom Year in Construction Materials-Abrasives: Min. Eng., vol. 190, No. 2, February 1951, p. 129.

Corundum and emery were the subjects of an article in a mining magazine.[14]

Prices of imported corundum concentrates have not been quoted in the trade press. Average value of the corundum concentrates imported in 1951, as shown in the import statistics, was $55.81 per short ton, compared with $54.88 in 1950.

Quotations on natural corundum grain in 1951, as given in the E&MJ Metal and Mineral Markets, remained unchanged from the previous year and were as follows: Per pound, sizes 8 to 60, inclusive, 8½ cents; 70 to 275, inclusive, 9½ cents; 500, 28 cents; 850, 43 cents; 1,000, 45 cents; 1,200–1,600, 65 cents; and 2,600, 70 cents.

TABLE 15.—World production of corundum, 1945–51, by countries, in metric tons

[Compiled by Helen L. Hunt]

Country[1]	1945	1946	1947	1948	1949	1950	1951
Argentina	70	(2)	(2)	(2)	(2)	(2)	(2)
Australia (New South Wales)	[3] 10					(2)	(2)
Brazil	(2)	(2)	2	(2)	(2)	(2)	(2)
Canada[4]	1,195	673					
French Equatorial Africa	142	46	3				(2)
India	409	97	182	284	1,493	304	557
Kenya						2	(2)
Madagascar	50	21	1	4	7		
Malaya, Federation of						[5] 10	(2)
Mozambique	152			6	(2)	16	(2)
Nyasaland	328	379			113	187	101
Southern Rhodesia		13		114			
South-West Africa						10	
Union of South Africa	4,379	1,854	2,313	2,537	2,464	3,201	4,563
Total (estimate)	[6] 10,000	[6] 8,000	[6] 8,000	[6] 8,000	[6] 9,000	[6] 9,000	10,000

[1] In addition to countries listed, corundum is produced in U. S. S. R., but data on production are not available; estimate is included in the total.
[2] Data not available; estimate by author of chapter included in total.
[3] Reported as corundum and emery (believed to be largely emery).
[4] Recovered from tailing dumps.
[5] Estimate.
[6] Revised figure.

Emery.—Domestic production of emery in 1951 advanced sharply over 1950 figures, the output being 11,634 short tons valued at $160,000 compared with 5,949 short tons valued at $75,000, increases of 96 percent and 113 percent, respectively. Importations of emery in 1951 also showed an increase to 2,810 short tons, valued at $33,519 compared with 1,726 short tons valued at $21,560 in 1950. The producers of emery in the United States in 1951, as in recent years, were Joe DeLuca and DiRubbo & Ellis, both of Peekskill, N. Y. Because of its marked resistance to wear, a large part of the domestic output is used as a nonskid agent in concrete steps and floors. The balance is used for other abrasive purposes. Sales since 1921 are presented graphically in figure 2.

As quoted in E&MJ Metal and Mineral Markets, the price in 1951 of domestic crude ore, first grade, was $12 a ton f. o. b. New York. Grain emery in 1951 (f. o. b. Pennsylvania in 350-pound kegs) was 10 cents a pound for Turkish and Naxos grain and 6½ cents a pound for American grain. These prices were unchanged from the previous year.

[14] Lomas, J., Corundum and Its Ally Emery: Canadian Min. Jour., vol. 72, No. 12, December 1951, pp. 54–55.

TABLE 16.—Emery sold or used by producers in the United States, 1946–51

Year	Short tons	Value	Year	Short tons	Value
1946	6,188	$62,099	1949	4,909	$60,917
1947	5,798	66,927	1950	5,949	75,308
1948	5,405	69,408	1951	11,634	160,212

INDUSTRIAL DIAMONDS

World production of industrial diamonds in 1951 was approximately 14 million carats, an increase of 11 percent over 1950. The Belgian Congo continued to be the largest producer—over 10,000,000 carats, or about 72 percent of the industrial diamond world supply. Other large diamond-producing areas, in order of production, were: Union of South Africa, Gold Coast, Portuguese Angola, and Sierra Leone. No industrial diamonds were mined in the United States.

Importations into the United States of industrial diamonds of all classifications during 1951 totaled 12.2 million carats valued at $46.7 million, an increase of 9 percent by weight and 26 percent in value over the preceding year. This represented about 86 percent of the world production of industrial diamonds.

The United States Government continued to purchase industrial diamonds for the National Stockpile.

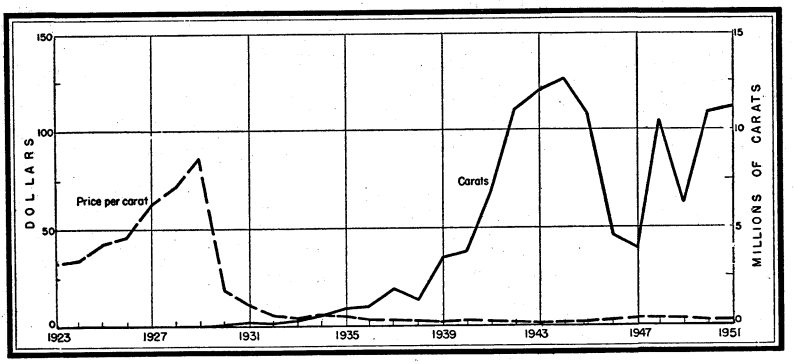

FIGURE 3.—United States imports and average price per carat of industrial diamonds, 1923–51.

Owing to the increased demand for industrial diamonds, the DeBeers Consolidated Mines, Ltd., of South Africa was reopening some of its properties that had been closed for a number of years,[15] and recent activity in an old diamond field in India was noted.[16] A firm of industrial diamond dealers made its first payment on a loan by the Economic Cooperation Administration for development of industrial diamond production in French Equatorial Africa. The loan was mainly for earth-moving equipment.[17]

Over 95 percent of all industrial diamonds imported into the United States passed through the sales agent for the principal African pro-

[15] Mining and Industrial Magazine of Southern Africa, Chairman's Speech, Annual General Meeting June 5, 1951: Vol. 41, No. 6, June 1951, pp. 295–296; Mining Mag., vol. 84, No. 3, March 1951, pp. 160–161; Mining World, Vol. 13, No. 6, May 1951, p. 50.
[16] Mining World, International News—India: Vol. 13, No. 7, June 1951, p. 48.
[17] New York Herald, June 18, 1951

ducers—the Industrial Distributors, Ltd., a South African corporation and a subsidiary of the DeBeers Consolidated Mines, Ltd. The largest producer of industrial diamonds is the Forminière, a company operating in the Belgian Congo. It has a sales contract with Industrial Distributors, Ltd., which runs until the end of 1955.[18] World demand exceeded the sales offerings [19] and an increase in the price of all classifications of industrial diamonds was announced.[20]

TABLE 17.—Industrial diamonds (including diamond dust and manufactured bort) imported for consumption in the United States, 1950–51, by countries

[U. S. Department of Commerce]

Country	Bort, manufactured (diamond dies)		Bort (glaziers' and engravers' diamonds, unset, and miners')		Carbonado and ballas		Dust	
	Carats	Value	Carats	Value	Carats	Value	Carats	Value
1950								
Belgian Congo			[1] 5,631,820	[1] $10,346,325			8,700	$16,723
Belgium-Luxembourg	110	$3,600	74,033	353,418			24,155	11,700
Brazil			[1] 95,938	[1] 728,286	3,174	$50,506		
British Guiana			[1] 1,249	[1] 10,515				
British Malaya			18,140	22,926				
British West Africa			[1] 28,219	[1] 154,693			3,466	9,607
Canada			46,346	176,429				
France	1,755	99,149	160	3,013			[1] 49,909	14,235
French Equatorial Africa			37	98				
French Guiana			753	5,796				
Germany	28	1,210						
Israel			1,600	3,919			5,325	4,424
Netherlands	720	69,223	21,769	164,357			29,000	44,278
Switzerland	12	643	2,377	30,593				
Union of South Africa			[1] 4,619,648	[1] 23,117,774			19,685	70,959
United Kingdom	69	1,731	[1] 489,559	[1] 1,579,669			19,075	35,920
Venezuela			[1] 4,214	[1] 44,515				
Total	2,694	175,556	[1] 11,035,862	[1] 36,742,326	3,174	50,506	[1] 159,315	207,846
1951								
Argentina			155	4,337				
Australia							500	1,125
Belgian Congo			6,685,514	12,959,227			19,661	52,057
Belgium-Luxembourg	500	19,217	402,934	4,372,051			43,448	26,849
Brazil			89,101	1,457,224	2,239	31,629		
British Guiana			187	2,404				
Canada	5	425	326,393	1,870,011			7,821	19,874
Colombia			1,200	3,840				
France	3,824	234,117	60,755	1,180,971				
Germany	234	8,549						
Israel	18	114	2,625	25,031				
Netherlands	1,253	127,989	120,472	1,088,664			5,500	11,200
Switzerland	537	19,679	46,135	681,479			31,625	12,822
Union of South Africa			443,168	1,450,081			5,385	18,043
United Kingdom	288	2,615	3,860,757	20,509,048			47,820	320,776
Venezuela			10,326	219,793			5,000	8,750
Total	6,659	412,705	12,049,722	45,824,161	2,239	31,629	166,760	471,496

[1] Revised figure.

Flotation of small diamonds suitable for industrial use had been successful, thus making possible the recovery of valuable industrial material that formerly was lost,[21] and methods for saving a large proportion of the industrial diamonds in alluvial deposits were de-

[18] South Africa, vol. 63, No. 3249, May 26, 1951, p. 436.
[19] Engineering and Mining Journal, World Diamond Demand Far Exceeds Offerings: Vol. 152, No. 8, August 1951, p. 92; Nat. Jeweler, January 1951, p. 98.
[20] Mining World, vol. 13, No. 4, April 1951, p. 27.
[21] Weavind, R. G., Wolf, I., and Young, R. S., Flotation of Diamonds: Min. Eng., vol. 3, No. 7, July 1951, p. 596.
Optima, Flotation of Diamonds: Vol. 1, No. 2, 1951, p. 30.

TABLE 18.—Industrial diamonds (excluding diamond dust and manufactured bort) imported for consumption in the United States, 1946–51

[U. S. Department of Commerce]

Year	Carats	Value		Year	Carats	Value	
		Total	Average			Total	Average
1946	4,652,639	$14,406,137	$3.10	1949	6,279,096	$17,392,288	$2.77
1947	3,999,119	13,312,668	3.33	1950 [1]	11,039,036	36,792,832	3.33
1948	10,421,207	32,581,385	3.13	1951	12,051,961	45,855,790	3.80

[1] Revised figures.

scribed,[22] as well as methods for crushing bort and other types of industrial diamonds.[23]

The role of the diamond in engineering [24] and the important industrial uses of diamonds [25] were the subjects of recent reviews. The use of industrial diamonds in the ceramic and glass industries was increasing,[26] and grinding of large optical parts with diamonds had become a recognized practice,[27] as well as the use of diamond-impregnated tools for cutting concrete.[28]

A review of new techniques employed in diamond-core drilling and a study of diamond drilling costs [29] and a description of the reconditioning of diamond coring bits were published.[30] Recovery of small diamonds and diamond scrap from grinding was the subject of several articles.[31]

ARTIFICIAL ABRASIVES

The combined tonnage of aluminum oxide and silicon carbide manufactured in the United States and Canada in 1951 increased 54 percent and its value 72 percent over the previous year's production. Aluminum oxide showed a 54-percent increase in tonnage and a 79-percent increase in value, its tonnage nearly equaling that of the record year 1943 and its value considerably exceeding that of 1943. Included with the aluminum oxide were 27,262 short tons of "white high-purity" material valued at $3,749,670 compared with 20,188 short tons valued at $2,607,590 in 1950, an increase of 35 percent in quantity and 44 percent in value for that item. The tonnage of aluminum oxide used for refractories was 4 percent, compared with 2 percent in 1950. A record production of silicon carbide was achieved in 1951—100,498

[22] Michael, R. W., How To Increase Production of Western Hemisphere Diamonds: Eng. and Min. Jour., vol. 152, No. 12, December 1951, pp. 90–91.
[23] Young, R. S., Crusher Plates for Diamonds: Jour. Metals, vol. 191, No. 2, February 1951, p. 97.
[24] Diamond News, vol. 24, No. 6, March 1951, pp. 3, 5, 7, 9, 11, and 13.
[25] Mill and Factory, vol. 48, February 1951, pp. 127–130.
[26] Glass Industry, vol. 32, No. 7, July 1951, p. 366.
Grits and Grinds, Diamond Wheels in the Glass Industry: Vol. 42, No. 4, April 1951, pp. 3–7.
[27] Industrial Diamond Review, Diamond Grinding of Large Optical Parts: Vol. 11, No. 129, August 1951, pp. 173–174, 183.
[28] Steel, New Products and Equipment for Cutting Concrete: Vol. 129, No. 9, Aug. 27, 1951, pp. 114–116; Eng. Jour., vol. 34, No. 9, September 1951, p. 930.
[29] Feiss, Julian W., Mining Research at Mount Weather, Va.: Min. Cong. Jour., vol. 37, No. 5, May 1951, pp. 49–53.
[30] Klapka, Karl J., How To Use Diamond-Impregnated Coring Bits: Eng. and Min. Jour., vol. 152, No. 12, December 1951, pp. 87–89.
[31] McDonald, A. D., and Benfield, D. A., The Recovery of Diamond From Scrap Sintered Tungsten Carbide (Communication of Diamond Research Laboratory, Johannesburg): Ind. Diamond Rev., vol. 11, No. 128, July 1921, pp. 155–157.
Young, R. S. and McDonald, A. D., Diamonds From Dust: Iron Age, vol. 167, No. 26, June 28, 1951, pp. 76–77.
Linari-Linholm, A. A., Electrostatic Separation of Diamonds: (Reprinted and shortened from Jour. Chem. Metal. & Min. Soc. South Africa, vol. 51, No. 4 (October 1950, pp. 131–157), Ind. Diamond Rev., vol. 11, No. 125, April 1951, pp. 89–92; No. 126, May 1951, pp. 119–122.

short tons valued at $11,735,000—a gain of 55 percent in quantity and 61 percent in value over 1950. Forty-six percent of the silicon carbide manufactured in 1951 was used for refractories compared with 24 percent in the previous year. The marked increase in the use of silicon carbides in refractories was indicated by a tonnage of 45,862 for that purpose in 1951, an increase of nearly 300 percent over the corresponding figure for 1950.

The output of metallic abrasives in the United States in 1951 increased 14 percent in quantity and 53 percent in value over 1950.

TABLE 19.—Crude artificial abrasives produced in the United States and Canada, 1947–51

Year	Silicon carbide [1]		Aluminum oxide [1] (abrasive grade)		Metallic abrasives [2]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1947	63,724	$5,633,811	160,022	$10,158,432	154,191	$12,449,855	377,937	$28,242,098
1948	63,033	5,874,731	154,972	10,279,583	147,218	15,174,773	365,223	31,329,087
1949	67,539	6,055,763	125,806	8,500,074	104,778	9,312,368	298,123	23,868,205
1950	65,004	7,303,671	140,352	11,958,035	144,333	11,699,764	349,689	30,961,470
1951	100,498	11,734,812	216,329	21,444,343	165,138	17,923,301	481,965	51,102,456

[1] Bureau of Mines not at liberty to publish data for United States separately. Figures include a small quantity used for refractories and other nonabrasive purposes.
[2] Shipments from United States plants only.

TABLE 20.—Stocks of crude artificial abrasives and capacity of manufacturing plants, as reported by producers in the United States and Canada, 1947–51, in short tons

Year	Silicon carbide		Aluminum oxide		Metallic abrasives [1]	
	Stocks Dec. 31	Average annual capacity	Stocks, Dec. 31	Average annual capacity	Stocks, Dec. 31	Average annual capacity
1947	3,524	72,350	32,977	233,500	9,987	245,479
1948	5,387	73,250	34,177	233,500	9,907	240,129
1949	21,964	81,121	49,505	237,072	10,144	231,650
1950	8,766	84,398	22,025	238,500	7,291	209,850
1951	11,786	106,741	32,428	249,000	9,843	244,178

[1] Figures pertain to United States plants only.

Stocks of aluminum oxide increased 47 percent, silicon carbide 34 percent, and metallic abrasive 35 percent from the 1950 figures. The ratio of production to annual plant capacity of silicon carbide was 94 percent (77 percent in 1950), for aluminum oxide, 87 percent (59 percent in 1950). Metallic abrasives showed a production of 68 percent of plant capacity, a slightly lower ratio than in 1950.

To conform with antitrust laws, a group of manufacturers was ordered by a Federal Court to dissolve a selling organization for coated abrasive products after 22 years activity. They were required to end their joint ownership in coated abrasive factories in Canada, Great Britain, Germany, and Brazil.[32]

Standardization and simplification in the coated abrasive industry was the subject of a recent article.[33]

[32] Business Week, No. 1120, Feb. 17, 1951, p. 146.
[33] Products Finishing, vol. 15, No. 9, June 1951, pp. 18, 20, 22, 26, 28, 30.

A new electric furnace plant to manufacture silicon carbide abrasives was started at Cap-de-la-Madeleine, Quebec.[34]

One of the larger abrasive manufacturers was planning a 30-percent expansion of its silicon carbide production.[35]

Recommendations for the correct mounting and use of abrasive grinding wheels, based on tests at a number of large manufacturing plants, were made by the Grinding Wheel Institute.[36]

According to a study reported in 1951 of abrasive grinding operations in Germany, about 1 kilogram (about 2 pounds) of grinding-wheel material was consumed for every ton of iron (or steel) produced in that country. The increase expected in West European steel production would, it was believed, lead to a corresponding boom in the grinding-wheel industry.[37]

Steps in grinding, lapping, and polishing of steel balls for use in ball bearings were described in the technical press.[38]

Abrasive tumbling as a precision finishing method was the subject of a paper presented at the 37th annual convention of the American Electroplaters' Society.[39]

Rapid finishing of steel machine parts by the use of cloth abrasive belts was recommended for a number of operations.[40]

MISCELLANEOUS MINERAL-ABRASIVE MATERIALS

In addition to the natural and manufactured abrasive substances for which data are included in other sections of this chapter, many other mineral materials have been used for abrasive purposes. A number of oxides, including tin oxides, magnesia, iron oxides (rouge and crocus), cerium oxide, chromium oxide, and manganese oxide, have been employed as polishing agents. Zirconium silicate and calcined kaolin have been suggested for polishing optical glass. Certain carbides, such as boron carbide and cemented carbides, which include tantalum carbide, titanium carbide, and tungsten carbide, have been used for their abrasive properties, especially when extreme hardness or durability are demanded. Other substances with abrasive applications include finely ground and calcined clays, lime, talc, ground feldspar, river silt, slate flour, and whiting.

FOREIGN TRADE [41]

Imports.—The total value of imports for consumption of both natural and artificial abrasives during 1951 increased 34 percent over the preceding year. Large gains, percentagewise, were shown in the importation of industrial diamonds, in artificial abrasives, and in manufactured abrasive products. Only in minor instances were decreases noted.

Exports.—The value of natural and artificial abrasives exported during 1951 was $25.2 million, an increase of 56 percent over 1950.

[34] Canadian Mining Journal, New Abrasive Plant: vol. 72, No. 4, April 1951, p. 198.
[35] Chemical and Engineering News, vol. 29, No. 35, Aug. 27, 1951, p. 3540.
[36] Steel, Correct Mounting Methods Eliminate Grinding-Wheel Breakage: vol. 128, No. 19, May 7, 1951 pp. 122–124.
[37] Industrie-Anzeiger . . . (Essen), vol. 73, No. 40, May 18, 1951, pp. 429–430 (in German).
[38] Steel, vol. 129, No. 5, July 30, 1951, p. 104.
[39] Steel, Abrasive Tumbling: Vol. 128, No. 6, Feb. 5, 1951, pp. 81–84.
[40] Wilcox, R. H., Abrasive Belt Grinding: Mill & Factory, vol. 49, No. 4, October 1951, pp. 90–93.
[41] Figures on imports and exports compiled by M. B. Price and E. D. Page, of the Bureau of Mines, from records of the U. S. Department of Commerce

TABLE 21.—Abrasive materials (natural and artificial) imported for consumption in the United States, 1949–51, by kinds

[U. S. Department of Commerce]

Kind	1949		1950		1951	
	Quantity	Value	Quantity	Value	Quantity	Value
Burrstones: Bound up into millstones short tons	10	$897	3	$514	18	$3,142
Grindstones, finished or unfinished short tons	143	7,998	297	13,586	213	15,892
Hones, oilstones, and whetstones short tons	16	23,366	19	26,398	12	28,098
Corundum (including emery):						
Corundum ore do	2,013	186,328	3,543	194,427	4,893	273,095
Emery ore do	1,512	20,294	1,726	21,560	2,810	33,519
Grains, ground, pulverized, or refined pounds	5,143	594	21,097	1,442	20,872	1,154
Paper and cloth coated with emery or corundum reams	718	88,044	18,552	193,305	4,669	141,068
Wheels, files, and other manufactures of emery pounds	15,217	17,101	15,542	12,657	59,829	49,171
Wheels of corundum or silicon carbide pounds	63	117	2,755	1,863	2,343	4,064
Garnet in grains, ground, etc do			6,181	159		
Tripoli or rottenstone short tons	[1]	808	[1]	68	11	430
Pumice:						
Crude or unmanufactured do	8,843	79,804	19,268	125,726	15,752	182,737
Wholly or partly manufactured short tons	756	19,121	982	18,356	750	18,041
Manufactures, not separately provided for		694		953		2,591
Diamonds:						
Bort, manufactured carats	1,060	79,950	2,694	175,556	6,659	412,705
Bort (glaziers' and engravers' diamonds, unset, and miners') carats	6,273,892	17,334,843	[2] 11,035,862	[2] 36,742,326	12,049,722	45,824,161
Carbonado and ballas do	5,204	57,445	3,174	50,506	2,239	31,629
Dust do	101,300	250,310	[2] 159,315	207,846	166,760	471,496
Flint, flints, and flintstones, unground short tons	7,554	165,290	34,802	187,113	17,780	548,471
Grit, shot, and sand, of iron and steel pounds	785,308	33,771	2,707,274	281,067	3,068,156	729,050
Artificial abrasives:						
Crude, not separately provided for:						
Carbides of silicon (carborundum, crystalon, carbolon, and electrolon) pounds	78,566,074	3,126,125	79,862,853	3,377,890	131,969,230	5,684,492
Aluminous abrasives, alundum, aloxite, exolon, and lionite pounds	179,502,573	4,849,980	234,208,185	7,003,527	333,236,295	10,740,002
Other do	883,297	27,884	2,225,600	73,008	1,624,240	59,130
Manufactures:						
Grains, ground, pulverized, refined, or manufactured pounds	139,090	15,241	761,849	80,791	1,951,005	204,450
Wheels, files, and other manufactures, not separately provided for pounds	4,065	3,389	28,372	11,354	37,711	28,960
Total		26,389,394		[2] 48,801,998		65,487,548

[1] Less than 0.5 ton.
[2] Revised figure.

TABLE 22.—Abrasive materials (natural and artificial) exported from the United States, 1947–51

[U. S. Department of Commerce]

Year	Grindstones and pulpstones		Diamond dust		Diamond grinding wheels		Other natural, artificial, and metallic abrasives, and products[1] (value)	Total value
	Pounds	Value	Carats	Value	Pounds	Value		
1947	4,591,080	$217,747	122,925	$324,572	13,217	$212,074	$20,199,815	$20,954,208
1948	2,887,995	131,725	52,600	80,352	11,562	270,929	14,784,664	15,267,670
1949	1,407,680	82,090	55,637	133,917	10,285	321,936	16,909,456	17,447,399
1950	1,027,599	55,283	58,563	126,089	12,807	502,523	[2] 15,491,157	[2] 16,175,052
1951	1,344,458	76,330	60,621	166,539	15,317	539,770	24,374,394	25,157,033

[1] Exclusive of steel wool.
[2] Revised figure.

Aluminum

By Delwin D. Blue

GENERAL SUMMARY

PRODUCTION of aluminum increased in 1951, not only in the United States but in virtually every producing country of the world. The 1951 record postwar production reflected the unstable political conditions that existed in that year, the high demand for aluminum for defense purposes, the increased substitution of aluminum for other metals that were in more critical supply, and the application of aluminum in new uses through improved production techniques.

In the United States virtually all consumption of aluminum was under Government control, prices were controlled by ceiling price regulations, and steadily increasing tonnages were going into defense uses. A vast expansion program was in progress that when completed would approximately double capacity for primary aluminum production compared with 1949. The total new supply of aluminum (production, secondary recovery, imports) increased less than 6 percent, even though primary production and secondary recovery increased substantially, because of decreased receipts of aluminum from foreign sources. A decrease in exports was caused by the high demand for aluminum in the United States.

TABLE 1.—Salient statistics of the aluminum industry in the United States, 1946–51

	1946	1947	1948	1949	1950	1951
Primary production short tons	409,630	571,750	623,456	603,462	718,622	836,881
Value	$115,812,000	$161,626,000	$180,755,000	$190,303,000	$235,977,000	$305,074,000
Quoted price per pound cents	15.0	15.0	15.7	17.0	17.7	19.0
Secondary production short tons	278,073	344,837	286,777	180,762	243,666	292,608
Imports	$12,463,960	$6,603,722	$42,203,519	$36,815,965	$68,565,400	$63,465,000
Exports	$20,284,053	$52,231,972	$43,219,940	$32,924,653	$22,153,000	$19,260,000
World production short tons	870,000	[1] 1,190,000	[1] 1,395,000	[1] 1,440,000	[1] 1,650,000	1,975,000

[1] Revised figure.

In 1951 a major development occurred in the antitrust suit initially begun in 1937 against the Aluminum Co. of America. A Federal district court entered a judgment which directed the sale of over a million shares of stock of Aluminum, Ltd., within a period of 10 years and the transfer of the voting rights of over a half million shares to 3 court-appointed trustees, prohibited the sale of more than 50,000

shares to any one person unless the Attorney General was first notified, and required those obligated to dispose of stocks to report regularly to the trustees. The court reserved jurisdiction over the case if stock disposals during the next 5 years failed to establish competition within the aluminum industry.

A large part of the hearings before the Subcommittee on Study of Monopoly Power (Celler Committee) of the United States House of Representatives, January 22 to February 9, was devoted to the aluminum-production situation.[1]

GOVERNMENT REGULATIONS

The uses and distribution of aluminum during 1951 were largely controlled by orders and regulations issued by the National Production Authority of the United States Department of Commerce under authority of the Defense Production Act of 1950. (See section on Prices for discussion of price regulations.) NPA Order M–5, Rated Orders for Aluminum (issued in October 1950), continued in force as amended. On July 1, when the Controlled Materials Plan for aluminum, copper, and steel went into effect, Order M–7 (which had been issued in November 1950) was revoked, and its provisions were incorporated in NPA Order M–47–A. At the end of 1951 the following were the more important NPA orders and regulations applying to aluminum:

Order M–5, Rated Orders for Aluminum, provided rules for accepting and scheduling authorized controlled material orders and rated orders for aluminum.

M–22, Aluminum—Distribution of Aluminum Scrap, regulated the segregation, acceptance, delivery and distribution of aluminum scrap and prohibited undue accumulations of such scrap.

M–47–A, Use of Iron and Steel, Copper and Aluminum in Certain Consumer Durable Goods and Related Products, limited the use of iron and steel, copper, and aluminum in the manufacture of specified goods in order to promote equitable distribution of the limited quantities of these metals remaining after provision for defense and defense supporting activities.

M–67, Aluminum Foil in Containers or Packaging Material, placed restrictions upon the use of aluminum foil in rigid or flexible containers, wrappers, bags, and envelopes and specified quantity limitations in the use of aluminum foil for packaging various classes of products.

M–84, Aluminum for Destructive Purposes, restricted the use of aluminum for destructive purposes to the minimum amount and lowest grade necessary for the particular use.

M–88, Aluminum Distributors, provided means whereby aluminum distributors might obtain replacements of their stock and specified tonnage and item limitations for authorized and unauthorized material orders.

Regulation 2, Basic Rules of the Priorities System, stated what kind of orders are rated orders, how to place them, and the preference status of such orders.

All of the Controlled Materials Plan regulations were applicable to aluminum and aluminum products. CMP Regulations 1 to 7 were in force at the end of 1951.

Other NPA orders placed limitations on the use of aluminum for specific applications as indicated by the order titles: Order M–26, Packaging Closures; Order M–27, Collapsible Tubes; and Order M–50, Electric Utilities.

[1] Study of Monopoly Power: Hearings, Subcommittee on Study of Monopoly Power of the Committee on the Judiciary, House of Representatives, 82d Cong., 1st sess.; serial 1, part 1, Aluminum, 1951, 916 pp.

DOMESTIC PRODUCTION

Output of aluminum in the United States in 1951 was exceeded only by the peak war year 1943 and totaled about 1,129,000 short tons despite strikes and power shortages that hampered production. Production of primary metal provided 74 percent, metal recovery from new scrap 19 percent, and old scrap 7 percent of the total. The Government-initiated expansion program was increased from 446,000 to 677,000 annual tons of new capacity. One new plant initiated production in December; expansion of three established plants was realized; and previously installed capacity, which had been idle for lack of power, was put into production, using high-cost subsidized power. The recovery of aluminum from new scrap also increased.

Primary.—Domestic production of primary aluminum in 1951 was 837,000 short tons, an increase of 16 percent over 1950. The only previous year with greater production was 1943, which was at the height of World War II, when a number of Government-owned reduction plants, constructed for emergency operation and using high-cost power, were in operation.

Production has increased in each succeeding quarter beginning with the first quarter of 1950; during August, the peak month in 1951, production was 73,816 short tons.

TABLE 2.—Production of primary aluminum in the United States, 1949–51, by quarters, in short tons

	1949	1950	1951
1st quarter	157,957	161,213	200,716
2d quarter	165,169	180,353	202,875
3d quarter	157,520	185,973	215,943
4th quarter	122,816	191,083	217,347
Total	603,462	718,622	836,881

At the end of 1951, 12 reduction plants (Massena and St. Lawrence, N. Y., considered 1 plant) were in operation. The plant at Chalmette, La., initiated operation on December 10, 1951, but the production from this plant added very little to the yearly total. The increased production for 1951 over 1950 came mainly from plants at Point Comfort, Tex.; Jones Mills, Ark.; Spokane, Wash.; and St. Lawrence and Massena, N. Y. The Point Comfort plant operated for its first full year. Four potlines at Jones Mills were operated throughout the year for the first time since World War II, and in addition a fifth line constructed under the expansion program began to produce in June. At Spokane a seventh potline was added, and additional pots were put on existing lines. By using high-cost power, production was increased at the St. Lawrence and Massena, N. Y., plants. Equipment that had previously been idle was placed in operation. Other plants part of whose production was obtained by use of high-cost Government-subsidized power were those at Alcoa, Tenn., Badin, N. C., and Listerhill, Ala. Because of the low water conditions and insufficient quantities of high-cost power in the Tennessee Valley, significant increases in production were not realized at these plants.

Factors responsible for production losses were strikes at two plants of the Reynolds Metals Co., and power shortages in the Pacific Northwest and in the Tennessee Valley. Strikes occurred at Reynolds' Listerhill, Ala., plant in May and at the Troutdale, Oreg., reduction works on December 12. The production loss from these 2 strikes was approximately 8,000 tons. Union contracts that expired in 1951 were extended pending the outcome of wage hearings before the Wage Stabilization Board.

A power shortage in the Pacific Northwest caused a partial shutdown of reduction facilities in Oregon and Washington during the latter part of September. On September 10 the Defense Electric Power Administration issued DEPA Order EO–4, which provided for orderly steps to be taken to meet varying degrees of power shortages and to achieve optimum power distribution in the interest of national defense. In case of power curtailment, the first 225,000 kw. was to be taken from the aluminum industry.

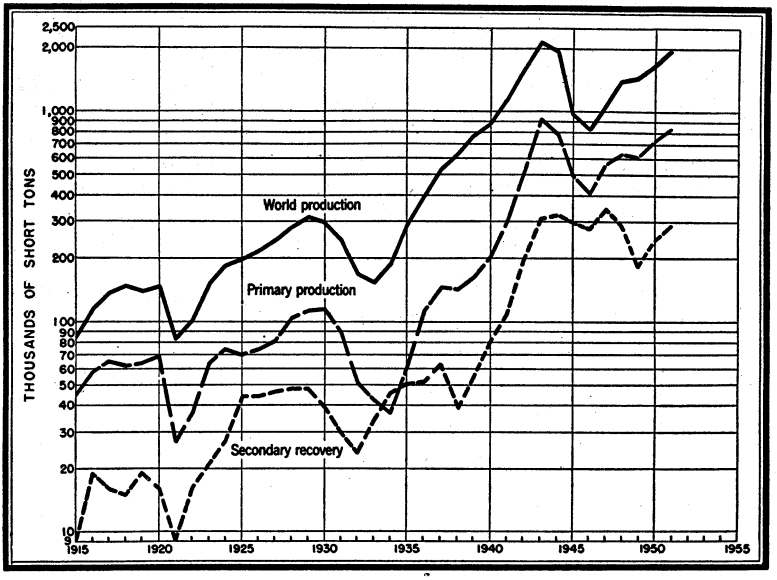

FIGURE 1.—World and domestic primary production and domestic secondary recovery of aluminum, 1915–51.

On September 18 two potlines were closed down, one at Kaiser's Spokane, Wash., plant and the second at Alcoa's Vancouver, Wash., works. Reynolds kept its facilities at Troutdale, Oreg., and Longview, Wash., in operation by substituting steam-generated power for curtailed hydroelectrical power. Full power was returned to the reduction plants on October 3; production losses were estimated at 3,000 tons.

Expansion.—Under the authority of the Defense Production Act of 1950 the Government had initiated in that year an expansion program planned to create enough new capacity to meet essential civilian and military requirements and leave a surplus for stockpiling. New facilities required to meet these demands were variously estimated at 500,000 to 1,000,000 tons of production capacity per year at the start of the expansion program; as the defense program progressed, the estimated demand increased.

At the beginning of 1951 negotiations were underway between the Government and 5 concerns for constructing new production facilities with an aggregate annual capacity of 446,000 tons. During 1951 this projected capacity was increased to 677,000 annual tons, and the distribution among the various producers was changed. At the inception of the expansion program it was deemed advisable to bring as many new producers as possible into the aluminum industry to promote a more competitive structure. A number of industrial concerns, largely established metal fabricators or secondary producers investigated the possibilities of producing aluminum, but because of the large capital investment required for constructing facilities with capacities large enough for economical production and because of the integration of mining, alumina production, and reduction facilities that had been established in the industry, most of these companies withdrew from the program. However, the Apex Smelting Co., Chicago, Ill., a large, secondary metal (nonferrous) producer, and the Harvey Machine Co., Torrance, Calif., a fabricating firm, negotiated with the Government for entry into aluminum production. Apex withdrew from the program early in 1951; Harvey negotiated with the Reconstruction Finance Corp., for funds to establish an alumina plant in Washington and a reduction plant at Kalispell, Mont. Because of difficulties encountered in obtaining a Government loan, Harvey joined with the Anaconda Copper Mining Co. in December. Under the joint venture a reduction plant with 72,000 tons annual capacity was planned for construction at Kalispell, Mont., with alumina supply to come from other producers.

All new facilities included in the primary-aluminum expansion program were being financed with private funds. Government aid was being furnished in the form of accelerated amortization, procurement contracts, and priorities for equipment and construction materials. Unlike some of the facilities constructed during World War II, all of the plants in the 1950–51 program were being designed and located for continued operation in the post emergency period.

Although Alaska was not an aluminum producer and there were no firm plans for production at the end of 1951, this Territory had been suggested with increasing frequency as one of the most promising remaining sites for additional reduction facilities in North America. The Alaska Development Board reported that large hydroelectric power potentials existed at locations having complete natural protection from possible attack and yet readily accessible to ocean navigation. Plant sites in the Skagway-Hains district had been investigated by several primary producers.

TABLE 3.—Estimated annual primary aluminum capacity of the United States, as of Dec. 31, 1949–50, and planned expansion as of Dec. 31, 1950, in short tons

	Dec. 31, 1949 [1]	Dec. 31, 1950 [2]	Planned expansion 1950–51 [3]	Total
Aluminum Co. of America:				
Alcoa, Tenn.	145,300	145,500		145,500
Badin, N. C.	33,850	43,500		43,500
Massena, N. Y.	57,500	127,000		127,000
St. Lawrence, N. Y.				
Vancouver, Wash.	76,100	76,000		76,000
Point Comfort, Tex.	57,000	57,000	35,000	92,000
Wenatchee, Wash.			85,000	85,000
Rockdale, Tex.			85,000	85,000
Total	369,750	449,000	205,000	654,000
Reynolds Metals Co.:				
Jones Mills, Ark.	73,850	[4] 74,000	23,000	97,000
Troutdale, Oreg.	72,000	[4] 76,000	2,000	78,000
Listerhill, Ala.	48,600	50,000		50,000
Longview, Wash.	30,500	31,000	20,000	51,000
San Patricio, Tex.			80,000	80,000
Arkadelphia, Ark.			55,000	55,000
Total	224,950	231,000	180,000	411,000
Kaiser Aluminum & Chemical Co.:				
Spokane, Wash.	108,125	150,000	20,000	170,000
Tacoma, Wash.	24,250	25,000	8,000	33,000
Chalmette, La.			200,000	200,000
Total	132,375	175,000	228,000	403,000
Anaconda Copper Mining Co., Kalispell, Mont.			50,000	50,000
Total	727,075	855,000	663,000	1,518,000

[1] Opinion of Judge D. J. Knox, United States District Court, Southern District of New York, Equity No. 85-73, United States of America, plaintiff versus Aluminum Co. of America et al., defendents. Represents economic capacity, having reference to the availability and price of electrical energy.
[2] Economic capacity plus capacity requiring high cost power.
[3] All of this capacity not available until 1954.
[4] Does not include capacity which had become available under the expansion program.

Secondary.—Domestic recovery of aluminum from secondary sources totaled 292,608 short tons in 1951, an increase of 20 percent over 1950. This increase was obtained despite a rollback in scrap and secondary ingot prices (*see* section on Prices) in June which resulted in a reduction in the recovery from aluminum scrap from an average of 25,700 tons per month during the first 6 months of 1951 to 18,800 tons in August and 16,500 tons in September. The highest secondary aluminum recovery was in July because of the time period allowed in the price-rollback order for working out high-priced stocks. During October, November, and December the average monthly recovery from aluminum scrap was 19,600 tons.

Secondary aluminum was recovered from aluminum-base scrap by the three primary producers, about 65 secondary smelters, and several thousand foundries and other consumers. Total secondary aluminum recovery also includes small tonnages of aluminum recovered as an alloying constituent in the smelting of copper-, zinc-, and magnesium-base scrap. The recoverable aluminum content (expressed as alloy equivalent) of new nonferrous scrap was 216,017 short tons, a 29-percent increase over 1950. Recovery from old scrap, however, was approximately the same in 1950 and 1951, 76,358 and 76,591 short tons, respectively. Aluminum-base scrap-

consumption distribution was as follows: Primary producers and independent fabricators, 24 percent; foundries and chemicals, 6 percent; and independent secondary smelters, 70 percent.

Detailed information regarding secondary aluminum in 1951 is given in the Secondary Metals—Nonferrous chapter of this volume.

CONSUMPTION

Apparent consumption of primary aluminum in 1951 was 975,000 short tons as computed by adding primary sold or used by producers (production adjusted for stock changes at primary reduction plants) and net imports of ingot, slab, plate, sheet, bar, and other crude and semifabricated forms. This apparent consumption included aluminum going to the National Stockpile but did not reflect stock changes by aluminum-metal consumers.

Secondary aluminum for consumption was obtained from domestic and imported scrap. Imported scrap aluminum was largely in pig form for easier handling and shipping. Aluminum recovered from "loose" imported scrap is included in domestic recovery; but, since this type of material represented a small proportion of the total imports, the factored net scrap imports must be considered as additional metal available for consumption. The recovery of aluminum from net imports of scrap was calculated at 90 percent of the weight.

TABLE 4.—Apparent consumption of primary aluminum and ingot equivalent of secondary aluminum in the United States, 1946–51, in short tons

Year	Primary			Secondary		
	Sold or used by producers	Imports (net) [1]	Apparent consumption [2]	Domestic recovery		Imports (net) [3]
				From old scrap	From new scrap	
1946	435,964	25,913	575,687	90,535	187,538	12,468
1947	570,923	−46,694	571,789	163,847	180,990	13,412
1948	625,834	40,041	684,575	95,648	191,129	64,165
1949	587,532	48,424	635,956	44,596	136,166	35,751
1950	731,087	167,249	898,336	76,358	167,308	60,443
1951	845,392	129,852	975,244	76,591	216,017	16,694

[1] Crude and semifabricated, excluding scrap. May include some secondary.
[2] For 1946–48, apparent consumption modified by changes in stocks held by the Office of Metals Reserve.
[3] Ingot equivalent of net imports (wt.×0.90). Imports are largely scrap pig. Some duplication of secondary aluminum occurs because of small amount of loose scrap imported which is included as secondary recovery from old scrap.

Shipments of aluminum wrought and cast products, as reported by the Bureau of the Census, totaled 1,153,000 short tons in 1951; 275,000 tons was shipped as castings and 878,000 tons as wrought products.[2] Shipments of cast and wrought products increased only 25,000 tons or 2.2 percent over 1950; an indeterminate amount of this increase was accounted for by increased statistical coverage of shipments of wrought products.[3]

[2] Bureau of the Census, Facts for Industry: Series M24–1–01, Apr. 28, 1952.
Bureau of the Census, Facts for Industry: Series M24E–01, Aug. 12, 1952.
[3] Bureau of the Census, Facts for Industry: Series M24B–31, May 25, 1951.

TABLE 5.—Net shipments of aluminum wrought and cast products by producers in the United States, 1946–51, in short tons [1]

[U. S. Department of Commerce]

	1946	1947	1948	1949	1950	1951
Wrought products:						
Plate, sheet and strip	433,491	555,579	634,148	395,012	581,567	536,683
Rolled structural shapes, rod, bar, and wire	65,319	78,690	91,496	101,825	134,890	172,582
Extruded shapes, tube bloom, and tubing	63,039	61,524	85,972	74,998	129,038	156,472
Powder flake and paste	8,576	8,283	8,477	7,238	11,230	12,385
Total	570,425	704,076	820,093	579,073	856,725	878,122
Castings:						
Sand	80,423	81,661	76,923	61,302	92,391	103,335
Permanent mold	76,569	93,391	91,813	61,761	90,683	86,365
Die	36,851	57,822	64,452	49,170	83,600	78,878
Other	513	1,045	2,621	3,656	4,867	6,639
Total	194,356	233,919	235,809	175,889	271,541	275,217
Grand total	764,781	937,995	1,055,902	754,962	1,128,266	1,153,339

[1] Net shipments consist of total shipments less shipments to other metal mills for further fabrication.

Data on the other major consumption classification were available only for 1950 and 1951. In 1951 consumption of aluminum for dissipative uses was 83,213 short tons, an increase of 11 percent over the 75,060 tons used for the same purposes in 1950. Of the total 1951 "dissipative" consumption (such as deoxidizers, hardeners, and chemicals), 62 percent was consumed as secondary ingot, 27 percent as primary ingot, and the remaining 11 percent in the form of scrap. Forty-nine percent of this total was used for deoxidizing steel, 15 percent in zinc-base alloys, 12 percent in the production of anhydrous aluminum chloride, 4 percent in steel alloying, 3 percent in copper-base alloys, 2 percent in magnesium-base alloys, and the remainder

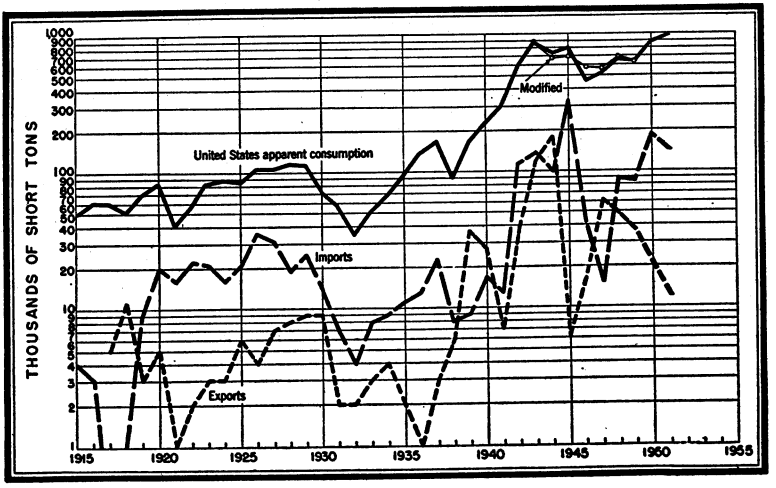

FIGURE 2.—Imports, exports, and apparent consumption of aluminum, 1915–51. Imports and exports do not include scrap.

for thermite for welding, in Alnico and nickel alloys, in chemical reactions, galvanizing baths and other minor miscellaneous applications.[4]

USES

During 1951 a large proportion of the aluminum supply went into defense and defense supporting activities. Information on uses to which this metal was put was restricted for security reasons, and an industrial use distribution pattern was not available. Use of aluminum in consumer items such as automobiles, refrigerators, stoves, washing machines, etc., was reduced. In some manufactures steel stampings and castings replaced aluminum; in other instances aluminum parts replaced parts previously made of copper and brass.

Despite the controls placed on the uses of aluminum (*see* section on Government Regulations) new applications were developed. In the electrical field a gradual switch from brass to aluminum bases for electric light bulbs was in progress, and the use of aluminum in flash bulbs, decorative lights, lamps, and distribution transformers was increasing. The Bell Telephone System was experimenting on the use of aluminum wire in communications equipment. A new method of producing light, "electroluminescence," was developed, which utilized neither an incandescent filament nor an evacuated bulb but employed a sheet of glass on one surface of which was applied an electrically conducting coating covered with a suitable phosphor coating and backed with foil. A new glass radiant-heating panel consisted of an aluminum grid about 0.001 inch thick backed with tempered glass and had a maximum heat output of 3 watts per square inch of radiating surface.

New uses for aluminum in the transportation and building-product industries (except for military transport and structures) were curtailed because of the unavailability of this metal. Aluminum radiators for automobiles were widely discussed, but no satisfactory economical methods for assembly had been developed. The La Sabre, an experimental automobile, was on display and contained many light-metal (aluminum and magnesium) parts and assemblies. In addition to cast-aluminum pistons and clutch housing, the oil filter, fuel pump and carburetor bodies in some automobiles were aluminum die castings. The SS. *United States*, which was nearing completion at Newport News, Va., had a superstructure constructed almost entirely of aluminum.

A new type of container, in which aluminum sheets coated with plastic were bonded under heat and pressure, was developed by the Reynolds Metals Co. to make a container similar to "tin" cans now manufactured by the billions. A multi-purpose suspended ceiling consisting of perforated aluminum acoustic pans combined with radiant heating in a steel framework was in pilot-stage production. Aluminum was being tested in the petroleum-refining industries for pipelines, heat exchangers, and condensers because of its good resistance to corrosives, such as sulfides, organic acids, and furfural.

STOCKS

Inventories of primary aluminum at the reduction plants at the beginning of 1951 were 16,636 short tons and had been reduced to

[4] National Production Authority, Research and Statistics Branch, Survey of Aluminum Destructive Uses, 1950–52, Aluminum and Magnesium Division, Aug. 14, 1952. 9 pp

8,125 tons by the end of the year; the average rate of production during the last quarter was 2,362 tons per day.

Stocks of ingot at secondary smelters (excluding secondary operations of primary metal producers) decreased from 7,533 tons at the beginning of 1951 to 4,050 tons, equivalent to 1 week's production, on December 31. Stocks of aluminum-base scrap held by secondary smelters, primary producers, fabricators, foundries, and miscellaneous manufacturers decreased from 18,799 short tons to 12,558. Scrap stocks held by consumers at the end of the year represented about 2 weeks' consumption.

Reserves of aluminum in the National Stockpile increased, and a part of the stockpile supply was provided through Government subsidization of production at plants where low-cost power (below 5 mills per kilowatt-hour) was not available. During the last quarter of 1951 the subsidized production was diverted from the stockpile to make up for the production losses caused by the power shortages in the Pacific Northwest. The withdrawal of 10,000 tons from the stockpile was also authorized in December.

Aluminum stocks held by metal producers, primary and secondary, were adequate for supplying aluminum consumers for less than 1 week and were approaching minimum working inventories. Data on aluminum held by fabricators, manufacturers, and distributors were not available, nor were those on scrap-aluminum stocks held in junk yards and by scrap-metal dealers.

PRICES

The base price of primary aluminum ingot, 99 plus percent pure, remained constant at 19 cents per pound, f. o. b. shipping point, throughout 1951. The price of primary aluminum was controlled under the General Ceiling Price Regulation issued January 26, 1951, that established ceiling prices for all commodities and services (except those specifically exempt) upon the basis of prices in effect during the period December 19, 1950, to January 25, 1951, inclusive.

TABLE 6.—Prices of aluminum ingot and other major metals, 1941–51 [1]

Year	Aluminum, primary ingot (cents per pound)	Copper, electrolytic, New York (cents per pound)	Composite finished steel (cents per pound)	Lead, New York (cents per pound)	Zinc, Prime Western, St. Louis (cents per pound)
1941	16.50	11.87	2.65	5.79	7.48
1942	15.00	11.87	2.65	6.48	8.25
1943	15.00	11.87	2.65	6.50	8.25
1944	15.00	11.87	2.65	6.50	8.25
1945	15.00	11.87	2.73	6.50	8.25
1946	15.00	13.92	3.00	8.11	8.73
1947	15.00	21.15	3.42	14.67	10.50
1948	15.74	22.20	3.91	18.04	13.58
1949	17.00	19.36	4.21	15.36	12.15
1950	17.69	21.46	4.40	13.39	13.88
1951:					
1st quarter	19.00	24.37	4.70	17.00	17.50
2d quarter	19.00	24.37	4.71	17.00	17.50
3d quarter	19.00	24.37	4.71	17.00	17.50
4th quarter	19.00	24.37	4.71	18.97	19.47
Average	19.00	24.37	4.71	17.49	17.99

[1] Source: Metal Statistics, 1952 (American Metal Market).

Although all other leading metals (steel, copper, lead, and zinc) were controlled by the same price regulation, increases were granted for lead and zinc during the last quarter of 1951, and steel prices had increased during January. The price of copper (electrolytic at New York) remained constant at 24.37 cents per pound. Yearly average prices for all of these metals increased because of the lower prices in effect during the early periods of 1950.

The price of secondary ingot at the beginning of 1951 was the highest in history. In January 95–5 aluminum-silicon alloy was selling for 33¾ cents per pound; high-grade scrap (2–S clips) was selling at the same price as primary ingot. These prices continued, with small increases and decreases, depending on the grade of ingot and scrap, until July. On June 29, the Office of Price Stabilization issued CPR–54, Aluminum Scrap and Secondary Ingot, which established ceiling prices on aluminum scrap and secondary ingot, and stated, "The ceiling prices in this regulation are designed to correct this situation (price differential between primary and secondary) by rolling back the prices of secondary aluminum ingot and aluminum scrap to levels which reflect the value of their metallic content in terms of the ceiling prices prevailing for primary aluminum." Prescribed periods were allowed for the scrap dealers and secondary smelters to work out their high-cost inventories. The new prices established by the order reduced the average price of scrap by more than 50 percent and of secondary ingot by about 37 percent.

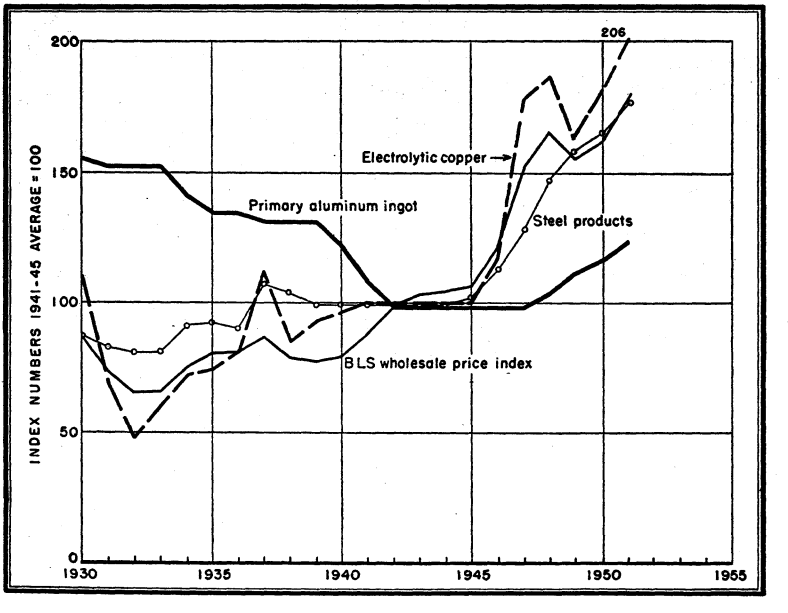

FIGURE 3.—Price of aluminum ingot, electrolytic copper, and finished steel, compared with Bureau of Labor Statistics, general wholesale price index, 1930–51. Index numbers computed for aluminum ingot, electrolytic copper, and finished steel from prices reported by the American Metal Market, Bureau of Labor Statistics Index transposed from 1926 to 1941–45 base.

FOREIGN TRADE [5]

United States foreign trade in aluminum in 1951, as indicated by the total value of exports and imports, declined 8.8 percent from 1950. Exports decreased 13 percent and imports 7.4 percent.

The major United States aluminum-import items were crude metal, major exports semifabricated (semicrude), and manufactured items; however, for the first time in history imports of semicrude aluminum exceeded exports. Foreign trade declined throughout 1951; 67 percent of the exports and 62 percent of the imports were made during the first 6 months. The only foreign-trade classifications of aluminum that showed gains during the last half of 1951 were exports of crude and scrap metal; both had a low yearly tonnage. The per pound value of exported crude and semifabricated aluminum was higher than that of imported materials; exports averaged 22.5 cents per pound for pig, ingot, and slab and 34.3 cents per pound for semifabricated compared with 16.9 and 29.6 cents per pound respectively for imports. Per pound export values for scrap were much lower than for scrap imports (4.5 cents compared to 15.9 cents), reflecting the low grade of exported scrap, mostly borings and turnings, and the high grade of imported scrap, mostly "remelt pig."

TABLE 7.—Aluminum imported for consumption in the United States, 1949–51, by classes

[U. S. Department of Commerce]

Class	1949		1950		1951	
	Short tons	Value	Short tons	Value	Short tons	Value
Crude and semicrude:						
Metal and alloys, crude	77,342	$21,569,460	176,778	$48,366,733	122,404	$41,395,428
Scrap	40,120	10,542,685	67,959	14,149,860	20,009	6,376,578
Plates, sheets, bars, etc	7,864	3,969,939	10,955	5,016,561	19,403	11,486,358
Total	125,326	36,082,084	255,692	67,533,154	161,816	59,258,364
Manufactures:						
Bronze powder and powdered foil	7	12,127	30	30,791	78	83,706
Foil less than 0.006 inch thick	197	188,308	297	335,088	810	1,268,292
Leaf (5½ by 5½ inches)	(1)	29,527	(1)	[2] 38,727	(1)	27,784
Table, kitchen, hospital utensils, etc	93	177,006	163	256,523	548	1,010,295
Other manufactures	(3)	316,044	(3)	[2] 371,697	(3)	1,816,259
Total	(3)	723,012	(3)	[2] 1,032,826	(3)	4,206,336
Grand total	(3)	36,805,096	(3)	[2] 68,565,980	(3)	63,464,700

[1] Leaves: 1949, 5,585,064; 1950, 10,515,034 (revised); 1951, 7,790,455; equivalent weight not recorded.
[2] Revised figure.
[3] Quantity not recorded.

Canada continued in 1951 as the major foreign supply of aluminum to the United States. Imports from Canada accounted for 73 percent of the total tonnage of crude and semicrude (semifabricated) aluminum and 14 percent of the value of aluminum manufactures. Crude aluminum (ingot, pig, slab, etc.) imports are the most important in tonnage and value, and Canada supplied 86 percent of this type of metal. The other important (over 500 tons) exporters of crude

[5] Figures on imports and exports compiled by M. B. Price and E. D. Page, of the Bureau of Mines, from records of the U. S. Department of Commerce.

aluminum to the United States were: Italy, 7,526 tons; Norway, 3,103 tons; Japan, 2,939 tons; and Switzerland, 502 tons. The distribution of aluminum-scrap imports was: Canada, 26 percent; Japan, 23 percent; Germany, 12 percent; Netherlands, 11 percent; France, 10 percent; New Guinea, 5 percent from surplus war material remaining from World War II, South Pacific Allied operations; United Kingdom, 4 percent; and the remainder from 25 other countries. Canada supplied 38 percent of the semicrude aluminum (plates and sheets); United Kingdom, 21 percent; Italy, 12 percent; Germany, 11 percent; France, Belgium, and Japan, 4 percent each and 5 other countries 6 percent. Countries from which over $100,000 value each in aluminum manufactures was imported, in order of value contributions, were: Italy, Germany, United Kingdom, Canada, Japan, and Switzerland.

The year 1951 marked the fourth successive year in which aluminum exports declined. During 1949, 1950, and 1951 decreasing quantities of crude and semicrude (semifabricated) aluminum were exported while the value of exported aluminum manufactures remained relatively constant, indicating high demand for raw material at home and a steady demand for United States articles abroad. Of the total tonnage of crude and semicrude exported, 64 percent was shipped to countries in the Western Hemisphere. Pig, ingot, slab, and crude aluminum exports were distributed as follows: 31 percent to Canada, 32 percent to Mexico, 25 percent to Argentina, 6 percent to Brazil, 4 percent to other Central and South American countries, 1.6 percent to Israel, and less than ½ percent to France and Greece. The United Kingdom received 95 percent of the exported scrap and most of the remainder went to Canada. Canada also received 28 percent of the semicrude aluminum, Venezuela 14 percent, Mexico 11 percent, Cuba 5 percent, 24 other Western Hemisphere countries 11 percent, Israel 9 percent, Philippines 10 percent, and Indonesia 6 percent; the remaining 6 percent went to 35 countries.

TABLE 8.—Aluminum exported from the United States, 1949–51, by classes

[U. S. Department of Commerce]

Class	1949		1950		1951	
	Short tons	Value	Short tons	Value	Short tons	Value
Crude and semicrude:						
Ingots, slabs, and crude	8,018	$3,169,680	662	$259,408	960	$432,832
Scrap	397	51,588	800	93,317	1,460	130,098
Plates, sheets, bars, etc	28,764	18,233,412	19,822	10,676,040	10,995	7,544,458
Total	37,179	21,454,680	21,284	11,028,765	13,415	8,107,388
Manufactures:						
Foil and leaf	1,462	1,205,492	832	720,885	159	224,602
Mill shapes	2,179	2,507,381	1,952	2,316,685	1,402	2,052,040
Powders and pastes (aluminum and aluminum bronze) (aluminum content)	366	380,439	251	246,505	552	536,525
Table, kitchen, and hospital utensils	925	1,673,619	678	1,319,548	744	1,656,619
Other manufactures	(1)	5,703,042	(1)	6,520,597	(1)	6,682,768
Total	(1)	11,469,973	(1)	11,124,220	(1)	11,152,554
Grand total	(1)	32,924,653	(1)	22,152,985	(1)	19,259,942

[1] Quantity not recorded.

During 1951 the duty on crude aluminum was reduced from 2 to 1½ cents per pound as a result of the Torquay Agreement, effective June 6, 1951. Duties on scrap and semifabricated aluminum were 1½ and 3 cents per pound, respectively, as prescribed in the Geneva Agreement effective January 1, 1948. The 1½-cent-per-pound duty on scrap had been suspended from October 1, 1950, to January 30, 1952, by act of Congress (Public Law 535, 82d Cong.), and scrap aluminum entered duty free throughout 1951.

In November the Defense Production Authority disclosed terms of a complicated trade agreement with the United Kingdom that would divert 11,000 short tons of Canadian aluminum scheduled for delivery to the United Kingdom to the United States. The metal was to be delivered over a 5-month period starting in November. In return, the United States was to allot additional tonnages of finished steel, "premium-priced" steel ingots, and iron and steel scrap to the United Kingdom. The aluminum was to be returned to Canada starting in the last quarter of 1952.

TECHNOLOGY

The techniques used in producing primary aluminum have remained basically the same in recent years. Recent improvements in reduction plants have been largely in improved design and larger production units. New alloys with improved physical properties were developed in 1951, and numerous improvements were made in fabricating techniques.

The location of reduction plants before World War II, was based on the availability of low-cost hydroelectric power. The plant at Jones Mills, Ark., constructed with Government funds during World War II, was the first economic plant to use thermal power and marked the beginning of a new trend in aluminum production. With low-cost power from hydroelectric installations no longer available in the required quantities the aluminum industry turned to thermal power for a number of new plants. Power for 68 percent of the new capacity planned under the Government programmed expansion was to be thermally generated. The added capacity at Point Comfort, Tex., and new installations at San Patricio, Tex., and Chalmette, La., were to use power generated from natural gas. Power for Reynolds' Jones Mill, Ark., plant was obtained from diesel-gas generators and from thermal power purchased from the Arkansas Power & Light Co. The new reduction plant under construction at Arkadelphia, Ark., was to receive five-eighths of its power from the Arkansas Power & Light Co. The Rockdale, Tex., plant was to utilize power generated by burning lignite char.

Hydroelectric installations were to supply the power required for added capacity at plants in the Pacific Northwest at Longview, Spokane, and Tacoma, Wash., and Troutdale, Oreg., and for new reduction plants at Wenatchee, Wash., and Kalispell, Mont. Three-eighths of the power requirements for a new plant at Arkadelphia, Ark., were to be hydroelectric, supplied by the Southwest Power Administration.

Although supplies of cryolite, fluorspar, and sulfur were adequate to meet the needs of the aluminum industry during 1951, the introduction of large tonnages of new capacity in 1952 was expected to require large excesses of electrolyte (cryolite) for initial filling and operation of new electrolytic cells. The supply of natural cryolite from Greenland, the only commercial producer of this mineral, was limited. The Government, in conjunction with the primary aluminum producers, was making plans for increasing the supply of synthetic electrolytes during the latter part of 1951. These plans included the construction of new processing facilities, the opening of new fluorspar (used in production of synthetic cryolite) deposits, and the purchase of additional supplies from foreign sources.

The Kaiser Aluminum & Chemical Corp. plant at Chalmette, La., was the first new reduction plant to start production since World War II. When completed, it was expected to be the largest aluminum-production plant in the United States and the second largest in the world, second only to the Aluminum Co. of Canada plant at Arvida, Quebec. The Chalmette plant required about 75 buildings with nearly 35 acres of floor space. Eight potlines composed of 1,152 electrolytic cells (144 per line) and 2 power installations with a capacity of 478,200 kilowatts, equal to nearly one-half of the installed capacity at Hoover Dam, were completed or under construction. The electrolytic cells were equipped with Soderberg type self-baking electrodes. Two potlines were supplied with power from 80 Nordburg Radial engines connected to direct current generators. The other 6 lines were to receive power from a steam power plant that included 15 outdoor-type Foster-Wheeler steam generators, fourteen 25,000-kw. General Electric turbogenerators plus rectifier and transformer facilities for converting the high-voltage alternating current to 700-volt direct current for potline operation. Two smaller, 11,250-kw. generators supplied alternating current for auxiliary services. Both power plants used natural gas, as fuel and gas requirement were to be approximately 50 billion cubic feet annually. Among other material requirements were to be 380,000 tons of alumina per year, 88,000 tons of petroleum coke, 34,000 tons of pitch, 8,000 tons of anthracite, 11,000 tons of fluoride salts, and 50 billion gallons of water.

In 1951 a new "superstrength" alloy temporarily designated as XA78S, was developed through the cooperation of the Aluminum Co. of America, Navy Department, Bureau of Aeronautics, Department of the Air Force, and the aircraft industry. This alloy was an aluminum-zinc-copper magnesium alloy similar to 75S, the highest strength alloy in commercial use, and had approximately 10 percent higher tensile and yield strength, with about the same elongation and fatigue properties. It was available to plane builders for experimental and controlled production use only. Limited tests indicated that the increase in mechanical properties would involve some sacrifice in workability. Alcoa patented a new type of aluminum-wire alloy containing boron (less than 0.5 percent) that was reported to have a better combination of strength and conductivity properties and could be cold-worked from hot-rolled rod without preparatory annealing. An improved aluminum casting alloy, known as ML, was developed

at the Materials Laboratory at Wright-Patterson Air Force Base, Dayton, Ohio, that had tensile, creep, and stress rupture properties about one-third higher at temperatures between 500° and 700° F. than other light-metal alloys previously used for cast-aircraft components. Other new aluminum alloys developed were XA54S, a high-strength sheet and plate alloy designed for use in pressure vessels, and B50S–0, featuring easy workability and high fatigue strength for use in the manufacture of coiled tubing. Cupal, a bimetallic sheet, strip or tube of copper clad aluminum was developed and produced in Germany and distributed by the Eastern Brass & Copper Co., New York.

Joining of aluminum by soldering presented a problem because of the necessity for breaking up the tenacious oxide film that forms on aluminum. An ultra-high-frequency soldering gun that breaks up this oxide layer by sound waves was developed by Mullard Electronic Products, London. A new lead-free aluminum solder melting at 400° F. and flowing at 450° F., called Brazalloy No. 37, for use with Brazalloy AS No. 37 Flux, was developed for soldering all types of aluminum but 24ST alloy. Welding by the shielded-inert-gas metal-arc process, called sigma welding, employed a consumable wire electrode and permitted higher current densities (20 times carbon arc, double heliarc), deep penetration, narrow weld, and heat-affected area and produced less distortion in welded parts.

WORLD REVIEW [6]

World production of primary aluminum ingot in 1951 was 1,790,000 tons (partly estimated), a 20-percent increase over 1950 (revised data) and 2¼ times the post-World War II low year in 1946. North American producers in the United States and Canada dominated primary production, supplying 65 percent of the world total. Europe, exclusive of the U. S. S. R. and satellite countries, produced 20 percent, Asia 2.5 percent, and Russia and its satellites 12.5 percent (estimated). Every aluminum-producing country except the United Kingdom increased output in 1951. Brazil, the only new producer, was obtaining aluminum from a reactivated plant that had been idle since 1946. The United States, with the largest tonnage gain (107,300 tons), had a small percentage increase, 16.5 percent, when compared with Western European producers. Western Germany increased production by 166 percent, France 50 percent, Italy 34 percent, Austria 47 percent, and Switzerland 25 percent. In the Far East, Japan was the only large producer and increased output 49 percent over 1950. By continental areas, North America showed a gain of 15 percent, Europe (excluding U. S. S. R. and satellites) 45 percent, and Asia 44 percent over 1950. Despite the large increase in primary aluminum produced in 1951, construction of additional facilities was underway in Canada, United States, Brazil, Norway, Spain, Western Germany, Sweden, Yugoslavia, Hungary, U. S. S. R., and Taiwan. A new plant was under construction in Tasmania, Australia. Gold Coast (Africa), Venezuela, Borneo, and New Guinea were being studied as possible future sites for aluminum smelters.

[6] Weight units metric tons unless otherwise specified.

TABLE 9.—World production of aluminum, 1945–51, by countries, in metric tons

[Compiled by Pauline Roberts]

Country	1945	1946	1947	1948	1949	1950	1951
Austria	5,250	1,032	4,544	13,319	14,835	17,988	26,380
Brazil	480						(1)
Canada	195,691	175,449	271,302	333,007	335,172	[2] 360,043	[3] 405,600
China: Manchuria	[2] 1,500					(1)	(1)
France	37,225	47,952	53,395	[2] 63,701	54,140	[2] 60,715	91,080
Germany:							
West Germany	[2] 20,000			7,306	28,848	[2] 27,840	74,136
East Germany		(1)	(1)	(1)	(1)	(1)	(1)
Hungary	2,351	1,970	5,203	[3] 9,400	[3] 14,000	(1)	(1)
India	2,290	3,296	[2] 3,275	3,421	3,547	3,650	3,960
Italy	4,347	11,040	25,065	[2] 33,081	[2] 25,675	37,070	49,750
Japan	16,450	3,190	2,700	6,965	21,222	24,764	36,780
Korea	[4] 1,243	1,600	1,300	[3] 1,300	(1)	(1)	(1)
Norway	4,608	16,692	21,725	31,041	[2] 35,697	[2] 46,560	51,240
Spain	592	1,007	1,000	523	1,212	[2] 2,338	3,847
Sweden (includes alloys)	3,236	3,566	2,892	3,279	3,929	[2] 4,038	6,600
Switzerland	5,029	13,083	18,458	[2] 19,200	[2] 21,600	[3] 19,200	[3] 24,000
Taiwan (Formosa)	592		[2] 15	2,509	[2] 1,312	1,761	2,598
U. S. S. R.[3]	86,310	105,000	120,000	140,000	165,000	190,000	200,000
United Kingdom	32,432	32,067	29,384	30,510	30,832	29,941	28,200
United States	449,109	371,608	518,680	565,587	547,449	651,920	759,202
Yugoslavia		560	1,330	[2] 1,880	[2] 2,490	[3] 2,500	(1)
Total (estimate)	870,000	790,000	1,080,000	1,265,000	1,305,000	1,495,000	1,790,000

[1] Data not available; estimate by authors of chapter included in total.
[2] Revised figure.
[3] Estimated.
[4] April to June, inclusive.

Australia.—Australia's first primary aluminum plant, being constructed at Bell Bay, Tasmania, was expected to reach the production stage by late 1953 or early 1954. The annual capacity of this plant was rated at 13,000 metric tons of aluminum ingot. Reports on the construction progress disclosed that 95 percent of the steel for buildings and stores and 75 percent of the plant and equipment had been ordered. Japanese steel was imported to expedite construction. Technical assistance on the layout of the works and the design of specialized equipment was supplied by British Aluminum Co., Ltd.

Austria.—Aluminum production in Austria reached a postwar high of 26,380 tons. Austria had production facilities to produce over 50,000 annual tons, as shown by the peak August production of 4,192 tons, but the power supply was not adequate to supply these facilities. The major part of the production—about 20,000 tons—was obtained from the Ranshofen works and the remainder from Lend (Salzburg). A new 6,000-ton-per-year addition to the Lend plant was completed and put in operation in October. This plant produced its own power and would not be affected by power shortages. The power supply, which showed a marked increase in 1951, was expected to show further improvement in 1952. New power stations went into operation, and the new Limberg reservoir was completed. Completion of the Kapiun hydroelectric plant, expected in 1952, would raise the production of the Ranshofen plant. It was reported that producers were unable to accept all foreign orders for virgin metal, even though offers up to $700 a ton exceeded world market levels.

An aluminum semifabrication plant (extrusions, sheet, wire, etc.) went into operation in the summer of 1951 and had manufactured some 9,000 tons of aluminum shapes by the end of the year. This

plant was being expanded to produce a number of new aluminum-alloy semifabricated materials.

Brazil.—In 1951 Brazil became, for the second time, the only South American producer of primary aluminum. The aluminum plant at Ouro Prêto, Minas Geraes, began operating in October and was being run by Electroquimica Brasileira. This plant was constructed during World War II and produced 480 tons of metal in 1945 but closed early in 1946. The annual capacity of the smelter was between 2,000 and 3,000 tons. Bauxite was obtained from nearby deposits; power was supplied from company-owned hydroelectric plants and mineral pitch by the National Steelworks at Volta Redonda. Other raw materials, such as petroleum coke, caustic soda, fuel oil, and cryolite, were imported. The majority of the company stock was indirectly held by Aluminum, Ltd., through its subsidiary Aluminio de Brazil. The Companhia Brasileira de Alumino started construction of a 7,000-ton-per-year-capacity plant in São Paulo. It was planned to purchase equipment in Italy and Western Germany. The two facilities were to have capacity to supply most of Brazil's demand for aluminum.

Canada.—Production of primary aluminum in Canada increased 13 percent over 1950 to 405,600 tons. Four reduction plants were in operation, all in Quebec Province, at Arvida, Isle Maligne, Shawinigan Falls, and Beauharnois. Aluminum production was lower than anticipated because of subnormal water conditions during the fall months, causing a partial shutdown of the potlines at Arvida and Shawinigan Falls. A strike at the Shawinigan Falls plant also depressed production, however, company officials stated that because of low water conditions the strike was of comparatively little significance. The Beauharnois works, closed since the end of the war, was reopened, and an expansion of the Isle Maligne was completed during the second quarter of 1951.

Shipments of aluminum in all forms, according to the 1951 Annual Report of Aluminium, Ltd., totaled 434,000 tons. The distribution of aluminum in ingot form was 181,600 tons to the United Kingdom, 93,700 tons to the United States, 78,500 tons to Canada, and 48,900 tons to other countries. Shipments to the United States included 4,000 tons of ingot diverted from the United Kingdom under a trade agreement which called for a total delivery of 10,000 tons over a 5-month period beginning in November. The decline from 1950 of 53,800 tons in shipments to the United States was due in large part to contracts with the United Kingdom under which Canadian commitments to that country were increased. In addition, Canadian consumption increased 18,500 tons and shipments to other countries 11,100 tons.

The Canadian aluminum industry was conducting two major expansion programs, one in the Province of Quebec and the second in the Province of British Columbia. The program in Quebec was largely one of increasing hydroelectric power-generating capacity to permit full utilization of the existing aluminum-reduction capacity in Quebec and to supply additional power for a second expansion at the Isle Maligne plant. The Quebec smelters had not operated at rated capacity since World War II, when large amounts of purchased power were diverted, by Government orders, from less essential uses. Two new power plants on the Peribonka River, known as Chute du

Diable and Chute-a-la-Savane, with a firm generating capacity totaling 410,000 hp., were scheduled for completion in late 1952 or early 1953. The expansion program in British Columbia called for construction of a reduction smelter and power facilities, with alumina to be supplied from a plant in Jamaica. The project included construction of a dam across the Nechako River to seal the eastern exit of the watershed; a 10-mile tunnel through the Coastal Range to the Kemano powerhouse built a quarter of a mile inside the Coastal Range's Portal Mountain, with an initial capacity of 450,000 hp. and a potential capacity of 1,650,000 hp.; and a 50-mile transmission system to Kitimat, where the reduction plant was to be located. Harbor and dock facilities for rapid handling of alumina cargos from Jamaica were to be constructed at Kitimat, which is on tidewater at the head of the Douglas Channel. The hydro potential of the British Columbia project was rated capable of generating enough power to produce 500,000 tons of aluminum annually. The development was planned as a three-stage expansion. The first stage was to provide power and reduction facilities for 83,000 tons of aluminum annually; in the second stage a total of 250,000 tons was to be produced annually and in the third stage 500,000 tons. Initial production was planned for mid-1954. The completion dates of latter stages was to depend on the world demand for aluminum. Construction of the dam, tunnel, powerhouse site, smelter site, and dock facilities was in progress during 1951.

France.—In 1951 France, the largest producer in Western Europe, produced 91,080 tons of aluminum, the highest annual production ever attained and a 50-percent increase over 1950. Of the total, the Compagnie de Produits Chimiques et Électrométallurgiques Alais, Froges et Camargue (Pechiney) produced 82 percent and the Société d'Électrochimie, d'Électrométallurgie et des Ocieries Électriques d'Ugine (Ugine) the remainder. All aluminum in France was marketed through L'Aluminium Français. The record production was possible because of modernization of plant facilities and an improved electrical power supply. Despite the increased production, exports were banned except to fulfill previous commitments to the Netherlands and South America and that which went to Belgium in exchange for copper. Exports were approximately 8,000 tons, less than half of 1950 exports. The consumption pattern in France showed the automobile industries as the major consumer (approximately 30 percent) followed by the electrical industries (approximately 24 percent). The domestic price of primary aluminum, fixed by the French Government, was raised from 161,000 francs per ton (21 cents per pound) to 181,000 francs (23.5 cents per pound) in October. A premium of 19,000 francs per ton (2.5 cents per pound) was added in December to cover higher power costs, part of which was supplied from thermal power plants, during the winter. Export prices were not controlled.

Germany.—Aluminum production in West Germany was more than 2½ times that of 1950, totaling 74,136 tons in 1951. The combined capacity of the three plants operating in 1951 was about 95,000 annual tons, but power shortages prevented capacity operation. The ceilings placed on aluminum production by the allied powers were removed, and previous plans for dismantling aluminum facilities were abandoned. The second of three potlines at the Luenen (West-

phalia) works was opened in March 1951; the first line had resumed operation in December of 1950, and total operation of the plant was planned in 1952. The third line of the Toeging (Bavaria) plant, which had been dismantled, was being rebuilt. The Erftwerke (Grevenbroich) hyrdoelectric plant and aluminum plant (near Cologne) were being reconstructed, and operation of 11,000 tons of annual capacity was anticipated for early 1953. Construction of new power facilities on the German-Austrian border, to be owned by the Austrian-Bavarian Power Co., was begun in March, mainly to supply power to Toeging in Western Germany and the Ranshofen plant in Austria. A rolling mill near Ranshofen opened in 1951 and produced about 10,000 tons of aluminum sheet and shapes. The price of aluminum from January to April was 2.08 DM per kilogram, equal to approximately 22.4 cents per pound.

Statistical data on aluminum production in East Germany (Soviet) were not available and it was doubtful that appreciable amounts of primary aluminum were produced in this area. A small potline at Bittlefeld (Saxony) was reported in operation to supply pure aluminum for upgrading reclaimed metal.

Hungary.—Hungary was the only Soviet satellite country known to produce primary aluminum. Under the Soviet blueprint for expansion of mineral and metal production in the satellite countries, Hungary was to expand aluminum production. A precise evaluation of the progress made toward realization of these plans was impossible because of the lack of reliable statistical data.

India.—Two companies, the Indian Aluminium Co., Ltd., an Indo-Canadian company, and the Aluminium Corp. of India, an all-Indian company, supplied all of the primary production of India. Plans for expanding facilities to supply India's total requirements were being investigated by the producers and by the Government. The Government of India Planning Commission recommended expansion of existing facilities in preference to establishing new plants. The maximum capacity to which the existing plants could be expanded, based on the availability of electrical power, was estimated at about 5,000 annual tons. A new plant of 15,000 tons annual capacity was tentatively suggested for Hirakud in Orissa, using hydroelectric power from a dam and generating facilities yet to be installed. Exports of all aluminum products were prohibited, except for aluminum utensils, which India had exported to South Asia, the Middle East, and East Africa for a number of years.

Italy.—Production of primary aluminum in Italy in 1951 was at an alltime high. The total annual capacity of the country was approximately 57,000 tons, held by three companies: Societa Allumino Veneto per Azioni (S. A. V. A.), with a plant at Porto Marghera; Industria Nozionale Allumina (I. N. A.), incorporated in the Montecatini enterprises in 1951 with plants at Mori and Belzano; and Societa dell'Allumino Italiana (S. A. I.), with a small plant at Borgofrance d'Ivria. The capacity was distributed approximately as follows: I. N. A., 60 percent; S. A. V. A., 30 percent; and S. A. I., 10 percent. S. A. V. A. also produced "superpurity" aluminum of 99.99-percent purity. New hydroelectric facilities on the Travignolo (Province of Trento), with a yearly output of 100 million kw.-hrs., were under construction for improved power supply at Porto Marghera.

The official price of aluminum (99.0 percent purity) was raised from 340 lire to 365 lire per kilogram (24.7 cents to 26.5 cents per pound) in March. The import duty on aluminum was 28 percent *ad valorem*.

Japan.—Production of primary aluminum in Japan in 1951 was about 36,780 tons, an increase of about 49 percent over 1950. The increased production came from reactivation of production facilities that had been idle since World War II. The 1951 production was about one-third of the rated primary capacity of Japan in 1942. Primary aluminum was produced by three companies, Japan Light Metals (Nippon Kerkinzoku KK), Showa Electrical Industries (Showa Denko KK), and Nisshin Chemical (Nisshin Kaguku KK). Exports of primary pig and ingot aluminum, which totaled more than production in 1950, declined from 14,844 tons to 4,546 in 1951. The decrease in exports was caused by increased consumption in Japan and the premium price of Japanese aluminum. In January the price of 99.5-percent aluminum was increased to 210,000 yen per ton (26.5 cents per pound) and in September to 235,000 to 240,000 yen per ton (30 cents per pound).

New Guinea.—A prospective aluminum reduction development in New Guinea that would use waterpower from the Owen Stanley Range was being investigated by the Australian Government and the British Aluminium Co., Ltd. A preliminary survey revealed that 15 million kw. of power could easily be developed and that 100 million kw. would eventually be available.

Norway.—Norwegian production of primary aluminum reached an alltime high of 51,240 tons in 1951, marking the sixth successive year of increasing production. The increase over 1950 was due largely to the first full year's operation of the second potline of the reduction plant at Aardal.

Although Norway's aluminum requirements were estimated at 10,000 to 15,000 tons per year, less than one-third of the production, work on a new 40,000-ton-per-year-capacity smelter at Sunndalsora was in progress. According to plan, the plant was to consist of an anode paste plant, 2 potlines of 132 cells each, a rectifier station, and facilities for producing notched bars, wire bars, rolling slabs, billets, and alloy ingots. Space was reserved for an additional 34 cells, which would increase the capacity to 50,000 tons a year. Alumina was to be imported under a long-term contract with Aluminium Union, Ltd., of Canada, which provided for delivery of 800,000 tons of oxide. The new works was to cost an estimated $35,000,000, $24,000,000 of which the Norwegian Government was to receive in the form of an ECA loan. The ECA loan was to be repaid by deliveries of aluminum over a 10-year period starting in 1955. The State-owned Aura power station was being expanded to a generating capacity of 250,000 kw, about half of which was for the Sunndalsora plant. Initial production was anticipated in 1954.[7]

Exports of aluminum were 41,881 tons in 1951 as compared to 40,351 tons in 1950 and were expected to be somewhat lower in 1952 because of increased domestic consumption, chiefly in electrical power transmission. A/S Aardal og Sunndal Verk was reported to be

[7]Light Metals, New Aluminum Smelter for Norway: Vol. 15, No. 166 ,January 1952, pp. 14, 15

receiving about 4,000 kroner per ton (25.4 cents per pound) for aluminum at the end of 1951.

Spain.—The production of aluminum in Spain increased 65 percent over 1950 to 3,847 tons. The added production was obtained by expanding operations at the reduction plant of Empresa Nacional de Alumino S. A. at Valladolid. This plant, opened in November of 1949, had a planned capacity of 5,000 annual tons and produced about 2,500 tons in 1951. Consumption (fabrication) capacity exceeded the supply of ingot material and prices were much higher than in other Western European countries. Duties on imports varied from 19 cents per pound for ingot to $1.19 for foil sheets and coils less than 0.5 mm. thick. The high duties, exchange difficulties, and low domestic production depressed fabrication and consumption.

Sweden.—Sweden increased its production of aluminum and aluminum alloys from 4,038 tons in 1950 to 6,600 in 1951. Swedish consumption was estimated at 16,000 to 17,000 tons annually, and plans were underway for increasing the production capacity to 10,000 tons per year by 1954. The major part of Sweden's imports was from Norway.

Switzerland.—An increase of almost 5,000 tons in 1951 production over 1950 was due chiefly to greater demand and higher prices for aluminum products. Electrical power was purchased from noncompany sources to maintain maximum production during the winter months, when company-owned hydropower production decreased. Imports of virgin aluminum increased from 2,745 tons in 1950 to 5,120 in 1951. The domestic price for pure aluminum pig, which was 2 francs per kilogram (21.2 cents per pound) during 1950, was raised to 2.3 francs per kilogram (24.3 cents per pound) in January 1951. The average price of exported aluminum pig was 258 francs per 100 kilograms (26.8 cents per pound) in November 1951 compared with 206 francs (21.5 cents) in November 1950.

Taiwan (Formosa).—Production of 2,598 tons of aluminum by the Taiwan Aluminum Corp., the only producer in 1951, marked a postwar peak but fell short of the 3,300-ton goal. Production was limited by a shortage of raw materials and replacement equipment and by insufficient power for continuous operation. The company made plans to rehabilitate additional units of the reduction plant, which had an annual capacity of 15,000 tons under Japanese management, and for installation of a foil mill to supply the island's tea and cigarette industries.

United Kingdom.—Production of virgin aluminum in the United Kingdom declined about 6 percent from 1950 because of inability to maintain an adequate labor force for the Highland Reduction Works. During the post-World War II years United Kingdom production had been relatively constant, and no large increase in domestic production was feasible because of the limited power resources of the British Isles. The domestic primary aluminum capacity of 30,000 annual tons supplied about one-sixth of United Kingdom requirements, and provisions for obtaining the major part of its aluminum requirements were made through long-term contracts with Canada. The United Kingdom was actively investigating new sites that might offer promise of economical aluminum production in Gold Coast (Africa) and Borneo.

Throughout 1951 the aluminum picture in the United Kingdom was similar to that in the United States; demand was ahead of supply, consumption of primary metal was controlled by the Government, ceiling price orders were necessary to control the price of secondary metal. The price of virgin aluminum was raised from 120 to 124 pounds per long ton (15–15.5 cents per pound) in January 1951, where it remained throughout the year.

Yugoslavia.—The aluminum-reduction plant at Lozovak, Dalmatia, was being expanded during 1951. The reported capacity of this plant was 3,000 tons a year before expansion and the capacity was to be raised to 7,000 tons. Construction continued on a plant partly built by the Germans during World War II at Strnisce, Slovenia. The first reduction building, reported to be the largest industrial building in Yugoslavia, had been completed, and electrolytic cells were being installed. The yearly capacity of the first potline was to be 15,000 tons a year, and initial operation was planned for 1954.

Antimony

By Abbott Renick and E. Virginia Wright

GENERAL SUMMARY

THE 1951 world output of antimony—64,000 metric tons—was 20,000 tons higher than in 1950 and exceeded the 1942–46 average (40,860 tons) by 57 percent.

Increases in the domestic primary antimony industry were as follows: Mine output, 39 percent; smelter production of metal, oxide, and sulfide, 29 percent; consumption of primary antimony, 13 percent; and industry stocks, 6 percent. Imports of antimony contained in ore, of metal, and of oxide and needle antimony increased 2 percent. Secondary production was 10 percent above the 1950 output. Quoted prices for antimony, RMM Brand, in cases, New York City, varied between a low of 33.78 and high of 51.85 cents per pound. According to the American Metal Market, average price for the metal during 1951 was 44.17 cents (New York equivalent) per pound compared with 29.41 cents in 1950.

The "new supply" of primary antimony in 1951, in terms of recoverable metal, was 20,430 short tons. A breakdown of this supply shows that domestic antimony ores contributed 3,194 tons,[1] domestic

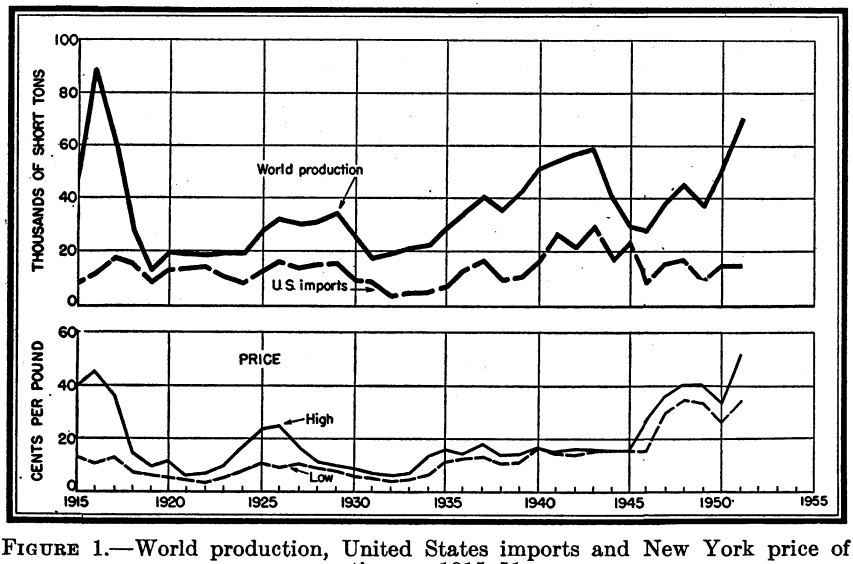

FIGURE 1.—World production, United States imports and New York price of antimony, 1915–51.

[1] In terms of recoverable metal content calculated at 92 percent of mine and mill production.

and foreign lead-silver ores 2,356 tons, and imports 14,880 tons. The contained antimony imported for consumption arrived as follows: Ore and concentrates (in terms of recoverable metal), 10,953 tons; metal, 2,231; needle, 4; and antimony oxide, 1,692. The supply from secondary sources was 23,943 short tons.

Total consumption of antimony in the United States in 1951 was 43,818 short tons, comprising 17,519 tons of primary, 2,356 tons of antimony contained in domestic and foreign silver and lead ores consumed by primary lead refineries in the manufacture of antimonial lead, and 23,943 tons of secondary antimony.

TABLE 1.—Salient statistics of antimony in the United States, 1942–46 (average) and 1947–51

	1942–46 (average)	1947	1948	1949	1950	1951
Production:						
Primary (antimony content):						
Mine (shipments)—short tons	3,534	5,316	6,489	1,636	2,497	3,472
Smelter, from domestic and foreign ores—do	14,816	13,782	14,308	8,099	9,471	12,228
Secondary (antimony content)—do	17,166	22,984	21,592	18,061	21,862	23,943
Imports for consumption—do	20,084	15,153	17,198	9,463	15,538	16,181
Antimony in ore—do	19,065	9,257	13,464	7,473	9,746	11,905
Needle—do	105	17	533	81	19	6
Metal—do	914	5,879	3,201	1,853	4,632	2,231
Oxide—do	[1]			56	1,160	2,039
Exports of antimony ore and metal—do	568	808	327	485	154	168
Consumption of primary antimony [2]—do	22,078	16,647	15,455	11,530	15,494	17,519
Average price of antimony at New York [3] cents per pound	16.09	33.45	36.67	38.73	29.41	44.17
World production [4] (contained)—metric tons	40,860	38,000	45,000	37,000	[5]44,000	64,000

[1] Data not available, 1942–43. None imported, 1944–46.
[2] Antimony contained in domestic and foreign silver-lead ores, recovered at primary lead refineries, and marketed in antimonial lead, not included.
[3] American Metal Market.
[4] Exclusive of U. S. S. R.
[5] Revised.

Government Regulations.—As a result of the defense program, together with the continued high level of civilian demand, the Government moved to conserve the supply of antimony. The National Production Authority placed limitations on inventories of antimony and materials containing antimony, other than ores and concentrates. Effective February 16, 1951, Order M–39 limited acceptance of deliveries to the smallest quantity of material reasonably required to meet the current scheduled rate of operations during the next succeeding 60-day period, or in excess of a practicable minimum working inventory. Order M–39 provided that any person who produced, consumed, imported, shipped, or received 2,000 pounds or more of antimony contained in antimony ores and concentrates, antimony metal, antimony oxide, or antimony sulfide in any calendar month or who, on the last day of any calendar month, had in his possession or under his control 2,000 pounds or more of antimony contained in these forms and materials, should complete and file Bureau of Mines report form 6–1016–M. (*See* Price section of this chapter for price regulations.)

DOMESTIC PRODUCTION

MINE PRODUCTION

During 1951 production (shipments) of antimony ores and concentrates totaled 9,401 short tons containing 3,472 tons of antimony, of which 3,194 tons was estimated as recoverable. (For recovery of antimony from silver and lead ores, see Smelter Production section of this chapter.) Compared with 1950, the 1951 output from antimony ores and concentrates increased 39 percent.

Alaska.—Earl Pilgrim operated the Stampede mine in the Kantishna district, where a new ore discovery was made during the year; Alamco, Inc., conducted the Sawtooth Mining Co. operations and also worked the Tok district property of Sam Gamblin.

Idaho.—Bradley Mining Co., the principal producer of antimony in the United States, produced 8,120 short tons of concentrate containing 2,851 tons of antimony. Improvements and plant additions included moving the crushing plant feed bins to a new location.

Hermada Mining Co. operated its mine in Elmore County, and the Sunshine Mining Co., Shoshone County, recovered considerable antimony from silver-lead ores.

Nevada.—G. A. Peterson operated the New Potosi mine in Mineral County, and John Heizer operated an antimony mine in Pershing County.

Washington.—Gray, Oberbillig, and Person (G. O. P. Antimony, Inc.) operated the Lucky Knock and Bales Mines in Okanogan County.

TABLE 2.—Antimony-bearing ores and concentrates produced (shipments) in the United States,[1] 1942–46 (average) and 1947–51, in short tons

Year	Gross weight	Antimony content		Year	Gross weight	Antimony content	
		Quantity	Average percent			Quantity	Average percent
1942–46 (average)	13,239	3,534	26.7	1949	5,260	1,636	31.1
1947	20,020	5,316	26.6	1950	6,888	2,497	36.3
1948	16,239	6,489	40.0	1951	9,401	3,472	37.0

[1] Includes Alaska.

SMELTER PRODUCTION

Primary.—Antimony smelters in the United States produced metal, oxide, sulfide, and residues containing a total of 12,228 short tons of antimony from domestic and foreign ores in 1951, a 29-percent increase over 1950. Approximately 61 percent of the output in 1951 (about 65 percent in 1950) was in the form of oxide.

In 1951, 2,356 short tons of antimony (17 percent less than in 1950) was recovered in antimonial lead produced by domestic primary lead refineries from silver and lead ores. (*See* Lead chapter of this volume for detailed discussion of antimonial lead production.)

Secondary.—Antimony produced at secondary metal plants was 21,883 short tons, plus 2,060 tons recovered in antimonial lead from scrap at primary lead refineries, for a total production of 23,943 short tons, a 10-percent increase over the 21,862 tons produced in 1950. (*See* Secondary Metals—Nonferrous chapter of this volume for detailed review.)

TABLE 3.—Antimony metal, alloys, and compounds produced in the United States, 1942–46 (average) and 1947–51, in short tons

Year	Primary metal, oxide and sulfide (antimony content)	Antimonial lead produced at primary lead refineries						Total secondary antimony (content of alloy [3])
		Gross weight	Antimony content					
			From domestic ores [1]	From foreign ores [2]	From scrap	Total		
						Quantity	Percent	
1942–46 (average)	[4]	56,031	1,796	535	1,468	3,800	6.8	17,166
1947	13,782	86,075	1,460	571	2,902	4,933	5.7	22,984
1948	14,308	100,764	2,190	1,031	2,539	5,760	5.7	21,592
1949	8,099	41,402	1,214	396	1,775	3,385	8.2	18,061
1950	9,471	61,912	2,253	597	1,654	4,504	7.3	21,862
1951	[5] 12,228	65,309	1,663	693	2,060	4,416	6.8	23,943

[1] Includes primary residues and small quantity of antimony ore.
[2] Includes foreign base bullion and small quantity of foreign antimony ore.
[3] Includes antimony content of antimonial lead produced at primary lead refineries from scrap.
[4] Data not available.
[5] Includes primary antimony residues.

CONSUMPTION AND USES

The total consumption of antimony in the United States in 1951 was 43,818 short tons, an increase of 9 percent over 1950. Primary antimony used was 17,519 short tons (15,494 tons in 1950); the antimony content of lead-silver ores consumed in the manufacture of antimonial lead by primary lead refineries was 2,356 short tons (2,850 in 1950), and the alloy content of secondary antimony was 23,943 short tons (21,862 tons in 1950).

Consumption of primary antimony in the manufacture of finished products exceeded that for 1950 by 13 percent, with use in metallic products decreasing 19 percent and in nonmetallic products increasing 66 percent. (See table 4.) Antimony recovered and simultaneously consumed in antimonial lead was 17 percent less than in 1950. Consumption of secondary antimony was chiefly in metallic products and increased 10 percent over the amount consumed in 1950.

Progress was announced in 1951 in the development of a marine paint to eliminate the hazard of fire. "Erifon," a flame retardant, was described as essentially a solution of titanium tetrachloride and antimony chloride in water.[2]

A new fluorescent lamp with a double cathode in place of the standard single cathode was reported to have exceedingly long life—up to 10,000 hours under rigorous conditions. The addition of antimony 51 to the phosphor powder was said to be an effective activator, which also reduced the tendency toward tube discoloration of standard lamps.[3]

[2] E&MJ Metal and Mineral Markets, vol. 22, No. 19, May 10, 1951, p. 7.
[3] Mining Journal (London), vol. 236, No. 6028, March 2, 1951, p. 204.

TABLE 4.—Industrial consumption of primary antimony, 1947–51, in short tons[1]

Product	1947	1948	1949	1950[2]	1951[2]
Metal products:					
Ammunition	24	21	6	9	4
Antimonial lead	[3] 6,172	[3] 6,024	[3] 4,737	[3] 4,912	2,431
Battery metal	(4)	(4)	(4)	(4)	2,774
Bearing metal and bearings	2,056	1,803	873	3,256	1,308
Cable covering	61	62	172	72	95
Castings	129	81	49	126	79
Collapsible tubes and foils	77	31	14	23	18
Galvanizing					11
Sheet and pipe	225	195	306	300	180
Solder	132	145	155	162	123
Type metal	1,216	1,019	587	766	709
Other	(4)	(4)	(4)	(4)	41
Total metal products	10,092	9,381	6,899	9,626	7,773
Nonmetal products:					
Ammunition primers	16	6	9	9	18
Antimony sulfide (precipitated)					[5] 68
Fireworks	(6)	(6)	(6)	(6)	20
Flameproof coatings and compounds	(6)	(6)	(6)	(6)	463
Flameproofed textiles	205	388	273	369	2,590
Frits and ceramic enamels	1,754	1,561	1,155	1,462	1,476
Glass and pottery	421	352	296	579	570
Matches	23	37	28	56	31
Paint and lacquers	1,324	1,288	874	267	962
Pigments	(6)	(6)	(6)	(6)	705
Plastics	[7] 156	228	498	737	747
Rubber products	39	41	55	103	19
Toy caps	(6)	(6)	(6)	(6)	24
Other [8]	2,617	2,173	1,443	2,286	2,053
Total nonmetal products	6,555	6,074	4,631	5,868	9,746
Grand total	16,647	15,455	11,530	15,494	17,519

[1] Data for 1947–48 compiled from monthly applications filed with the Office of Materials Distribution, U. S. Department of Commerce (formerly with War Production Board and Civilian Production Administration).
[2] Data 1950–51 include certain intermediate smelting losses which have been deducted for earlier years.
[3] Includes alloys, battery metal, and other.
[4] Included with "Antimonial lead."
[5] Not reported as an end use in prior years.
[6] Included with "Other nonmetal products."
[7] Consumption April through December 1947; January-March included with "Other."
[8] Also includes antimony trichloride and sodium antimonate to avoid disclosure of individual company operations.

STOCKS

At the close of 1951 industry stocks of antimony were 6 percent higher than the 8,888 tons reported at the end of 1950. Mine stocks at the beginning and end of 1951 were 626 and 479 tons, respectively. Other industry stocks were 8,262 tons at the end of 1950 and 8,934 tons on December 31, 1951.

TABLE 5.—Industry stocks of antimony in the United States at end of year, 1950–51, in short tons of contained antimony

Raw material	December 31, 1950			December 31, 1951		
	Mine	Other[1]	Total[1]	Mine	Other	Total
Ore and concentrates	626	2,630	3,256	479	3,257	3,736
Metallic antimony		2,240	2,240		2,574	2,574
Antimony oxide		2,662	2,662		2,672	2,672
Antimony sulfide (needle)		184	184		109	109
Primary antimony residues and slag[2]		546	546		322	322
Total	626	8,262	8,888	479	8,934	9,413

[1] Revised.
[2] Not shown in Antimony chapters for prior years.

PRICES

The price of antimony metal in bulk, f. o. b. Laredo, Texas, averaged 42.35 cents per pound; ranging from a low of 32.00 to a high of 50.00 cents, in 1951. The average New York price was 1.82 cents a pound higher than the average Laredo quotation being 44.17 cents a pound for 1951, according to American Metal Market averages for the year.

According to E&MJ Metal and Mineral Markets, opening and subsequent changes in nominal quotations for antimony ore during 1951, per unit (20 pounds) of antimony contained, were as follows:

	50–55 percent	*58–60 percent*	*60–65 percent*
Jan. 4, 1951	$4. 50–$4. 60	$4. 75–$4. 85	$5. 25–$5. 35
Jan. 25, 1951	4. 75– 5. 00	5. 00– 5. 25	6. 25– 6. 50
Mar. 1, 1951	5. 25– 5. 50	5. 50– 5. 75	6. 50– 7. 50
May 3, 1951	5. 50– 5. 75	5. 75– 6. 25	7. 00– 7. 50
June 28, 1951	6. 00– 6. 25	6. 50– 7. 00	7. 00– 7. 50
Sept. 13, 1951	6. 25– 6. 50	6. 75– 7. 00	7. 25– 7. 50
Nov. 1, 1951	6. 25– 6. 50	6. 75– 7. 00	7. 75– 8. 25
Dec. 6, 1951	5. 50– 6. 00	5. 75– 6. 25	7. 25– 7. 50
Dec. 20, 1951	5. 50– 5. 75	5. 75– 6. 00	6. 75– 7. 00

Effective November 21, 1951, the Office of Price Stabilization issued Ceiling Price Regulation 96, covering sales of antimony metal, antimony oxide, and sodium antimonate, including any sold by an importer or exporter. In general, the regulation set basic ceiling prices for carlots, with adjustments to reflect certain transportation charges and with specified differentials for less than carlots and for special packing.

Ceiling prices for carlots of antimony metal were set at 49½ cents, 50 cents and 50½ cents per pound, f. o. b. shipping point, depending on grade.

A ceiling price for delivered carlots of antimony oxide in bags was set at 48 cents a pound; for sodium antimonate the price was set at 42 cents. Effective December 13, 1951, the OPS issued General Overriding Regulation 9, Amendment 10. This exempted from price control all sales of domestic antimony ores and concentrates.

FOREIGN TRADE [4]

Imports.—Antimony in ore, imported for consumption, increased 22 percent in 1951. The average grade of ore was about 44 percent. Antimony metal imports declined 52 percent under the 1950 imports of metal; imports of antimony as needle continued negligible. Imports of antimony ore and concentrates were principally from Bolivia, Mexico, Union of South Africa and Canada. Imports of metal were chiefly from Mexico, Belgium-Luxembourg, Yugoslavia, France, United Kingdom, and Peru.

The 1951 imports of antimony oxide, the largest ever recorded, exceeded those of 1950 by 76 percent. The bulk of it came from the United Kingdom and Belgium-Luxembourg.

TABLE 6.—Antimony imported for consumption in the United States, 1947–51 [1]

[U. S. Department of Commerce]

Year	Antimony ore			Antimony needle		Antimony metal		Type metal and antimonial lead [2] (short tons)	Antimony oxide	
	Short tons (gross weight)	Antimony content		Short tons (gross weight)	Value	Short tons	Value		Short tons (gross weight)	Value
		Short tons	Value							
1947	28,471	9,257	$2,672,249	17	$7,914	5,879	$3,487,126	187	----------	----------
1948	41,610	13,464	4,312,431	533	314,809	3,201	2,022,676	1,569	----------	----------
1949	17,855	7,473	2,488,271	81	42,537	1,853	1,242,582	654	56	$27,290
1950	22,307	9,746	1,850,162	19	8,895	4,632	2,204,091	[3] 1,936	1,160	428,386
1951	27,354	11,905	4,621,437	6	5,936	2,231	1,780,576	676	2,039	1,525,016

[1] Does not include antimony contained in lead-silver ore.
[2] Estimated antimony content; for gross weight and value, see Lead chapter of this volume.
[3] Revised figure.

Exports.—Exports in 1951 (gross weight) of antimony ore and concentrates were 5 short tons valued at $5,072; and of metal and alloys, 163 tons valued at $146,051. During 1950 exports (gross weight) included 6 short tons of antimony ore and concentrates valued at $865 and 148 tons of metal and alloys valued at $86,496. Reexports of ore in 1951 were 128 tons valued at $30,943, and of regulus or metal, needle, scrap, and alloys, 6 tons valued at $6,050.

[4] Figures on imports and exports compiled by M. B. Price and E. D. Page, of the Bureau of Mines, from records of the U. S. Department of Commerce.

TABLE 7.—Antimony imported into the United States, 1947–51, by countries [1]

[U. S. Department of Commerce]

Country	Antimony ore			Needle antimony		Antimony metal		Antimony oxide	
	Short tons (gross weight)	Antimony content		Short tons (gross weight)	Value	Short tons	Value	Short tons (gross weight)	Value
		Short tons	Value						
1947	28,482	9,421	$2,673,325	17	$7,914	5,899	$3,499,947		
1948	41,610	13,464	4,312,431	533	314,809	3,317	2,096,573		
1949	17,855	7,473	2,488,271	81	42,537	2,065	1,357,634	56	$27,290
1950									
Australia	57	20	10,539						
Belgium-Luxembourg	(2)	(2)	(2)	6	2,354	936	407,275	236	84,894
Bolivia [3]	8,859	5,488	1,176,272					20	2,332
Canada	748	258	33,748					50	1,730
Chile [3]	1,510	877	168,190						
China				13	6,541	92	31,779		
Czechoslovakia						44	20,724		
France	100	55	9,047			277	118,515	39	16,700
French Morocco	88	79	18,143						
Germany						325	108,467		
Iran [4]	110	[5] 66	13,200						
Japan	39	23	1,244			(6)	250		
Mexico	11,504	3,127	440,173			1,478	825,108		
Netherlands						138	55,671		
Peru [3]	1,053	[5] 358	80,924						
Spain						52	20,552		
Sweden						55	22,326		
Switzerland						11	6,403		
Thailand	27	16	6,219						
United Kingdom						285	134,556	815	322,730
Yugoslavia						795	369,873		
Total	24,095	[5] 10,367	1,957,699	19	8,895	4,488	2,121,499	1,160	428,386
1951									
Belgium-Luxembourg				6	5,936	320	267,890	192	127,858
Bolivia [3]	7,209	4,609	2,153,787						
Canada	2,335	794	174,687			23	22,081		
Chile [3]	760	492	207,583						
China				2	1,096				
Czechoslovakia						17	7,275		
France	187	49	18,505			217	139,159	11	7,145
French Morocco	164	90	45,810						
Greece	18	7	2,565						
Honduras	10	5	2,286						
Italy						19	17,610		
Mexico	14,086	4,003	978,490			1,094	833,635		
Mozambique	150	90	40,136						
Netherlands						22	21,292		
Peru [3]	522	262	108,804			103	85,967		
Spain						11	9,870		
Union of South Africa	3,174	1,904	995,523						
United Kingdom						134	125,004	1,836	1,390,013
Yugoslavia						271	250,605		
Total	28,615	12,305	4,728,176	8	7,032	2,231	1,780,388	2,039	1,525,016

[1] Data are general imports, that is, include antimony imported for immediate consumption, plus material entering the country under bond. Table does not include imported antimony contained in lead-silver ores.
[2] Revised to none.
[3] Imports shown from Chile probably were mined in Bolivia or Peru and shipped from a port in Chile.
[4] Originally reported as Belgium-Luxembourg.
[5] Revised figure.
[6] Less than 0.5 ton.

TECHNOLOGY

Smelting antimony in Yugoslavia was the subject of an article, in which short descriptions of three antimony smelters were given, and the development and modernization were described in more detail.[5]

Articles were published in 1951 on the electrodeposition of ductile and malleable antimony [6] and a procedure for the photoelectric spot analysis of antimony.[7]

In a 1951 paper on the gold-antimony mineralization in the Yellow Pine District, Idaho, resemblance of the early gold mineralization to that at Rocky Bar and Boise Basin was noted and the belief expressed that both the gold and antimony mineralization occurred in the early Tertiary epoch.[8]

Several United States patents relative to antimony were issued during 1951.[9]

WORLD REVIEW

Australia.—The smelter of O. T. Lempriere & Co., Ltd., at Sydney, has been designed to treat ore of an average grade of not less than 50 percent; on material of this grade the annual capacity is about 1,200 short tons of metal.[11]

Austria.—The Schlaining mine (Soviet Zone) produced 6,066 metric tons of ore in the first 9 months of 1950.[12]

The Bleiberger Bergweksunion started operating an antimony-dressing plant at its Rabant mine in 1951.[13]

Algeria.—In 1951 Algerian production of antimony ore was 4,829 metric tons with a content of 1,462 metric tons antimony.[14]

Canada.—Sole producer in Canada has been the Consolidated Mining, Smelting & Power Co., Ltd., which recovers the metal as antimonial lead alloy from residues of lead refining.[15]

France.—Antimony smelter production in France in 1951 was 1,521 metric tons, representing an increase of 24 percent over 1950.[16]

Greece.—Deposits of antimony occur throughout Thrace and Macedonia in Greece. The only producing company in 1951 was Hellenic Mining Co., on the island of Chios. Most of the ore mined was stored at the mine for milling after construction of a proposed flotation plant. The Lakhanas mine in the Province of Serres received an Economic Cooperation Administration loan of $24,932 in foreign exchange credits and 311 million drachmas for local expenditures

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[5] Jensen, C. W., Smelting Antimony in Yugoslavia: Mining Mag., vol. 84, No. 1, January 1, 1951.
[6] Bergman, Adolph, The Electrodeposition of Ductile and Malleable Antimony: Metal Progress, vol. 59, No. 2, February 1951, pp. 245–247.
[7] Baer, Erich, Maurukas, Jonas, and Russell, Margaret, A Procedure for the Photoelectric Spot Analysis of Antimony: Science, vol. 113, No. 2923, January 5, 1951, pp. 11–12.
[8] Anderson, Alfred L., Metallogenic Epochs in Idaho: Econ. Geol., vol. 46, No. 6, September–October, 1951, pp. 592–607.
[9] Meyer, Max, Process for Refining Lead and Its Alloys: U. S. Patent 2,543,041, February 27, 1951.
Friedheim, Ernest H. A. (assigned to Meyer Metallurgical Corp., N. Y., N. Y.), Related to Therapeutically Active Antimony Compounds: U. S. Patent 2,543,041, February 27, 1951.
Luther, Paul E., Related to Self-Lubricating Alloys: U. S. Patent 2,558,523, June 26, 1951.
[11] Metal Bulletin (London), No. 3598, June 8, 1951, pp. 10–11.
[12] Bureau of Mines, Mineral Trade Notes: Vol. 32, No. 1, January 1951, p. 8.
[13] Mining World, vol. 13, No. 1, January 1951, p. 49.
[14] Metal Bulletin (London) No. 3692, May 13, 1952, p. 13.
[15] Northern Miner, vol. 37, No. 7, May 10, 1951, p. 11.
[16] Metal Bulletin (London), No. 3672, February 29, 1952, p. 15.

Italy.—Azienda Minerali Metallici Italiani (State control 100 percent) mines antimony-ore deposits and operates an antimony smelter at Su Suergiu in Sardinia and at Manciano in Tuscany. Prewar output was 1,000 metric tons annually.[17]

Peru.—Interest in antimony properties increased. Several foreign and domestic companies were prospecting near Luliaca in Southern Peru, and near Canta.[18]

Turkey.—The Eti Bank and the Mining Research and Exploration Institute (MTA) estimated antimony-ore (50-percent) reserves at 40,000 metric tons. The projected output of antimony for 1952–53 is 5,000 metric tons.[19]

United Kingdom.—The consumption of antimony metal and compounds (in terms of antimony metal) in 1951 was reported as follows:[20]

	Long tons
Batteries	1,206
Other antimonial lead	778
Bearings	463
Oxide and compounds	3,382
Miscellaneous uses	447
Total, all trades	6,276

The above figures exclude the consumption of antimony in scrap, which was as follows:

	Long tons
Antimonial lead	2,800
All other purposes	1,056
Total consumption in scrap	3,856

Union of South Africa.—There has been a notable expansion of antimony production since 1938. Production in 1951 amounted to 15,858 metric tons. The Union is now the largest producer in the world.

Production is confined to the Murchison Range in the North-Eastern Transvaal, where a long and narrow belt of mineralised schistose rocks occurs in granite and gneiss. The feature of this belt is a mineralised zone, "the Antimony Line", which is characterised by antimony minerals. The most important of these is stibnite, but berthierite, tetrahedrite, corynite, chalcostibite and various oxides of antimony occur in minor quantities.

Although mineralisation occurs throughout the greater part of this line, only at certain localities have antimonial deposits of commercial value been found. These are mineralised lens-like irregular bodies, varying in width from a few inches to 20 ft.

All the antimony minerals contain some gold and silver and it was for their gold content that the reefs were originally worked. There have, in fact, been three distinct phases in the mining of Murchison ores. Originally the antimonial ores were worked exclusively for gold, reduction being complicated by the refractory nature of the ores. Then antimony was exploited as a byproduct and now it might be said that antimony has become the main product and gold the byproduct.[21]

[17] Metal Bulletin (London), Special Italian Supplement.
[18] Engineering and Mining Journal, vol. 152, No. 6, June 1951, p. 140.
[19] Bureau of Mines, Mineral Trade Notes: Vol. 32, No. 5, May 1951, p. 3.
[20] Metal Age, No. 4, April 1952, p. 15.
[21] Chemical Age (London), December 2, 1950, p. 779.

TABLE 8.—World production of antimony (content of ore), 1946–51, by countries, in metric tons [1]

[Compiled by Pauline Roberts]

Country	1946	1947	1948	1949	1950	1951
North America:						
Canada [2]	291	522	141	72	[3] 292	591
Honduras	9		6	[4] 9	([4])	([4])
Mexico [2]	6,572	6,925	7,380	5,753	5,868	6,824
United States	2,272	4,823	5,887	1,484	2,265	3,150
South America:						
Bolivia (exports)	6,964	10,857	12,260	10,275	8,781	11,816
Peru	1,045	1,164	1,556	[3] 729	971	1,107
Europe:						
Austria	[3] 36	[3] 114	[5] 269	[5] 379	[5] 409	[5] 498
Czechoslovakia	2,300	4,500	4,100	([6])	[7] 2,000	([6])
France	220	201	275	294	[3] 355	650
Greece				[3] 49	[3] 350	810
Italy	403	513	[3] 559	[3] 627	[3] 679	822
Portugal	3	25	41	21	15	([6])
Spain	[3] 157	[3] 138	[3] 219	[3] 259	[3] 200	[3] 380
Yugoslavia	1,891	1,361	[3] 2,250	2,789	3,205	([6])
Asia:						
British Borneo: Sarawak			4	1	2	
Burma [7]		46	121	70	6	([6])
China	426	1,909	3,251	[3 7] 4,000	[7] 6,000	[7] 8,000
Iran [9]				175	230	[7] 230
Japan	53	108	135	172	161	221
Thailand		113	92	[3] 265	[3] 87	65
Turkey (Asia Minor)	80	140	600	[3] 460	[3] 1,288	3,360
Africa:						
Algeria		130	746	1,338	[3] 1,250	1,462
French Morocco	260	470	520	[3] 700	[3] 706	960
Southern Rhodesia	16	83	9	41	[3] 24	62
Spanish Morocco	[3] 117	[3] 145	[3] 272	[3] 150	[3] 353	([10])
Union of South Africa	2,525	3,302	4,106	4,461	[3] 8,311	15,858
Oceania:						
Australia	539	173	188	[3] 198	[3] 227	310
New Zealand			5	3		
Total (except U. S. S. R.)	26,000	38,000	45,000	37,000	[3] 44,000	64,000

[1] Approximate metal content of ore produced, exclusive of antimonial lead ores. U. S. S. R. and Hungary produce antimony, but data on production are not available; estimates for Hungary are included in the totals.
[2] Includes antimony content of antimonial lead.
[3] Revised figure.
[4] Less than 0.5 metric ton.
[5] Excludes Soviet Zone, data for which are not available, but estimates for which are included in the totals.
[6] Data not available; estimate by the chapter author included in total.
[7] Estimate.
[8] Including Spanish Morocco.
[9] Fiscal year ended Mar. 20 of year following that stated.
[10] Included in Spain.

Yugoslavia.—Antimony deposits at Zajaca were estimated in 1951 to contain 150,000 metric tons.[22]

The main deposits are in the Zajaca Bazen (Zajaca Basin) and the well known Krupanj properties are part of this group. The town of Loznica in Serbia is nearby. There is an antimony smelter at Zajaca, and an ore dressing plant here is treating antimony ores by the flotation process; Yugoslavia is the first European country to do this. There are a number of small flotation plants in the neighbourhood but a big one is being constructed at Zajaca; the small plants will not be put out of use when it is completed. Efforts are being made throughout the country to find additional antimony deposits. The Krupanj plant was destroyed during the war. The capacity of the Zajaca undertaking (styled Rudnici i Topionice Antimona Zajaca) is 1,500 metric tons of metallic antimony yearly.[23]

[22] Mining Journal (London), vol. 237, No. 6080, February 29, 1952.
[23] Metal Bulletin (London), Suppl., October 27, 1951, p. 6.

Arsenic

By Abbott Renick

GENERAL SUMMARY

PRODUCTION of white arsenic in the United States increased 22 percent in 1951 over that in 1950 and exceeded the 1946–50 average (14,735 short tons) by 10 percent. Imports for consumption in 1951 decreased 2 percent. Producer stocks of white arsenic increased from 2,479 tons to 4,790 in the course of the year.

Of the total white arsenic available for United States consumption in 1951, domestic production (from domestic and foreign ores) constituted 53 percent and imports 47 percent. Apparent consumption was 1,839 tons less than supply.

Droughts in the cotton belts during the year reduced the requirements for pesticides, which are used by farmers as insecticides. Adequate stocks of the organic insecticides were available to reduce the requirements of lead arsenate and calcium arsenate.

The quotation for white arsenic was steady through the year at 6½ cents per pound.

TABLE 1.—Salient statistics of the white arsenic industry in the United States, 1942–46 (average) and 1947–51, in short tons [1]

Year	Production	Sales	Imports	Exports [2]	Apparent consumption [3]	Producers' stocks	Price per pound [4]
1942-46 (average)	26,107	26,956	13,879	1,308	39,528	1,771	$0.044
1947	18,755	18,188	13,940	[5] 1,000	31,128	1,038	.06
1948	18,639	14,965	9,336		24,301	4,712	.06–.06¼
1949	12,795	10,181	4,696		14,877	7,326	.06–.05¼
1950	13,273	17,330	14,774		32,104	2,479	.05–.06½
1951	16,190	14,351	14,518		28,869	4,790	.065

[1] For data for earlier years (1910–46), see Arsenic chapter, Minerals Yearbook 1949.
[2] Figures for 1943–45 from U. S. Department of Commerce; figures for other years reported by producers to Bureau of Mines.
[3] Producers' shipments plus imports minus exports.
[4] Refined white arsenic, carlots, as quoted by Oil, Paint and Drug Reporter.
[5] Conjectural.

DOMESTIC PRODUCTION

Reports from producers indicate that the output of crude and refined white arsenic in the United States totaled 16,190 tons in 1951, an increase of 2,917 tons over 1950.

Crude and refined white arsenic was produced in 1951 by the Anaconda Copper Mining Co., at Anaconda, Mont. (copper smelter); United States Smelting, Refining & Mining Co., at Midvale, Utah (lead smelter); and American Smelting & Refining Co., in plants at Tacoma, Wash. (copper smelter), and Murray, Utah (lead smelter). Arsenic metal was not produced during 1951.

TABLE 2.—Production and shipments of white arsenic by United States producers, 1942–46 (average) and 1947–51

Year	Crude			Refined			Total		
	Production (short tons) [1]	Shipments		Production (short tons)	Shipments		Production (short tons)	Shipments	
		Short tons	Value		Short tons	Value		Short tons	Value
1942–46 (average)	22,689	23,471	$1,084,047	3,418	3,485	$201,723	26,107	26,956	$1,285,806
1947	17,636	17,119	1,424,316	1,119	1,069	109,440	18,755	18,188	1,533,756
1948	17,213	13,749	1,141,213	1,426	1,216	119,054	18,639	14,965	1,260,267
1949	12,289	9,597	713,984	506	584	50,527	12,795	10,181	764,511
1950	11,903	15,778	955,739	1,370	1,552	113,240	13,273	17,330	1,068,979
1951	15,485	13,656	972,832	705	695	69,242	16,190	14,351	1,042,074

[1] Excludes crude consumed in making refined. Includes crude white arsenic equivalent of compounds made directly from ores, flue dust, and speiss, as follows: 1942–46 (average), 239 tons; 1947, 97; 1948, 88; 1949, 26; 1950, none; 1951, none.

CONSUMPTION AND USES

During 1951 apparent consumption of white arsenic was 28,869 short tons, a 10 percent decline below 1950. The major portion of white arsenic produced is employed in manufacturing lead and calcium arsenate insecticides. Serious droughts in sections of the cotton area in 1951 minimized boll-weevil infestation. Ample supplies of lead arsenate and calcium arsenate were available during the year.

Arsenic is also consumed in glass manufacture, sheep dip, poisoned baits, pharmaceuticals, acid-resistant copper, and antimonial lead alloys. Sodium arsenate is used as a weed killer. Wolman salts or tanalite (25 percent sodium arsenate) is used as a wood preservative. Arsenical sprays have been employed since the end of the last century to protect growing tobacco.

TABLE 3.—Production of arsenical insecticides and consumption of arsenical wood preservatives in the United States, 1942–46 (average) and 1947–51

Year	Production of insecticides (short tons) [1]		Consumption of wood preservatives (pounds) [2]
	Lead arsenate (acid and basic)	Calcium arsenate (100 percent $Ca_3(AsO_4)_2$)	Wolman salts (25 percent sodium arsenate)
1942–46 (average)	35,543	25,804	1,052,289
1947	15,094	23,594	1,156,847
1948	12,316	13,618	1,286,302
1949	8,434	8,003	1,003,992
1950	19,750	23,750	1,197,617
1951 [3]	13,545	19,772	1,544,181

[1] Bureau of Foreign and Domestic Commerce, U. S. Department of Commerce.
[2] Forest Service, U. S. Department of Agriculture.
[3] Preliminary figures.

STOCKS

Producers' stocks of white arsenic at the end of 1951 were 4,790 short tons, a sharp increase from 2,479 at the close of 1950. Data are not available on stocks of calcium and lead arsenate held by producers.

PRICES

The carlot quotation for refined white arsenic held at 6½ cents per pound through 1951. The Metal Bulletin (London) quotation for metal opened in January 1951 at £425 and in the latter part of December was £500 per long ton. The London price of white arsenic, 99–100 percent, opened in January at £44¼–£47¼, and in the latter part of December was quoted at £55¼–£57¼.

FOREIGN TRADE [1]

Imports.—White arsenic imported totaled 14,518 short tons in 1951 compared with 14,774 tons in 1950, 4,696 tons in 1949, and an average of 12,366 tons in 1946–48. Of the tonnage imported in 1951, 75 percent came from Mexico, which has long been the principal foreign source. France supplied 13 percent.

Imports of metallic arsenic totaled 220,668 pounds, with United Kingdom supplying 59, Sweden 21, and Germany 19 percent.

Virtually all of the 1951 imports of arsenic sulfide originated in Belgium-Luxembourg; arsenical sheep dips came exclusively from United Kingdom.

TABLE 4.—White arsenic (As_2O_3 content) imported for consumption in the United States, 1947–51, by countries

[U. S. Department of Commerce]

Country	1947		1948		1949		1950		1951	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Belgium-Luxembourg			5	$961	30	$1,997	952	$43,544		
Bolivia	11	$1,040								
Canada	109	10,414	83	6,278	96	11,816	179	16,194	742	$69,036
France	55	6,230					497	39,397	1,919	247,443
Germany							11	755		
Italy			337	57,479						
Japan									276	39,180
Mexico	10,710	773,133	7,132	598,989	4,511	544,895	12,659	1,290,712	10,899	1,147,395
Peru	150	16,394	98	8,860					61	6,468
Poland-Danzig	177	24,922			48	4,866	39	2,950		
Portugal	55	8,207	28	4,409			50	3,204		
Sweden	1,228	148,669	1,204	157,233	11	1,261	387	29,427	621	72,317
U. S. S. R	1,445	156,459	449	49,320						
Total	13,940	1,145,468	9,336	883,529	4,696	564,835	14,774	1,426,183	14,518	1,581,839

[1] Figures on imports and exports compiled by M. B. Price and E. D. Page, of the Bureau of Mines, from records of the U. S. Department of Commerce.

Exports.—Producers of white arsenic reported no direct foreign sales in 1951. Exports of calcium arsenate increased 39 percent from those of 1950, whereas exports of lead arsenate decreased 40 percent. Mexico was the principal recipient of calcium arsenate, with Colombia, Nicaragua, Cuba, and others following in order. Their respective proportions of the total were 73, 18, 6, 2, and 1 percent. Cuba was the principal recipient of lead arsenate and, with Chile, received 86 percent of the total exported.

TABLE 5.—Arsenicals imported into and exported from the United States, 1947–51, by classes, in pounds

[U. S. Department of Commerce]

Class	1947	1948	1949	1950	1951
Imports for consumption:					
White arsenic (As_2O_3) content	27,879,965	18,671,621	9,392,699	29,547,402	29,036,555
Metallic arsenic	18,928	36,587	45,369	137,533	220,668
Sulfide	44,092	88,608	44,092	147,055	148,299
Sheep dip	83,654	38,275	55,830	77,219	62,050
Lead arsenate	120,000	----------	----------	----------	13,669
Arsenic acid	----------	----------	200	2,000	5,600
Calcium arsenate	----------	----------	----------	228,000	1,554,207
Sodium arsenate	----------	----------	----------	110,152	180,040
Paris green	----------	----------	----------	88,640	----------
Exports:					
White arsenic	[1] 2,000,000	(1)	(1)	(1)	(1)
Calcium arsenate	4,967,249	4,569,346	4,047,406	3,857,107	5,356,867
Lead arsenate	3,103,863	2,037,645	860,530	1,040,100	626,184

[1] Beginning Jan. 1, 1946, not separately classified. Figure for 1947 is conjectural; none believed exported in 1948–51.

WORLD REVIEW

Canada.—Although arsenical ores are widely distributed in Canada, the production of arsenic is limited to a few localities where it is recovered as a byproduct in treatment of gold or silver-cobalt ores. About 1,202 tons of white arsenic was produced in 1951 compared with 397 in 1950. Domestic demand for refined white arsenic has shown a marked increase over the past several years. Canada's output of crude white arsenic continued to come from the O'Brien Gold Mines Co., and consolidated Beattie Mines, Ltd., in Cadillac and Duparquet Townships, Quebec.

United Kingdom.—The Metal Bulletin reported as follows: [1]

In contrast to earlier years, there was a growing demand for white arsenic during 1951 and with synthetic insecticides of the DDT group becoming increasingly difficult to produce as a result of sulphuric acid shortages a return to arsenical compounds was noted. Rising costs, notably in the price of coal, made for higher selling prices of foreign white in this country although attempts were made to give users the benefit of a stabilized quotation; however, leading suppliers were forced owing to limited availability to exclude sporadic business in favour of meeting regular consumers' needs, and even the latter were rationed in their figures with supplies virtually impossible to obtain in the open market. In the main, metal prices remained fairly steady although rising costs in general made for increases on occasion.

[1] Metal Bulletin (London), No. 3654, Dec. 28, 1951, p. 27.

Mexico.—Byproduct white arsenic was recovered by Cia. Metalurgica Peñoles, S. A. (subsidiary of American Metal Co.), at its Torreoñ, Coahuila, lead smelter. The American Smelting & Refining Co. produced white arsenic at its San Luis Potosi copper smelter.

Portugal.—Production of white arsenic (over 99 percent As_2O_3) fell slightly—from 317,548 kilograms during the first 6 months of 1950 to 301,808 kilograms in the first 6 months of 1951.

TABLE 6.—World production of white arsenic, 1945–51, by countries, in metric tons [1]

[Compiled by Berenice B. Mitchell]

Country [1]	1945	1946	1947	1948	1949	1950	1951
Argentina [2]	42	(3)	(3)	(3)	(3)	(3)	(3)
Australia	2,021	1,651	1,210	520	257	163	(3)
Belgium (exports)		(3)	(3)	151	527	1,909	325
Brazil	962	829	1,001	984	959	1,067	1,321
Canada	928	338	357	527	239	[4] 360	1,091
France	1,530	3,140	2,510	[4] 2,256	2,313	2,454	(3)
Germany, West (exports)	(3)	(3)	(3)	37	1,081	1,124	(3)
Greece		8	14	18	[4] 20	33	56
Iran [5]	(3)	(3)	(3)	(3)	[6] 80	[6] 25	(3)
Italy	100	1,420	1,620	1,730	1,440	[4] 670	(3)
Japan	(3)	1,092	1,407	1,765	2,489	1,627	1,300
Mexico	15,013	9,648	9,685	7,571	3,576	8,987	12,766
New Zealand	17	18	8	8	19	10	
Peru	3,200	753	608	1,011	980	(3)	(3)
Portugal	243	508	1,005	1,616	[4] 975	801	940
Southern Rhodesia	624	216	416	283	148	114	76
Spain	393	440	484	573	124	159	375
Sweden	6,119	10,109	16,088	16,979	8,967	(3)	(3)
Union of South Africa	100	12	3	13			
United Kingdom [7]	117	147	91	(3)	(3)	(3)	(3)
United States	22,089	9,263	17,014	16,909	11,607	12,041	14,687
Total [1]	55,600	41,000	56,000	55,000	37,000	[4] 44,000	51,000

[1] Arsenic is also believed to be produced in Austria, China, Czechoslovakia, East Germany, Hungary, Korea, and U. S. S. R., but data are not available. Estimates by the author for Austria and East Germany have been included in the total. There is too little information to estimate the other countries.
[2] Arsenic content of ore mined.
[3] Data not available; estimate by author of chapter included in total.
[4] Revised figure.
[5] Fiscal year ended March 20 of year following that stated.
[6] Estimate.
[7] White arsenic, including arsenic soot.

Asbestos

By Oliver Bowles and F. M. Barsigian

GENERAL SUMMARY

PRODUCTION of asbestos in Canada, our principal source, surpassed all previous records by a wide margin in 1951. Nevertheless, the demand for asbestos has increased so sharply that most grades were in short supply. Demand for the shorter grades, particularly group 7, was lighter during the latter part of the year. Shortages were more acute for Rhodesian chrysotile than for Canadian.

Although domestic sales exceeded the high record of 1949 by 19 percent, they represented only 6 percent of domestic requirements. Major production is in Vermont. Arizona furnished moderate supplies of chrysotile, including some of high-quality spinning grade. Several States reported small sales of amphibole asbestos.

As in 1950, imports and apparent consumption exceeded all previous records. Imports from Canada again attained an all-time high, but imports of low-iron chrysotile from Southern Rhodesia continued to decline—a condition that has created a critical situation with respect to this type of asbestos, which is obtainable from other sources only in quite limited quantities.

Acquisition of strategic grades for the National Stockpile continued to be difficult because industrial demand, of which a large percentage was directly or indirectly for the defense program, was quite urgent. Prices of Canadian asbestos were 10 to 25 percent higher in 1951 than in 1950. Vermont prices remained at 1950 levels until October 1951, when they were advanced to figures comparable with the corresponding Canadian grades. Prices were advanced further early in 1952.

TABLE 1.—Salient statistics of the asbestos industry in the United States, 1947–51

	1947	1948	1949	1950	1951
Domestic asbestos:					
Produced.....short tons..	25,139	37,237	42,918	41,358	51,730
Sold or used.....do....	24,035	37,092	43,387	42,434	51,645
Value.....	$918,558	$1,806,261	$2,614,416	$2,925,050	$3,912,500
Imports (unmanufactured).....short tons..	594,839	647,881	509,366	[1] 705,458	761,873
Value.....	$29,821,519	$37,974,092	$33,939,582	[1]$47,284,205	$58,521,046
Exports (unmanufactured)[2].....short tons..	2,680	9,227	20,045	20,890	16,526
Value.....	$436,300	$1,804,611	$4,152,344	$4,084,384	$3,662,270
Apparent consumption [3].....short tons..	616,194	675,746	532,708	727,002	796,992
Exports of asbestos products [3].....	$11,139,553	$9,326,705	$9,667,847	$8,147,141	$14,321,278

[1] Revised figure.
[2] 1947–50 figures revised to include material that has been imported and subsequently exported without change.
[3] 1947–50 figures revised due to change in basis of calculation. *See* footnote 2.

PRODUCTION

As indicated in table 1, domestic production was 25 percent higher and sales 22 percent higher in 1951 than in 1950. Chrysotile was produced in Vermont and Arizona and amphibole in Georgia, North Carolina, and Oregon. So few companies have produced amphibole asbestos during recent years that separate figures cannot be published.

Alaska.—No asbestos was produced in 1951 from the Alaska deposit in the Kobuk River district, but Philip S. Hoyt, P. O. Box 83, Aguila, Ariz., reported some prospecting.

Arizona.—In 1951 chrysotile production in Arizona was somewhat higher than in the previous year. Some high-quality material suitable for the National Stockpile was recovered. The following firms and individuals were active: American Asbestos Cement Corp., P. O. Box 2033, Globe (on February 5, 1951, took over Wilson Cherry Creek mine, formerly operated by Gila Asbestos Co.); Apache Asbestos Mines, Inc., P. O. Box 983, Globe; Bear Canyon Mining Co., Globe; Dennis Brown, P. O. Box 328, Globe; Ned H. Brown, P. O. Box 1797, Clifton; Arthur Enders, P. O. Box 362, Globe; Charles Ireland, P. O. Box 374, Globe (lease ended May 1951—operation taken over by Frank Witte); D. W. Jaquays, 1219 South 19th Ave., Phoenix; Kyle Asbestos Mines of Arizona, P. O. Box 302, Globe; Metate Asbestos Corp., Globe; Phillips Asbestos Mines, Drawer 71, Globe; and Pine Top Asbestos Mines, Globe.

California.—Commercial production in California was at a standstill in 1951. A small amount of tremolite was reported sold to the Powhatan Mining Co. for use as a filter medium. The owners of the property, formerly operated by the Loma Blanca Mines, Inc., reported that their mine is open to lease. Prospecting and exploration were continued in California, some of it under Defense Minerals Exploration Administration loans, but no significant discoveries have yet been made.

Georgia.—Powhatan Mining Co., Woodlawn, Baltimore 7, Md., produced amphibole from mines in Meriwether and Rabun Counties. Industrial Minerals Corp., 30 North La Salle St., Chicago 2, Ill., reported development work on tremolite in Rabun County.

Montana.—Some exploratory work was conducted near Cliff Lake, Madison County, by Madisonian Mining & Milling Co. under a DMEA loan.

North Carolina.—Powhatan Mining Co. produced amphibole in Transylvania County near Lake Toxaway. Industrial Minerals Corp., 30 North La Salle St., Chicago 2, Ill., continued development work on amphibole deposits in Macon and Yancey Counties.

Oregon.—Philip S. Hoyt, P. O. Box 83, Aguila, Ariz., reported production in Oregon of a small amount of asbestos suitable for use as filter fiber.

Vermont.—The Vermont Asbestos Mines Division of the Ruberoid Co., 500 Fifth Ave., New York 18, N. Y., the largest producer of chrysotile in the United States, continued operation on an enlarged scale and also conducted exploratory work, partly under a DMEA loan.

Wisconsin.—The DMEA has approved a small exploration loan to determine the extent of a chrysotile deposit in eastern Marinette County. Results of the work are not yet available.

Wyoming.—The Philip Carey Manufacturing Co. was planning limited exploration of an asbestos deposit on Casper Mountain, Natrona County, under a DMEA loan.

CONSUMPTION AND USES

As indicated in table 2, apparent consumption of raw asbestos in the United States was about 10 percent higher in 1951 than that in 1950, which itself was an all-time high record. Asbestos is used in a multitude of industrial applications; therefore, its consumption in general moves in consonance with the trend of industrial production. Asbestos is also used extensively as a constituent of building materials and insulation products; therefore its consumption is particularly influenced by the volume of building construction. These trends are shown graphically in figure 1.

TABLE 2.—Apparent consumption of raw asbestos in the United States, 1942–51

Year	Short tons	Value	Year	Short tons	Value
1942	433, 949	$21, 582, 096	1947 [1]	616, 194	$30, 303, 777
1943	445, 902	23, 351, 483	1948 [1]	675, 746	37, 975, 742
1944	389, 241	18, 864, 291	1949 [1]	532, 708	32, 401, 654
1945	378, 030	15, 926, 622	1950 [1]	727, 002	46, 124, 871
1946	458, 727	17, 880, 214	1951 [1]	796, 992	58, 771, 276

[1] 1947–50 figures revised owing to change in basis of calculation. Export figures for 1947–51 used in arriving at apparent consumption include material that has been imported and subsequently exported without change (exports of "foreign" merchandise).

PRICES

Prices of Canadian asbestos, as quoted in short tons, f. o. b. mines, in the magazine Asbestos were raised substantially on January 15, 1951, to the following levels: Group 1 (Crude No. 1) $1,100–$1,500; group 2 (Crude No. 2, Crude Run-of-Mine, and Sundry), $485–$900; group 3 (Spinning Fiber), $275–$450; group 4 (Shingle Fiber), $135–$151; group 5 (Paper Fiber), $95–$119; group 6 (Waste, Stucco, or Plaster), $70; group 7 (Refuse or Shorts), $32–$63. These prices remained in effect throughout the year.

Vermont prices, quoted in short tons f. o. b. Hyde Park or Morrisville, Vt., remained at the December 1950 level until October 1951. In June 1951, however, a new item was introduced for Vermont fibers, namely, Spinning and Filtering Fibers, which were quoted at $254.10–$274.45. In October Vermont prices were increased to the following levels: Group 3 (Spinning and Filtering), $279.50–$302; group 4 (Shingle Fiber), $135–$162; group 5 (Paper Fiber), $81.50–$115; group 6 (Waste, Stucco, or Plaster), $71.40; group 7 (Refuse or Shorts), $34–$63. These prices remained in effect for the balance of the year. Prices of all grades, both Canadian and Vermont, except Canadian Crude No. 1, were again advanced substantially in January 1952.

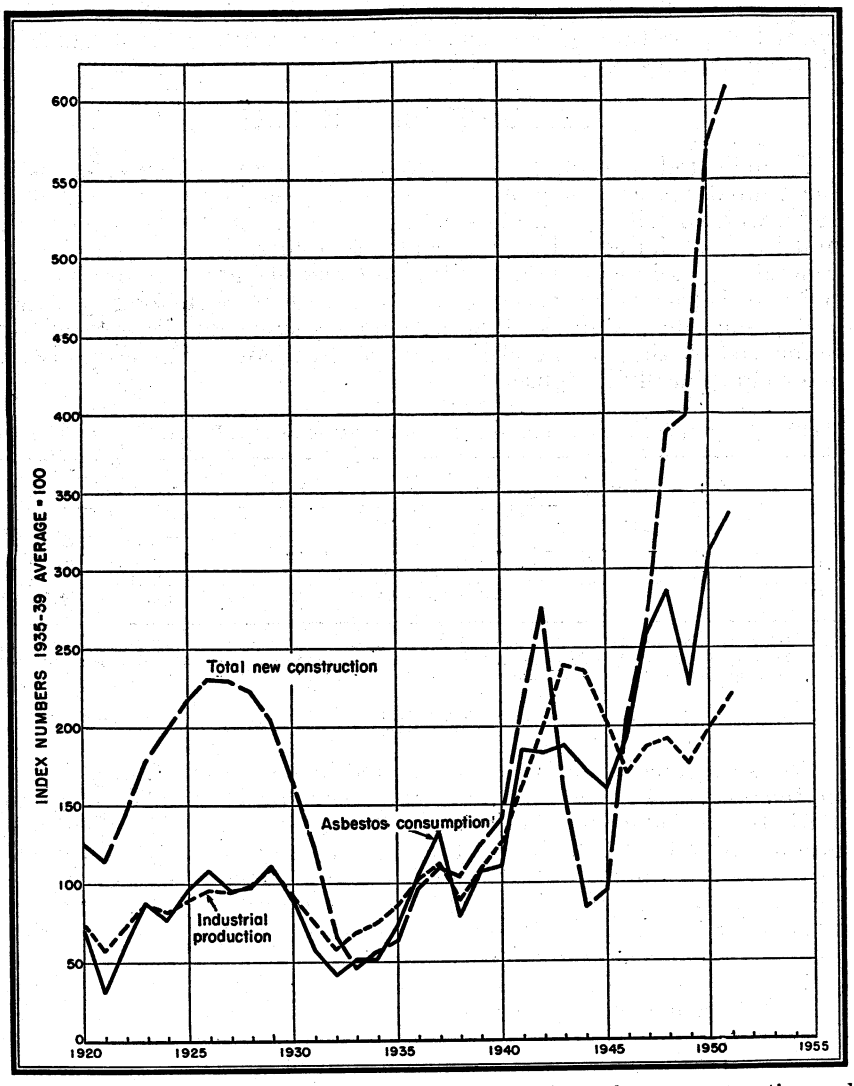

FIGURE 1.—Consumption of asbestos compared with total new construction and industrial production, 1920–51. Statistics on value of construction from Bureau of Foreign and Domestic Commerce and on industrial production from Federal Reserve Board.

FOREIGN TRADE [1]

Imports.—The United States is the largest consumer of asbestos in the world but produces only a small percentage (6 percent in 1951) of its requirements. Accordingly, foreign supplies are essential to

[1] Figures on imports and exports compiled by M. B. Price and E. D. Page, of the Bureau of Mines, from records of the U. S. Department of Commerce.

the asbestos-products industries. In 1951 imports were 8 percent higher than in 1950. About 95 percent of the total imports originated in Canada, 3 percent in the Union of South Africa, and 1 percent in Southern Rhodesia. On a value basis the African percentages are much higher.

TABLE 3.—Asbestos (unmanufactured) imported for consumption in the United States, 1947–51, by country and class

[U. S. Department of Commerce]

Country	Crude (including blue fiber)		Mill fibers		Short fibers		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1947	35,951	$4,810,852	162,405	$13,957,307	396,483	$11,053,360	594,839	$29,821,519
1948	38,088	5,420,600	176,908	18,028,161	432,885	14,525,331	647,881	37,974,092
1949	39,272	6,741,789	127,504	14,476,260	342,590	12,721,533	509,366	33,939,582
1950								
Australia	273	60,882					273	60,882
Bolivia	[1] 104	[1] 26,119					[1] 104	[1] 26,119
Canada	[1] 1,764	[1] 424,879	[1] 177,228	[1] 21,068,673	[1] 499,704	[1] 20,044,814	[1] 678,696	[1] 41,538,366
Finland	1	135					1	135
Italy	5	2,227	14	12,184			19	14,411
Portugal	40	3,137					40	3,137
Southern British Africa	[1] 1,522	[1] 342,953					[1] 1,522	[1] 342,953
Southern Rhodesia	[1] 8,908	[1] 2,731,929	556	286,825			[1] 9,464	[1] 3,018,754
Union of South Africa [2]	[1] 14,760	[1] 2,196,246	147	12,302			[1] 14,907	[1] 2,208,548
U. S. S. R	426	69,180					426	69,180
United Kingdom	(3)	(3)	[1] 6	[1] 1,720			[1] 6	1,720
Total	[1] 27,803	[1] 5,857,687	[1] 177,951	[1] 21,381,704	[1] 499,704	[1] 20,044,814	[1] 705,458	[1] 47,284,205
1951								
Australia	311	76,225					311	76,225
Bolivia [4]	324	121,085					324	121,085
British East Africa	160	35,409					160	35,409
Canada	736	362,075	224,770	28,780,021	501,264	23,052,818	726,770	52,194,914
France [5]			11	1,632			11	1,632
Italy	1	3,074	22	20,554			23	23,628
Southern British Africa	712	162,891					712	162,891
Southern Rhodesia	7,700	2,237,654	25	6,344			7,725	2,243,998
Union of South Africa [2]	23,448	3,448,373	109	18,299	26	5,428	23,583	3,472,100
U. S. S. R	1,897	171,354	330	16,500	10	175	2,237	188,029
Yugoslavia			17	1,135			17	1,135
Total	35,289	6,618,140	225,284	28,844,485	501,300	23,058,421	761,873	58,521,046

[1] Revised figure.
[2] Includes 10 tons ($2,715) of blue (crocidolite) crudes in 1950 and 512 tons ($52,065) of amosite crudes in 1951, credited by the U. S. Department of Commerce to Mozambique; 100 tons ($9,400) amosite crudes credited to French West Africa; 140 tons ($34,115) credited to Southern Rhodesia; and 6 tons ($2,002) blue (crocidolite) crudes credited to United Kingdom. Since Mozambique is not an asbestos producer and the Union of South Africa is the only producer of amosite, appropriate adjustments have been made by the Bureau of Mines.
[3] Revised to none.
[4] Includes 28 tons ($12,545) of blue (crocidolite) crudes credited by the U. S. Department of Commerce to Chile.
[5] Classified by U. S. Department of Commerce as amosite crude; reclassified by Bureau of Mines as mill fibers.

Exports.—Exports of unmanufactured asbestos were somewhat smaller in 1951 than in 1950. Because of current shortages of spinning fibers some measure of export control was deemed necessary, and export licenses were required beginning late in 1951. As indicated in table 4, the value of asbestos products exported increased sharply.

TABLE 4.—Asbestos and asbestos products exported from the United States, 1947–51 [1]

[U. S. Department of Commerce]

Year	Unmanufactured asbestos				Asbestos products	
	Domestic [2]		Foreign [3]		Domestic [2]	Foreign [3]
	Short tons	Value	Short tons	Value	Value	Value
1947	2,036	$308,414	644	$127,886	$11,135,113	$4,440
1948	6,530	1,173,259	2,697	631,352	9,321,351	5,354
1949	17,621	3,618,703	2,424	533,641	9,666,560	1,287
1950	[4] 18,980	[4] 3,646,828	1,910	437,556	[4] 8,097,192	49,949
1951	14,298	3,216,810	2,228	445,460	14,320,389	889

[1] These data cover exports of both "domestic" and "foreign" merchandise (for definition, *see* footnotes 2 and 3); similar tables in Asbestos chapters for earlier years covered exports of domestic merchandise only, as defined in footnote 2.
[2] Material of domestic origin, or foreign material that has been milled, blended or otherwise processed in the United States.
[3] Material that has been imported and subsequently exported without change.
[4] Revised figure.

TABLE 5.—Asbestos and asbestos products exported from the United States, 1950–51, by kinds [1]

[U. S. Department of Commerce]

Product	1950		1951	
	Quantity	Value	Quantity	Value
Unmanufactured asbestos:				
Crude and spinning fibers—short tons	6,255	$1,682,403	1,306	$479,228
Nonspinning fibers—do	[2] 11,157	[2] 1,830,857	11,449	2,567,289
Waste and refuse—do	1,568	133,568	1,543	170,293
Total unmanufactured—do	[2] 18,980	[2] 3,646,828	14,298	3,216,810
Asbestos products:				
Brake blocks—do	219	[2] 396,654	363	680,989
Brake lining:				
Molded and semimolded—do	1,751	[2] 2,685,709	3,472	6,017,473
Not molded—linear feet	[2] 511,381	[2] 336,201	1,034,930	661,474
Clutch facing—number	[2] 1,051,005	[2] 570,381	1,452,270	935,913
Construction materials—short tons	12,925	1,755,149	14,757	2,526,784
Pipe covering and cement—do	1,143	205,185	2,026	453,367
Textiles, yarn, and packing—do	1,215	1,814,105	1,176	2,391,982
Manufactures, n. e. s	(3)	333,808	(3)	652,407
Total		[2] 8,097,192		14,320,389

[1] Excludes material that has been imported and subsequently exported without change.
[2] Revised figure.
[3] Quantity not recorded.

TECHNOLOGY

Further progress has been made in reducing the iron content of Canadian chrysotile to make it a suitable substitute for the low-iron chrysotile obtained in decreasing quantities from Southern Rhodesia. Certain grades of low-iron Quinterra paper, made of purified Canadian short-fiber asbestos by the Johns-Manville Corp., are now on the market for wrapping wire and other insulation purposes. Raybestos-Manhattan, Inc., is continuing research on low-iron Novabestos paper; a high-quality paper of this type is now made of combined

fiberglass and asbestos. Experiments by the Naval Research Laboratory on deironing asbestos with a Vortrap, to which reference was made in the Asbestos chapter for 1950, were continued, but no definite results were announced.

Progress is reported on fiberglass research, particularly on high-silica fibers that will give better service than soda-lime-glass fibers, as substitutes for asbestos. To make such fibers in submicron sizes is difficult, but progress has been achieved.

Claims have been made that the Aerofall mill has advantages over standard equipment, both in percentage of recovery and in grade of the fiber produced. This mill reduces the fiber-bearing rock by abrasion and impact in a single stage. Reduction is accompanied by air classification. Details of the mill and results of tests have been published.[2] It has been reported that an Aerofall mill is or will be installed in the Beaver mill of the Asbestos Corp. in Quebec and two such machines in the Rhodesian Monteleo mill, 15 miles south of Shabani, Southern Rhodesia.

The physical and chemical properties of the various types of asbestos have been described in some detail by Badollet.[3] The data presented comprise information assembled by search of the literature, supplemented by experimental work.

WORLD REVIEW

Official statistics of world production for 1951 are far from complete, but estimates for unreported countries are included in the total shown in table 6. New figures or improved estimates have necessitated substantial revisions in the totals listed for 1946–50. The total output of all producing countries gained substantially in 1950 and 1951.

CANADA

Canadian asbestos shipments in 1951 attained an all-time record of 973,198 short tons, valued at $81,584,345, compared with 875,344 short tons, valued at $65,854,568, in 1950—a gain of 11 percent in quantity and 24 percent in value. The following companies were operating in the Quebec area in 1951: Asbestos Corp., Ltd.; Johnson's Co.; Bell Asbestos Mines; Canadian Johns-Manville Corp.; Nicolet Asbestos Mines, Ltd.; Quebec Asbestos Corp.; and Flintkote Mines, Ltd. Further expansion in production is in prospect. The Jeffrey mill of Canadian Johns-Manville Corp. is being modernized. Asbestos Corp., Ltd., is planning extensive mill construction at the Vimy Ridge deposit, where large reserves of asbestos-bearing rock have been proved by diamond drilling. The new mill of Johnson's Co. at Black Lake was being constructed in 1951. United Asbestos Corp., Ltd., is taking steps to develop its promising deposit under Black Lake. Expanding uses for the shorter grades of Canadian asbestos are described by Rukeyser.[4]

[2] Weston, D., The Aerofall Mill in the Milling of Industrial Minerals: Canadian Min. and Met. Bull. vol. 43, No. 464, December 1950, pp. 668–674.
[3] Badollet, M. S., Asbestos, a Mineral of Unparalleled Properties: Canadian Min. and Met. Bull., vol. 54, No. 468, April 1951, pp. 237–246.
[4] Rukeyser, W. A., New Uses for Low-Priced Fibers Vital to Canadian Asbestos: Eng. and Min. Jour., vol. 151, No. 3, March 1950, pp. 76–80.

TABLE 6.—World production of asbestos, 1946–51, by countries, in metric tons [1]

[Compiled by Helen L. Hunt]

Country [1]	1946	1947	1948	1949	1950	1951
Australia:						
New South Wales	241	290	330	284	[2] 380	[3] 400
South Australia	8	40	41	17	13	[3] 10
Western Australia	380	1,069	977	1,318	[2] 1,250	[3] 1,300
Bolivia (exports)		141	147	182	166	316
Brazil	1,214	2,631	1,304	1,415	(4)	(4)
Canada (sales)[5]	506,371	600,391	650,239	521,543	794,095	882,866
Chile	280	(4)	150	291	172	(4)
Cyprus	4,142	6,795	8,106	12,556	14,989	[6] 15,330
Egypt	65	1,015	1,625	117	260	1,247
Finland [7]	5,781	6,351	10,818	8,395	10,949	(4)
France	575	934	[2] 1,309	[2] 1,090	6,080	(4)
French Morocco	446	825	399	402	511	604
Greece	4	40	(4)	9	30	(4)
India	312	[2] 163	28	148	211	(4)
Italy	8,814	10,719	13,044	[2] 15,877	21,433	22,651
Japan	3,997	4,249	4,809	5,456	[2] 4,848	6,139
Kenya	165	582	510	716	229	396
Madagascar	1	(8)	(8)	2	1	(4)
New Zealand					42	(4)
Portugal	12	91	414	101	271	(4)
Southern Rhodesia	50,686	49,073	62,502	72,246	64,888	70,454
Spain			35	40	41	(4)
Swaziland	29,155	25,360	29,421	30,814	29,635	31,719
Switzerland	40					
Turkey	55	36	203	170	245	(4)
Union of South Africa	18,348	27,344	41,490	64,334	79,300	97,402
United States (sold or used by producers)	12,769	21,804	33,649	39,360	38,495	46,851
Venezuela	65	240	192	192	190	260
Total (estimate)	[2] 750,000	[2] 900,000	[2] 1,025,000	[2] 975,000	[2] 1,300,000	1,400,000

[1] In addition to countries listed, asbestos is produced in Argentina, Bulgaria, China, Czechoslovakia, Indochina, Korea, Tasmania, and U. S. S. R. Estimates by authors of the chapter are included in total.
[2] Revised figure.
[3] Estimate.
[4] Data not available; estimate by authors of the chapter included in total.
[5] Exclusive of sand, gravel, and stone (waste rock only), production of which is reported as follows: 1946, 5,749 tons; 1947, 8,718 tons; 1948, 40,066 tons; 1949, 32,015 tons; 1950, 43,551 tons; 1951, 30,628 tons.
[6] Exports.
[7] Includes asbestos flour.
[8] Less than 0.5 ton.

The Munro mine of Canadian Johns-Manville Corp. in Cochrane district, Ontario, which began production in April 1950, is producing substantial quantities of chrysotile of nonspinning grades. A detailed discussion of the geology and early stages of development of the

TABLE 7.—Sales of asbestos in Canada, 1950–51, by grade

[Dominion Bureau of Statistics]

	1950			1951		
	Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per ton
Grade:						
Crudes	904	$587,569	$649.97	748	$568,725	$760.33
Fibers	305,194	41,002,785	134.35	333,001	49,399,632	148.35
Shorts	569,246	24,264,214	42.63	639,449	31,615,988	49.44
Total	875,344	65,854,568	75.23	973,198	81,584,345	83.83
Rock mined	12,210,780			12,623,529		
Rock milled	8,635,036			10,219,658		

Munro deposit has been published.[5] Little progress is reported by Teegana Mines, Ltd., in developing its property near South Porcupine in Deloro Township, Ontario.

There is increasing interest in the McDame Creek asbestos deposit in northern British Columbia, now being developed by Conwest-Exploration Co., Ltd. The fiber is said to be high-quality spinning-grade chrysotile. Production is expected in 1953.

SOUTHERN AFRICA

Southern Rhodesia.—As indicated in table 8, asbestos production in Southern Rhodesia in 1951 was considerably higher than in 1950. Principal production is from the Shabani mines and from operations in the Mashaba and Filabusi districts, controlled by Turner & Newall, Ltd., of Manchester, England. In 1951 a new company was planning mining and milling operations on a deposit 15 miles from Shabani. It is named Rhodesia Monteleo Asbestos, Ltd., a subsidiary of African & European Investment Co., Ltd., of Johannesburg. Several other mines and prospects have been recorded, but their output has been quite small.

TABLE 8.—Asbestos produced in Southern Rhodesia, 1946–51

Year	Short tons	Value	Year	Short tons	Value
1946	55,872	£1,676,503	1949	79,638	£3,986,703
1947	54,094	1,738,484	1950	71,527	4,615,490
1948	68,897	2,604,623	1951	77,663	5,452,108

Union of South Africa.—Output of asbestos in the Union continued the remarkable gains that have characterized recent years. Production in 1951 was 23 percent greater than in 1950. Amosite production (*see* table 10) continued its upward trend, 1951 output exceeding that of 1950 by 28 percent. Current production, however, includes a larger proportion of the shorter grades than formerly. Production of Transvaal crocidolite (blue asbestos) was about the same as in 1950, but the output of Cape blue advanced 19 percent. Production of chrysotile increased 36 percent. Kinlock Asbestos (Pty.), Ltd., is a substantial producer. The Doyershock Asbestos Mine (Pty.), Ltd., adjoining the Kinlock property, produces a moderate tonnage. The Munnick-Myburgh mine, which has been inactive for some years, has been reopened by African & European Investment Co., Ltd. A new mill having a capacity of 8,000 tons of rock a month has been completed.

The current heavy demand for short fibers has created interest in recovery of shorts in South Africa. The long distance of the African mines from markets makes it imperative that every possible economy be practiced if any profit is to be made from shorts.

Sinclair has described crocidolite mining.[6]

[5] Hendry, N. W., Chrysotile Asbestos in Munro and Beatty Townships, Ontario: Canadian Min. and Met. Bull., vol. 44, No. 465, January 1951, pp. 29–36.

[6] Sinclair, W. E., The Present Status of Crocidolite Asbestos: Asbestos, vol. 32, No. 11, May 1951, pp. 4–12, Production of Crocidolite or Blue Asbestos in South Africa: Asbestos, vol. 33, No. 1, July 1951, pp. 4–10; vol. 33, No. 2, August 1951, pp. 4–12.

TABLE 9.—Asbestos produced in and exported from the Union of South Africa, 1947–51 [1]

Year	Production (short tons)			Exports	
	Transvaal	Cape Province	Total	Short tons	Value
1947	21,959	8,183	30,142	33,237	£927,371
1948	37,434	8,301	45,735	38,550	1,138,792
1949	58,918	11,999	70,917	63,428	2,600,323
1950	[2] 72,203	15,211	[2] 87,414	[2] 70,609	[2] 3,475,200
1951	89,290	18,078	107,368	89,735	5,056,143

[1] Data from Union of South Africa, Department of Mines, quarterly reports.
[2] Revised figure.

TABLE 10.—Asbestos produced in the Union of South Africa, 1947–51, by variety and source, in short tons [1]

Variety and source	1947	1948	1949	1950	1951
Amosite (Transvaal)	18,780	30,372	41,974	[2] 42,393	54,053
Chrysotile (Transvaal)	2,253	4,441	7,609	[2] 14,334	19,509
Blue (Transvaal)	896	2,608	9,181	[2] 15,387	15,581
Blue (Cape)	8,183	8,301	11,999	15,211	18,078
Anthophyllite (Transvaal)	30	13	154	89	147
Total	30,142	45,735	70,917	[2] 87,414	107,368

[1] Data from Union of South Africa, Department of Mines, quarterly reports.
[2] Revised figure.

Swaziland.—The Havelock mine close to the Transvaal border has become an important producer. Output in 1951 reached an all-time high. It is reported that a new mine adjacent to the Havelock is being worked by Msuali Asbestos Co., also known as African Chrysotile Co.

OTHER COUNTRIES

Bolivia.—The Province of Chapare has the distinction of possessing the only known commercial deposit of crocidolite (blue asbestos) in the Western Hemisphere. The material is in demand for air filters, and the small imports are purchased mainly for the National Stockpile.

Brazil.—Deposits of chrysotile asbestos are worked in a small way at Djalma Dutra, State of Bahia, and near Nova Lima, State of Minas Gerais.

Colombia.—Active measures are being taken to develop chrysotile asbestos deposits at or near Yarumal, State of Antioquia. An official of Emergency Procurement Service has examined a deposit at Neira, near Manizales, State of Caldes. Samples submitted to the Bureau of Mines were found to consist in part of chrysotile and in part of nemalite, which is fibrous brucite ($Mg(OH)_2$). Possible utilization of the latter fibers is now under investigation. All of the chrysotile is of the slip-fiber type.

Morocco.—A deposit of high-quality chrysotile has been worked to some extent at N'Cob, about 185 miles by road from Marrakech.

Asphalt and Related Bitumens

By A. H. Redfield [1] and Willa D. Granacher

GENERAL SUMMARY

DOMESTIC demand [2] for petroleum asphalt (including small quantities of imported lake asphalt and, in 1950, of grahamite) was nearly 13 percent larger in 1951 than in 1950, but export demand was 28 percent greater. As export demand in 1951 was less than 1½ percent of the total demand, the total demand increased only 13 percent from 1950 to 1951. In numerical terms, an increase of 1,372,686 short tons in domestic demand, augmented by an increase of 39,620 tons in export demand, was met by an increase of 1,466,356 tons in refinery production and an increase of 119,442 tons in imports of petroleum and lake asphalt. Included in the change in domestic demand was the effect of an increase in refinery stocks of asphalt of 241,275 tons during 1951 compared with an increase of 68,179 tons in 1950.

TABLE 1.—Supply and distribution of asphalt and related bitumens in the United States, 1950–51, in short tons

	1950	1951
SUPPLY		
Native asphalt and related bitumens:		
Production	1,250,862	1,443,955
Imports (chiefly lake asphalt)	5,863	6,304
Petroleum asphalt (excluding road oil):		
Production	10,589,099	12,055,455
Imports	323,571	442,572
Stocks, Jan. 1	894,182	962,361
Total supply	13,063,577	14,910,647
DISTRIBUTION		
Native asphalt and related bitumens:		
Domestic demand [1]	[2] 1,232,441	1,419,037
Exports	[2] 18,421	24,918
Petroleum asphalt (excluding road oil):		
Indicated (apparent) domestic demand [1]	[2] 10,706,729	12,079,811
Exports	[2] 143,625	183,245
Stocks, Dec. 31	962,361	1,203,636
Total distribution	13,063,577	14,910,647

[1] Domestic demand for native asphalt excludes, and that for petroleum asphalt includes, lake asphalt, since this has the same sorts of uses as the manufactured product.
[2] Revised figure.

NATIVE ASPHALT AND BITUMENS

Bituminous Rock.—Sales of bituminous rock by producers in the United States increased from 1,184,676 short tons in 1950 to 1,378,434

[1] Deceased.
[2] The term "domestic demand" as used in this chapter means apparent consumption, that is, production plus net imports and changes in refiners' stocks.

tons in 1951 and in value from $3,522,308 to $4,159,259. Bituminous limestone amounted to 1,071,955 tons valued at $2,737,056 in 1950 and 1,247,940 tons valued at $3,178,323 in 1951. Bituminous sandstone totaled 112,721 tons valued at $785,252 in 1950 and 130,494 tons valued at $980,936 in 1951. The average sales value of bituminous limestone—$2.55—remained the same as in 1950. The average sales value of bituminous sandstone increased from $6.97 per ton in 1950 to $7.52 in 1951.

Gilsonite.—Sales of gilsonite by producers in northeastern Utah decreased from 66,186 tons valued at $1,774,330 in 1950 to 65,521 tons valued at $1,895,374 in 1951. The average sales value per ton at the mine or railhead increased from $26.81 in 1950 to $28.93 in 1951.

MANUFACTURED OR PETROLEUM ASPHALT

Production.—Petroleum refineries in the United States produced 12,055,500 short tons of asphalt in 1951, a 14-percent increase over the 10,589,100 tons produced in 1950. The increases were general but were greater in the East Coast, Indiana-Illinois-Kentucky, etc., and Oklahoma-Kansas-Missouri districts.

Stocks.—Stocks of asphalt held at refineries increased 25 percent from 962,400 short tons on December 31, 1950, to 1,203,600 tons on December 31, 1951. The increases were general throughout the United States except in the Louisiana-Arkansas district, where stocks were reduced.

TABLE 2.—Supply and disposition of petroleum asphalt (exclusive of road oil) at petroleum refineries in the United States in 1951, by refinery district, in short tons

District	Production	Receipts[1]	Stocks		Consumption by producers, transfers,[2] losses, and exports	Sales to domestic consumers
			Jan. 1	Dec. 31		
East Coast	3,132,400	486,100	149,800	204,500	71,200	3,492,600
Appalachian	408,200	42,700	24,000	41,300	25,700	407,900
Indiana, Illinois, Kentucky, etc.	2,102,900	28,500	198,200	215,300	159,300	1,955,000
Oklahoma, Kansas, Missouri	1,149,300	106,300	129,500	209,500	51,700	1,123,900
Texas:						
Gulf Coast	847,600		66,100	72,500	101,800	739,400
Inland	705,100	29,500	49,100	94,000	67,700	622,000
Total Texas	1,552,700	29,500	115,200	166,500	169,500	1,361,400
Louisiana-Arkansas:						
Louisiana Gulf Coast	596,200	1,000	76,000	66,500	129,300	477,400
Arkansas and Inland Louisiana	660,700	15,400	96,200	78,700	72,600	621,000
Total Louisiana-Arkansas	1,256,900	16,400	172,200	145,200	201,900	1,098,400
Rocky Mountain	541,600	71,400	61,100	92,900	63,900	517,300
California and Washington	1,911,500		112,400	128,400	151,200	1,744,300
Total: 1951	12,055,500	780,900	962,400	1,203,600	894,400	11,700,800
1950	10,589,100	909,400	894,200	962,400	901,800	10,528,500

[1] Receipts from intraindustry refinery transfers, addition of other petroleum products blended to make cut-back asphalts, imports, and transfers from stocks formerly not classified as asphalt.
[2] Transfers between refineries and transfers of asphalt to stocks not so classified.

Sales.—Sales of petroleum asphalt to domestic consumers increased 11 percent in quantity from 1950 to 1951 and, because of higher prices, 22 percent in value. The average sales price per short ton increased from $16.87 in 1950 to $18.47 in 1951. The greatest increases in both tonnage and in value were in the Texas, East Coast, and Indiana-Illinois-Kentucky, etc., districts. In contrast to the general trend, the Louisiana-Arkansas district showed a decrease of 7 percent in its quantity of sales but a 5-percent increase in value in 1951 over 1950.

Of the total petroleum asphalt sold to domestic consumers in 1951, 27 percent was manufactured from foreign petroleum, imported mainly from Venezuela, Colombia, Mexico, and the Persian Gulf, compared with 25 percent in 1950. Although runs of foreign crude to stills increased only 3 percent from 1950 to 1951, sales of asphalt made from foreign crude increased 19 percent from 1950 to 1951. Of the foreign crude processed, 8 percent was converted to asphalt in 1950 and a little over 9 percent in 1951. Ninety-seven percent of the asphalt made from foreign petroleum in 1951 was manufactured in east coast refineries, compared with 94 percent in 1950.

TABLE 3.—Asphalt and asphalt material (exclusive of road oil) sold at petroleum refineries to domestic consumers in the United States in 1951, by form and use

[Value f. o. b. refinery]

Form and use	From domestic petroleum		From foreign petroleum		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
Solid and semisolid products of less than 200 penetration:						
Asphalt for—						
Paving	2,756,889	$47,098,862	1,371,589	$27,035,700	4,128,478	$74,134,562
Roofing	1,365,437	24,084,058	714,724	14,433,210	2,080,161	38,517,268
Waterproofing	106,124	2,331,055	16,088	347,941	122,212	2,678,996
Blending with rubber	10,546	249,942	10,868	306,202	21,414	556,144
Briquetting	196,570	3,384,523	13,753	290,458	210,323	3,674,981
Mastic and mastic cake	2,037	48,645			2,037	48,645
Pipe coatings	22,508	606,228	3,765	75,816	26,273	682,044
Molding compounds	30,571	608,015	8,297	201,562	38,868	809,577
Miscellaneous uses	243,973	5,320,103	166,317	3,384,394	410,290	8,704,497
Total	4,734,655	83,731,431	2,305,401	46,075,283	7,040,056	129,806,714
Semisolid and liquid products of more than 200 penetration:						
Flux for—						
Paving	401,333	5,694,197	41,528	822,925	442,861	6,517,122
Roofing	826,861	12,288,784	55,422	1,157,235	882,283	13,446,019
Waterproofing	5,604	157,505	432	9,920	6,036	167,425
Mastic	14,471	435,282			14,471	435,282
Cut-back asphalts:						
Rapid-curing	1,105,362	21,614,781	373,356	7,745,338	1,478,718	29,360,119
Medium-curing	1,246,858	23,450,214	238,519	4,910,712	1,485,377	28,360,926
Emulsified asphalts and fluxes	130,345	2,670,547	85,902	2,002,158	216,247	4,672,705
Paints, enamels, japans, and lacquers	48,666	1,605,680	20,941	429,793	69,607	2,035,473
Other liquid products	59,607	1,158,034	5,539	145,177	65,146	1,303,211
Total	3,839,107	69,075,024	821,639	17,223,258	4,660,746	86,298,282
Grand total: 1951	8,573,762	152,806,455	3,127,040	63,298,541	11,700,802	216,104,996
1950	7,904,731	129,846,469	2,623,735	47,717,124	10,528,466	177,563,593

TABLE 4.—Sales of asphalt (exclusive of road oil) at petroleum refineries to domestic consumers in the United States, 1950–51, by refinery district

District	1950		1951	
	Short tons	Value	Short tons	Value
East Coast	2,993,481	$54,761,544	3,492,552	$70,569,180
Appalachian	405,248	8,153,349	407,921	9,029,274
Indiana, Illinois, Kentucky, etc	1,709,444	30,171,094	1,954,961	37,806,652
Oklahoma, Kansas, Missouri	1,041,627	16,263,097	1,123,929	18,179,307
Texas:				
Gulf Coast	507,032	8,270,651	739,428	12,674,919
Inland	584,774	9,649,617	622,032	10,684,159
Total Texas	1,091,806	17,920,268	1,361,460	23,359,078
Louisiana-Arkansas:				
Louisiana Gulf Coast	555,538	8,204,244	477,429	8,048,326
Arkansas, Louisiana Inland	630,079	9,748,262	620,981	10,752,655
Total Louisiana-Arkansas	1,185,617	17,952,506	1,098,410	18,800,981
Rocky Mountain	499,221	7,084,163	517,290	7,664,247
California	1,602,022	25,257,572	1,744,279	30,696,277
Total United States	10,528,466	177,563,593	11,700,802	216,104,996

Highway and street construction and airport-runway surfacing used (in the form of paving asphalt, paving flux, cutback asphalts, and asphalt emulsions) 71 percent of the total asphalt sold to domestic consumers by petroleum refineries in 1951 compared with 66 percent in 1950. Sales of all grades of asphalt devoted wholly or principally to street and road construction increased 20 percent in 1951 over 1950.

Roofing manufacture made the second largest demand for asphalt, absorbing 27 percent of the total in 1950 and 25 percent in 1951. Although sales of prepared roofing and asphalt siding reported to the Bureau of the Census decreased 9 percent—from 65,024,467 (revised figure) squares in 1950 to 59,116,749 in 1951—and of saturated felt increased 2 percent—from 650,389 (revised figure) short tons in 1950 to 662,961 in 1951—domestic sales of roofing asphalt and roofing flux combined increased 4 percent—from 2,846,623 short tons in 1950 to 2,962,444 tons in 1951. These figures do not include roofing asphalt and flux consumed by the refining companies in factories owned by themselves or by affiliated companies making prepared roofing and siding and saturated felts.

Sales of asphalt emulsified with water were 85 percent greater in 1951 than in 1950. Petroleum refineries sold 119,489 tons (28,151,609 gallons) valued at $2,440,692 in 1950 and 216,247 tons (51,034,292 gallons) valued at $4,672,705 in 1951. In addition, 75,558,691 gallons valued at $9,323,628 in 1950 and 142,084,036 gallons valued at $16,148,374 in 1951 were sold by secondary producers that purchased asphalt from petroleum refineries and manufactured it into emulsions. Accordingly, total known sales of emulsified asphalts and fluxes increased 84 percent in quantity—from 104,710,300 gallons (444,441 tons) in 1950 to 193,118,328 gallons (818,298 tons) in 1951—and 76 percent in value—from $11,764,320 in 1950 to $20,821,079 in 1951.

TABLE 5.—Asphalt and asphalt material (exclusive of road oil) sold at petroleum refineries to domestic consumers in the United States in 1951, by varieties, in short tons

	East Coast	Appalachian	Indiana-Illinois-Kentucky, etc.	Oklahoma-Kansas-Missouri	Texas	Louisiana-Arkansas	Rocky Mountain	California	Total	
									Short tons	Value
Solid and semisolid products of less than 200 penetration:										
Asphalt for—										
Paving	1,479,792	142,642	471,627	237,799	350,547	564,072	204,876	677,123	4,128,478	$74,134,562
Roofing	868,402	118,110	391,708	82,504	197,454	200,964	7,684	213,335	2,080,161	38,517,268
Water proofing	17,005	2,084	19,951	17,936	10,327	20,039	441	34,429	122,212	2,678,996
Blending with rubber	10,891	1,560	171	2,960		901	1,268	3,663	21,414	556,144
Briquetting	18,331	1,618	96,620	77,151			11,057	5,546	210,323	3,674,981
Mastic and mastic cake	1,790	121	126						2,037	48,645
Pipe coatings	2,472	2,405	562	2,836	491	2,768	F 168	14,571	26,273	682,044
Moulding compounds	12,996	1,856	2,202	870	5,674	2,652	9,450	3,168	38,868	809,577
Miscellaneous uses	232,772	1,388	66,490	61,788	2,561	23,119	8,375	13,797	410,290	8,704,497
Total	2,644,451	271,784	1,049,457	483,844	567,054	814,515	243,319	965,632	7,040,056	129,806,714
Semisolid and liquid products of more than 200 penetration:										
Flux for—										
Paving	43,906	1,590	31,864	43,509	145,965	65,319	14,013	96,695	442,861	6,517,122
Roofing	60,626	24,970	381,574	168,898	18,792	28,435	148	198,840	882,283	13,446,019
Water proofing	432		2,807	1,039			326	1,432	6,036	167,425
Mastic					11,002	2,400		1,069	14,471	435,282
Cutback asphalts:										
Rapid-curing	395,418	58,484	207,352	95,395	475,867	79,229	79,442	87,531	1,478,718	29,360,119
Medium curing	242,749	14,480	241,357	306,266	120,225	90,606	162,293	307,401	1,485,377	28,360,926
Emulsified asphalt and fluxes	80,120	4,731	8,877	12,115	17,911	6,803	2,020	83,670	216,247	4,672,705
Paints, enamels, japans, and lacquers	21,174	31,882	11,691	837	2,318			1,705	69,607	2,035,473
Other liquid products	3,676		19,982	12,026	2,326	11,103	15,729	304	65,146	1,303,211
Total	848,101	136,137	905,504	640,085	794,406	283,895	273,971	778,647	4,660,746	86,298,282
Grand total:										
Short tons	3,492,552	407,921	1,954,961	1,123,929	1,361,460	1,098,410	517,290	1,744,279	11,700,802	
Value	$70,569,180	$9,029,274	$37,806,652	$18,179,307	$23,359,078	$18,800,981	$7,664,247	$30,696,277		216,104,996

APPARENT CONSUMPTION

The apparent domestic consumption of petroleum asphalt increased 13 percent in 1951 over 1950. The apparent average monthly domestic consumption of petroleum asphalt (including small quantities of imported lake asphalt and grahamite, which have similar uses and are supplementary to petroleum asphalt) increased from 892,227 (revised figure) short tons in 1950 to 1,006,651 in 1951. Total apparent consumption was 10,706,729 tons (revised figure) in 1950 and 12,079,811 in 1951.

DISTRIBUTION BY RAIL

Revenue-freight statistics showing the tonnage of each important commodity originated and terminated in each State by class I railroads, formerly compiled and issued by the Interstate Commerce Commission, were discontinued by the Commission at the end of 1950. Accordingly an index, however imperfect, of the consumption of asphalt by States is no longer available. Apparently, however, increasing quantities of asphalt are delivered to consumers by waterways, minor railroads, and motor trucks, as quantities terminated by class I railroads were equivalent to only 62 percent of the apparent consumption of asphalt in the United States in 1949 and only 53 percent of the total in 1950.

FOREIGN TRADE [3]

Imports.—Imports of natural asphalt and bitumen into the United States totaled 5,863 short tons valued at $136,003 in 1950 and 6,304 tons valued at $112,007 in 1951. Imports of lake asphalt from Trinidad increased from 4,855 tons valued at $66,953 to 6,270 tons valued at $110,940. Imports of grahamite from Cuba amounted to 880 short tons valued at $27,880 in 1950, but none was imported in 1951. Imports of solid petroleum asphalt increased from 308,959 short tons valued at $3,275,967 in 1950 to 422,345 tons valued at $5,013,730 in 1951. Netherlands Antilles was the principal source. In addition, the United States received 80,365 barrels (14,612 tons) of liquid petroleum asphalt valued at $205,031 in 1950 and 111,250 barrels (20,227 tons) valued at $280,294 in 1951. Nearly all of these imports for 1950 came from the Netherlands Antilles and those for 1951, from Venezuela.

Exports.—The tonnage of natural asphalt, unmanufactured, exported from the United States increased from 18,421 short tons (revised figure) valued at $910,910 (revised figure) in 1950 to 24,918 tons valued at $1,277,783 in 1951. Of the 1951 exports, 77 percent went to Europe, notably to the United Kingdom, France, Germany, Italy, Sweden, Netherlands, Belgium and Luxembourg, Denmark, and Switzerland. Canada received 9 percent of the total, Brazil 2 percent, India 2 percent, and Mexico 2 percent. Exports of petroleum asphalt from the United States increased from 143,625 tons (revised figure) valued at $4,519,641 (revised figure) in 1950 to 183,245 tons

[3] Figures on imports and exports compiled by M. B. Price and E. D. Page, of the Bureau of Mines, from records of the U. S. Department of Commerce.

valued at $6,391,462 in 1951. Larger shipments to South America (notably Brazil), to Europe (especially United Kingdom and France), and to Asia (especially the Philippines and Indochina) accounted for the increase.

TABLE 6.—Petroleum asphalt (unmanufactured) [1] exported from the United States, 1950–51, by country of destination

[U. S. Department of Commerce]

Country	1950		1951	
	Short tons	Value	Short tons	Value
North America:				
British Honduras	275	$8,598	248	$10,548
Canada	5,785	379,573	3,861	210,410
Canal Zone	4,762	77,058	4,823	85,265
Costa Rica	1,160	22,260	623	21,641
Cuba	1,502	46,500	5,395	165,695
Dominican Republic	511	17,311	103	3,388
El Salvador	2,532	39,996		
Guatemala	11,576	205,868	885	22,798
Honduras	15	524	19	394
Mexico	25,576	614,174	26,252	588,125
Nicaragua	4,987	142,797	319	15,482
Panama	338	9,116	251	6,512
Other North America	70	2,600	160	11,321
Total North America	59,089	1,566,375	42,939	1,141,579
South America:				
Argentina	26	2,360	88	6,483
Bolivia	150	7,061	823	25,512
Brazil	23,123	1,011,964	54,132	2,505,738
Chile	1,174	31,452	1,024	35,454
Colombia	17	1,871	114	6,584
Ecuador	55	1,946	506	29,073
Uruguay	[2] 3,756	[2] 129,614	2,861	94,237
Venezuela	385	24,592	366	25,410
Other South America	79	1,810	59	7,815
Total South America	[2] 28,765	[2] 1,212,670	59,973	2,736,306
Europe:				
Austria	1,847	43,355	1,464	47,313
Belgium-Luxembourg	2,532	96,681	2,450	84,881
Denmark	29	2,417		
France	462	24,024	10,371	304,518
Greece	11,626	301,462	10,518	410,925
Italy	95	7,356	13	2,274
Netherlands	8	721	25	1,219
Norway	172	6,922	179	9,794
Spain	169	4,992	30	1,847
Sweden	158	12,232	102	7,277
Switzerland	775	32,802	1,397	63,678
Turkey	7,809	303,458	3,920	145,950
Other Europe	9	367	86	7,478
Total Europe	[3] 25,691	[3] 836,789	30,555	1,087,154
Asia:				
British Malaya	24	315	938	27,108
Ceylon	19	783	133	2,951
French Indochina	6,311	157,356	12,283	326,733
Hong Kong	396	13,817	4,682	115,762
India			4,412	96,420
Indonesia	5,752	147,177	134	11,137
Israel	3,199	84,538	4	325
Japan	66	3,442	434	24,060
Lebanon	166	5,442		
Pakistan			520	10,142
Philippines	1,827	46,789	8,742	290,037
Saudi Arabia	65	4,263	8	502
Thailand			1,762	49,326
Other Asia	30	1,353	112	3,708
Total Asia	[3] 17,855	[3] 465,275	34,164	958,211

For footnotes, see end of table.

TABLE 6.—Petroleum asphalt (unmanufactured)[1] exported from the United States, 1950–51, by country of destination—Continued

Country	1950		1951	
	Short tons	Value	Short tons	Value
Africa:				
Belgian Congo	1,640	$57,719	1,377	$55,994
French Morocco	592	49,995	74	6,600
French West Africa	764	30,352	301	21,100
Liberia	200	7,184	356	14,528
Mozambique	2,922	74,700	582	15,264
Southern Rhodesia	4	126	550	15,586
Tunisia	248	20,533		
Union of South Africa	5,070	168,969	10,258	266,544
Other Africa	387	13,175	54	3,418
Total Africa	11,827	422,753	13,552	399,034
Oceania:				
Australia	166	7,311	385	12,422
French Pacific Islands	189	7,047	219	8,247
New Zealand	43	1,421	1,458	48,509
Total Oceania	398	15,779	2,062	69,178
Grand total	[3] 143,625	[3] 4,519,641	183,245	6,391,462

[1] In addition, exports of "petroleum asphalt manufactures" were valued as follows: 1950—$381,019; 1951—$2,351,776 (quantity not available).
[2] Revised figure.
[3] Total for Europe revised to include Turkey; formerly included with Asia.

ROAD OIL

Road oil is less easy to define in terms of its physical properties than in terms of its practical uses. Any residue of petroleum distillation, or blend of residues and distillates, that is liquid enough to be applied easily to a roadway without preheating, that is sufficiently cohesive to bind the surface particles into a surface that is moderately dust-free in dry weather and not too muddy in wet weather, that is cheap enough to be bought as surface dressing for secondary roads built for light vehicular traffic may be sold as road oil. Consequently, statistics submitted to the Bureau of Mines by the refiners may confuse road oil with asphalt fluxes and cutback asphalts. Residual oils that had been stored as fuel oils may find their final use as road dressing. Consequently, adjustments have to be made each year for transfers into and out of road-oil stocks to achieve a balance between recorded figures of road-oil production and stocks at the beginning of the year on the one hand and domestic sales and stocks at the end of the year on the other. The same type of oil may be designated by one refiner as "road oil" and by another as "slow-curing cut-back asphalt." A railroad tank-car of "fuel oil" may be diverted in transit to a highway contractor and spread upon a highway.

Sales of road oil by petroleum refineries in the United States decreased 11 percent in quantity—from 7,326,000 barrels in 1950 to 6,494,000 barrels in 1951—but because of higher prices decreased only 1 percent in value—from $16,876,000 in 1950 to $16,651,000 in 1951. Of the total sales of road oil to domestic consumers, 71,291 barrels valued at $233,269 in 1950 and 59,832 barrels valued at $208,349 in 1951 were made in east coast refineries from foreign petroleum, imported chiefly from Venezuela, Colombia, and Mexico.

TABLE 7.—Supply and disposition of road oil in the United States in 1951, by refinery district, in thousands of barrels

District	Production	Receipts[1]	Stocks		Consumption by producers, transfers,[2] losses, and exports	Sales to domestic consumers
			Jan. 1	Dec. 31		
East Coast	208	55	10	16	186	71
Appalachian		3				3
Indiana, Illinois, Kentucky, etc	1,394	442	26	17	346	1,499
Oklahoma, Kansas, Missouri	464	277	72	26	183	604
Texas	30	62	1	1	1	91
Louisiana-Arkansas	3	6	3	2	4	6
Rocky Mountain	1,617	193	99	102	444	1,363
California	2,368	541	186	238		2,857
Total: 1951	6,084	1,579	397	402	1,164	6,494
1950	6,928	1,393	366	397	964	7,326

[1] Receipts from intraindustry refinery transfers, imports, and transfers from stocks formerly not classed as road oil.
[2] Transfers between refineries and transfers to stocks not classified as road oil.

TABLE 8.—Road oil sold by petroleum refineries to domestic consumers in the United States, 1950–51, by refinery district

District	1950		1951	
	Thousand barrels	Thousand dollars	Thousand barrels	Thousand dollars
East Coast	83	267	71	245
Appalachian			3	56
Indiana, Illinois, Kentucky, etc	1,505	4,075	1,499	4,418
Oklahoma, Kansas, Missouri	1,151	2,480	604	1,225
Texas	222	507	91	276
Louisiana-Arkansas	8	21	6	21
Rocky Mountain	1,520	3,383	1,363	3,099
California	2,837	6,143	2,857	7,311
Total	7,326	16,876	6,494	16,651

Barite

By Joseph C. Arundale and F. M. Barsigian

GENERAL SUMMARY

IN 1951 the domestic barite industry produced 845,600 short tons of primary barite;[1] 52,800 short tons was imported; a record 950,900 short tons was consumed. Over 62 percent of the tonnage consumed was used in oil-well drilling muds. New production was reported from Montana, and a new producer began operations at Upper Brookfield, Nova Scotia.

TABLE 1.—Salient statistics of the barite and barium-chemical industries in the United States, 1947–51

	1947	1948	1949	1950	1951
Barite:					
Primary:					
Produced.....short tons..	884,219	777,841	731,308	693,424	845,579
Sold or used by producers:					
Short tons.....	834,082	799,848	717,313	695,414	860,669
Value.....	$6,171,342	$6,693,413	$5,642,226	$6,193,906	$7,968,023
Imports for consumption:					
Short tons.....	53,222	53,204	26,178	58,381	52,755
Value.....	$378,294	$443,515	$192,567	$431,879	$419,494
Consumption.....short tons..	835,818	894,309	719,543	[1] 786,131	[1] 950,893
Ground and crushed sold by producers:					
Short tons.....	549,965	631,424	554,028	573,359	703,014
Value.....	$8,979,400	$11,195,365	$10,156,590	$11,305,209	$14,590,000
Barium chemicals sold by producers:					
Short tons.....	72,919	71,717	57,012	73,689	86,032
Value.....	$7,035,104	$7,028,058	$5,646,403	$7,885,586	$11,656,497
Lithopone sold or used by producers:					
Short tons.....	165,024	140,033	78,335	105,650	102,837
Value.....	$17,382,592	$16,135,976	$8,977,178	$13,129,363	$14,470,742

[1] Includes some witherite.

Barite is growing rapidly in importance to the national economy. It has been mined in the United States since the middle of the 19th century, when production first was reported in Virginia. A few years later it was discovered in Missouri, where it has been produced continuously for 100 years. Several significant events have marked development of the domestic industry. The first use of barite was as a paint filler. In 1892 a lithopone industry was established in the United States, and this created the second major market for barite. Production of barite in Georgia began in 1901 and in Kentucky in 1903. The first domestic barium-chemical plant began operation at Blue Island, Ill., in 1908. Washers and jigs were installed in Georgia

[1] The term "primary barite," as used in this chapter, applies to barite as first offered to the trade, whether lump, crushed, or ground. Where ground barite has been reported to the Bureau of Mines as original production, an estimate of the value of the lump equivalent of the ground has been assigned to such tonnage

and Tennessee in 1914–16 and in Missouri in 1923. In 1926 the use of barite as a weighting agent in drilling mud was patented; over two-thirds of the domestic output was employed for this purpose in 1951. The use of barite as a flux in glass began in 1928. The deposit, from which barite was being produced in Arkansas in 1951, was discovered in 1900, but sustained production did not begin until 1941, when this barite first was recovered by flotation on a commercial scale.

DOMESTIC PRODUCTION

Mine production of barite, which had slumped after the record year 1947, surged to a near-record 845,600 short tons in 1951 under the impetus of an accelerated well-drilling program. Demand, which had begun to increase in the latter part of 1950, continued to expand during 1951. By the end of the year shortages were being reported, and producers were attempting to increase their capacities. Arkansas again was eminent in output, with a record tonnage going to the well-drilling trade. Missouri was second in rank, with a substantial increase over the previous year, but did not reach 1947 output.

Arizona.—The Arizona Barite Co. continued to produce ground barite for the well-drilling trade at its mine and mill near Mesa.

Arkansas.—The two producers in Arkansas—Magnet Cove Barium Corp. and Baroid Sales Division of National Lead Co.—increased their output to supply a record tonnage of ground barite to the well-drilling industry.

TABLE 2.—Domestic barite sold or used by producers in the United States, 1949–51, by States

State	1949		1950		1951	
	Short tons	Value	Short tons	Value	Short tons	Value
Arkansas [1]	363,382	$2,907,056	343,168	$3,088,512	407,085	$3,765,536
Georgia	50,267	465,325	72,888	766,711	73,117	841,440
South Carolina	(2)	(2)				
Tennessee	13,376	137,120				
Missouri	186,891	1,497,985	212,736	1,924,520	281,895	2,697,200
Nevada	70,576	416,416	47,608	268,874	63,201	387,026
Other States [3]	32,821	218,324	19,014	145,289	35,371	276,821
Total	717,313	5,642,226	695,414	6,193,906	860,669	7,968,023

[1] Value estimated.
[2] Included with "Other States."
[3] Arizona, California, Idaho, Montana (1951 only), New Mexico, and South Carolina (1949 only).

TABLE 3.—Ground (and crushed) barite produced and sold by producers in the United States, 1947–51

Year	Plants	Production (short tons)	Sales	
			Short tons	Value
1947	23	552,227	549,965	$8,979,400
1948	23	630,808	631,424	11,195,365
1949	24	561,258	554,028	10,156,590
1950	26	569,129	573,359	11,305,209
1951	24	704,709	703,014	14,590,000

California.—Only one producer was operating in California during 1951—Barium Products, Ltd., at the Almanor mine near Greenville in Plumas County. Crude barite from this mine was ground at Modesto.

Georgia.—Several producers operated in Georgia during the year, and output went principally to well-drilling on the Gulf coast and to eastern glass and chemical producers.

Idaho.—Simplot Fertilizer Co. produced barite near Hailey and ground it at Pocatello. This product was sold for well-drilling.

Missouri.—1951 marked 100 years of continuous barite production. During the year new producers and processors increased the State's total output.

Montana.—A new producer, F. & S. Contracting Co., reported production of barite near Greenough, Missoula County.

Nevada.—Baroid Sales Division of National Lead Co. temporarily discontinued production in Nevada, but shipments were made from stocks. Barium Products, Ltd., continued to produce at two locations near Battle Mountain and shipped the product to Modesto, Calif. California-Nevada Barytes Mines, Division of Glidden Co., produced from the Jumbo mine in Tonopah County and the Barium King mine in Lander County.

New Mexico.—The Mex-Tex Mining Co. produced barite from the Royal Flush mine near Bingham and processed it at its mill south of San Antonio, N. Mex. Mudrite Chemicals discontinued production near Hatch.

South Carolina.—Industrial Minerals, Inc., produced barite near Kings Creek for eastern markets.

Tennessee.—L. A. Wood and B. C. Wood continued production near Sweetwater.

CONSUMPTION AND USES

Domestic consumption of barite about doubled in the 10 years ended in 1951. The most significant changes in consumption of barite in 1951 were the large increases in tonnage used in well-drilling muds and as aggregate in concrete. Completion of 44,516 wells (including service wells) with a total footage of 172,331,000 feet set a new record for well drilling in the United States in 1951. The average depth of holes continued to increase. This activity created an unprecedented demand for barite as the weighting material in drilling fluids required in areas with high formation pressures.

The use of barite as a dense aggregate in concrete was growing rapidly. By 1951 heavy concrete was used principally for weighting oil and gas pipelines in swampy areas and in river crossing. Barite-containing plasters had been used for years in some X-ray rooms, but a newer use for barite was as a dense aggregate in concrete radiation barriers at atomic energy installations.

TABLE 4.—Crude barite (domestic and imported) used in the manufacture of ground barite and barium chemicals in the United States, 1946–51, in short tons

Year	In manufacture of—			Total	Year	In manufacture of—			Total
	Ground barite [1]	Litho-pone	Barium chemicals			Ground barite [1]	Litho-pone	Barium chemicals	
1946	465,468	154,166	102,439	722,073	1949	567,249	71,710	80,584	719,543
1947	561,230	167,321	107,267	835,818	1950	578,078	99,703	[2] 108,350	786,131
1948	640,284	153,987	100,038	894,309	1951	711,531	107,094	[2] 132,268	950,893

[1] Includes some crushed barite.
[2] Includes some witherite.

TABLE 5.—Ground (and crushed) barite sold by producers, 1949–51, by consuming industry

Industry	1949		1950		1951	
	Short tons	Percent of total	Short tons	Percent of total	Short tons	Percent of total
Well drilling	494,579	89	483,519	84	594,668	85
Glass	21,768	4	24,638	4	25,779	4
Paint	20,000	4	28,000	5	28,000	4
Rubber	14,000	2	19,000	3	15,000	2
Concrete aggregates			15,784	3	38,143	5
Undistributed	3,681	1	2,418	1	1,424	(1)
Total	554,028	100	573,359	100	703,014	100

[1] Less than 0.5 percent.

TABLE 6.—Lithopone sold or used by producers in the United States, 1947–51

	1947	1948	1949	1950	1951
Plants	8	8	8	7	6
Short tons	165,024	140,033	78,335	105,650	102,837
Value	$17,382,592	$16,135,976	$8,977,178	$13,129,363	$14,470,742

TABLE 7.—Distribution of lithopone shipments, 1949–51, by consuming industry

Industry	1949		1950		1951	
	Short tons	Percent of total	Short tons	Percent of total	Short tons	Percent of total
Paints, varnishes, and lacquers	[1] 56,146	72	78,177	74	76,614	75
Floor coverings	6,380	8	5,297	5	4,620	4
Coated fabrics and textiles	6,602	8	7,945	8	4,814	5
Paper	2,375	3	2,290	2	6,462	6
Rubber	3,245	4	4,092	4	3,295	3
Other	3,587	5	7,849	7	7,032	7
Total	78,335	100	105,650	100	102,837	100

[1] Includes a quantity, not separable, used for printing ink.

TABLE 8.—Barium chemicals produced and used or sold by producers in the United States, 1947–51, in short tons

Chemical	Plants	Produced	Used by producers [1] in other barium chemicals [2]	Sold by producers [3]	
				Short tons	Value
Black ash: [4]					
1947	15	173,385	172,987	248	$15,888
1948	16	152,383	151,509	459	31,442
1949	15	97,693	97,753	246	16,464
1950	12	130,967	130,305	499	33,084
1951	12	152,792	150,434	455	28,361
Carbonate (synthetic):					
1947	5	46,761	20,767	25,985	1,739,144
1948	5	43,227	16,588	27,482	1,927,599
1949	4	36,122	10,077	27,010	1,942,845
1950	4	49,299	13,063	36,266	2,746,628
1951	4	60,181	18,541	40,568	3,322,276
Chloride (100 percent $BaCl_2$):					
1947	4	13,444	3,135	9,867	986,958
1948	4	13,008	3,534	8,998	964,311
1949	3	10,513	2,872	7,679	848,637
1950	3	12,285	3,324	8,874	992,722
1951	4	17,959	4,911	12,364	1,830,070
Hydroxide:					
1947	4	5,774	568	4,910	787,711
1948	4	5,030	92	4,849	809,589
1949	4	3,849	140	3,737	694,097
1950	4	7,927	82	7,888	1,540,046
1951	5	13,483	231	12,757	3,185,405
Oxide:					
1947	3	7,318	6,865	378	74,320
1948	3	7,247	6,449	577	127,716
1949	3	5,795	4,899	1,118	233,733
1950	3	8,129	6,021	2,162	451,277
1951	3	9,347	6,334	3,073	729,379
Sulfate (synthetic):					
1947	8	27,353	10,980	16,086	1,302,869
1948	7	22,733	[5]	17,134	1,601,497
1949	7	15,182	----------	15,371	1,436,557
1950	6	15,821	----------	15,676	1,505,628
1951	6	14,237	----------	13,426	1,448,628
Other barium chemicals: [6]					
1947	[7]	21,107	4,092	15,445	2,128,214
1948	[7]	13,469	[8] 8,994	12,218	1,565,904
1949	[7]	5,320	2,890	1,851	474,070
1950	[7]	5,049	2,878	2,324	616,201
1951	[7]	6,999	2,545	3,389	1,112,378
Total: [9]					
1947	20	----------	----------	72,919	7,035,104
1948	20	----------	----------	71,717	7,028,058
1949	20	----------	----------	57,012	5,646,403
1950	17	----------	----------	73,689	7,885,586
1951	18	----------	----------	86,032	11,656,497

[1] Of any barium chemical.
[2] Includes purchased material.
[3] Exclusive of purchased material and exclusive of sales by one producer to another.
[4] Black-ash data include lithopone plants.
[5] Included with "Other barium chemicals."
[6] Consists mostly of titanium dioxide-barium sulfate pigments (1947–48 only), with small quantities of barium acetate, chromate, nitrate, perchlorate, peroxide, and sulfide. Specific chemicals may not be revealed by specific years.
[7] Plants included in above figures.
[8] Also includes barium sulfate (synthetic).
[9] A plant producing more than 1 product is counted but once in arriving at grand totals.

PRICES

Crude.—Late in 1951 trade journal quotations on Missouri crude increased from $9.50 to $10.40 for barite with a minimum 94 percent $BaSO_4$ and less than 1 percent iron; 93 percent $BaSO_4$ was increased from $9.25 to $10.15 per short ton, f. o. b. mines. Georgia crude, jig, and lump was unchanged at $13–$13.50 per long ton.

Ground.—Missouri, water-ground, floated, bleached was unchanged at $37.60 per short ton on carlots, f. o. b. works. Georgia, beneficiated in paper bags was unchanged at $16–$18 per net ton.

Witherite.—Prices on airfloated witherite (barium carbonate) were unchanged at $65 per short ton on carlots and $72 on less than carlots.

TABLE 9.—Range of quotations on barium chemicals in 1951

[Oil, Paint and Drug Reporter]

Barium carbonate, precipitated, bags, 10 tons and up, works	short ton	$72.50 –$87.50
Barium chlorate, kegs, works	pound	.30 – .35
Barium chloride, technical, bags, carlots, works	100 pounds	7.80
Barium chromate, bags, freight equaled	pound	.31½– .32
Barium dioxide (peroxide), drums, carlots, works	do	.12 – .15
Barium hydrate, crystals, bags	do	.09 – .09½
Barium nitrate, barrels, carlots, works	do	.11½– .15¼
Barium oxide, ground, drums, carlots, works	do	.11 – .12
Blanc fixe (dry):		
Direct process, bags, carlots, works	short ton	90.00
Byproduct, bags, carlots, works	do	85.00 –100.00
Lithopone: [1]		
Ordinary, bags, carlots, delivered	pound	.07½
Less carlots, same basis	do	.08¼– .08½
Titanated (high-strength), bags, carlots, delivered	do	.09½
Smaller lots	do	.10½

[1] Pacific coast prices on lithopone 1 cent per pound higher.

FOREIGN TRADE [2]

Barite.—The United States annually imports a considerable tonnage of barite to supplement domestic supplies. In the past most of such imports went to eastern chemical producers. However, some recent shipments were made to the Gulf coast area for use in well-drilling.

Imports of barite from Nova Scotia continued to increase, but imports from other sources were small. Yugoslavia, which supplied a considerable tonnage in 1949 and 1950 to chemical producers on the east coast, suspended shipments in 1951 but was expected to resume in 1952.

The Tariff Act of 1930 established the import duty on crude barite at $4 per long ton and at $7.50 per long ton of ground barite. As a result of the General Agreement on Tariffs and Trade signed at Geneva on October 30, 1947, the duty on crude barite was reduced to $3.50 per long ton with a rate of $3.20 accorded to Cuba. The duty on ground barite was unchanged. A similar agreement made at Torquay, England, effective June 6, 1951, reduced the rate on crude to $3 per long ton from all sources, and the rate on ground barite was lowered to $6.50 per long ton.

Witherite.—The only witherite produced in the United States was that which occurred as an "impurity" in barite. All imports of witherite came from Great Britain.

[2] Figures on imports and exports compiled by M. B. Price and E. D. Page, of the Bureau of Mines, from records of the U. S. Department of Commerce.

TABLE 10.—Barite imported for consumption in the United States, 1947–51, by countries

[U. S. Department of Commerce]

	1947		1948		1949		1950		1951	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Crude barite:										
Algeria							(1)	$2		
Canada	48,364	$355,349	39,877	$359,161	8,813	$60,429	44,501	328,689	51,447	$409,506
Italy	2	40	5,601	51,257	5,712	65,024				
Mexico	4,856	22,905	7,726	33,097	3,589	9,516	3,296	4,213	1,308	9,988
Yugoslavia					8,064	57,598	10,584	98,975		
Total crude barite	53,222	378,294	53,204	443,515	26,178	192,567	58,381	431,879	52,755	419,494
Ground barite:										
Algeria									84	2,870
Greece			(1)	11	211	2,241	478	5,363	31	337
India									28	925
Italy							200	4,535	17	435
Total ground barite			(1)	11	211	2,241	678	9,898	160	4,567

[1] Less than 0.5 ton.

TABLE 11.—Witherite, crude, unground, imported for consumption in the United States, 1946–51

[U. S. Department of Commerce]

Year	Short tons	Value [1]	Year	Short tons	Value [1]
1946	1,107	$31,599	1949	2,113	$63,369
1947	739	25,757	1950	2,089	51,381
1948	2,470	94,809	1951	2,016	51,673

[1] Valued at port of shipment.

TABLE 12.—Barium chemicals imported for consumption in the United States, 1947–51

[U. S. Department of Commerce]

Year	Lithopone		Blanc fixe (precipitated barium sulfate)		Barium chloride		Barium hydroxide	
	Pounds	Value	Short tons	Value	Pounds	Value	Short tons	Value
1947	112	$21						
1948								
1949	24,003	2,053	1	$54	8	$8		
1950	2,402,572	179,197	53	6,174				
1951	1,587,900	151,165	12	1,616	1,712,756	99,453	279	$55,344

Year	Barium nitrate		Barium carbonate precipitated		Other barium compounds	
	Short tons	Value	Short tons	Value	Short tons	Value
1947	66	$9,511			6	$1,916
1948	141	17,492			11	3,771
1949	84	7,819			11	5,651
1950	149	21,083	286	$28,222	35	11,669
1951	368	62,277	794	72,977	32	12,503

TABLE 13.—Lithopone exported from the United States, 1946–51

[U. S. Department of Commerce]

Year	Short tons	Value		Year	Short tons	Value	
		Total	Average			Total	Average
1946	9,651	$888,555	$92.07	1949	14,460	$1,918,913	$132.70
1947	13,652	1,784,414	130.71	1950	9,357	1,248,538	133.43
1948	21,015	2,972,912	141.47	1951	20,473	3,615,915	176.62

WORLD REVIEW

Barite deposits are numerous and widespread throughout the world, and many countries produce barite for domestic consumption or export. In general, the important consuming countries have production adequate to their needs or have nearby supplies. However, some do import barite for economic reasons or because of temporary inadequacy of domestic production facilities.

TABLE 14.—World production of barite, 1946–51, by countries, in metric tons[1]

[Compiled by Helen L. Hunt]

Country[1]	1946	1947	1948	1949	1950	1951
Algeria	14,240	23,692	16,681	16,874	[2] 22,890	21,021
Argentina	10,000	[3] 35,000	[4]	[4]	[4]	[4]
Australia	7,711	5,500	3,831	5,552	[2] 6,028	[3] 6,500
Austria	816	1,932	3,672	8,004	10,800	9,645
Brazil	10,326	13,971	[3] 10,000	6,010	6,860	50
Canada	109,242	116,731	86,860	42,763	[2] 70,013	76,674
Chile	3,752	2,546	2,141	1,461	1,360	[4]
Colombia	[4]	[3] 2,800	120	58	[4]	[4]
Egypt		167		30		41
France	34,570	53,970	47,951	32,833	25,027	[4]
French Morocco				305	[2] 4,912	3,256
Germany:						
East Germany	5,900	[4]	[4]	[3] 55,500	[4]	331,324
West Germany	[3] 39,836	[2] [5] 45,555	[2] [5] 60,068	128,000	230,269	
Greece		[3] 20,000	18,706	15,604	20,799	29,399
India	29,558	24,700	22,691	21,487	8,211	[4]
Ireland	13,557	12,927	7,035	5,968	4,821	[3] 7,500
Israel and Palestine	3	[4]	[4]	[4]	[4]	[4]
Italy	32,132	68,736	[2] 65,662	[2] 51,583	48,142	75,016
Japan	581	907	3,404	[2] 9,840	14,239	16,704
Korea:						
Korea, Republic of				[4]	[4]	[4]
Northern Korea	[3] 100	[3] 1,000	[4]	[4]	[4]	[4]
Leeward Islands: Antigua	52	14				
Peru	7,187	6,560	1,787	6,350	3,031	23,015
Portugal	294	1,211	406	427	128	
South-West Africa				48		
Southern Rhodesia	173	18	51	488	261	85
Spain	12,245	19,817	14,153	7,665	7,147	12,449
Swaziland	224	172	98	104	441	477
Sweden	505	1,319	1,914	923	50	[4]
Tunisia	408	470	230	630	25	10
Union of South Africa	2,326	2,672	1,734	2,222	2,268	2,038
United Kingdom [6]	112,705	96,267	123,719	118,878	98,557	[4]
United States	657,908	802,146	705,642	663,428	629,060	167,092
Yugoslavia	[4]	[4]	28,648	36,445	29,730	24,822
Total (estimate)	[2] 1,200,000	[2] 1,450,000	[2] 1,375,000	[2] 1,375,000	[2] 1,450,000	1,700,000

[1] In addition to countries listed, barite is produced in Belgium, China, Cuba, Czechoslovakia, Mexico, and U. S. S. R., but data on production are not available. Estimates by authors of the chapter are included in total.
[2] Revised figure.
[3] Estimate.
[4] Data not available; estimate by author of chapter included in total.
[5] Excludes British zone.
[6] Includes witherite.

Austria.—Barite was produced in Austria from the Grosskogel, Fieberbrunn-Niederkogelalpe, and the Kitzbugler Horn mines in Tirol province in the French zone and the Sonnwendstein Mine in Lower Austria in the Russian zone.[3]

Canada (Nova Scotia).—The new barite-processing mill of Maritime Barytes, Ltd., at Upper Brookfield, Colchester County, was officially opened on July 14, culminating 3 years of effort.

The company was reported to have 110 acres of surface rights and several square miles of mining rights in the Brookfield area. Diamond drilling revealed that the ore extended at least 350 feet down and 500 feet back from the surface of the outcrop. Enough ore was estimated to be available for recovery by open-pit methods to run the processing mill on a 24-hour basis for 10 years.

The processing plant has a grinding capacity of 120 tons per 24 hours. However, the company indicated that production was to be aimed at 50 to 60 tons of the white filler barite during the 24-hour period, with 1 ton of well-drilling-grade barite produced as a virtual byproduct of each 2 tons of white barite. The company reportedly was planning to emphasize the production of white barite. A production figure of 10,000 tons per year of the white barite was mentioned to the American consulate at Halifax. The white barite was expected to test 99 percent $BaSO_4$, with the barite for use in oil-well drilling testing 97 to 98 percent $BaSO_4$.

The president of the Maritime-Barytes, Ltd., indicated that, even if only 5,000 tons of white filler barite could be marketed each year, the plant would be well beyond the break-even point. With an estimated output of 10,000 tons of the white variety, however, and consequent production of the oil-drilling-grade barite, a total volume of 15,000 tons of the 2 varieties would be available for market.

Figures for barite production and shipments from the Canadian Industrial Minerals mine at Walton in the first quarter of 1951 follow: 6,112 short tons mined, 3,062 tons milled, and 112 tons of ground barite sold. No sales of crude barite were made in the period. Production and sales were down sharply from the previous quarter (last quarter of 1950). No shipments can be made from the port of Walton Village during January, February, and March because of navigational difficulties; therefore, the sharp decline in sales and shipments is an annual occurrence. However, output and sales increased in April and May. In May, 14,176 tons was mined (none in April); milled barite totaled 7,932 for April and May. Sales of crude barite were 12,939 tons in May (none in April), and sales of ground barite totaled 8,781 tons for both April and May.

The last quoted price for "Cimbar" ground barite was $C13.80 per ton, f. o. b. mine. This price, covering costs for milling and bagging of about $C4.70 per ton as well as mining costs, was considered by the company to be the lowest at which the product could be offered.[4]

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[3] Bureau of Mines, Mineral Trade Notes: Vol. 33, No. 4, October 1951, p. 24; vol. 32, No. 1, January 1951, p. 26.

[4] Bureau of Mines, Mineral Trade Notes: Vol. 33, No. 1, July 1951, pp. 23–24.

Philippine Republic.—A small barite mine was opened in 1950 at Lobo, Batangas Province. The mine produced 200 tons of ore for local consumption. The company was endeavoring to import equipment for a grinding mill, with the ultimate objective of exporting ground barite to oil firms in the East Indies.[5]

Spain.—Production (in 1949) of barite in Spain came from 11 operations in 8 provinces: two each in Almeria, Gerona, and Leon, and one each in Castellon, Guadalajara, Navarro, Santander, and Tarragona.[6]

[5] Bureau of Mines, Mineral Trade Notes: Vol. 32, No. 4, April 1951, p. 27.
[6] Bureau of Mines, Mineral Trade Notes: Vol. 32, No. 5, May 1951, p. 37.

Bauxite

By Horace F. Kurtz

GENERAL SUMMARY

ALTHOUGH many mineral deposits containing the element aluminum occur in large quantities throughout the earth's crust, bauxite, a rock consisting chiefly of aluminum hydrate minerals, has been the principal ore from which the metal is recovered and high-aluminum artificial abrasives, refractories, and chemicals are produced. Bauxite has been an important raw material to these nonmetal industries, but the growth of the bauxite industry has nearly paralleled that of the major bauxite consumer, the aluminum industry. A consistently increasing demand for bauxite became abnormally great during World War II, when aluminum production was expanded for military uses. Postwar metal surpluses and the lowered demand for aluminum temporarily reduced bauxite requirements; however, a steadily increasing per capita consumption of aluminum, together with plans for expanding the aluminum industry to meet new defense requirements, indicate that by 1953 bauxite consumption will surpass the peak level attained during the war.

TABLE 1.—Salient statistics of bauxite in the United States, 1935–51, in long tons

	1935–39 (average)	1940–44 (average)	1945–49 (average)	1950	1951
Crude-ore production (dry equivalent)	347,411	2,606,980	1,178,612	1,334,527	1,848,676
Imports (as shipped)	401,209	947,726	1,718,049	[1] 2,516,247	2,829,929
Exports (as shipped)	79,903	208,217	81,450	[1] 45,406	89,948
World production	3,260,000	7,840,000	6,040,000	[1] 8,030,000	10,480,000

[1] Revised figure.

Since the Guiana bauxite deposits were opened in the 1920's, a gradual trend toward greater dependence on imports developed in the United States. About 53 percent of the bauxite actually used in the 6 years since World War II was of foreign origin, chiefly from Surinam, and this percentage was expected to increase after shipments from Jamaica were begun in 1952. In addition to actual consumption, large quantities were imported for the National Strategic Stockpile in recent years. The security risks of relying more on imported ore were expected to be partly offset by the proximity of the new source of supply, since the shipping lane from Jamaica is considerably shorter and more easily protected than that from other foreign suppliers.

Total world reserves of bauxite exceeded most estimates of world requirements for the remainder of the twentieth century, although most of the leading consuming countries were deficient in reserves. Bauxite shortages in the United States stimulated the search for new techniques, but the fact that bauxite was the only ore from which aluminum was recovered on a commercial scale in 1951 indicated that

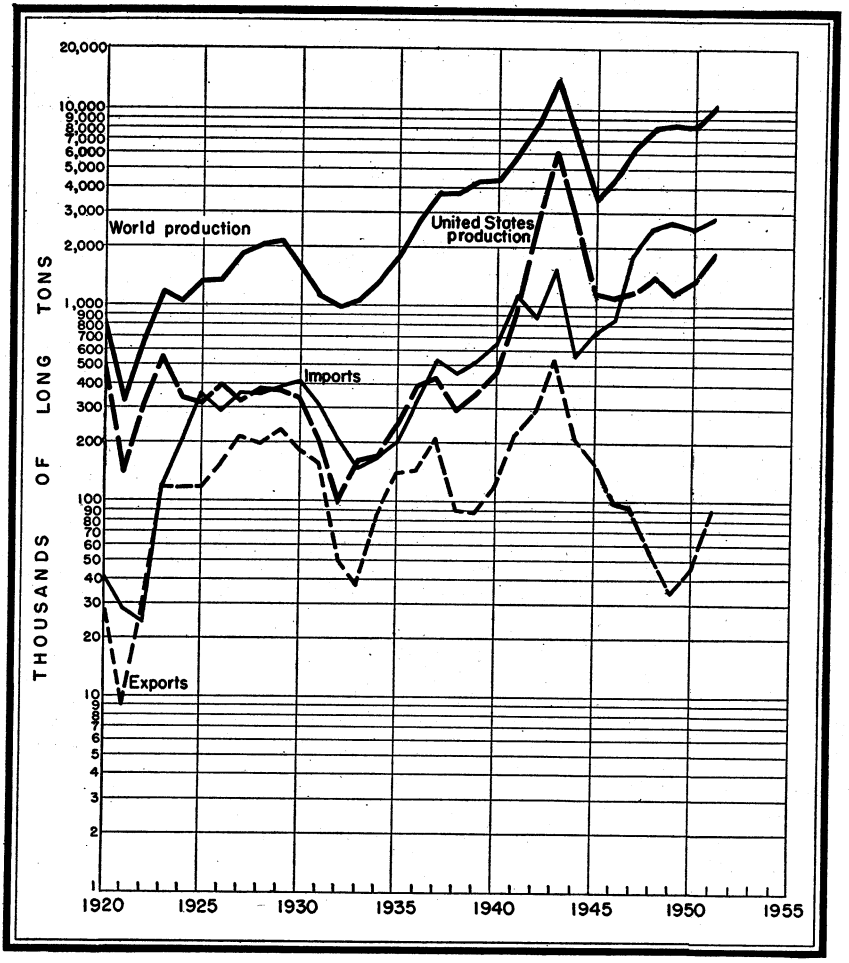

FIGURE 1.—Domestic production, imports, exports, and world production of bauxite, 1920–51.

no method of recovering the metal from other materials had yet been proved competitive. It was recognized that raw materials other than bauxite may become economical substitutes through development of processes involving cheaper operating costs, recovery of valuable by-products, or as a result of changing economic factors, such as transportation and raw material costs.

RESERVES

The Bureau of Mines estimated Arkansas reserves of bauxite on an unmined, undried basis to be 49 million tons as of January 1944. During 1944 and 1945 the Bureau's drilling program developed approximately 12 million tons of new reserves, which increased the total for Arkansas to 61 million tons "in place" or about 40 million tons on a mined and dried basis. Subtraction of the 12 million tons mined between the beginning of 1944 and the close of 1951 left a remainder

of 28 million tons. None of the foregoing figures included discoveries by private companies since 1944; moreover, new techniques of mining and the increasing use of the Bayer-sinter process to produce alumina may permit inclusion of ore deposits previously considered marginal or uneconomic. The Bauxite chapter of Minerals Yearbook, 1950, cited numerous references on bauxite reserves in the United States and discussed the estimates in greater detail.

On July 17, 1951, the Defense Minerals Administration amended Mineral Order 5 to include bauxite in the list of minerals on which the Federal Government would help prospectors and mine operators finance the cost of searching for new deposits. The incentive was a Government contribution of 50 percent of the cost of exploration projects, subject to DMA regulations and specified terms of the contracts.

Discovery of a new potential source of alumina in Florida was announced by the Geological Survey.[1]

DOMESTIC PRODUCTION

The production of bauxite in the United States increased 39 percent over 1950 to a rate surpassed only during the war years 1942–44. Despite the increase, domestic output comprised only 40 percent of the total new supply as determined by adding imports to production.

TABLE 2.—Production of bauxite in the United States, 1947–51, by quarter years, in long tons [1]

[Dried-bauxite equivalent]

Quarter ended—	1947	1948	1949	1950	1951
March 31	323, 180	295, 488	320, 157	322, 006	378, 031
June 30	301, 561	359, 284	294, 023	368, 256	502, 088
September 30	282, 665	437, 457	208, 926	293, 724	453, 564
December 31	294, 649	364, 919	325, 686	350, 541	514, 993
Total	1, 202, 055	1, 457, 148	1, 148, 792	1, 334, 527	1, 848, 676

[1] Quarterly figures adjusted to final annual totals.

Table 3 contains data, by States, on bauxite production and shipments to consumers from mines and processing plants. "Processing plants" include plants engaged in drying, calcining, and activating bauxite but exclude consuming plants which produce alumina, crude aluminum oxide abrasives, or other products not identified as bauxite. Data on total shipments from mines, which were shown in Bauxite chapters of previous Minerals Yearbooks, were excluded from this chapter because they approximated production and were not considered significant. The table on shipments to consumers, by consuming industries, which had been given in previous Bauxite chapters to indicate consumption, was also omitted from this chapter because data on actual consumption have become available for a sufficient number of years.

Alabama.—Bauxite production in Alabama, all mined in the Eufaula district, doubled that of 1950. The Alcoa Mining Co. operated a drying plant in this area, but the only other operator—D. M. Wilson

[1] Geological Survey, Aluminum Phosphate Deposits Found in Florida Land-Pebble Phosphate Field: U. S. Dept. of the Interior, Information Service, Dec. 26, 1951.

TABLE 3.—Mine production of bauxite and shipments from mines and processing plants to consumers, in the United States, 1947–51, by States, in long tons

State and year	Mine production			Shipments from mines and processing plants to consumers [1]		
	Crude	Dried bauxite equivalent	Value [2]	As shipped	Dried bauxite equivalent	Value [2]
Alabama, Florida, and Georgia:[3]						
1947	58,418	48,492	$301,128	50,024	51,291	$512,707
1948	74,511	61,807	397,222	59,520	59,474	504,556
1949	65,137	53,868	344,217	45,792	46,407	425,532
1950	32,706	27,192	161,274	35,741	35,473	272,320
1951	38,807	33,402	217,774	39,122	38,123	363,602
Arkansas:						
1947	1,368,693	1,153,563	6,583,538	1,186,726	1,108,932	7,960,997
1948	1,649,926	1,395,341	8,299,486	1,430,688	1,314,069	9,458,476
1949	1,287,358	1,094,924	6,433,964	1,232,883	1,132,330	8,119,574
1950	1,552,047	1,307,335	7,531,535	1,416,724	1,301,374	9,277,076
1951	2,153,786	1,815,274	12,259,742	1,583,320	1,493,557	11,994,882
Total United States:						
1947	1,427,111	1,202,055	6,884,666	1,236,750	1,160,223	8,473,704
1948	1,724,437	1,457,148	8,696,708	1,490,208	1,373,543	9,963,032
1949	1,352,495	1,148,792	6,778,181	1,278,675	1,178,737	8,545,106
1950	1,584,753	1,334,527	7,692,809	1,452,465	1,336,847	9,549,396
1951	2,192,593	1,848,676	12,477,516	1,622,442	1,531,680	12,358,484

[1] Ore shipped to producers' processing plants is excluded; dried, calcined, and activated bauxite shipped from these plants is included. Not comparable with shipments shown in corresponding table in 1950 Bauxite chapter.
[2] Computed from selling prices and values assigned by producers.
[3] Production in Virginia ceased in 1946. Bauxite was processed in Florida in 1947–49.

Bauxite Co.—shipped its ore in crude form. The entire output was chemical- and refractory-grade ore averaging approximately 15 percent SiO_2.

Arkansas.—The bauxite-mining district south and southwest of Little Rock, Ark., produced 98 percent of the national output in 1951. Most of the ore was mined in Saline County and the remainder in Pulaski County. Production by strip mining has increased in Arkansas since 1949, while the quantities mined by underground methods remained virtually the same. Consequently, the proportion from underground mines declined from an estimated 29 percent to 17 percent over the 3-year period.

The Alcoa Mining Co. was the largest producer of domestic bauxite in 1951. Most of the ore was dried at its plant in Saline County and shipped to the East St. Louis, Ill., alumina plant. Smaller quantities

TABLE 4.—Recovery of processed bauxite in the United States, 1947–51, in long tons

Year	Crude ore treated	Processed bauxite recovered			
		Dried	Calcined or activated	Total	
				As recovered	Dried bauxite equivalent
1947	655,702	410,727	102,320	513,047	564,829
1948	688,898	476,921	68,800	545,721	584,856
1949	597,536	431,158	55,544	486,702	517,412
1950	657,798	480,623	63,713	544,336	579,884
1951	1,059,645	756,060	103,588	859,648	914,433

were used in the chemical and cement industries. Alcoa's mill in Pulaski County calcined bauxite, which was sold chiefly for use in the manufacture of abrasives. The Reynolds Mining Corp., the second-largest domestic bauxite producer, mined in Saline County exclusively. All of its shipments were in crude form to the parent aluminum firm, Reynolds Metals Co.

The Dixon pit and the 400 B. C. mines of the Dulin Bauxite Co. and the Ratcliffe pit of the affiliated Riffe Construction Co. were active bauxite producers during 1951. Although the largest part of the production was shipped undried to a local alumina plant, Dulin also calcined ore for the abrasives industry.

The Berry-Mahan, Rauch Lease, Lewis, and Heckler surface mines near Berger, Pulaski County, were operated by the American Cyanamid Co. in 1951. Most of the ore was treated at the company drying plant before shipment to chemical and oil-refining plants. Consolidated Chemical Industries, Inc., had not mined bauxite since 1948; however, deliveries of high-silica ore were made in 1951 from mine inventories to its concentrating plant. This bauxite eventually was used in the production of aluminum sulfates. The underground Young mine was operated by the Crouch Mining Co. in conjunction with a calcining kiln in Saline County. The Norton Co. continued stripping for abrasive-grade bauxite in the southern part of the Arkansas district during 1951. Calcined ore was shipped to the company abrasives plants. Activated bauxite was produced from purchased ore by the Porocel Corp. Sales of the finished material were made to the oil industry.

Georgia.—The American Cyanamid Co. remained the only bauxite producer in Georgia throughout 1951. Chemical-grade ore was mined at the Fountain and Julia mines, Bartow County, in the northern part of the State, and at the Lane McMicheal mine, Macon County, and processed at the Halls Station drying plant in Bartow County.

CONSUMPTION AND USES

The needs of the rearmament program were reflected in the bauxite industry in 1951 as consumption rose 19 percent over 1950 to reach the highest level in 7 years. All bauxite-consuming industries used more ore than in 1950, but most of the increase in tonnage consumed went into the production of alumina, which was ultimately reduced to aluminum. Expansion plans announced by the primary aluminum producers indicated that the trend for larger consumption by the metallurgical industry would continue for at least 3 more years.

Consumption on an "as-received" basis was 4,005,879 tons, consisting of 1,185,231 tons of crude bauxite, 2,606,882 tons of dried bauxite, and 213,766 tons of calcined and activated bauxite. Bauxite entering the National Stockpile was not included in consumption data.

Alumina.—The plants at Mobile, Ala., East St. Louis, Ill., Hurricane Creek, Ark., and Baton Rouge, La., had a combined production of 1,832,000 short tons of alumina in 1951. On a weighted-average dry-bauxite basis, these plants required about 1.84 long tons of ore per short ton of alumina. Approximately 93 percent of the total United States production, excluding alumina scale and similar byproducts, was calcined alumina, 6 percent alumina trihydrate, and the remainder alumina in tabular, activated, and other forms.

TABLE 5.—Bauxite consumed in the United States,[1] 1950–51, by industries, in long tons

[Dried-bauxite equivalent]

Industry	1950			1951		
	Domestic	Foreign	Total	Domestic	Foreign	Total
Alumina	1,317,829	1,573,285	2,891,114	1,563,663	1,801,260	3,364,923
Abrasive [1]	[2] 97,075	[2] 98,537	[2] 195,612	122,644	181,792	304,436
Chemical	[2] 95,391	67,610	[2] 163,001	90,568	78,954	169,522
Refractory	[2] 7,097	[2] 25,406	[2] 32,503	14,886	33,687	48,573
Other	[2] 34,990	[2] 8,084	[2] 43,074	53,749	4,464	58,213
Total [1]	[2] 1,552,382	[2] 1,772,922	[2] 3,325,304	1,845,510	2,100,157	3,945,667

[1] Includes consumption by Canadian abrasives industry.
[2] Revised figure.

An estimated 96 percent of the calcined alumina was consumed at the 12 primary aluminum plants in operation during 1951. The largest other use was in the production of white artificial abrasives. Alumina trihydrate or aluminum hydroxide was used principally in the production of chemicals, including fluoride fluxes for aluminum reduction plants.

The increased consumption of bauxite at alumina plants was uninterrupted since 1946. During 1951 the three primary aluminum producers were enlarging alumina capacity to meet the requirements from the expanding aluminum industry. The Government, acting under authority of the Defense Production Act of 1950 (Public Law 774), approved accelerated amortization for tax purposes on construction for six alumina plants. On completion these plants were to be able to provide 3,437,000 tons of alumina per year.

Aluminum Ore Co. was increasing capacity at both its Mobile, Ala., and East St. Louis, Ill., plants during 1951. It also began construction of a new plant near Bauxite, Ark., which would be able to treat high-silica Arkansas bauxite by the combination Bayer-sinter process. Reynolds Metals Co. was increasing the capacity of its combination-type plant at Hurricane Creek, Ark., and equipping it to operate partly on Jamaican ore. Reynolds also announced that it would construct a new plant near Corpus Christi, Tex., to process Jamaican bauxite exclusively. Kaiser Aluminum & Chemical Corp. was increasing its alumina capacity at Baton Rouge, La., and planned to install facilities to treat Jamaican ore. Although all of the plants were to be able to make alumina from Arkansas, Jamaica, or Guiana bauxite, maximum efficiency is attained by designing plant facilities to treat specific ores. All six plants were to recover alumina by variations of the Bayer process; but the term "combination process" has been applied to methods which include sintering of the red mud from high-silica bauxite, and the term "modified Bayer process" has been used to distinguish the technique for treating Jamaican ore.

Abrasive.—Producers of aluminous abrasives in the United States and Canada increased their consumption of calcined bauxite 56 percent in 1951. The gain, which reflected demand from many industries, was attributed to a general increase in industrial activity resulting from the rearmament program. Since most of the crude aluminum oxide abrasive produced in Canada was returned to the United States for manufacture and consumption of the final product, Canadian bauxite consumption was included in the data for abrasives. Figures

for bauxite converted to alumina before the manufacture of special white abrasives are included with alumina in table 5.

Chemical.—In addition to large quantities of alumina, the chemical industry used directly about 4 percent of the bauxite consumed during 1951. The data for the chemical industry in table 5 include bauxite used by municipal water-treatment plants.

TABLE 6.—Production and shipments of selected aluminum salts in the United States, 1950–51

Type of salt	1950				1951			
	Production (short tons)	Shipments [1]			Production (short tons)	Shipments [1]		
		Shippers	Short tons	Value		Shippers	Short tons	Value
Aluminum sulfate:								
Ammonium	700,633	2	680,958	$20,463,473	18,837	3	18,784	1,574,134
Potassium		2						
Sodium		1				1		
General:								
Commercial		13			721,620	15	719,184	22,090,751
Municipal	14,990	6	15,046	335,069	14,425	6	14,287	348,525
Iron-free	39,708	7	39,959	1,834,037	50,124	8	47,776	2,514,897
Sodium aluminate	9,122	8	10,429	1,060,080	10,178	8	9,456	955,431
Aluminum chloride:								
Liquid	13,303	6	13,286	739,202	11,464	4	11,158	656,695
Crystal	35,066	2	35,118	6,497,829	37,728	2	36,845	10,225,229
Anhydrous		8				7		
Total	812,822	[2] 36	794,796	30,929,690	868,958	[2] 37	862,056	38,769,893

[1] Shipped or used by producers.
[2] A company shipping or using more than 1 kind of salt is counted but once in arriving at total.

Bauxite was the largest source of aluminum for the salts production shown in table 6, but about 97,000 short tons of clay, 24,000 tons of commercial aluminum trihydrate, 11,000 tons of secondary aluminum, and small quantities of other aluminum-bearing materials were also used in 1951. Important changes in the production of aluminum salts included increases in sodium, iron-free, and commercial-grade aluminum sulfate.

Refractory.—In 1951 the refractory industry used nearly 50 percent more bauxite than in the preceding year and reported that over two-thirds of the material was foreign in origin. It was anticipated that even greater tonnages of this specially calcined bauxite would be used in high-temperature refractories in future.

Other Industries.—Other bauxite consumers depended chiefly on domestic ore supplies. In this category the manufacture of calcium aluminate cement was the predominate use. Many companies in the oil and natural-gas industries and several producers of ferrous metals used bauxite in 1951, but their combined consumption was less than 1 percent of the total.

STOCKS

Total stocks of bauxite on December 31, 1951, were 7 percent greater than at the end of the preceding year, despite withdrawals from the stockpiles near the Hurricane Creek, Ark., alumina plant. The General Services Administration reported that 365,706 long tons (crude bauxite converted to a dry equivalent tonnage) were sold to the Reynolds Metals Co. in 1951 from stockpiles accumulated during World War II for use at the Hurricane Creek plant. After calculation

to convert bauxite in various degrees of processing to a dried-equivalent basis, it was noted that consumers' inventories increased about 34 percent during 1951, while those at mines and processing plants were 85 percent greater.

TABLE 7.—Stocks of bauxite in the United States December 31, 1947–51, in long tons

Year	Producers and processors		Consumers		Government, crude [1]	Total [1]	
	Crude	Processed [2]	Crude	Processed [2]		Crude and processed [2]	Dried-bauxite equivalent
1947	560,967	11,497	35,983	399,224	3,277,090	4,284,761	3,724,759
1948	654,601	7,441	57,191	590,124	3,277,090	4,586,447	4,023,300
1949	574,983	8,467	34,183	832,083	3,277,090	4,726,806	4,184,786
1950 [3]	543,284	17,392	42,150	723,103	3,061,034	4,386,963	3,809,765
1951	890,336	18,552	44,169	1,008,767	2,630,792	4,592,616	4,069,796

[1] Excludes National Stockpile.
[2] Dried, calcined, activated, and sintered.
[3] Revised figures.

All inventory data presented in this chapter exclude bauxite in the National Strategic Stockpile. During 1951 both metal-grade and refractory-grade bauxite were on the Government's purchase list of strategic materials for this stockpile.

TABLE 8.—Chemical analysis in bauxite purchase specifications used for the National Stockpile during 1951

[Percent by weight]

	Metal grade, dry basis	Refractory grade, calcined basis
Alumina (Al_2O_3)	55.0 minimum	85.0 minimum.
Silica (SiO_2)	5.0 maximum	7.0 maximum.
Alkalies (as oxides)	1.0 maximum	Not specified.
Ferrous iron (as FeO)	3.0 maximum	Do.
Ferric iron (as Fe_2O_3)	Not specified	3.75 maximum.
Phosphorus (as P_2O_5)	1.0 maximum	Not specified.
Manganese, chromium, and vanadium (as MnO_2, Cr_2O_3, and V_2O_5).	2.0 maximum	Do.
Titania (TiO_2)	Not specified	3.75 maximum.
Loss on ignition	50% of Al_2O_3 minimum.	.5 maximum.

PRICES

The average value of crude bauxite shipped from domestic mines to consumers and processing plants, as estimated from company reports, was $5.67 per long ton in 1951. Average values for processed ore, f. o. b. producing plants, were $7.71 per long ton of dried bauxite, $17.32 per ton of calcined bauxite, and $63.23 per ton of activated bauxite. Since the values of large quantities of bauxite were assigned to tonnages produced for consumption by the producer or an affiliate, average prices could not be considered as exact costs to purchasers on the open market. Furthermore, prices of bauxite in all states of processing depended upon the grade of each shipment, which was determined largely by chemical analysis.

Market quotations published in E&MJ Metal and Mineral Markets were as follows throughout 1951: Domestic ore, chemical, crushed and

dried, 55 to 58 percent Al_2O_3, 1.5 to 2.5 percent Fe_2O_3, $8 to $8.50 f. o. b. Alabama and Arkansas mines; other grades, 56 to 59 percent Al_2O_3, 5 to 8 percent SiO_2, $8 to $8.50, f. o. b. Arkansas mines; pulverized and dried, 56 to 59 percent Al_2O_3, 8 to 12 percent SiO_2, $14 to $16, f. o. b. Arkansas mines; abrasive grade, crushed and calcined, 80 to 84 percent Al_2O_3, $17, f. o. b. Arkansas mines; crude (not dried) 50 to 52 percent (Al_2O_3 on dry basis), $4.50 to $5.50, f. o. b. Arkansas mines.

The average price of the crude bauxite from the Hurricane Creek stockpiles sold to the Reynolds Metals Co. by General Services Administration during 1951, calculated on a long dry ton equivalent basis, was $6.67. Dry samples analyzed 51 percent Al_2O_3, 11 percent SiO_2, and 4 percent FeO.

Market price quotations for aluminum compounds were published in Oil, Paint and Drug Reporter and Paint, Oil and Chemical Review. The average value of aluminum sulfate, the leading aluminum salt produced, was 1.5 cents per pound.

FOREIGN TRADE[2]

United States imports of crude and dried bauxite increased 12 percent during 1951. Preparations for large-scale mining in Jamaica and increased production in the Guianas, which were being made by subsidiaries of all three American aluminum producers, foretold continuation of increasing dependence on foreign bauxite. Imports had exceeded domestic output since 1947 and were expected to be twice the domestic rate of production by the end of 1952.

Surinam, from which 2,318,917 long tons (as shipped) was received, was the largest supplier and provided most of the increase in imports during 1951. Indonesia shipped 365,309 tons, British Guiana 127,477 tons, and Trinidad (probably all South American ore) 18,226 tons. Bauxite totaling 1,712,737 tons entered the United States through the Mobile customs district, 1,021,060 tons through New Orleans, and the remainder through 8 other districts. Nearly all of the alumina and over half of the other aluminum compounds imported in 1951 came from Canada.

TABLE 9.—Bauxite and aluminum compounds imported for consumption in the United States, 1947–51

[U. S. Department of Commerce]

Year	Bauxite (crude and dried)[1]		Alumina		Aluminum compounds	
	As imported (long tons)	Value	Short tons	Value	Short tons	Value
1947	1,821,580	$11,869,631	------	------	80	$2,348
1948	2,488,915	15,820,743	6	$3,547	5,559	124,167
1949	2,688,164	16,353,298	175	19,192	1,472	46,736
1950	[2] 2,516,247	[2] 15,729,855	218	20,038	3,113	126,715
1951	2,829,929	17,862,887	965	88,135	5,334	275,238

[1] Only small quantities of undried bauxite were imported. Complete data on imports of calcined bauxite were not available. Beginning September 1950, calcined bauxite for refractory uses only was imported as follows: 1950, 9 tons ($329); 1951, 18,642 tons ($405,438).
[2] Revised figure.

[2] Figures on imports and exports compiled by M. B. Price and E. D. Page, of the Bureau of Mines, from records of the U. S. Department of Commerce.

Duties on imports remained unchanged throughout 1951 as follows: Crude and dried bauxite, 50 cents per long ton; calcined bauxite for use in the manufacture of refractories, $1 per long ton; other calcined bauxite, 15 percent ad valorem; alumina and refined aluminum hydroxide, ¼ cent per pound.

Exports of bauxite, virtually all of which were shipped to Canada, nearly doubled in 1951. Most of the 71,313 long tons, classified as bauxite and other aluminum ores, was calcined bauxite, and 18,635 tons were classified as bauxite concentrates, alumina included. Colombia was the chief recipient of the aluminum sulfate exported, while Canada and Mexico received most of the other aluminum compounds.

TABLE 10.—Bauxite and aluminum compounds exported from the United States, 1947–51

[U. S. Department of Commerce]

Year	Bauxite (including bauxite concentrates), long tons			Aluminum sulfate		Other aluminum compounds	
	As exported	Dried bauxite equivalent [1]	Value	Short tons	Value	Short tons	Value
1947	94,369	141,235	$1,888,040	23,389	$706,572	3,753	$738,374
1948	54,113	86,284	1,202,036	14,342	467,622	3,539	599,210
1949	34,902	57,628	512,779	14,706	554,710	4,155	664,018
1950	[2] 45,406	[2] 72,014	[2] 1,155,673	13,010	461,653	4,393	742,941
1951	89,948	138,916	2,217,426	19,865	755,897	4,601	1,067,050

[1] Calculated by Bureau of Mines.
[2] Revised figure.

WORLD REVIEW

Estimates of total world bauxite reserves ranged from 1.2 to 1.6 billion tons. The combined reserves of the Guianas, the Caribbean Islands, and the United States were about one-half billion tons. The rate of bauxite discoveries on a worldwide basis has historically exceeded depletion; but the increasing rate of bauxite mining, as shown in table 12, has tended to narrow the difference.

TABLE 11.—Past, present, and potential bauxite-producing countries, in order of quantities mined and estimated reserves

Rank	Total production, 1900–50	Production 1951	Estimated reserves
1	United States	Surinam	Jamaica.
2	France	British Guiana	Hungary.
3	Surinam	United States	Gold Coast.
4	British Guiana	France	Brazil.
5	Hungary	U. S. S. R.	Yugoslavia.
6	U. S. S. R.	Indonesia	British Guiana.
7	Italy	Yugoslavia	Greece.
8	Yugoslavia	Hungary	France.
9	Indonesia	Greece	Surinam.
10	Gold Coast	Italy	China.

The world production in 1951 gained 31 percent over 1950, as all major bauxite-producing countries reported increased activity. Production in the Western Hemisphere was 62 percent of the total—approximately the same proportion as in other recent years. Out-

put in the U. S. S. R. and satellite countries was 11 percent, and other countries, principally France, Indonesia, Yugoslavia, Greece, Italy, and Gold Coast, provided the remaining 27 percent.

TABLE 12.—World production of bauxite, 1945–51, by countries, in metric tons

[Compiled by Pauline Roberts]

Country	1945	1946	1947	1948	1949	1950	1951
Australia	3,492	3,789	4,956	5,736	5,377	[1] 3,523	[2] 3,700
Austria	8,756			5,324	6,526	616	7,795
Brazil	19,546	[1] 4,458	[1] 6,735	[1] 14,772	[1] 16,213	[2] 17,000	[3]
British Guiana	678,482	[5] 1,137,991	[5] 1,318,190	1,903,230	1,785,860	1,608,831	2,034,888
China							[2] 10,000
France	308,127	449,125	680,123	803,535	757,560	[1] 805,228	1,124,400
French West Africa	[4]	[4]	[4]	[4]	10,400	10,125	
Germany, West	[2] 4,000	[4]	18,000	[3]	[3]	[3]	[3]
Gold Coast	148,547	116,846	[5] 97,437	[5] 133,055	[5] 147,340	[5] 116,793	[2] [5] 140,000
Greece		1,315	22,420	[1] 44,238	48,852	77,448	197,060
Haiti	300	300					
Hungary	35,402	101,140	340,260	[1] [2] 340,000	[1] [2] 340,000	350,000	[3]
India	14,116	16,668	18,835	20,995	[1] 43,224	65,433	[2] 65,000
Indonesia	[2] 2,000		24,559	437,822	678,138	[1] 531,143	642,316
Italy	25,093	65,447	171,083	[1] 153,711	104,852	153,433	174,274
Mozambique	4,369	1,622	2,960	857	1,369	4,336	[3]
Rumania		663	[2] 600	[3]	[3]	[3]	[3]
Spain	5,119	4,926	5,822	6,805	11,962	13,219	12,667
Surinam	[5] 683,990	[5] 857,843	[5] 1,809,837	2,149,906	2,126,654	2,080,657	2,671,330
U. S. S. R. (estimate)	400,000	425,000	500,000	600,000	[3]	[3]	[3]
United Kingdom: Northern Ireland	36,981						
United States (dried equivalent of crude ore)	996,754	1,121,774	1,221,348	1,480,535	1,167,230	1,355,946	1,878,347
Yugoslavia	[2] 55,000	55,000	88,000	136,000	[2] 368,000	[2] 201,000	453,000
Total	3,430,000	[1] 4,360,000	[1] 6,330,000	[1] 8,260,000	[1] 8,290,000	[1] 8,160,000	10,650,000

[1] Revised figure.
[2] Estimate.
[3] Data not available; estimate by author of chapter included in total.
[4] Negligible.
[5] Exports.

British Guiana.—Bauxite production in British Guiana in 1951 increased 26 percent to surpass 2 million tons for the first time. All of the colony's production was exported; approximately 90 percent was shipped to Canada, 8 percent to the United States, and most of the remainder to United Kingdom. The Demerara Bauxite Co., an affiliate of the Aluminum Co. of Canada, Ltd., was reported to have placed in operation a new drying kiln of 400,000 tons annual capacity. A second new kiln, under construction, was to produce a supercalcined refractory-grade bauxite. It was expected that a large portion of the calcined ore would be shipped to the United States.

France.[3]—Recent estimates of bauxite reserves in France, the largest European producer, have ranged from 30 million tons to over 100 million tons. The alumina in the bauxite occurs principally as the monohydrate mineral, boehmite. While bauxite is found in many Provinces of France, Var and Hérault have been the leading producers. In 1951 French production increased 40 percent to the highest level in that nation's long record as a bauxite producer. Since 1939 mechanization has doubled the production per miner. One of the reasons for the gain in output was the increasing demand from the French aluminum industry, resulting from a greater availability of power for metal production. However, the excess mining potential has made France an important supplier for foreign markets. In 1950 about 135,000 metric tons was exported to Western Germany, 71,000

[3] Bureau of Mines, Mineral Trade Notes: Vol. 33, No. 4, October 1951, pp. 3–6

tons to United Kingdom, and 18,000 tons to other European countries. Toulon, which was to have its bauxite loading capacity expanded, was the chief port from which shipments were made in 1951, but much ore was sent to Germany by rail.

The price of French bauxite in June 1951, as established by Government decree, was 1,074 francs (official exchange rate, 350 francs—$US 1.00) per metric ton, f. o. b. mines. This rate applied to red, metal-grade bauxite analyzing 55 percent Al_2O_3 and 5 percent SiO_2. Premiums of 45 francs per ton for each percent Al_2O_3 over 55 and 135 francs per ton for each percent of SiO_2 under 5 were granted. The average selling price was approximately 1,300 francs. Prices for gray, abrasive-grade bauxite and white, refractory-grade bauxite were given as 1,800 to 2,500 francs per ton and 2,500 to 5,000 francs per ton, respectively.

French West Africa.—The Société des bauxites du Midi installed equipment for the commercial production of bauxite on the Island of Kassa off the French Guinea coast of French West Africa. Dried ore was to be shipped, mostly to Canada, at the rate of 300,000 to 400,000 metric tons annually beginning late in 1952. The more extensive ore deposits on the mainland in the Boffa-Boké region and on the Konkouré River also attracted attention because of the great hydroelectric potential in these areas.

Greece.—Greece more than doubled its bauxite production in 1951 and regained the importance it held as an exporter immediately before World War II. Further increases were foretold at the close of the year through announcement of a contract between the United States Mutual Security Agency and the Eleusis Bauxite Mines. Funds advanced to the Greek company for mining equipment and working capital were to be repaid by delivery of 450,000 metric tons of bauxite to the United States Government. It was planned to have this bauxite converted to aluminum for the National Stockpile by two German producers.

Hungary.—The bauxite reserves in Hungary are the largest known in Europe. Before World War II virtually all of the mine production was exported. Completion of the Almásfüzitó alumina plant in 1951, however, was a significant step in the country's plan to process its own ore. It was reported that the plant was designed for a subsequent expansion that would make it the largest alumina plant in Europe.[4]

Italy.—The reserves of bauxite in Italy have been estimated at 11 million tons, most of which are located in the southern end of the Italian Peninsula. Although production gained and imports declined in 1951, nearly one-third of the new supply came from Yugoslavia. Alumina production increased substantially as Italy continued to meet domestic requirements and to export to Switzerland and Austria.

Jamaica.—The greatest development of bauxite-producing facilities in the world in 1951 was under way on the Island of Jamaica, as three mining companies—subsidiaries of North American aluminum producers—prepared to mine from ore deposits discovered there since 1942. Numerous articles appeared in the press, describing the

[4] Light Metals, Exploitation of Bauxite in Hungary: Vol. 15, No. 166, January 1952, pp. 9–11.

thorough planning and well-integrated construction of the open-pit mining, processing, transportation, housing, and other facilities of all three companies.[5]

Reynolds Jamaica Mines, Ltd., was expected to be the first to produce, with shipments beginning in mid-1952. An agreement reached in 1951 provided that the Economic Cooperation Administration advance Reynolds $2,284,000 in addition to previous ECA loans. The new funds, to be supplemented by Reynolds, were to expand facilities previously planned. According to plans, Reynolds would eventually produce 750,000 to 1 million tons per year.

The Kaiser Bauxite Co. expected to begin a 1-million-ton-per-year mining operation in Jamaica on completion of its facilities late in 1952. A new railway was under construction to haul ore to the drying plant, storage bins, and port at Little Pedro on the southern coast.

The third company, Jamaica Bauxites, Ltd., a subsidiary of Aluminium, Ltd. was the only company that planned to mine bauxite and also produce alumina in Jamaica.[6] Facilities for producing 450 metric tons of alumina per day were under construction near Mandeville, Manchester Parish. It was anticipated that the plant would ultimately be expanded to a capacity of 670 tons. Alumina was to be shipped from a new pier at Old Harbour Bay on the southern coast and consumed largely at the new reduction plant of the parent company in British Columbia, Canada.

Malaya.—Bauxite mined during the Japanese occupation of Malaya was exported to Japan during 1951. Several companies had shown an interest in the deposits in southern Jahore, and mining may be resumed in 1952.

Surinam.—Although there were reports that several foreign companies and the colony's mining bureau were conducting new bauxite investigations in Surinam, the world's largest bauxite producer in 1951, only two companies actually mined the ore. Of the total production (which included 62,000 metric tons of abrasive ore and 54,000 tons of chemical-grade bauxite) the Surinam Bauxite Co. produced 2,184,000 tons and the N. V. Billiton Co. 487,000 tons. All bauxite mined in Surinam during 1951 was exported, and the United States received approximately 96 percent. The Surinam Bauxite Co., a subsidiary of the Aluminum Co. of America, was engaged in opening the Rickanau Hill deposit north of the exhausted Moengo mines and the Rorac deposit about 5 miles north of the Paranam operations. Both companies planned increases in kiln capacity.

U. S. S. R.[7]—Official U. S. S. R. statistics on the 1951 production of bauxite, as in the case of most other commodities, were not available Estimates shown in table 12 were based largely on estimates of aluminum production. It is believed that most of the aluminum was produced from domestic bauxite, but significant allowances were made for production from imported bauxite, nephelite, and alunite.

Venezuela.—The Venezuelan Government announced that bauxite had been discovered near Upata, in Estado Bolivar. Estimates ranging up to 2 million tons of high-grade ore were reported.

[5] Champion, Harold, Bauxite from Jamaica: Light Metals, vol. 15, No. 166, January 1952, pp. 6–9.
[6] Engineering and Mining Journal, New Large Alumina Plant: Vol. 153, No. 3, March 1952, pp. 94–96.
[7] The Metal Bulletin, Survey of the Soviet Union's Non-Ferrous Metals Industries: No. 3490, May 9, 1950 pp. 11–22.

Beryllium

By Stanley Needleman

GENERAL SUMMARY

MILITARY and essential civilian demands for beryllium products, particularly beryllium-copper, exceeded the beryl supply available to consumers during 1951. The situation was most critical at midyear because of the export restrictions placed upon beryl exports by Brazil from January 1 to July 16, 1951. A total supply of 4,800 short tons of beryl was available in the United States; of this amount, 484 tons was produced from domestic mines, and 4,316 tons was imported. Commercial beryl usually contains 10 to 12 percent beryllium oxide.

Concern over the beryl supply caused industry and Government groups to convene for study of the situation. Attention was directed to low-grade domestic deposits, especially with reference to developing suitable mining and milling methods. Beryl has been included in Group I of the Munitions Board list of critical and strategic materials to be acquired for the National Stockpile. To prevent curtailment in the output of beryllium products, beryl was exempted from price control by the Office of Price Stabilization under Regulation 9, Amendment 4, effective August 10, 1951.

The Defense Minerals Administration, succeeded by the Defense Minerals Exploration Administration and the Defense Materials Procurement Agency under authority of the Defense Production Act of 1950, actively participated in an effort to improve the domestic beryl situation. Government subsidies stimulated interest in domestic deposits formerly considered uneconomic.

TABLE 1.—Salient statistics of beryllium concentrates (beryl) in the United States, 1936–51, in short tons

Year	Domestic production [1] [2]	Imports for consumption	Exports		Consumption [3]	Average price per unit BeO		World production [2]
			Ore	Metal, alloys, scrap		Domestic [4]	Foreign [5]	
1936	28	162	(6)	(6)	[7] [8] 200	$3.00	$4.12	479
1937	75	182	(6)	(6)	[7] [8] 200	2.19	4.42	413
1938	25	146	(6)	(6)	[7] [8] 300	3.08	4.10	1,153
1939	95	459	(6)	(6)	[7] [8] 500	2.86	3.18	996
1940	121	810	(6)	(6)	[7] [8] 600	3.08	2.97	2,393
1941	158	2,666	(6)	(6)	[7] [8] 1,200	4.62	5.40	4,507
1942	269	2,050	.8	12.6	[8] 2,352	8.99	6.71	3,312
1943	356	4,840	2.5	27.5	[8] 3,058	12.47	7.80	6,010
1944	388	3,115	9.5	42.1	2,176	14.47	9.18	3,261
1945	39	1,201	.1	51.6	1,738	15.73	10.98	1,085
1946	100	1,188	1.4	69.9	1,013	17.79	8.90	1,873
1947	145	767	.2	140.7	1,735	17.39	14.95	1,576
1948	99	1,720	.1	13.0	1,970	26.87	17.41	2,723
1949	[8] 475	3,811	.3	94.0	1,029	32.10	22.52	5,053
1950	559	[8] 4,860	.1	110.5	3,007	30.51	25.43	7,332
1951	484	4,316	.3	94.8	(9)	33.34	31.67	6,305

[1] Mine shipments.
[2] Average 10 percent BeO content.
[3] As reported by consumers.
[4] F. o. b. mine, Colorado.
[5] C. i. f. United States ports.
[6] Not separately classified.
[7] Estimated.
[8] Revised.
[9] Data not available for publication.

RESERVES

World reserves of recoverable beryl, excluding satellite nations of the Soviet Union, have been estimated at about 250,000 short tons.

Estimates of potential beryl reserves in Canada have been made only for Manitoba, Ontario, and the Northwest Territories; further detailed geologic study of Canadian pegmatites may add appreciably to this knowledge.

Domestic reserves in South Dakota, New Hampshire, Colorado, Maine, and North Carolina total about 25,000 short tons. Reserves have been increased with the introduction of recently developed techniques for utilizing low-grade ores.

Most of South Dakota's beryl reserves are in the southern Black Hills, in Pennington and Custer Counties. Pegmatites in the Black Hills area have been estimated to contain 11,824 short tons of beryl; according to the Geological Survey, 2,636 tons can be recovered by hand sorting. Measured reserves total about 234 tons. The major reserves occur in the Keystone, Custer-Pringle, and Hill City districts.

A survey of the New England pegmatites has been conducted by the Bureau of Mines since 1949. This is part of an overall program to increase beryl production by developing low-grade deposits. Substantial tonnages of pegmatite reserves were indicated as a result of the drilling portion of the survey.

Low-grade beryl deposits also have been found in North Carolina, Colorado, Utah, Idaho, South Dakota, Wyoming, New Mexico, Arizona, California, and the New England States.

DOMESTIC PRODUCTION

MINE PRODUCTION

Domestic production of beryl during 1951 was 484 short tons, over 13 percent less than the record output of 1950. The Harding mine, near Dixon, N. Mex., was again the largest individual beryl producer; an output of about 140 tons was attained. As a result, New Mexico continued to lead the States in beryl production, followed closely by South Dakota. Other producing States, in order of importance, were Colorado, New Hampshire, Maine, Arizona, and North Carolina. Beryl production in the Black Hills area of South Dakota was reported by Keystone Feldspar & Chemical Co. (Peerless mine), J. A. Johnson (Big Chief claims), Howard L. Peterson (Hugo and Etta mines), and Lawrence A. Sears (Johnson mine), all near Keystone, and Walter Clifford, George C. Bland (Beecher mine), John D. Fisher, and Francis Michaud (The Mick), near Custer. Principal Colorado production came from the Beryllium Mining Co. (New Anniversary claims) near Ohio City, Gunnison County; Nelson-Hermstein Mining & Developing Co. (Devil's Hole mine), near Canon City, Fremont County; and Consolidated Feldspar Corp. (various unspecified properties). Shipments were reported in 1951 from New Hampshire by Whitehall Mining Co., Ruggles quarry, near Grafton.

TABLE 2.—Beryllium concentrates (beryl) shipped from mines in the United States, 1945–51, by States, in short tons

State	1945	1946	1947	1948	1949	1950	1951
Colorado			(1)	(1)	[2] 144	97	97
New Hampshire	1	5	(1)	(1)	(1)	106	50
New Mexico			(1)		8	(1)	141
South Dakota	38	95	70	45	[2] 139	96	138
Other [3]			75	54	[2] 184	260	58
Total: Short tons	39	100	145	99	[2] 475	559	484
Value	$6,133	$17,787	$25,214	$26,600	[2] $152,485	$170,550	$161,361
Average value per ton	$157.26	$177.87	$173.89	$268.69	$321.02	$305.10	$333.36

[1] Included with "Other," to avoid disclosure of individual company operations.
[2] Revised figure.
[3] Includes States indicated by footnote reference 1; in addition, 1947, Connecticut and Maine; 1948, Maine; 1949, Arizona, Maine, and North Carolina; 1950, Arizona and Maine; 1951, Arizona, Maine, and North Carolina.

A deposit of helvite (sulfosilicate of manganese, iron, and beryllium) at Iron Mountain, N. Mex., has remained undeveloped mainly because of difficulties encountered in producing a suitable concentrate economically.

REFINERY PRODUCTION

Beryllium Corp., Reading, Pa., consumed beryl to produce beryllium-copper master alloy (4 percent Be); beryllium-aluminum master alloy (5 percent Be); beryllium-nickel (2.7 percent Be); and beryllium-copper alloys (0.25–2.85 percent Be) in the form of sheet, strip, rod, wire, castings, and safety tools. Brush Beryllium Co., Cleveland and Luckey, Ohio, continued to produce beryllium metal and oxide and other beryllium products, principally for the Atomic Energy Commission. The company obtained $800,000 from the Reconstruction Finance Corp. to construct a new plant, 18 miles west of Luckey, Ohio, midway between Elmore and Oak Harbor, in which the company was to resume production of beryllium-copper master alloy. Operations were expected to begin late in 1952.

Clifton Products Inc., Painesville, Ohio, inactive in commercial production of beryllium since early 1949, produced some beryllium products for special uses and intensified efforts in the field of beryllium research.

Beryl Ores Co., Arvada, Colo., continued to beneficiate low-grade ore (some as low as 2.5 percent BeO) and to grind beryl for use in the ceramic industry; the ore is purchased from other producers. The company reportedly produced a small quantity of beryllium oxide.[1]

The Champion Spark Plug Co., Toledo, Ohio, and Detroit, Mich., and A. O. Smith Co., Milwaukee, Wis., consumed beryl for ceramic materials. The Foote Mineral Co., Philadelphia, Pa., continued to grind and blend beryl for the ceramic industry.

CONSUMPTION AND USES

Consumption of beryl in 1951 for the production of metal, alloys, and compounds continued at a high level. Consumers relied upon their own stocks during the first half of the year because of Brazilian

[1] E&MJ Metal and Mineral Markets, vol. 152, No. 7, July 1951, p. 162.

export limitations. The problem of meeting the growing military and civilian demands, especially for beryllium-copper, was made less acute by the development of new alloys containing smaller percentages of beryllium and by substituting beryllium-free materials for certain less critical uses.

Industrial research on beryllium alloys resulted in the development and introduction to the trade of a new copper-base alloy containing less than 2 percent beryllium. This new alloy is an effective substitute for the conventional beryllium-copper alloy (2 percent Be) in many applications. Through its use, the available supply of beryllium was significantly extended. An aluminum alloy containing a high percentage of beryllium was introduced to the trade for special defense applications in photographic and aircraft equipment.

Beryllium's most important commercial applications are as an alloying agent with copper and as metal, oxide, and other compounds. Beryllium-copper alloys, containing 0.15 to 2.85 percent beryllium, have many important metallurgical applications, military and civilian. This wide utilization is possible because of their adaptability to heat treatment, high strength (tensile and fatigue), corrosion and wear resistance, hardness, high conductivity (electrical and thermal), low creep tendency, and nonmagnetic and nonsparking properties. Beryllium-copper alloys are now being used in aircraft, guided missiles, weapons, electronics, construction equipment, ships, communications, machine tools, and nuclear energy studies.

Patents issued during 1951 included methods for producing beryllium-copper cyclotron target,[2] beryllium-zinc silicate,[3] beryllium-calcium silicate phosphors,[4] and a beryllium-gold alloy for use in neutronic reactors.[5]

STOCKS

During 1951 Government stocks continued to increase through the concerted efforts of various Government agencies to meet the objective of the National Stockpile program.

As a result of the export restriction placed upon beryl by Brazil during the first half of 1951, industrial inventories were depleted temporarily because domestic production and imports from other sources could not meet requirements. At the end of 1951 industry stocks of beryllium metal, alloys, and compounds were about the same as reported at the end of 1950. Statistics covering these stocks are not available for publication.

PRICES

E&MJ Metal and Mineral Markets quoted domestic beryl ore, per unit BeO, 10–12 percent BeO, f. o. b. mine, as follows: Colorado, nominal throughout 1951; North Carolina, January 11, $26–$28; March 1, $28–$30; July 5, $32–$34; August 23, $33–$37; and unchanged thereafter. Quotations for the same grade of imported ore,

[2] Hamilton, J. G., Putnam, T. M., and Wiens, J. B. (assigned to Atomic Energy Commission), Beryllium Target and Method of Manufacture: U. S. Patent 2,549,596, Apr. 17, 1951.
[3] Roos, Jacob (assigned to General Electric Co.), Preparation of Zinc-Beryllium Silicate Phosphors: U. S. Patent 2,542,260, Feb. 20, 1951.
[4] Smith, A. L. J. (assigned to Radio Corp. of America), Calcium-Beryllium Silicate Phosphor: U. S. Patent 2,547,790, Apr. 3, 1951.
[5] Hirsch, H., and Kowalchik, M. (assigned to Atomic Energy Commission), Gold-Beryllium Alloy: U. S. Patent 2,556,921, June 12, 1951.

c. i. f. United States ports, were: February 15, $28; July 5, $32 August 16, $33–$36.50; and unchanged thereafter.

On November 15, 1950, the beryllium industry had changed the beryllium-copper pricing policy by beginning to quote the master alloy (4 percent Be average content) in terms of alloy instead of contained beryllium. The master alloy remained unchanged during 1951 at $1.56 per pound of alloy ($30–$32 per pound of contained beryllium). Beryllium-magnesium-aluminum (5 percent Be) and beryllium-aluminum (5 percent Be) master alloys were quoted at $55 and $69 per pound of contained beryllium, respectively. Beryllium-nickel (2.7 percent Be and 1 percent Cr) was quoted at $2.70 per pound of alloy. Quoted prices for beryllium-metal powder, standard mesh, per pound, were: $95, technical grade; and $103, premium grade.

High-fired refractory-grade beryllium oxide was quoted at $15–$18 per pound, depending upon quantity. Beryllium nitrate was offered at $3.95–$5.00 per pound, depending upon quantity.

Prices quoted for beryllium metal, lump or pebble size, per pound were: $56.96–$71.50, technical grade; and $104.50, premium grade.

FOREIGN TRADE [6]

Imports of 4,316 short tons of beryl into the United States during 1951 were about 11 percent less than the record high of 4,860 tons (revised) received in 1950. The Union of South Africa was the principal source, furnishing about 40 percent of total imports; Brazil, the second important source, contributed about 25 percent. Significant amounts were received also from Southern Rhodesia, India, Mozambique, and Portugal.

The United States also imported 30,110 pounds of a product containing beryllium oxide and beryllium carbonate from Italy and 17 pounds of beryllium carbonate from Canada. The material from Italy represented reshipment of processed old stocks purchased by the Italians from Brazil and Argentina before World War II.

Exports of beryllium metal, alloys, and scrap from the United States during 1951 totaled 189,513 pounds, valued at $309,830. The recipients were: United Kingdom, 97,904 pounds; Canada, 59,775 pounds; Sweden, 11,009 pounds; Western Germany, 6,497 pounds; Australia, 5,069 pounds; Argentina, 3,438 pounds; Greece, 2,606 pounds; Belgium, 1,320 pounds; with the balance of 1,895 pounds distributed among six other countries. Exports of beryl totaled 504 pounds, valued at $1,053; Canada was the recipient.

Beryllium ore, metal, alloys, compounds, and scrap remained on the list of products requiring licenses for export from the United States, in accordance with the directive of the Office of International Trade of the United States Department of Commerce that became effective on July 16, 1948. No license was necessary for materials shipped to Canada.

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[6] Figures on imports and exports compiled by M. B. Price and E. D. Page, of the Bureau of Mines, from records of the U. S. Department of Commerce.

TABLE 3.—Beryllium concentrates (beryl) imported for consumption in the United States, 1936–51, by countries, in short tons

[U. S. Department of Commerce]

Year	Argentina	Australia	Brazil	India	Mozambique	Southern Rhodesia	Union of South Africa (includes South-West Africa)	Other	Total	
									Short tons	Value
1936	154		2				6		162	$6,681
1937	152			30					182	8,031
1938	78			58			10		146	5,990
1939	384		75						459	14,574
1940	422		377		[1] 5		6		810	23,865
1941	861		1,805						2,666	143,992
1942	703		912	397			38		2,050	137,597
1943	1,162	457	2,551	509			86	[2] 75	4,840	377,726
1944	229	518	1,453	892		7	(3)	[4] 15	3,115	286,091
1945		105	572	484				[5] 40	1,201	131,841
1946	53	20	996	119					1,188	105,708
1947		45	722					[6] 18	767	114,667
1948	55		1,545		55		47	[7] 150	1,720	299,375
1949			3,264		107		290	[8 9] 162	3,811	858,308
1950			[8] 2,703		130	464	1,401	[10] 185	[8] 4,860	[8] 1,235,639
1951			1,094	449	174	692	1,722		4,316	1,366,772
Total, 1936–51	4,253	1,145	18,071	2,938	471	1,163	3,606	646	32,293	5,116,857
Percent	13.2	3.6	55.9	9.1	1.5	3.6	11.2	1.9	100	

[1] Figure reported to Bureau of Mines; value not included in total value figure.
[2] Madagascar, 74 short tons; Portugal, 1 ton.
[3] Less than 0.5 ton.
[4] British East Africa (principally Uganda), 15 tons; Anglo-Egyptian Sudan, less than 0.5 ton.
[5] British East Africa (principally Uganda), 7 tons; Madagascar, 11 tons; Nigeria, 22 tons.
[6] Hong Kong, 18 tons (country of export only—ore produced principally in Brazil and Argentina before, or during, World War II); Chile, less than 0.5 ton.
[7] British East Africa, 11 tons; French Morocco, 22 tons; Japan, 107 tons (country of transshipment only, *see* footnote 6 on Hong Kong for original source); Norway, 10 tons.
[8] Revised figure.
[9] British East Africa (principally Uganda), 11 tons; Canada, 29 tons; French Morocco, 77 tons; Japan, 17 tons; Portugal, 28 tons.
[10] British East Africa (principally Uganda), 47 tons; Finland, 6 tons; French Morocco, 23 tons; Japan, 12 tons; Portugal, 97 tons.

TECHNOLOGY

Investigations of metallurgical and technologic problems involving beryllium metal, alloys, and compounds were continued by interested Government agencies, industry, research institutions, and universities because of the metal's strategic and industrial importance. New techniques were developed in the production of beryllium-copper castings.[7]

The Bureau of Mines continued research to develop a satisfactory and economical method for recovering beryl and other important associated minerals from pegmatites. Research on beneficiating low-grade beryl ore met with some success; a flotation method was developed on a laboratory scale. Investigations were made to determine the most efficient and economical method of mining pegmatites.

WORLD REVIEW

Afghanistan.—Afghanistan first reported beryl production in 1950. According to unconfirmed reports, about 2 metric tons of beryl was

[7] Richards, John T., Beryllium-Copper Parts Designed for Investment Casting: Am. Machinist, vol. 95, No. 28, July 14, 1951, pp. 1046–1049. Beryllium-Copper Sand Castings: Foundry, vol. 79, No. 8, August 1951, pp. 90–256.

produced in 1951 from a deposit in the Kunar Valley, north of Jalalabad.

Argentina.—On December 21, 1951, Argentina issued Decree 23,063 transferring complete control of beryl from the Argentine Industrial Credit Bank to the Argentine Trade Promotion Institute. All beryl stocks and contracts were included in the transfer.

On January 10, 1951, the Minister of Industries and Commerce in Argentina announced a stimulating base price of 150 pesos per unit of beryl. The price to producers was 20 pesos per kilogram late in June. The increase was officially attributed to higher mining costs and the prices of the international market. No production statistics for Argentina are available for 1951.

Belgian Congo.—Beryl was reported in the pegmatites of Maniema and Ruanda-Urandi.

TABLE 4.—World production of beryllium concentrates (beryl), 1946–51, by countries, in metric tons [1]

[Compiled by Stanley Needleman and Berenice B. Mitchell]

Country [1]	1946	1947	1948	1949	1950	1951
Afghanistan					7	(2)
Argentina	130	10	[3] 50	(2)	(2)	(2)
Australia	19	54	56	36	23	94
Brazil (exports)	1,294	1,027	1,783	3,078	2,625	1,533
Canada					[3] 26	(2)
Chile			([3] [4])			
France			2	(2)	(2)	(2)
French Morocco			51	160	56	84
India	112	(2)	(2)	(2)	(2)	215
Korea, Republic of	(2)	(2)				(2)
Madagascar	(2)	([4])	9	27	486	530
Mozambique	22	61	81	136	[5] 264	230
Northern Rhodesia					5	
Norway				[3] 9		(2)
Portugal	(2)		[6] 10	[6] 20	[6] 49	112
Southern Rhodesia				23	846	1,007
South-West Africa		52	90	239	659	753
Tanganyika			[7] 2	1		
Uganda		18	44	34	44	2
Union of South Africa				223	844	593
United States (mine shipments)	91	132	90	[5] 431	507	439
Total (estimate)	1,700	1,430	2,470	4,587	6,651	5,720

[1] In addition to the countries listed beryllium concentrates have been produced in a number of countries, for which no production data are available; except for U. S. S. R., their aggregate output is not significant.
[2] Data not available; estimates by author of the chapter included in total.
[3] United States imports.
[4] Less than 0.5 ton.
[5] Revised figure.
[6] Estimate.
[7] Exports.

Brazil.—Brazil has been the source of most of the world's beryl supply since 1935. Principal producing States have been Paraíba, Rio Grande de Norte, Ceará, and, more recently, Minas Geraes. The bulk of the output has come from about 200 deposits, although as many as 400 are believed to have contributed to the production. Because of transportation difficulties, the commercial possibilities of the known productive areas have not been investigated thoroughly. Records of pegmatite mining in Brazil during World War II have indicated that between 3,000 and 3,500 tons of rock yielded an average

of 10 metric tons of beryl and 1 ton of tantalite, at an estimated cost of $1 per metric ton of rock mined. Other deposits have been found in Pernambuco, Bahia, and Gouvernador Valodones.

In July, the Brazilian Government issued a decree limiting the export of beryl to 1,500 metric tons for the second half of 1951 and establishing a minimum price of about $36.50 per metric ton unit on the concentrates.[8]

Negotiations were conducted by American and Brazilian representatives of private companies directed toward the erection of two beryllium oxide processing plants in Brazil. Proberil, a Brazilian company financed with Brazilian and American capital, planned to build an oxide plant near São Paulo.[9]

Canada.—Reports of numerous beryl occurrences in Canada have been published in recent years, but few of these discoveries have developed into large commercial sources. Canadian Beryllium Mines & Alloys, Ltd., shipped 29 short tons of beryl (10 percent BeO) late in October 1950. This ore had been on hand for years and was sold because of prevailing high prices. The company reported 250 short tons of low-grade ore in stock on June 30, 1951; the ore reportedly came from properties in Renfrew County, Ontario.[10]

Beryl occurrences continued to be reported from the Amos Val d'Or area in Figuery Township, Province of Quebec; they appeared to contain isolated beryl crystals in pegmatite dikes. No pockets of any magnitude had been found; however, the size and continuity of the dikes did not preclude the possibility of extensive beryl deposits. Inasmuch as the grade of the ore seemed to be low, such a deposit probably would have to be worked on a large tonnage basis in order to be economical. Beryl occurs, in potentially large quantities, in the Cat Lake-Winnipeg River area, about 90 miles northeast of Winnipeg, Manitoba, near the Ontario boundary.

France.—In recent years France reportedly has been stockpiling beryl for possible use by its Atomic Energy Commission. Sources of the ore are Madagascar, French Morocco, Portugal, Mozambique, South West Africa, Brazil, and India. A small quantity of beryl has been produced in France from a mine near La Vedrenne, north of Limoges.

Pechiney (Compagnie de Produits Chimiques et Électrométallurgiques), formerly known as Alais Frogues et Camargue, has been the only beryl processor in France. The company has two ore-processing plants in the Province of Savoie—one at St. Jean de Maurienne, to produce beryllium-copper alloys; the other at Maurienne, to produce beryllium metal. The company also refines some semiprocessed beryllium-copper master alloy; this source material, in part, is imported by Pechiney from the United Kingdom and produced, in part, by the company itself.

French Morocco.—Mines des Zenaga, in the Anti-Atlas Mountains, reported a production of 75 metric tons of beryl during 1951. A deposit in the Tiznit area, in the extreme southern part of French Morocco, attracted the attention of prospectors and engineers.[11]

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[8] Mining World, vol. 13, No. 12, November 1951, p. 52.
[9] Metal Bulletin (London), No. 3648, December 1951, p. 18.
[10] Bureau of Mines, Mineral Trade Notes: Vol. 33, No. 1, July 1951, p. 5.
[11] Mining World, vol. 13, No. 12, November 1951, p. 53.

Germany.—In Western Germany the processing of beryl to produce beryllium metal continued to be prohibited under the terms of an agreement reached by France, the United Kingdom, and the United States. Degussa, in Frankfort, fabricated imported beryllium metal for use in X-ray equipment, and Vacuumschmelze, A. G., formerly Heraeus Vacuumschmelze, A. G., at Hanau, produced beryllium-copper and other beryllium alloys from imported master alloy stock.

India.—India produced 215 metric tons of beryl during 1951; this was the first year since 1946 for which the country released beryl-production statistics. The Indian Atomic Energy Commission was actively guiding research directed toward exploiting the country's mineral resources. Export restrictions were relaxed for the first time since 1946 to allow certain shipments of beryl to the United States for atomic energy projects.[12]

Beryl was recovered as a byproduct from a mica-mining operation at Rajputana.[13] Small quantities of beryl have been produced near Nellore in the State of Madras. Potentially commercial deposits occur in Mysore State and in Madras State, near Saidapuram, Pattalai, Sermattam Palaiyam, and Tittampalaiyam.

Madagascar.—Expanded beryl production in the Fianarantsoa area of Madagascar resulted in a total output of 584 short tons during 1951.

Mozambique.—In Mozambique, Empresa Miniera do Alto Ligonho was the largest producer of beryl during 1951. A small amount was shipped from the Boa Esperanca mine. Beryl occurrences were investigated and developed in the highly kaolinized pegmatites in the Alto Ligonho district, at Muiane, Naipa, Marigue, Nanro, Nahora, Macula, Nahia, and Piteia, and in the Alto Molocue district.

Portugal.—Portugal has commercial beryl deposits near Viseu, in the northeastern section of the country; the output from this area totaled 112 metric tons during 1951. A mine was operated at Mangualde, and interest was shown in a deposit near Vale da Serra. High prices and a steady demand stimulated the increased output of beryl in the country.

Southern Rhodesia.—Southern Rhodesia recorded an output of 1,110 short tons of beryl during 1951 to make the country the leading producer in Africa. Production came principally from deposits in the Gweld and Fort Victoria districts, with smaller amounts from the Salisbury, Mtoko, and Bulawayo districts. Douglas Lawrie, Ltd., at Bikita, 50 miles west of Fort Victoria, accounted for most of the production. At this operation tantalite and lithium minerals are recovered with the beryl. A new occurrence of beryl was reported near the Mititikwe River, 16 miles southeast of Fort Victoria. Recent discoveries in the Miami area disclosed important beryl concentrations in mica pegmatites. Low-grade beryl occurrences were discovered in the Filabusi area of the Bullawayo district.[14]

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[12] Mining World, vol. 13, No. 6, May 1951, p. 61.
[13] Mining Journal (London), vol. 236, No. 6026, February 1951, p. 148.
[14] Chief Government Engineer and Chief Inspector of Mines, Southern Rhodesia, Annua lReport, 1951.

South-West Africa.—The easy-to-mine beryl-bearing alluvial deposits were virtually depleted during 1951. These deposits occur near the pegmatites in the Warmbad district, near the Union of South Africa border, and in the Karabib-Usakos area east of Walvis Bay. The Jooste lithium mine was the principal pegmatite operation in the country.

Uganda.—Beryl production was 2 tons in 1951, compared with 44 tons for 1950. The production during both years came from the Ankole district.

United Kingdom.—In England, Mallory Metallurgical Products, Ltd. (Wembley, Middlesex), Telegraph Construction & Maintenance Co., Ltd. (Greenwich), and the Beryllium Smelting Co., Ltd. (London), produced beryllium alloys from master alloys imported from the United States. Several other British companies seriously considered manufacturing beryllium metal, alloys, and salts because the demand for semifabricated items in the United Kingdom exceeded the supply of master alloy imported from the United States. Plants in the United Kingdom continued to remelt ingots of the master alloy and add metals, such as cobalt, to produce ternary alloys before fabrication into rod, sheet, tube, and wire.[15]

[15] Metal Bulletin, No. 3654, Dec. 28, 1951, p. 27.

Bismuth

By Abbott Renick

GENERAL SUMMARY

THE DOMESTIC supply [1] of bismuth metal in 1951 decreased 21 percent from that in 1950. In spite of the fact that increased production capacity at principal refineries permitted handling accumulated bismuth-bearing material and treatment of imported bismuth concentrates from Korea, total refinery production of bismuth metal in the United States was 10 percent below that in 1950.

Exports of bismuth metal during 1951 decreased 26 percent from the 1950 figure, and the United Kingdom again received the major portion.

Stocks of metal held by producers were 41 percent higher on December 31, 1951, than at the end of 1950.

Peru continued in 1951 to be the largest foreign producer of refined metal, supplying 86 percent of the total imports into the United States.

The New York market price of metallic bismuth remained through the year at $2.25 per pound in ton lots, unchanged since September 5, 1950.

DOMESTIC PRODUCTION

Most of the bismuth produced in the United States is obtained as a byproduct from smelting domestic and foreign lead ores and from refining imported bismuth bars containing lead as a major impurity. Some bismuth was recovered in 1951 from imported bismuth-bearing tungsten ore. The Bureau of Mines is not at liberty to divulge the quantities produced, but 1951 output increased 33 percent over that in the previous year.

Companies reporting output of refined bismuth metal in 1951 were American Smelting & Refining Co., at Omaha, Nebr., and Perth Amboy, N. J.; Anaconda Copper Mining Co., at Anaconda, Mont.; and U. S. S. Lead Refinery, Inc. (subsidiary of United States Smelting, Refining & Mining Co.), at East Chicago, Ind. The Cerro de Pasco Corp., at its Brooklyn, N. Y. plant, is the principal domestic producer of bismuth alloys; the bismuth metal used is obtained from the company's lead smelter at La Oroya, Peru.

In Alaska, Native Bismuth, Inc., started development work at Charley Creek, approximately 35 miles north of Nome. Bismuth

[1] Opening stocks plus domestic refinery production plus imports minus exports minus year-end stocks.

occurs there as native bismuth and bismuthinite in a siliceous gangue material. An energetic development campaign was planned for the 1952 season.[2]

CONSUMPTION AND USES

As a result of the defense program and the continued high-level civilian demand, the requirements for bismuth exceeded the supply during the early part of 1951. Bismuth consumption in the pharmaceutical industry was approximately the same as in 1950. The National Production Authority placed various restrictions on the use of bismuth to conserve supplies. Effective March 9, 1951, Order M–48 restricted the use of bismuth and bismuth alloys to specified processes and purposes. The order set limitations on acceptance of deliveries to 60 percent of the base period established in the first half of 1950, limited inventories to 1 month's requirements, and provided for a set-aside reserve of 20 percent from production and imports. Order M–48 was amended August 10, 1951, so that, effective September 1, 1951, a consumer might accept up to 100 percent of his monthly supply during the base period.

TABLE 1.—Bismuth metal consumed in the United States in 1951, by uses [1]

Use	Pounds	Percent of total
Pharmaceutical	569,600	36
Ammunition and other solder	100,200	6
Fuse alloys	186,800	12
Manufacturing alloys	513,400	32
Other and unspecified alloys [2]	222,000	14
Total consumption	1,592,000	100

[1] Last 11 months only; figures for February through December compiled by National Production Authority, U. S. Department of Commerce.
[2] Principally rectifier coatings.

TABLE 2.—Percentage distribution of bismuth in the United States, 1947–51, by major use group [1]

Use group	1947	1948	1949	1950	1951
Pharmaceuticals	52	49	31	36	36
Metal and alloys [2]	48	51	69	64	64

[1] Computed from figures by Bureau of Mines, 1947–50; National Production Authority, 1951.
[2] Principally fabricating alloys but includes pure metal, ammunition solders, fuse alloys, aluminum alloys, and other minor compositions.

STOCKS

Producers' inventories of refined bismuth metal at the end of 1951 were 41 percent above the end of 1950.

[2]Mining World, vol. 14, No. 3, March 1952, p. 41.

PRICES

The New York price for bismuth metal remained unchanged at $2.25 per pound in ton lots throughout 1951, according to the E & MJ Metal and Mineral Markets. The Metal Bulletin (London) quotation for high-purity metal, per pound, 2 cwt. minimum, on January 5 was 17s., subsequent fluctuations being recorded as follows: June 1, 22s. 6d.; December 28, 28s. Bismuth ore, per pound of contained metal, c. i. f., was quoted on December 28 at 18s. 3d., for 65 percent minimum bismuth content, scaling downward to 7s. for ore containing less than 20 percent bismuth.

FOREIGN TRADE [3]

Imports.—Receipts of refined metal in 1951 were 34 percent less than in 1950. The approximate percentage distribution of receipts, by country of origin, was: Peru 86, Yugoslavia 7, Japan 4, Germany 2, and others 1. There were no transactions in chemical compounds, mixtures and salts of bismuth in 1951.

Exports.—Outgoing shipments of bismuth and alloys decreased 26 percent in 1951. The United Kingdom was again the principal recipient, taking 141,686 pounds; Germany received 2,032 pounds; France received 1,000 pounds.

TABLE 3.—Bismuth imported into and exported from the United States, 1942–46 (average) and 1947–51

[U. S. Department of Commerce]

Year	Imports of bismuth [1]		Exports of metal and alloys	
	Pounds	Value	Pounds	Value
1942–46 (average)	324,331	$322,530	61,960	$70,410
1947	310,561	480,808	240,833	452,147
1948	299,824	464,733	352,027	711,354
1949	541,852	833,940	190,882	356,576
1950	781,670	1,287,098	199,253	387,458
1951	514,020	1,003,285	146,998	376,246

[1] Does not include imports of bismuth contained in bismuth-lead bars from Mexico or imports of bismuth contained in concentrates.

TECHNOLOGY

A brief résumé of the Betts process was published.[4]

Bismuth-bearing slimes are also obtained as a byproduct of the Betts Method of lead refining. The slimes are washed, dried and smelted under oxidizing conditions with Na_2CO_3 and NaOH to yield alkaline slags that carry off the arsenic and antimony as sodium compounds, and the copper as oxide. The residue is crude bismuth, containing mainly silver and lead. This is electrolytically refined at 50 to 60° C. in an acid $BiCl_2$ solution containing rather more than 100 gm. hydrochloric acid per litre, and 3 to 4 gm. of bismuth. A Thum's cell is used, the same in principle as that employed in the refining of silver. The lead from the crude bismuth anode passes into solution as lead chloride which concentrates in the electrolyte. Part of the electrolyte is withdrawn from time to time, and the lead chloride crystallised out.

[3] Figures on imports and exports compiled by M. B. Price and E. D. Page, of the Bureau of Mines, from records of the U. S. Department of Commerce.

[4] Lomas, J., Bismuth: Mine and Quarry Eng., London, vol. 16, No. 9, September 1950, pp. 289–292.

The use of bismuth subcarbonate in treating gastric and duodenal ulcers was described in an article which reported on a clinical survey of 65 cases and concluded that bismuth in sufficient dosage appears to be a most valuable therapeutic weapon.[5]

The refining of bismuth, including the description of a small refinery, was the subject of a technical report.[6]

A review of bismuth[7] and notes on its properties, occurrence, production methods and application were the subjects of articles.[8] Application of a colorimetric method for determining bismuth in tungsten ores was discussed in another article,[9] and a procedure for the photoelectric spot analysis of bismuth and antimony was also described.[10]

A United States patent issued during 1951 relative to bismuth was: Reimert, L. J., and Fatzinger, E. A., Process Relates to Luminous Pigments Activated by Bismuth or Bismuth and Iron: U. S. Patent 2,544,236, Mar. 6, 1951.

WORLD REVIEW

Canada.—Estimated production of bismuth metal in 1951 was 234,000 pounds compared with 223,000 pounds in 1950.[11]

France.—In 1951 the French concern Mines et Usines de Salsigne mined 192,500 metric tons of ore compared with 187,000 tons in 1950. Among the metals recovered were 510 tons (300 tons in 1950) of copper and 59 tons (22 tons) of bismuth in ingots. Sales included 398 tons (773 tons) of copper and 67 tons (14 tons) of bismuth.[12]

Mexico.—No bismuth metal is produced in Mexico. The commodity obtained there, as an impure bismuth alloy, is a byproduct of smelting and refining some lead-silver ores and concentrates. The bismuth minerals of importance, in addition to native metal, include bismuthinite and what is locally called guanajatite ($BiSe_3$). The commercially important deposits are those found in El Carmen and the San Bernardo Mines near Zimpan, State of Hidalgo, in the Zapuri and Santa Barbara mines in Chihuahua, and in those near the city of San Luis Potosi.

Bismuth output in Mexico increased from 263 metric tons in 1950 to 338 tons in 1951.

United Kingdom.—Imports of bismuth metal amounted to 557,375 pounds for 1951 compared with 378,879 pounds in 1950.

Exports of bismuth metal excluding alloys amounted to 400,023 pounds for 1951 compared to 428,951 pounds in 1950.[13]

U. S. S. R.—The extent of production in the U. S. S. R. is unknown, but in 1940 operations were started by a new bismuth plant at Adrasinan in Tadzhikistran.[14]

[5] Deller, Croxon F., The Treatment of Gastric and Duodenal Ulcer: Medicine Illustrated, vol. 6, No. 2, February 1952, pp. 51–82.
[6] Powell, Alan R., The Refining of Bismuth: Inst. of Min. and Met., London, 1950, pp. 245–257.
[7] Lomas, J., Bismuth: Mine and Quarry Eng., London, vol. 16, No. 9, September 1950, pp. 289–292.
[8] South African Mining and Engineering Journal, Bismuth in Industry: Vol. 61, No. 2996, July 15, 1950, pp. 695–697.
[9] Analytical Chemistry, vol. 23, No. 10, pp. 1490–1491.
[10] Science, vol. 113, No. 2923, Jan. 5, 1951, pp. 11–12.
[11] Northern Miner, vol. 37, No. 41, Jan. 3, 1952, p. 5.
[12] Metal Bulletin, London, vol. 3685, Apr. 18, 1952, pp. 695–697.
[13] Metal Age, London, No. 2, February 1952, p. 12.
[14] South African Mining and Engineering Journal, Bismuth in Industry: Vol. 61, No. 2996, July 15, 1950, pp. 695–697.

TABLE 4.—World production of bismuth, 1944–51, by countries, in kilograms [1]

[Compiled by Pauline Roberts]

Country [1]	1944	1945	1946	1947	1948	1949	1950	1951
Argentina: Metal	14,000	20,120	22,000	22,000	(2)	(2)	(2)	(2)
In ore [3]	24,500	31,000	12,000	20,000	(2)	(2)	(2)	(2)
Australia (in ore) [4]	3,556	3,251	1,118	4,369	4,064	[5] 660	[5] 914	1,188
Belgian Congo (in ore)				815	456	540	668	225
Boliva (in ore and bullion exported) [6]	605	15,337	27,867	88,964	35,142	8,222	24,443	69,081
Canada (metal) [7]	56,188	86,098	109,090	128,988	108,971	46,680	[5] 86,918	106,140
China (in ore) [3]	(2)		1,380	(2)	(2)	(2)	(2)	(2)
France (in ore)	3,000			55,000	56,000	[5] 82,000		(2)
Japan (metal)	[5] 54,000	20,000	15,914	22,862	23,327	25,946	33,049	42,010
Korea, South	(2)	(2)			104,000	173,420	(2)	12,500
Mexico (in impure bars)	165,379	161,368	76,000	256,000	154,000	249,000	263,000	338,000
Peru: Metal	416,159	307,446	221,778	233,794	205,861	[5] 215,707	226,851	262,655
In lead-bismuth alloy		1,500	89,665	3,043	47,225	2,398	(2)	
South-West Africa (in ore) [3]						500	7,200	100
Spain (metal)	4,910	10,071	13,756	21,172	24,269	19,854	11,344	15,180
Sweden			12,441	10,998				(2)
Uganda					3,963	7,519	3,658	(2)
Union of South Africa (in ore)	818	610	711		437	5,045	7,649	3,184
United States	(9)	(9)	(9)	(9)	(9)	(9)	(9)	(9)
Yugoslavia (metal)	(2)	(2)	(2)	42,700	51,100	38,100	60,531	87,760
World production (estimate)	1,200,000	1,100,000	[5] 1,000,000	[5] 1,300,000	[5] 1,300,000	[5] 1,300,000	[5] 1,400,000	1,600,000

[1] Bismuth is believed to be produced also in Brazil, Burma, Germany, Norway, Rumania, U. S. S. R., and United Kingdom. Production figures are not available for these countries, but estimates by author are included in total.
[2] Data not available. Estimate by author included in total.
[3] Estimate.
[4] Partly estimated. Excludes content of some bismuth-tungsten concentrates.
[5] Revised figure.
[6] Excludes bismuth content of tin concentrates exported.
[7] Refined metal plus bismuth content of bullion exported.
[8] Incomplete data for year ended March 31 of year following that stated.
[9] Production included in total: Bureau of Mines not at liberty to publish separately.

Cadmium

By Robert L. Mentch

GENERAL SUMMARY

CONSUMPTION of cadmium in the United States in 1951 was curtailed enough to enable supplies to meet all military and essential civilian requirements despite a 10-percent decrease in primary production. Apparent consumption declined from 9,545,412 pounds in 1950 to 7,172,588 in 1951, owing largely to restrictions placed on end uses of cadmium by the National Production Authority. The reduction in consumption more than offset the decrease in production; as a result, stocks increased substantially. Net exports of metallic cadmium totaled 516,168 pounds in 1951, a reversal of position from 1950, when there was a net import balance of 277,182 pounds. The market price for commercial sticks remained unchanged at $2.55 a pound throughout the year. The Federal Government continued purchases for the National Stockpile.

TABLE 1.—Salient statistics of the cadmium industry in the United States, 1942–46 (average) and 1947–51, in pounds of contained cadmium

	1942–46 (average)	1947	1948	1949	1950	1951
Production (primary)	7,894,521	8,508,146	7,775,657	8,226,617	[1] 9,190,394	8,311,337
Imports (metal)	42,991	20,292	9,809	157,204	630,109	90,065
Exports (metal)	239,700	303,401	955,701	566,135	352,927	606,233
Consumption, apparent	7,906,282	7,726,753	7,797,105	7,486,274	[1] 9,545,412	7,172,588

[1] Revised figure.

Government Regulations.—On January 1, 1951, the National Production Authority, to insure adequate supplies of cadmium for military uses and essential civilian products for which there is no satisfactory substitute, imposed inventory controls on cadmium and limited the purposes for which cadmium, cadmium-containing items, and cadmium-plated items could be produced. The cadmium conservation order, M–19, was amended on March 16, April 26, and July 30, relaxing restrictions on the use of cadmium to permit its increased use in a wide range of military and civilian products. M–19 was amended because inventories of the metal had been accumulating in the hands of producers in anticipation of a larger volume of defense orders.

DOMESTIC PRODUCTION

Cadmium minerals are very rarely found in commercial quantities, hence no ore is mined solely for the recovery of cadmium. The most common mineral, greenockite (CdS, 77.8 percent cadmium), occurs

chiefly as a yellow stain or coating on the zinc sulfide, sphalerite. Cadmium metal is recovered almost entirely from zinc sulfide ores or other sulfide ores, principally lead and copper, containing zinc mineralization. With the exception of the ore bodies at Franklin and Sterling Hill, N. J., nearly all of the major zinc deposits in the United States contain cadmium in varying quantities. Zinc concentrates containing as much as 1 percent cadmium are unusual; in general, the content averages less than 0.5 percent. Zinc concentrates from the Tri-State area average about 0.35 percent cadmium and concentrates from mines in the Western States rarely carry more than 0.2 percent cadmium.

TABLE 2.—Cadmium produced and shipped in the United States, 1942–46 (average) and 1947–51, in pounds of contained cadmium

	1942–46 (average)	1947	1948	1949	1950 [1]	1951
Production:						
Primary:						
Metallic cadmium	7,661,217	8,007,287	7,582,961	8,023,616	8,849,690	8,114,238
Cadmium compounds [2]	233,304	500,859	192,696	203,001	340,704	197,099
Total primary production	7,894,521	8,508,146	7,775,657	8,226,617	9,190,394	8,311,337
Secondary (metal and compounds) [2 3]	202,639	104,764	121,159	384,398	427,052	167,957
Shipments by producers:						
Primary:						
Metallic cadmium	7,646,031	7,852,907	7,639,113	7,867,486	8,851,835	7,767,055
Cadmium compounds [2]	244,611	500,859	192,696	203,001	340,704	197,099
Total primary shipments	7,890,642	8,353,766	7,831,809	8,070,487	9,192,539	7,964,154
Secondary (metal and compounds) [2 3]	205,618	134,793	121,159	384,398	427,052	87,633
Value of primary shipments:						
Metallic cadmium	$6,189,463	$12,358,526	$12,679,571	$14,813,382	$17,925,482	$19,397,411
Cadmium compounds [4]	199,807	788,352	319,875	381,642	689,926	492,215
Total value	6,389,270	13,146,878	12,999,446	15,195,024	18,615,408	19,889,626

[1] Revised figures.
[2] Excludes compounds made from metal.
[3] Bureau of mines not at liberty to publish figures separately for secondary cadmium compounds.
[4] Value of metal contained in compounds made directly from flue dust or other cadmium raw materials (except metal).

The entire domestic supply of primary cadmium is recovered concurrently with the treatment of ores of other metals as a byproduct from the flue dusts of zinc blende roasting furnaces and lead blast furnaces, from zinc dust collected in the early stages of distillation in zinc retorts, and from the high-cadmium precipitate obtained in purifying zinc electrolyte at electrolytic zinc plants. A relatively small quantity of secondary metal is recovered from old bearings and other alloys but constitutes no great portion of the total supply. It is estimated that about 45 percent of the primary cadmium metal produced in the United States is of foreign origin, obtained from imported flue dust and imported zinc ores and concentrates. Mexico is the chief source of the foreign cadmium-bearing raw materials, followed by Canada and Peru. Because the geographic origin of the metal produced at United States plants cannot be determined accurately, the entire output is presented as domestic production.

The output of primary metallic cadmium and the production of cadmium contained in primary compounds at domestic plants de-

creased 8 and 42 percent, respectively, in 1951. Recovery of cadmium in secondary metal and compounds declined 61 percent.

A list of plants producing cadmium metal in the United States in 1951 follows.

Primary metallic cadmium

Colorado: Denver-American Smelting & Refining Co.
Idaho:
Bradley-Bunker Hill & Sullivan Mining & Concentrating Co.
Kellogg-Sullivan Mining Co.
Illinois:
Depue-New Jersey Zinc Co.
East St. Louis-American Zinc Co. of Illinois
Missouri: Herculaneum-St. Joseph Lead Co.
Montana: Great Falls-Anaconda Copper Mining Co.
Oklahoma:
Bartlesville-National Zinc Co., Inc.
Henryetta-Eagle-Picher Co. (Mining and Smelting Div.)
Pennsylvania:
Donora-United States Steel Co. (American Steel & Wire Div.)
Josephtown-St. Joseph Lead Co.
Palmerton-New Jersey Zinc Co.
Texas: Corpus Christi-American Smelting & Refining Co.
Utah: International-International Smelting & Refining Co.

Secondary metallic cadmium

Arkansas: Jonesboro-Arkansas Metals Co.
Kansas: Coffeyville-Sherwin-Williams Co.
New York: Whitestone, L. I.-Neo-Smelting & Refining Co.

Output of cadmium oxide (cadmium content) increased 5 percent during the year, while the cadmium content of sulfide produced decreased 39 percent. Data for the production of other cadmium compounds are unavailable for 1951.

TABLE 3.—Cadmium oxide and cadmium sulfide produced in the United States, 1946–51, in pounds

Year	Oxide		Sulfide [1]		Year	Oxide		Sulfide [1]	
	Gross weight	Cd content	Gross weight	Cd content		Gross weight	Cd content	Gross weight	Cd content
1946	364, 285	317, 767	3, 637, 177	1, 225, 680	1949	570, 993	497, 876	2, 631, 888	999, 386
1947	449, 847	392, 556	3, 501, 508	1, 308, 385	1950	579, 538	505, 336	4, 383, 943	1, 570, 522
1948	334, 859	291, 847	3, 137, 035	1, 096, 770	1951	606, 369	528, 645	3, 118, 413	955, 742

[1] Includes cadmium lithopone and cadmium sulfoselenide.

CONSUMPTION AND USES

The apparent consumption of primary cadmium in all forms totaled 7,172,588 pounds in 1951, as computed by deducting net exports of metal from production and adjusting for producers', distributors', and compound manufacturers' stock changes. This figure represented a 25-percent decrease over the quantity apparently consumed in 1950. In 1951, as in the previous 3 years, cadmium metal was purchased by the Federal Government for the National Stockpile. About 95 percent of available cadmium is used in electroplating, bearing alloys,

and pigments. The remaining 5 percent goes into solders, miscellaneous alloys, laboratory reagents, and photographic chemicals.

Electroplating.—The principal use of cadmium metal is as a protective coating for iron and steel, and, to a much smaller extent, high-copper alloys and other metals and alloys. Although cadmium may be applied by spraying or hot dipping, it is most commonly electrodeposited. Items commonly electroplated with cadmium include nails, screws, rivets, bolts, nuts, washers, fasteners, springs, electrical contacts, carburetor and magneto parts, and miscellaneous parts for a wide variety of products, including aircraft, ordnance, and automobiles.

Cadmium Bearing Alloys.—The second largest use of cadmium is as a bearing alloy. Cadmium-base bearing metals are used successfully in internal-combustion engines for service under high pressures and temperatures and at high speeds. The bearing alloys are generally of two types—the cadmium-nickel bearing, composed of 98.5 percent or more cadmium and 1.2 percent nickel, and the cadmium-silver bearing, containing 98.3 percent or more cadmium, 0.7 percent silver, and 0.6 percent copper.

Cadmium Solders and Other Cadmium Alloys.—Relatively small quantities of cadmium metal are used in the manufacture of low-melting-point alloys (chiefly tin-lead-cadmium and zinc-lead-cadmium) for soldering and brazing, and fusible alloys, composed largely of lead, bismuth, and cadmium, for sprinkler apparatus, fire-detector systems, and valve seats for high-pressure gas containers.

Cadmium Compounds.—Cadmium sulfide and cadmium sulfoselenide are standard agents for imparting high-quality yellow and red colors, respectively, to paint, soap, rubber, glass, ceramic glazes, paper, textiles, artists' colors, luminescent colors, leather, printing ink, and other products. A table listing the more important cadmium compounds, their physical properties, and uses can be found in the Cadmium chapter of Minerals Yearbook, 1949 (pp. 187–188).

STOCKS

Total domestic stocks of cadmium metal and compounds, excluding consumers' stocks, for which data are not available, increased 76 percent. Details are given in table 4.

TABLE 4.—Cadmium stocks at end of year, 1950–51, in pounds of contained cadmium [1]

	1950 [2]			1951		
	Metallic cadmium	Cadmium compounds	Total cadmium	Metallic cadmium	Cadmium compounds	Total cadmium
Metal producers (primary)	512,429	----------	512,429	859,630	----------	859,630
Compound manufacturers	15,427	187,206	202,633	58,111	244,987	303,098
Distributors [3]	47,897	61,170	109,067	205,415	78,657	284,072
Total stocks [4]	575,753	248,376	824,129	1,123,156	323,644	1,446,800

[1] Excludes cadmium in National Stockpile.
[2] Revised figures.
[3] Comprises principally 8 largest dealers and producers of plating salts.
[4] Excludes consumers' stocks, which were about 1,000,000 pounds at the end of 1944 (latest date for which figures were compiled).

PRICES

The quoted New York price of $2.55 a pound for commercial sticks of cadmium, established December 1, 1950, continued in effect throughout 1951. The price for special shapes remained unchanged at $2.80 a pound from December 1, 1950, through December 31, 1951. The average price received by producers of primary cadmium during the year was $2.50 a pound compared with $2.02 a pound in 1950.

The London market quoted cadmium at 18s. 3d. ($2.55) to 18s. 9d. ($2.62) per pound throughout the year.

FOREIGN TRADE [1]

Total imports for consumption of metallic cadmium and of cadmium contained in flue dust decreased 24 percent in weight and 14 percent in value in 1951. The total value of exports, principally metal, increased 175 percent over 1950.

Imports.—Imports of cadmium-bearing flue dust, all obtained from Mexico, were slightly larger than in 1950. Imports of metallic cadmium, however, declined more than 85 percent from the 1950 level. Of the 90,065 pounds imported, Belgium-Luxembourg supplied 59 percent, Japan 20 percent, Australia 11 percent, the Netherlands 6 percent, Canada 4 percent, and Sweden a small quantity.

TABLE 5.—Cadmium metal and flue dust imported for consumption in the United States, 1949–51, by countries

[U. S. Department of Commerce]

Country	1949		1950		1951	
	Pounds	Value	Pounds	Value	Pounds	Value
Metallic cadmium						
Australia	7,210	$7,919	7,918	$21,528	9,627	$30,962
Belgium-Luxembourg	48,503	101,560	143,825	518,552	52,870	209,246
Canada	68,140	139,392	237,494	472,322	3,336	11,684
Egypt			1,240	2,292		
Italy			4,400	10,120		
Japan	31,640	50,742	194,745	368,084	18,808	70,813
Netherlands			34,205	95,031	5,402	21,466
New Zealand			2,264	6,722		
Peru	1,711	3,422	3,010	6,624		
Sweden					22	111
United Kingdom			1,008	2,621		
Total metallic cadmium	157,204	303,035	630,109	1,503,896	90,065	344,282
Flue dust (Cd content)						
Brazil	2,906	2,801				
Mexico	1,786,761	1,593,142	1,601,640	1,519,104	1,606,775	2,261,390
Total flue dust	1,789,667	1,595,943	1,601,640	1,519,104	1,606,775	2,261,390
Grand total	1,946,871	1,898,978	2,231,749	3,023,000	1,696,840	2,605,672

Exports.—Exports of cadmium metal from the United States totaled 606,233 pounds in 1951, 72 percent higher than in 1950. Shipments to European Recovery Program "participating countries" accounted for approximately 98 percent of the total. Of the quantity

[1] Figures on imports and exported compiled by M. B. Price and E. D. Page, of the Bureau of Mines, from records of the U. S. Department of Commerce.

TABLE 6.—Cadmium exported from the United States, 1949–51, by kinds, in gross weight

[U. S. Department of Commerce]

Kind	1949		1950		1951	
	Pounds	Value	Pounds	Value	Pounds	Value
Dross, flue dust, residues, and scrap	500	$125	----------	----------	200, 579	$10, 029
Metal	566, 135	1, 264, 307	352, 927	$794, 540	606, 233	2, 198, 311
Alloys	3, 000	6, 150	9, 106	11, 575	5, 639	9, 311
Total	----------	1, 270, 582	----------	806, 115	----------	2, 217, 651

exported, the United Kingdom received 49 percent, France 42 percent, Germany 4 percent, Sweden 2 percent, and 12 other countries the remaining 3 percent. Exports of cadmium alloys decreased from 9,106 pounds in 1950 to 5,639 pounds in 1951. Canada received 89 percent of the total and Chile and Germany the remainder.

Tariff.—Action taken at the Geneva Trade Conference of 1947 reduced, as of January 1, 1948, the import duty on cadmium metal from 7½ cents per pound as established in the Canadian Trade Agreement of 1939 to 3¾ cents per pound. Cadmium contained in flue dust remained duty free in 1951.

WORLD PRODUCTION

World production of cadmium in recent years, insofar as data are available, is shown in table 7.

TABLE 7.—World production of cadmium, 1946–51, by countries, in kilograms

[Compiled by Berenice B. Mitchell]

Country	1946	1947	1948	1949	1950	1951
Australia (Tasmania)	231, 913	209, 030	293, 352	[1] 263, 767	[1] 299, 125	234, 708
Belgian Congo	16, 571	26, 040	18, 056	24, 635	[1] 29, 668	24, 316
Belgium [2]	88, 900	86, 300	157, 900	148, 000	365, 000	450, 000
Canada	364, 073	325, 874	347, 491	383, 983	[1] 384, 828	601, 460
France	47, 000	43, 000	50, 067	58, 123	71, 591	84, 997
Germany, West	1, 000	1, 206	3, 500	5, 000	----------	70, 000
Italy	40, 000	38, 400	47, 000	[1] 74, 000	[1] 75, 000	204, 000
Japan	7, 509	8, 710	[1] 18, 874	52, 484	90, 348	117, 687
Mexico [3]	717, 000	778, 000	905, 000	820, 000	689, 000	893, 000
Norway	28, 000	50, 000	62, 000	71, 400	78, 747	100, 000
Peru	850	1, 407	1, 592	800	1, 365	----------
Poland	115, 000	[1] [4] 120, 000	[4] 160, 000	[4] 240, 000	[2] 240, 000	[2] 240, 000
South-West Africa [5]	----------	----------	[1] 517, 093	[1] 753, 867	[1] 609, 625	650, 448
Spain	----------	----------	5, 368	5, 116	4, 348	3, 900
U. S. S. R. [2]	[6] 50, 000	57, 000	58, 000	58, 000	70, 000	80, 000
United Kingdom	121, 925	106, 440	115, 769	102, 662	[1] 118, 899	148, 343
United States:						
Metallic cadmium	2, 812, 439	3, 632, 025	3, 439, 555	3, 639, 432	4, 021, 254	3, 680, 537
Cadmium compounds (Cd content)	122, 827	227, 185	87, 405	92, 079	154, 540	89, 402
Total (estimate)	4, 048, 000	[1] 4, 933, 000	[1] 4, 866, 000	[1] 5, 219, 000	[1] 6, 005, 000	6, 129, 000

[1] Revised.
[2] Estimate.
[3] Cadmium content of flue dust exported for treatment elsewhere; represents in part shipments from stocks on hand. To avoid duplication of figures, data are not included in the total.
[4] Planned production.
[5] Cadmium content of concentrates exported for treatment elsewhere. To avoid duplication of figures, data are not included in the total.
[6] Estimated average for 1936–38.

Carbon Black

By D. S. Colby, H. J. Barton, and B. E. Oppegard

GENERAL SUMMARY

PRODUCTION of carbon black in the United States in 1951 totaled 1,677 million pounds, 21 percent above 1950. Total shipments increased 4 percent to 1,563 million pounds. Producers' stocks increased 114 million pounds to 203 million.

Largest gains were made in production and shipments of furnace blacks. Production of furnace blacks increased 35 percent in 1951. Shipments of furnace blacks increased 16 percent, while shipments of contact blacks declined 12 percent. Furnace blacks were 62 percent of total shipments in 1951 compared with 56 percent in 1950.

Stocks of contact blacks rose from a 36-day supply at the first of the year to an 88-day supply on December 31, 1951. Stocks of furnace blacks rose from a 10-day to a 30-day supply.

The value at plants of total production was $107,436,000. The average value was 6.41 cents per pound compared with 6.12 cents in 1950.

"Rest of Texas" showed the largest gain in production, and Arkansas produced carbon black for the first time.

TABLE 1.—Salient statistics of carbon black produced from natural gas and liquid hydrocarbons in the United States, 1947–51

	1947	1948	1949	1950	1951
THOUSAND POUNDS					
Production:					
Contact process (chiefly channel)	653,966	677,133	627,650	616,765	645,881
Furnace processes	664,999	620,596	595,986	765,225	1,031,482
Total	1,318,965	1,297,729	1,223,636	1,381,990	1,677,363
Shipments:					
Domestic sales	1,000,684	932,433	822,166	1,109,071	1,129,645
Exports	319,076	321,915	303,244	399,568	433,493
Total	1,319,760	1,254,348	1,125,410	1,508,639	1,563,138
Losses	321	250	8	269	534
Stocks of producers Dec. 31	75,112	118,243	216,461	89,543	203,234
VALUE					
Production thousand dollars	70,639	76,295	74,685	84,604	107,436
Average per pound cents	5.36	5.88	6.10	6.12	6.41

The quantity of natural gas used in producing carbon black increased slightly to 426 billion cubic feet with an average value of 5.21 cents per thousand cubic feet. Liquid hydrocarbons consumed increased 69 percent in quantity to 182 million gallons and were the source of 52 percent of the furnace blacks produced.

Exports increased 8 percent to 433 million pounds. They were controlled by the United States Department of Commerce during the entire year.

At the end of 1951, 58 plants were producing. Three new furnace plants began operation in 1951. Part of a furnace plant was moved

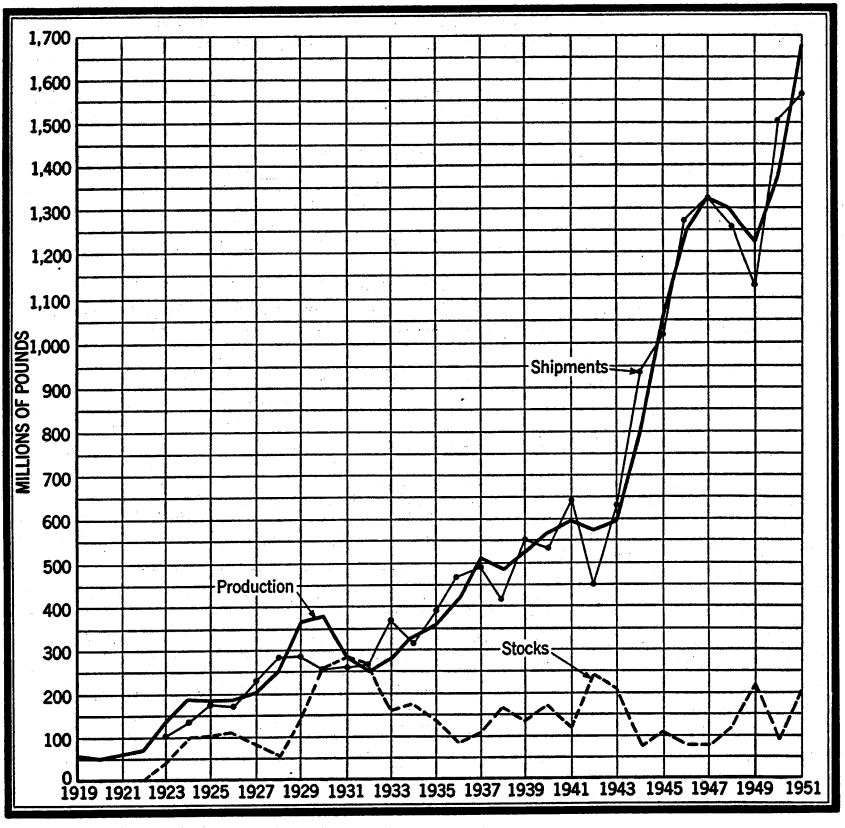

FIGURE 1.—Production, stocks, and shipments of carbon black, 1919–51.

from Kansas to Arkansas, and another furnace plant was moved from Oklahoma to Texas. Daily capacity at the end of 1951 was 5,163,000 pounds compared with 4,075,200 at the end of 1950.

PRODUCTION

By States.—Production increased in all producing States in 1951, and Arkansas produced carbon black for the first time. "Rest of Texas" showed the largest increase in production owing mainly to two new plants.

By Months.—Production of furnace grades rose steadily throughout 1951, averaging close to 2.5 percent gain per month. The production of contact grades held steady through the year, with some tendency to drop in the closing few months.

By Grades.—Production of contact blacks increased 5 percent above 1950, and production of furnace grades in 1951 was 35 percent above 1950. Furnace blacks represented 61 percent of total production in 1951 compared with 55 percent in 1950 and 49 percent in 1949. The production of high-abrasion furnace black exceeded that of any one other furnace grade and also showed the greatest increase in rate of production during the year.

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TABLE 2.—Carbon black produced from natural gas and liquid hydrocarbons in the United States, 1947–51, by State and district, in thousands of pounds

State and district	1947	1948	1949	1950	1951
Louisiana	190,252	165,032	160,460	226,177	258,989
Texas:					
Panhandle district	633,250	653,480	625,760	638,159	700,659
Rest of State	262,523	249,904	249,083	310,705	449,287
Total Texas	895,773	903,384	874,843	948,864	1,149,946
Other States	232,940	229,313	188,333	206,949	268,428
Grand total	1,318,965	1,297,729	1,223,636	1,381,990	1,677,363

TABLE 3.—Carbon black produced in the United States in 1951, by State and district, and natural gas and liquid hydrocarbons used in its manufacture

State	Producers reporting [1]	Number of plants	Production					
			Furnace black			Contact black		
			Thousand pounds	Value at plant		Thousand pounds	Value at plant	
				Total (thousand dollars)	Cents per pound		Total (thousand dollars)	Cents per pound
Louisiana	7	8	257,063	12,405	4.83	1,926	347	18.02
Texas:								
Panhandle district	12	23	369,503	22,202	6.01	331,156	25,893	7.82
Rest of State	8	16	250,252	15,936	6.37	199,035	14,652	7.36
Total Texas	14	39	619,755	38,138	6.15	530,191	40,545	7.65
Arkansas	1	1						
California	1	1	154,664	6,872	4.44			
Oklahoma	1	1						
Kansas	3	3				113,764	9,129	8.02
New Mexico	5	5						
Grand total	20	58	1,031,482	57,415	5.57	645,881	50,021	7.74

State	Natural gas used					Liquid hydrocarbons used	
	Million cubic feet	Average yield [2] (pounds per M cubic feet)		Value		Thousand gallons	Average yield (pounds per gallon)
		Furnace	Contact	Total (thousand dollars)	Average (cents per M cu. ft.)		
Louisiana	22,192	9.16	0.71	1,116	5.03	25,143	3.13
Texas:							
Panhandle district	206,506	7.80	1.70	11,242	5.44	83,077	3.31
Rest of State	115,781	4.59	1.98	5,099	4.40	72,504	2.50
Total Texas	322,287	6.02	1.80	16,341	5.07	155,581	2.93
Arkansas	[3] 81,944	7.91		[4] 4,756	[4] 5.80	1,619	3.62
California							
Oklahoma			1.80				
Kansas							
New Mexico							
Grand total	426,423	7.49	1.79	22,213	5.21	182,343	2.96

[1] Detail will not add to totals, because some producers operate in more than one area.
[2] Partly estimated.
[3] Comprises 18,820 million cubic feet used by furnace-plant operations in Arkansas, California, Oklahoma, and Kansas and 63,124 million cubic feet used by contact-plant operations in Kansas and New Mexico.
[4] Comprises 1,627 thousand dollars (8.64 cents per M cu. ft.) of natural gas used in Arkansas, California, Oklahoma, and Kansas for manufacture of furnace black and 3,129 thousand dollars (4.96 cents per M cu. ft.) used in Kansas and New Mexico for manufacture of contact black.

TABLE 4.—Production and shipments of carbon black in the United States in 1951, by months, in thousands of pounds

Month	Furnace						Contact	Total
	SRF [1]	HMF [2]	FEF [3]	HAF [4]	Other	Total		
PRODUCTION								
January	19,319	12,477	14,784	19,276	8,322	74,178	54,421	128,599
February	18,635	10,902	13,448	18,629	8,002	69,616	49,625	119,241
March	19,453	13,882	16,584	20,340	9,526	79,785	55,695	135,480
April	21,097	11,923	16,709	21,422	9,230	80,381	54,696	135,077
May	21,090	12,643	17,799	22,354	8,931	82,817	54,824	137,641
June	21,936	11,596	18,077	24,461	7,948	84,018	52,774	136,792
July	23,265	11,656	18,545	27,930	8,285	89,681	55,400	145,081
August	25,558	12,185	17,722	29,356	9,137	93,958	54,685	148,643
September	22,748	12,684	18,885	28,200	8,833	91,350	51,598	142,948
October	23,620	13,864	21,565	27,375	8,949	95,373	54,693	150,066
November	24,300	13,034	17,609	29,710	8,158	92,811	53,470	146,281
December	24,290	12,825	19,508	32,786	8,105	97,514	54,000	151,514
Total	265,311	149,671	211,235	301,839	103,426	1,031,482	645,881	1,677,363
SHIPMENTS (INCLUDING EXPORTS) [5]								
January	21,179	10,907	15,307	21,165	8,438	76,996	46,162	123,158
February	18,975	10,388	13,528	16,755	8,142	67,788	51,378	119,166
March	19,692	13,749	16,430	19,601	8,397	77,869	58,761	136,630
April	21,738	11,448	16,280	20,317	8,899	78,682	47,791	126,473
May	21,288	14,436	18,282	21,453	7,819	83,278	57,501	140,779
June	21,515	12,699	17,485	23,712	9,697	85,108	52,404	137,512
July	23,013	12,896	16,739	24,319	8,206	85,173	49,391	134,564
August	23,647	12,102	15,076	24,854	9,200	84,879	45,689	130,568
September	22,154	10,296	16,368	25,837	7,953	82,608	47,929	130,537
October	22,125	11,060	18,027	30,768	7,322	89,302	44,122	133,424
November	20,586	10,630	15,629	29,064	7,516	83,425	43,331	126,756
December	19,220	10,177	15,674	28,090	7,123	80,284	43,287	123,571
Total	255,132	140,788	194,825	285,935	98,712	975,392	587,746	1,563,138

[1] Semireinforcing furnace.
[2] High-modulus furnace.
[3] Fast-extrusion furnace.
[4] High-abrasion furnace.
[5] Compiled from reports of the National Gas Products Association and of producing companies not included in the association figures. Figures adjusted to agree with annual reports of individual producers.

Methods and Yields.—The average yield of contact black from natural gas continues to improve slightly each year; it reached 1.79 pounds per thousand cubic feet in 1951 compared with 1.75 in 1950. The yield from furnace plants cannot be accurately determined where both oil and gas are used as feed. The approximate yield from gas in 1951 was 7.49 pounds per thousand cubic feet of natural gas used and 2.96 pounds per gallon of liquid feedstock.

Natural gas used at furnace plants in 1951 totaled 66 billion cubic feet compared with 58 billion in 1950. Use of liquid hydrocarbons concurrently increased from 108 to 182 million gallons; these fuels yielded 52 percent of the furnace blacks produced. In 1950 liquid hydrocarbons produced 43 percent of the furnace blacks.

Liquid feed was used at 15 furnace plants in 1951, whereas in 1950 only 7 plants used it.

TABLE 5.—Natural gas and liquid hydrocarbons used in the manufacture of carbon black in the United States, and average yield, 1947–51

	1947	1948	1949	1950	1951
Natural gas used.....million cubic feet..	484,882	480,646	427,892	410,852	426,423
Average yield of carbon black per thousand cubic feet.....pounds..	2.51	2.41	2.38	2.57	2.67
Average value of natural gas used per thousand cubic feet.....cents..	3.57	4.73	4.76	4.79	5.21
Liquid hydrocarbons used.....thousand gallons..	[1] 31,000	44,551	72,387	107,707	182,343
Average yield of carbon black per gallon.....pounds..	[2]	3.11	2.86	3.02	2.96
Number of producers reporting	21	24	20	20	20
Number of plants	63	63	63	53	58

[1] Estimated.
[2] Data not available.

Number and Capacity of Plants.—The number of contact-type plants operating in 1951 remained unchanged at 35. The number of furnace plants operating at the end of 1951 was 23, 5 more than at the end of 1950. Three of these plants were entirely new: (1) The Continental Oil Black Co. plant in Calcasieu Parish, La.; (2) the J. M. Huber Corp. plant in Harris County, Tex.; and (3) the United Carbon Co. plant in Wheeler County, Tex. Columbian Carbon Co. moved a unit of its furnace plant in Grant County, Kans. to Union County, Ark. The furnace plant of General Atlas Carbon Co. in Texas County, Okla., which had been idle during 1950, was moved to Howard County, Tex.

The total daily capacity of operating plants at the end of 1951 was 5,163,300 pounds, 1,088,100 pounds over the previous year. The daily capacity of operating contact plants decreased 42,100 pounds to 1,662,100 pounds. The daily capacity of operating furnace plants increased 1,130,200 pounds to 3,501,200 pounds. New and reconstructed plants represented 539,700 pounds of this additional capacity. The remaining 543,400 pounds was capacity added to existing plants.

Producers.—One new producer began operations in 1951, Continental Oil Black Co. One producer, Charles Eneu Johnson Co., Inc., sold its production facilities to United Carbon Co.

TABLE 6.—Number and capacity of carbon-black plants operated in the United States, 1950–51

State or district	County or parish	Number of plants				Total daily capacity (pounds)	
		1950		1951			
		Contact	Furnace	Contact	Furnace	1950	1951
Texas: Panhandle district	Carson	1		1		1,768,100	2,025,900
	Gray	6	1	6	1		
	Hutchinson	6	3	6	3		
	Moore	4	1	4	1		
	Wheeler				1		
Total Panhandle district		17	5	17	6	1,768,100	2,025,900
Rest of State	Aransas	1	2	1	2	921,000	1,436,300
	Brazoria	1		1			
	Brooks	1		1			
	Ector	1		1			
	Gaines	1		1			
	Harris		1		2		
	Howard				1		
	Montgomery		1		1		
	Nueces	1		1			
	Reagan	1		1			
	Terry		1		1		
	Ward	1		1			
	Winkler	1		1			
Total rest of State		9	5	9	7	921,000	1,436,300
Total Texas		26	10	26	13	2,689,100	3,462,200
Louisiana	Avoyelles		1		1	618,700	778,600
	Calcasieu				1		
	Evangeline		1		1		
	Ouachita	1	2	1	2		
	Richland	2		2			
Total Louisiana		3	4	3	5	618,700	778,600
Arkansas	Union				1	506,700	612,600
California	Contra Costa		1		1		
Kansas	Grant	1	2	1	2		
Oklahoma	Texas		1		1		
New Mexico	Lea	5		5		260,700	309,900
Total United States		35	18	35	23	4,075,200	5,163,300

TABLE 7.—Carbon-black producers of the United States, as of December 31, 1951

State and company	County or parish	Nearest town	Process
Arkansas: Columbian Carbon Co	Union	El Dorado	Furnace.
California: Shell Chemical Corp	Contra Costa	Pittsburg	Do.
Kansas:			
Columbian Carbon Co	Grant	Hickok	Do.
Peerless Carbon Black Co	do	Ulysses	Contact.
United Carbon Co., Inc	do	Ryus	Furnace.
Louisiana:			
Cabot Carbon Co	Evangeline	Ville Platte	Do.
Carbon Blacks, Inc	Richland	Rayville	Contact.
Columbian Carbon Co	Avoyelles	Eola	Furnace.
Continental Oil Black Co	Calcasieu	Lake Charles	Do.
Southern Carbon Co	Ouachita	Hancock	Do.
Thermatomic Carbon Co	do	Sterlington	Do.
United Carbon Co., Inc	do	Swartz	Contact.
	Richland	Rayville	Do.
New Mexico:			
Cabot Carbon Co	Lea	Hobbs	Do.
Columbian Carbon Co	do	Eunice	Do.
Continental Carbon Co	do	do	Do.
United Carbon Co., Inc	do	do	Do.
Witco Carbon Co	do	do	Do.
Oklahoma: Cabot Carbon Co	Texas	Guymon	Furnace.
Texas:			
Barnhart Hydrocarbon Corp	Reagan	Big Lake	Contact.
Cabot Carbon Co	Carson	Skellytown	Do.
	Gray	Pampa	Do.
	Ward	Monahans	Do.
	Winkler	Kermit	Do.
Coltexo Corp	Gray	Lefors	Do.
	do	do	Do.
Columbian Carbon Co	Gaines	Seagraves	Do.
	Gray	Kingsmill	Do.
	Harris	Fortune	Furnace.
	Montgomery	Conroe	Do.
	Moore	Sunray	Contact.
	Nueces	Corpus Christi	Do.
	Terry	Seagraves	Furnace.
Combined Carbon Co	Hutchinson	Sanford	Contact.
Continental Carbon Co	Moore	Sunray	Furnace.
	do	do	Contact.
Crown Carbon Co	do	do	Do.
General Atlas Carbon Co	Gray	Pampa	Furnace.
	Howard	Big Spring	Do.
J. M. Huber Corp	Harris	Baytown	Do.
	Hutchinson	Borger	Do.
	do	do	Contact.
Peerless Carbon Black Co	Brazoria	Sweeny	Do.
	Gray	Pampa	Do.
Phillips Chemical Co	Hutchinson	Borger	Furnace.
	do	do	Do.
Sid Richardson Carbon Co	Ector	Odessa	Contact.
Texas Elf Carbon Co	Gray	Pampa	Do.
United Carbon Co., Inc	Aransas	Aransas Pass	Furnace.
	do	do	Do.
	do	do	Contact.
	Brooks	Falfurrias	Do.
	Hutchinson	Stinnett	Do.
	do	Borger	Do.
	do	Sanford	Do.
	do	do	Do.
	Moore	Sunray	Do.
	Wheeler	Shamrock	Furnace.

CONSUMPTION AND USES

Domestic sales of carbon black in 1951 totaled only 20 million pounds more than in 1950. The important development was the continued shift in demand to furnace blacks. Domestic sales of contact blacks decreased by approximately 120 million pounds. Furnace blacks constituted 73 percent of domestic sales in 1951 compared with 64 percent in 1950 and 56 percent in 1949.

Total furnace shipments were increasing during the first half of the year and leveled in the latter half. Contact-black shipments held steady during the first half of 1951 and declined during the latter half.

The increasing demand for furnace blacks is attributable to Government restrictions on consumption of natural rubber and the corresponding increased consumption of synthetic. United States consumption of new rubber in 1950 was 1,249 thousand long tons, of

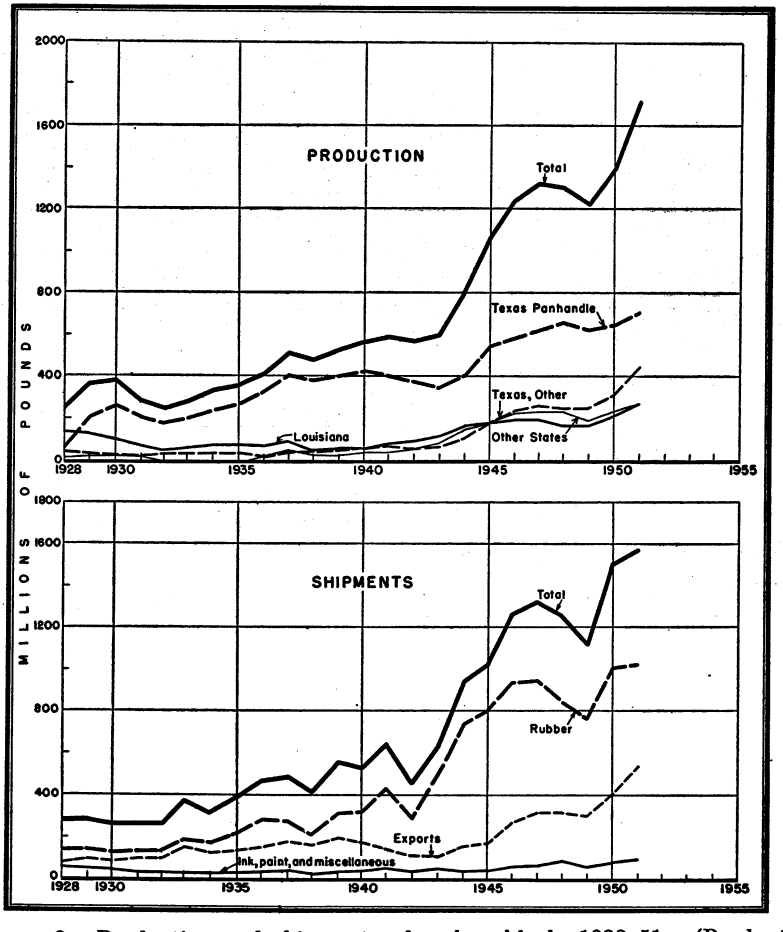

FIGURE 2.—Production and shipments of carbon black, 1928–51. (Production in "Texas, other" includes Oklahoma and Wyoming in 1932–36.)

which 43 percent was synthetic, whereas, in 1951 it was 1,213 thousand long tons, of which 63 percent was synthetic. Sales of carbon black to rubber companies in 1951 increased 3 percent to 1,061 million pounds. Because of the enlarged percentage of synthetic, average loading of new rubber increased by 45 pounds to 843 pounds per ton, assuming 5 percent loading for reclaim.

Sales of carbon black for ink declined and for paint increased only slightly in 1951. The considerable increases in these categories in 1950 thus appear to have been the result, in part, of scare buying.

TABLE 8.—Sales of carbon black for domestic consumption in the United States, 1947–51, by use, in thousands of pounds

Use	1947	1948	1949	1950	1951
Rubber	943,580	870,564	767,131	1,030,368	1,061,229
Ink	32,260	32,436	32,054	50,903	45,496
Paint	8,137	6,799	7,005	11,139	11,366
Miscellaneous	16,707	22,634	15,976	16,661	11,554
Total	1,000,684	932,433	822,166	1,109,071	1,129,645

STOCKS

Producers' stocks of both contact and furnace blacks increased gradually during the first half of 1951 and very rapidly during the latter half. By the end of 1951 stocks had approximately recovered the depletion that took place during 1950 and were still increasing. The day's supply of contact types rose from 36 at the beginning of the year to 88 at the end. Furnace-type stocks rose from a 10- to a 30-day supply.

TABLE 9.—Producers' stocks of contact- and furnace-type blacks in the United States, Dec. 31, 1947–51, in thousands of pounds

Year	Furnace						Contact	Total
	SRF [1]	HMF [1]	FEF [1]	HAF [1]	Other	Total		
1947	[2]	[2]	[2]	[2]	[2]	66,493	8,619	75,112
1948	[2]	[2]	[2]	[2]	[2]	90,597	27,646	118,243
1949	[2]	[2]	[2]	[2]	[2]	96,862	119,599	216,461
1950	5,275	[3] 6,276	[3] 3,381	7,831	1,438	24,201	65,342	89,543
1951	15,340	15,119	19,729	23,642	6,105	79,935	123,299	203,234

[1] For explanation, *see* table 4.
[2] Data not available.
[3] Adjusted figures (reclassification of grade).

PRICES

The average value of both furnace blacks and contact blacks increased above the 1950 figures. Furnace-black average value increased 0.31 cent per pound to 5.57 cents, and contact black increased 0.55 cent to 7.74 cents. Part of this increase can be attributed to the production of a higher proportion of the higher-valued grades, such as HAF (High-Abrasion Furnace). The market values as reported in the Oil, Paint and Drug Reporter remained unchanged throughout 1951.

The average value of natural gas used at carbon black plants increased in all States. Arkansas, California, Kansas, and Oklahoma showed values considerably above the average. The manufacture of carbon black in California is secondary to the production of hydrogen, so that gas value does not directly influence carbon-black production there. In Arkansas a large part of the feedstock is liquid hydrocarbons, and only a small amount of gas is used. Kansas and Oklahoma are losing their carbon-black production to areas with lower gas prices and to oil blacks. In 1947 Kansas and Oklahoma each had four operating plants; in 1951 Kansas had three and Oklahoma only one. It seems likely that in Kansas, where the price rise has been more recent, plants will be shut down, moved, or converted to oil.

TABLE 10.—Prices of carbon black in carlots, f. o. b. plant, 1947–51, in cents per pound

[Oil, Paint and Drug Reporter]

Date of change	Channel blacks		Furnace blacks			
	Ordinary rubber grades [1]		Semireinforcing grades (SRF)	High-Modulus grades (HMF)	Fine grades (FF)	High Abrasion grades (HAF)
	Bags	Bulk	Bags	Bags	Bags	Bags
Jan. 1, 1947	6.32	6.00	3.50	5.00	6.00	[2]
Oct. 1, 1947	6.32	6.00	3.50	5.00	6.00	[2]
Jan. 1, 1948	6.82	6.50	3.50	5.00	6.50	[2]
Apr. 1, 1948	7.32	7.00	3.50	5.00	7.32	[2]
Jan. 7, 1949	7.40	7.00	3.50	5.00	7.40	[2]
July 1, 1949	6.90	6.50	3.50	5.00	7.40	[2]
Oct. 1, 1950	7.40	7.00	4.00	5.50	8.00	[2]
Jan. 5, 1951	7.40	7.00	4.00	5.50	[2]	7.90

[1] Chiefly Easy-Processing (EPC) and Medium-Processing (MPC) but also includes Hard-Processing (HPC) and Conductive (CC) channel blacks.
[2] No quotation.

FOREIGN TRADE [1]

Imports.—Imports of "acetylene black" from Canada in 1951 totaled 9,441,895 pounds, with an average value of 13.3 cents per pound. Small quantities, totaling 37 pounds, were received from the United Kingdom and Switzerland. Other carbon-black imports totaled 129,697 pounds—122,900 pounds from Canada, 6,550 pounds from the United Kingdom, and the rest from the Netherlands, Germany, Switzerland, and Japan.

Exports.—The volume of exports in 1951 was limited by quota but was nevertheless 8 percent greater than in 1950. Most notable was the increase in exports to France from 52 million pounds in 1950 to 74 million in 1951. Italy also received considerably larger quantities and exports to Japan returned to a high level after having dropped sharply in 1950. Exports to the United Kingdom declined, but less so than would have been expected, considering their own recently completed producing plants.

[1] Figures on imports and exports compiled by M. B. Price and E. D. Page, of the Bureau of Mines, from records of the U. S. Department of Commerce.

TABLE 11.—Carbon black exported from the United States, 1949–51, by country of destination

[U. S. Department of Commerce]

Country	1949		1950		1951	
	Pounds	Value	Pounds	Value	Pounds	Value
Argentina	5,350,195	$496,501	14,253,880	$1,324,106	10,732,454	$1,086,974
Australia	20,938,320	1,900,144	24,454,785	2,094,740	27,138,625	2,406,309
Austria	3,442,650	302,610	4,361,092	376,838	3,618,325	320,827
Belgium-Luxembourg	4,951,585	494,972	8,283,850	775,845	10,442,505	987,369
Brazil	13,674,097	1,200,202	21,978,247	1,868,528	20,571,152	1,840,779
Canada	43,912,566	2,682,604	56,206,788	3,560,771	55,542,233	3,970,651
Chile	1,566,437	154,671	1,249,451	108,847	1,557,450	146,645
China	90,575	8,564	224,650	29,650		
Colombia	1,431,408	137,998	3,652,435	314,577	2,339,787	225,886
Cuba	419,950	34,130	1,138,950	89,126	1,494,550	129,828
Czechoslovakia			4,500	674		
Denmark	680,550	78,022	1,190,050	121,700	1,489,500	147,159
Finland	672,300	60,507	972,225	82,636	1,823,695	161,690
France	53,874,361	5,065,762	52,392,925	4,646,839	73,872,100	6,842,454
Germany	1,772,564	187,865	778,725	76,616	2,366,424	289,300
Hong Kong	510,626	60,131	433,151	53,896		
India	6,626,800	541,896	11,242,092	966,132	11,959,978	1,050,505
Indonesia	2,242,654	188,869	3,463,300	311,076	2,292,550	211,454
Ireland	1,430,190	143,850	1,250,965	120,918	1,600,800	165,591
Israel	131,225	13,390	114,525	12,159	784,825	69,490
Italy	12,840,070	1,275,246	20,233,380	1,860,757	27,477,119	2,575,628
Japan	10,958,200	1,010,570	1,812,238	214,623	7,933,391	814,268
Korea	825,234	46,769				
Malaya	358,750	32,646	794,023	72,798	964,300	97,494
Mexico	8,039,820	572,074	10,364,674	708,968	12,904,038	934,746
Netherlands	5,583,626	559,820	3,457,857	319,416	3,193,613	371,657
New Zealand	1,787,650	156,666	4,209,025	358,859	5,224,225	457,426
Norway	1,338,100	119,597	1,743,425	148,963	1,907,418	162,654
Pakistan	65,300	5,577	145,750	14,923	132,650	15,411
Peru	998,706	89,221	812,160	71,578	1,555,780	139,895
Portugal	982,950	90,629	1,354,650	126,257	1,724,185	167,433
Spain	2,029,550	188,526	1,989,600	173,583	3,235,730	294,788
Sweden	5,143,502	480,461	11,884,949	1,013,592	9,440,615	896,672
Switzerland	3,081,001	294,004	3,033,160	295,868	4,547,166	434,847
Turkey	599,250	45,168	925,700	70,873	493,350	39,787
Union of South Africa	12,019,829	1,121,695	16,723,450	1,455,811	18,203,460	1,646,436
United Kingdom	71,665,770	6,845,735	107,141,888	9,531,569	100,928,382	9,665,076
Uruguay	372,320	32,789	961,835	87,679	1,146,325	119,417
Venezuela	293,690	26,357	2,007,951	192,330	654,196	58,306
Yugoslavia	109,950	10,555	1,499,350	142,377	1,225,200	115,236
Other countries	431,900	43,164	825,850	82,133	975,192	94,628
Total	303,244,221	26,799,957	399,567,501	33,878,631	433,493,288	39,154,716

TABLE 12.—Carbon black exported from the United States in 1951, by months, in thousands of pounds

[U. S. Department of Commerce]

Month	Contact	Furnace	Total	Month	Contact	Furnace	Total
January	20,310	13,309	33,619	August	21,847	11,311	33,158
February	24,475	15,433	39,908	September	21,116	9,077	30,193
March	26,536	12,655	39,191	October	19,749	12,985	32,734
April	31,982	14,052	46,034	November	21,056	12,948	34,004
May	26,580	11,218	37,798	December	20,276	13,729	34,005
June	24,873	11,487	36,360				
July	23,194	13,295	36,489	Total	281,994	151,499	433,493

WORLD PRODUCTION

The more important producers of carbon black, aside from the United States, in 1951 were Germany with a production of approximately 90 million pounds, Japan with a production of about 10 million pounds, and the United Kingdom. The last country was producing at the end of 1951 at the approximate rate of 70 million pounds per year, but actual production during the year is estimated at half this quantity.

Cement

By Oliver S. North and Esther V. Balser

GENERAL SUMMARY

BOTH production and apparent consumption, as indicated by mill shipments, continued their postwar increases throughout 1951. Demand for cement during the year resulted in another record-breaking output, as 249.5 million barrels [1] of hydraulic cement was produced—8 percent more than in 1950, the previous record year. Nevertheless, production of one group of hydraulic cements—natural, masonry (natural), and puzzolan cements—was considerably lower than in 1950. The portland-cement industry operated at 87 percent and the remainder of the hydraulic cement industry at 83 percent of productive capacity during 1951. Mill shipments of portland cement totaled 241.2 million barrels—an increase of 6 percent over the 1950 figure and a new record. Shipments of other hydraulic cements decreased 18 percent. Stocks of all hydraulic cements on hand at mills December 31, 1951, amounted to 18.2 million barrels—36 percent more than at the end of 1950.

The average net mill realization per barrel of portland cement reached $2.54—a 19-cent increase over the average 1950 net realization. Other hydraulic cements, as a group, reported a 31-cent gain per barrel to $2.83.

The long-term trend, as shown by the moving 12-month total of production of finished portland cement in the Bureau of Mines Monthly Cement Reports, continued the upward swing begun immediately after World War II and reached a new alltime high in December 1951.

Monthly production of portland cement during 1951 totaled 17.4 million barrels in January, dropped to 15.2 million barrels in February, and then increased from month to month through October, except for a slight drop in September. A new record—22,797,000 barrels—was set in October. Production figures declined slightly in the last 2 months of the year but remained unusually high. The monthly average for the year was just over 20½ million barrels.

The pattern of monthly shipments from mills in 1951 was similar to that of 1950, but at a higher level, especially in the first 5 months of the year and in October, in which month over 26 million barrels were shipped. Shipments in the last 2 months of 1951 dropped rapidly from the October high and in both November and December were lower than in the corresponding month of 1950.

Through the first 5 months of 1951, except for a slight increase in March, stocks were lower than in 1950, but throughout the rest of the year producers managed to maintain stocks at 2 to 3 million barrels higher than in the same months of 1950. By year end, nearly 5 million more barrels of finished cement was on hand than at

[1] Barrel as used in this chapter, unless otherwise indicated, refers to a 376-pound barrel.

the end of 1950, the total being 17,993,000 barrels. Maximum for the year was reached on March 31, whereas the year's low was recorded at the end of October, when 7,162,000 barrels was in stock.

Consumption trends of portland cement in 1951, as indicated in figure 1, continued to be essentially the same as in 1950. The Middle States were again the leading consuming area.

States in the regions shown in figure 1 are as follows: Northeastern—Connecticut, Delaware, District of Columbia, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont; Southern—Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia; Middle—Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin; Rocky Mountain—Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, and Wyoming; and Pacific—California, Oregon, and Washington.

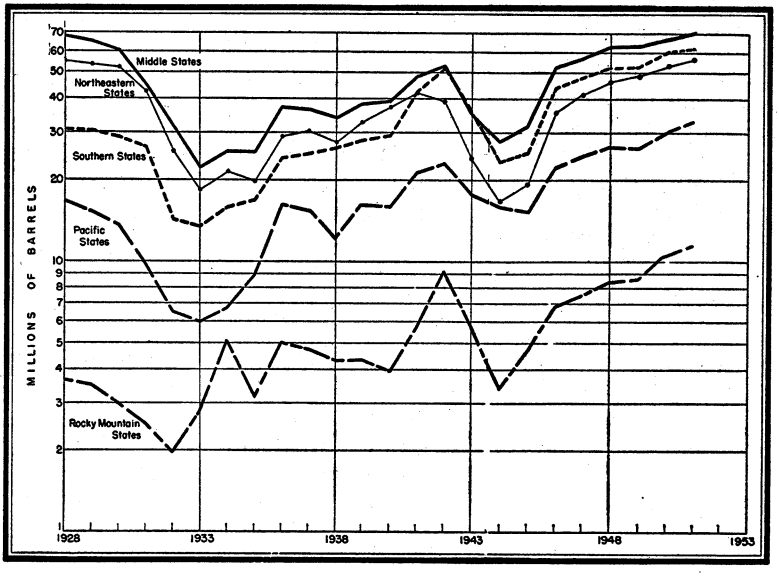

FIGURE 1.—Indicated consumption of portland cement in continental United States, 1928–51, by regions.

Five new cement-manufacturing plants were put in operation in 1951. Production began early in the year at the General Portland Cement Co. wet-process plant at Eagle Ford, Tex. Lone Star Cement Corp. began production in June at its 2-kiln, 4,000-barrel-per-day, dry-process plant near Roanoke, Va. Late in the year Lone Star completed its 1,500,000-barrel-per-year dry-process plant at Maryneal, Tex. In August, Ideal Cement Co. completed conversion to cement manufacture of a wartime alumina plant at Baton Rouge, La. This wet-process plant has a rated capacity of 1,500,000 barrels per year. Late in the year Marquette Cement Manufacturing Co.

TABLE 1.—Salient statistics of cement in the United States, 1947–51 [1]

	1947	1948	1949	1950	1951
Production:					
Portland—barrels [2]	186,519,347	205,448,263	209,727,417	226,025,849	246,022,476
Masonry, natural, and puzzolan (slag-lime)—barrels	2,951,098	3,440,248	3,185,229	4,246,299	3,449,463
Total—do	189,470,445	208,888,511	212,912,646	230,272,148	249,471,939
Capacity used at portland-cement mills—percent	74.9	80.8	81.0	84.3	87.4
Shipments from mills:					
Total—barrels	190,419,754	207,679,797	209,313,850	231,975,216	244,628,695
Value of shipments [3]	$361,978,374	$453,412,362	$481,183,393	$545,950,709	$623,003,439
Average value per barrel	$1.90	$2.18	$2.30	$2.35	$2.55
Stocks at mills, Dec. 31—barrels	10,157,015	11,303,591	14,920,104	[4] 13,308,190	18,151,434
Imports—do	4,606	282,752	109,821	[4] 1,409,974	892,703
Exports—do	[5] 6,771,250	5,922,163	4,561,899	2,418,435	2,932,787
Apparent consumption [6]—do	[5] 183,454,387	202,040,386	204,861,772	[4] 230,966,755	242,588,611
World production (estimated)—do	[4] 503,071,000	[4] 599,229,000	[4] 674,279,000	771,024,000	863,077,000

[1] Figures include Puerto Rico.
[2] Barrel as used in this chapter, unless otherwise indicated, refers to a 376-pound barrel.
[3] Value received f. o. b. mill, excluding cost of containers.
[4] Revised figure.
[5] 198,723 barrels, valued at $839,916, shipped under the U. S. Army Civilian Supply Program, is excluded from exports shown but deducted from apparent consumption.
[6] Shipments from domestic mills minus net exports.

completed its new wet-process plant at Brandon, Miss.; however, only a small output of clinker was produced in 1951, and no finished cement was produced and shipped.

A new plant near Bunnell, Fla., was reported under construction by Lehigh Portland Cement Co. Increased demand in Florida gave impetus to the project, besides encouraging construction of additional storage facilities in the State.

Many other cement producers throughout the country continued to expand and improve their facilities.

Tightness of cement supply in North Dakota caused renewed discussion of the possibility of erecting a plant with State funds.[2]

A five-man commission recommended construction—by private capital or by the State, if necessary—of a cement plant in North Carolina. A survey of the State disclosed that limestone and marl suitable for manufacturing portland cement occur in Pender County. A 1,000,000-barrel-per-year plant was suggested in the report.[3]

Indicative of the better balance between capacity and demand was the removal of cement on November 7, 1951, from National Production Authority's List A of Notice 1, which restricted manufacturer's inventories of scarce materials. Spot shortages were noticeable in some areas, and in many instances private users were forced to purchase out-of-area cements at higher delivered costs.

PRODUCTION, SHIPMENTS, AND STOCKS

PORTLAND CEMENT

Portland cement, which constituted nearly 99 percent of the hydraulic cements produced in 1951, was manufactured in 155 active plants in 36 States and Puerto Rico. Two new plants began production in Texas in 1951, as did single plants in Virginia and Louisiana.

[2] Rock Products, vol. 54, No. 2, February 1951, p. 79.
[3] Pit and Quarry, vol. 43, No. 11, May 1951, p. 163; No. 12, June 1951, p. 58.

The dry-process plant at Devils Slide, Utah, produced a small quantity of finished cement in 1951, after having been idle during 1950.

Output in 1951 was greater than in 1950 in 18 of the 19 districts defined by the Bureau of Mines. The changes from 1950 figures ranged from a 1-percent decrease in Kansas to a 32-percent increase in Puerto Rico. The greatest increase in continental United States was made by the Western Pennsylvania-West Virginia district, where production was up 16 percent. As usual, the Eastern Pennsylvania-Maryland district manufactured the greatest quantity, and output in California was again considerably higher than in the previous year, reaching nearly 30 million barrels in 1951. Eleven districts reported outputs exceeding 10 million barrels.

Shipments in 1951 were higher than in 1950 in all districts except the Kansas and the Western Missouri-Nebraska-Oklahoma-Arkansas districts; the former reported a decline of nearly 7 percent. Gains in continental United States ranged up to 17 percent in the Western Pennsylvania-West Virginia district, whereas shipments from mills in Puerto Rico were 35 percent higher than in 1950.

Stocks of finished cement were 37 percent higher on December 31, 1951, than on the same date of the preceding year. Stocks were higher in all districts except Puerto Rico and Western Pennsylvania-West Virginia, which were 78 percent and 18 percent, respectively, lower. Stocks were more than double the preceding December 31 figure in the Kansas, Western Missouri-Nebraska-Oklahoma-Arkansas, and California districts. The trend of month-end stocks of clinker followed essentially the 1950 pattern through the first 8 months of 1951, although at a lower level. During the last 4 months of the year, stocks of clinker were higher than in 1950 but followed a similar pattern, reaching a low for the year in October and then increasing through December.

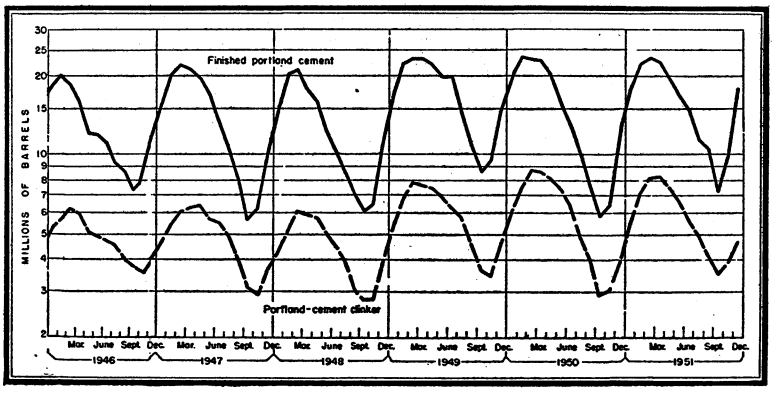

FIGURE 2.—End-of-month stocks of finished cement and portland-cement clinker, 1946–51.

TABLE 2.—Finished portland cement produced, shipped, and in stock in the United States, 1950–51, by districts

District	Active plants		Production			Shipments from mills							Stocks at mills on Dec. 31		
			Barrels			1950			1951				Barrels		
							Value			Value		Percent change from 1950 in—			
	1950	1951	1950	1951	Percent change from 1950	Barrels	Total	Average	Barrels	Total	Average	Barrels	Average value	1950 [1]	1951	Percent change from 1950
Eastern Pennsylvania, Maryland	21	21	34,212,318	36,322,651	+6.2	34,949,454	$83,442,830	$2.39	35,694,374	$91,726,329	$2.57	+2.1	+7.5	1,867,045	2,495,322	+33.7
New York, Maine	11	11	14,195,537	15,351,223	+8.1	14,398,689	33,600,329	2.33	15,098,821	37,870,008	2.51	+4.9	+7.7	844,452	1,096,854	+29.9
Ohio	9	9	10,606,739	11,873,852	+11.9	10,512,004	24,012,983	2.28	11,872,278	29,498,956	2.48	+12.9	+8.8	853,982	855,556	+0.2
Western Pennsylvania, West Virginia	7	7	9,381,631	10,849,106	+15.6	9,409,191	21,826,459	2.32	11,014,476	27,444,268	2.49	+17.1	+7.3	932,987	767,617	−17.7
Michigan	7	7	12,967,102	14,393,599	+11.0	12,854,423	29,619,766	2.30	14,112,639	35,121,324	2.49	+9.8	+8.3	1,317,145	1,598,105	+21.3
Illinois	4	4	7,924,079	8,483,783	+7.1	7,857,969	16,920,234	2.15	8,377,387	19,853,132	2.37	+6.6	+10.2	695,490	801,886	+15.3
Indiana, Kentucky, Wisconsin	6	6	13,450,769	14,163,250	+5.3	13,525,250	29,354,637	2.17	13,991,472	33,839,689	2.42	+3.4	+11.5	949,618	1,121,396	+18.1
Alabama	7	7	10,371,834	10,772,991	+3.9	10,574,955	23,175,772	2.19	10,586,825	24,523,073	2.32	+0.1	+5.9	398,650	584,816	+46.7
Tennessee	6	6	6,684,644	7,221,968	+8.0	6,663,427	14,682,487	2.20	7,162,841	17,203,080	2.40	+7.5	+9.1	317,894	377,021	+18.6
Virginia, Georgia, Florida, Louisiana, South Carolina	7	9	9,410,357	10,662,877	+13.3	9,398,899	22,663,150	2.41	10,479,709	27,312,775	2.61	+11.5	+8.3	379,203	562,371	+48.3
Iowa	5	5	7,415,625	8,364,692	+12.8	7,231,807	16,157,979	2.23	8,024,492	19,800,084	2.47	+11.0	+10.8	836,773	1,176,973	+40.7
Eastern Missouri, Minnesota, South Dakota	6	6	11,409,363	11,807,958	+3.5	11,389,872	26,598,857	2.34	11,696,053	29,725,620	2.54	+2.7	+8.5	902,333	1,014,238	+12.4
Kansas	6	6	8,616,357	8,514,521	−1.2	8,759,103	19,400,068	2.21	8,163,916	19,413,144	2.38	−6.8	+7.7	313,134	663,739	+112.0
Western Missouri, Nebraska, Oklahoma, Arkansas	6	6	8,193,685	8,707,964	+6.3	8,239,959	18,635,573	2.26	8,126,910	19,936,315	2.45	−1.4	+8.4	342,664	923,718	+169.6
Texas	11	13	17,150,293	18,132,373	+5.7	17,281,521	39,677,804	2.30	17,642,654	42,648,536	2.42	+2.1	+5.2	498,534	988,253	+98.2
Colorado, Arizona, Wyoming, Montana, Utah, Idaho	9	10	7,737,195	8,569,555	+10.8	7,886,861	22,628,743	2.87	8,264,888	25,503,189	3.09	+4.8	+7.7	345,208	649,875	+88.3
California	11	11	26,277,209	29,918,293	+13.9	26,685,004	65,258,675	2.45	28,956,470	77,753,697	2.69	+8.5	+9.8	817,970	1,779,793	+117.6
Oregon, Washington	9	9	6,802,763	7,671,760	+12.8	6,950,797	19,365,591	2.79	7,589,484	22,744,914	3.00	+9.2	+7.5	431,985	514,261	+19.0
Puerto Rico	2	2	3,218,349	4,240,060	+31.7	3,187,451	8,299,186	2.60	4,297,583	11,252,350	2.62	+34.8	+0.8	73,800	16,277	−77.9
Total	150	155	226,025,849	246,022,476	+8.8	227,756,636	535,321,123	2.35	241,153,272	613,170,483	2.54	+5.9	+8.1	13,118,867	17,988,071	+37.1
Pennsylvania	24	24	38,646,260	41,981,431	+8.6	39,450,611	94,604,230	2.40	41,560,431	107,035,506	2.58	+5.3	+7.5	2,503,633	2,924,633	+16.8
Missouri	5	5	9,777,855	10,230,449	+4.6	9,779,657	22,751,226	2.33	10,217,421	25,760,473	2.52	+4.5	+8.2	730,151	743,179	+1.8

[1] Revised figures.

TABLE 3.—Production, shipments from mills, and stocks at mills of finished portland cement in the United States in 1951, by month and district, in thousands of barrels [1]

District	January	February	March	April	May	June	July	August	September	October	November	December
PRODUCTION												
Eastern Pennsylvania, Maryland	2,884	2,514	2,821	3,080	3,132	3,042	3,282	3,232	3,109	3,246	3,033	2,975
New York, Maine	1,088	772	1,032	1,339	1,446	1,436	1,459	1,469	1,428	1,463	1,205	1,218
Ohio	770	719	858	1,029	955	1,114	1,154	1,093	1,118	1,138	1,051	874
Western Pennsylvania, West Virginia	788	651	826	842	982	884	997	954	1,100	1,101	888	837
Michigan	592	404	864	1,166	1,458	1,524	1,464	1,554	1,506	1,428	1,377	1,057
Illinois	634	483	655	670	733	757	752	825	804	757	694	721
Indiana, Kentucky, Wisconsin	1,034	775	990	1,142	1,296	1,329	1,316	1,390	1,305	1,374	1,098	1,112
Alabama	849	793	907	896	959	944	901	903	915	902	869	939
Tennessee	515	474	576	624	628	639	668	533	639	656	618	653
Virginia, Georgia, Florida, Louisiana, South Carolina	789	727	789	706	845	972	919	818	953	1,073	1,043	1,020
Iowa	666	544	422	518	696	611	827	904	778	935	721	742
Eastern Missouri, Minnesota, South Dakota	689	561	1,008	1,041	1,148	1,096	1,120	1,163	1,142	1,084	945	806
Kansas	585	625	757	750	759	744	623	693	785	765	696	733
Western Missouri, Nebraska, Oklahoma, Arkansas	645	561	577	714	751	835	745	826	780	777	750	748
Texas	1,417	1,185	1,527	1,459	1,531	1,547	1,599	1,589	1,525	1,583	1,571	1,601
Colorado, Arizona, Wyoming, Montana, Utah, Idaho	484	526	683	730	827	845	856	825	775	757	670	591
California	2,240	2,173	2,558	2,395	2,643	2,544	2,683	2,594	2,492	2,623	2,527	2,465
Oregon, Washington	459	455	534	685	745	720	711	793	762	732	616	460
Puerto Rico	306	259	324	398	390	401	363	356	353	403	365	322
United States: 1951	17,434	15,201	18,708	20,184	21,924	21,984	22,439	22,514	22,269	22,797	20,737	19,874
1950	15,202	13,115	14,301	18,134	19,941	20,001	20,709	21,884	20,945	22,461	20,226	19,116
SHIPMENTS												
Eastern Pennsylvania, Maryland	1,855	1,581	2,947	3,390	3,701	3,614	3,492	3,717	3,354	3,721	2,626	1,696
New York, Maine	531	490	997	1,392	1,773	1,732	1,587	1,693	1,487	1,742	1,062	617
Ohio	421	388	796	1,052	1,357	1,432	1,391	1,358	1,125	1,292	847	413
Western Pennsylvania, West Virginia	382	372	663	820	1,124	1,214	1,217	1,468	1,236	1,335	782	405
Michigan	452	375	670	1,082	1,659	1,777	1,731	1,886	1,518	1,579	924	460
Illinois	185	180	505	659	1,053	1,063	1,020	1,107	978	914	454	259
Indiana, Kentucky, Wisconsin	502	453	933	1,191	1,552	1,646	1,605	1,695	1,527	1,452	935	500
Alabama	796	741	863	930	1,015	980	938	913	877	962	889	683
Tennessee	416	427	652	648	680	658	654	636	632	712	633	416
Virginia, Georgia, Florida, Louisiana, South Carolina	769	625	808	764	879	952	945	898	926	1,117	1,027	769
Iowa	156	219	383	640	907	1,006	926	1,051	1,009	1,204	335	189
Eastern Missouri, Minnesota, South Dakota	421	328	780	1,044	1,338	1,325	1,179	1,378	1,274	1,514	763	352
Kansas	432	340	612	718	762	692	590	812	801	1,171	804	428
Western Missouri, Nebraska, Oklahoma, Arkansas	424	353	622	750	854	764	784	844	827	969	568	368

For footnotes, see end of table.

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TABLE 3.—Production, shipments from mills, and stocks at mills of finished portland cement in the United States in 1951, by month and district, in thousands of barrels [1]—Continued

District	January	February	March	April	May	June	July	August	September	October	November	December
SHIPMENTS—continued												
Texas	1,394	1,130	1,476	1,427	1,584	1,534	1,606	1,645	1,345	1,733	1,479	1,289
Colorado, Arizona, Wyoming, Montana, Utah, Idaho	402	386	659	802	925	881	848	894	809	816	532	311
California	2,073	2,269	2,496	2,400	2,522	2,555	2,533	2,643	2,450	2,740	2,358	1,941
Oregon, Washington	324	361	498	797	782	734	802	829	735	753	608	369
Puerto Rico	301	276	318	415	400	357	411	374	343	408	368	326
United States: 1951	12,236	11,294	17,678	20,921	24,867	24,916	24,259	25,841	23,253	26,134	17,994	11,791
1950	9,632	9,824	14,669	18,424	22,834	24,749	23,167	25,144	22,910	24,167	19,791	12,477
STOCKS (END OF MONTH)												
Eastern Pennsylvania, Maryland	2,866	3,799	3,673	3,364	2,794	2,222	2,012	1,527	1,282	808	1,215	2,494
New York, Maine	1,426	1,706	1,739	1,684	1,350	1,051	922	697	635	354	496	1,097
Ohio	1,202	1,534	1,596	1,573	1,171	853	616	351	344	190	394	856
Western Pennsylvania, West Virginia	1,339	1,619	1,782	1,804	1,662	1,331	1,111	598	462	229	335	767
Michigan	1,457	1,487	1,680	1,764	1,563	1,310	1,043	711	699	548	1,001	1,598
Illinois	1,145	1,447	1,597	1,608	1,288	983	715	432	258	101	341	802
Indiana, Kentucky, Wisconsin	1,470	1,792	1,850	1,801	1,549	1,231	950	644	419	344	507	1,119
Alabama	452	504	548	513	457	422	385	374	409	349	328	585
Tennessee	418	464	389	365	312	293	307	204	212	156	141	377
Virginia, Georgia, Florida, Louisiana, South Carolina	408	510	490	432	398	418	393	312	339	295	311	562
Iowa	1,347	1,672	1,711	1,589	1,378	984	884	737	507	238	623	1,176
Eastern Missouri, Minnesota, South Dakota	1,180	1,412	1,640	1,638	1,449	1,219	1,156	948	817	387	570	1,025
Kansas	466	750	895	927	925	977	1,009	891	874	468	360	664
Western Missouri, Nebraska, Oklahoma, Arkansas	563	771	726	690	588	658	619	602	554	362	544	924
Texas	526	581	631	662	609	622	615	559	739	588	680	992
Colorado, Arizona, Wyoming, Montana, Utah, Idaho	427	568	592	520	421	385	393	324	291	231	370	650
California	888	889	949	945	1,066	1,056	1,205	1,157	1,198	1,082	1,257	1,781
Oregon, Washington	563	657	693	581	545	531	440	404	431	409	417	508
Puerto Rico	79	62	69	51	41	84	37	19	29	23	20	16
United States: 1951	18,222	22,224	23,250	22,511	19,566	16,630	14,812	11,491	10,499	7,162	9,910	17,993
1950	20,275	23,583	23,216	22,936	20,050	15,298	12,848	9,608	7,642	5,945	6,382	[2] 13,024

[1] Figures in this table are from monthly reports and have not been adjusted to add to final annual totals.
[2] Revised figure.

TABLE 4.—Stocks of finished portland cement and portland-cement clinker at mills in the United States [1] on December 31, and yearly range in end-of-month stocks, 1947–51

	Dec. 31 (barrels)	Range			
		Low		High	
		Month	Barrels	Month	Barrels
1947—Cement	10,011,607	October	5,668,000	March	22,178,000
Clinker	3,605,299	November	2,929,000	May	6,353,000
1948—Cement	11,093,690	October	6,094,000	March	20,886,000
Clinker	3,781,250	November	2,781,000	do	6,072,000
1949—Cement	14,758,499	October	8,569,000	do	23,104,000
Clinker	4,586,746	November	3,387,000	do	7,764,000
1950—Cement	[2] 13,118,867	October	5,945,000	February	23,583,000
Clinker	[2] 3,924,801	do	2,852,000	March	8,821,000
1951—Cement	17,988,071	do	7,162,000	do	23,250,000
Clinker	4,699,461	do	3,544,000	April	8,194,000

[1] Includes Puerto Rico.
[2] Revised figure.

NATURAL, MASONRY (NATURAL), AND PUZZOLAN CEMENTS

Hydraulic cements other than portland were produced in nine plants in 1951. Output, shipments, and stocks during the year were, respectively, 19, 18, and 14 percent lower than in 1950. Producers of this group reported consumption of 44,611 short tons of coal and 175,056,000 cubic feet of gas (equivalent to approximately 3,661 short tons of coal).

TABLE 5.—Natural, masonry (natural), and puzzolan (slag-lime) cements produced, shipped, and in stock at mills in the United States, 1947–51

Year	Production		Shipments		Stocks on Dec. 31, barrels [1]
	Active plants	Barrels [1]	Barrels [1]	Value	
1947	9	2,951,098	2,927,885	$5,764,398	145,408
1948	9	3,440,248	3,375,135	7,734,289	209,901
1949	9	3,185,229	3,233,525	8,006,361	161,605
1950	9	4,246,299	4,218,580	10,629,586	[2] 189,323
1951	9	3,449,463	3,475,423	9,832,956	163,363

[1] Barrel, as used in this chapter, unless otherwise indicated, refers to a 376-pound barrel.
[2] Revised figure.

TYPES OF CEMENT

A breakdown of the total production of portland cement by various types for the 1947–51 period is shown in table 6. The output and shipments of all types except oil-well, white, and miscellaneous cements were higher than in 1950. Marked percentage increases were noted for the low-heat, portland-puzzolan, and air-entrained types.

Prepared Masonry Mortars.—Production of these mixed materials was reported by 100 plants in 1951 and totaled 11,007,893 barrels. Shipments reached 10,829,868 barrels valued at $33,518,197, an average mill value of $3.09 per barrel. These data are not included in the statistical tabulations in this chapter, but the portland cement used in manufacturing these mixtures is included.

TABLE 6.—Portland cement produced and shipped in the United States,[1] 1947–51, by types

Type and year	Active plants	Production (barrels)	Shipments		
			Barrels	Value	
				Total	Average
General use and moderate heat (types I and II):					
1947	150	157,525,464	158,637,287	$297,619,024	$1.88
1948	150	174,909,904	173,365,414	374,584,386	2.16
1949	150	177,597,585	174,569,746	396,817,234	2.27
1950	150	191,994,091	193,693,533	449,842,513	2.32
1951	155	207,702,941	203,279,206	510,975,002	2.51
High-early-strength (type III):					
1947	87	6,015,985	5,899,830	13,284,390	2.25
1948	87	5,513,312	5,615,894	14,224,177	2.53
1949	87	5,979,435	5,649,482	15,047,036	2.66
1950	90	6,667,974	6,607,172	18,094,386	2.74
1951	96	7,455,107	7,294,686	21,494,894	2.95
Low-heat (type IV):					
1947	5	125,113	137,469	252,721	1.84
1948	3	135,871	153,994	306,962	1.99
1949	6	159,739	129,411	329,284	2.54
1950	5	328,879	271,559	682,008	2.51
1951	6	900,624	790,819	2,647,460	3.35
Sulfate-resisting (type V):					
1947	5	64,126	94,455	231,523	2.45
1948	6	204,862	163,127	505,710	3.10
1949	5	95,023	113,370	472,016	4.16
1950	4	4,070	49,152	141,888	2.89
1951	3	9,908	87,635	342,689	3.91
Oil-well:					
1947	18	1,701,305	1,708,719	3,592,577	2.10
1948	14	1,817,746	1,966,854	4,972,499	2.53
1949	17	1,714,938	1,745,908	4,554,603	2.61
1950	17	1,829,651	1,830,167	4,735,423	2.59
1951	15	1,508,252	1,630,305	4,581,109	2.80
White:					
1947	4	855,323	837,489	3,762,417	4.49
1948	4	1,034,500	1,005,356	4,510,169	4.49
1949	4	1,071,100	1,031,408	4,985,107	4.83
1950	5	1,175,490	1,187,202	5,637,101	4.75
1951	4	1,139,500	1,109,088	5,631,518	5.08
Portland-puzzolan:					
1947	5	1,519,961	1,529,551	2,970,919	1.94
1948	6	1,545,584	1,693,207	3,733,436	2.20
1949	4	1,080,848	1,147,694	2,602,853	2.27
1950	5	1,369,764	1,321,223	3,232,282	2.45
1951	6	2,279,023	2,250,280	5,602,288	2.49
Air-entrained:					
1947	73	17,850,165	17,768,010	32,359,835	1.82
1948	73	19,421,610	19,453,359	40,322,716	2.07
1949	78	21,266,590	20,940,562	46,091,687	2.20
1950	80	21,717,585	21,860,316	50,107,196	2.29
1951	79	24,201,376	23,885,423	59,247,898	2.48
Miscellaneous:[2]					
1947	20	861,905	879,059	2,140,570	2.44
1948	20	864,874	887,457	2,518,018	2.84
1949	24	762,159	752,744	2,277,212	3.03
1950	24	938,345	936,312	2,848,326	3.04
1951	23	825,745	825,830	2,647,625	3.21
Grand total:					
1947	150	186,519,347	187,491,869	356,213,976	1.90
1948	150	205,448,263	204,304,662	445,678,073	2.18
1949	150	209,727,417	206,080,325	473,177,032	2.30
1950	150	226,025,849	227,756,636	535,321,123	2.35
1951	155	246,022,476	241,153,272	613,170,483	2.54

[1] Including Puerto Rico.
[2] Includes hydroplastic, plastic, and waterproofed cements.

CAPACITY OF PLANTS

The total estimated annual capacity of all portland-cement plants in 1951, as reported to the Bureau of Mines by producers, increased 5 percent over that reported in 1950 and reached 281,532,000 barrels. The overall rate of operations in 1951 was 87 percent of the total capacity, as compared with 84 percent in 1950. As indicated in table 7, the percentage of capacity utilized rose in 15 and decreased in 4 districts. In continental United States the changes ranged from a decrease of 15 percentage points in the Virginia-Georgia-Florida-Louisiana-South Carolina district to an increase of 10 percentage points in the Western Pennsylvania-West Virginia district. The apparent decrease in the Southeastern States is deceptive; actually it is due largely to the fact that new plants and additional facilities at old plants were in full-scale operation and contributing to the years production total for only a minor part of the year, and the capacity utilization figure is computed from all capacity available at year-end.

TABLE 7.—Portland-cement-manufacturing capacity of the United States, December 31, 1950–51, by districts

District	Estimated capacity Dec. 31 (barrels)		Percent of capacity utilized	
	1950	1951	1950	1951
Eastern Pennsylvania, Maryland	38,916,493	39,642,627	87.9	91.6
New York, Maine	17,084,962	17,606,719	83.1	87.2
Ohio	12,994,125	13,094,125	81.6	90.7
Western Pennsylvania, West Virginia	14,971,300	14,821,300	62.7	73.2
Michigan	15,793,782	16,452,410	82.1	87.5
Illinois	9,460,680	9,459,260	83.8	89.7
Indiana, Kentucky, Wisconsin	17,929,470	18,431,172	75.0	76.8
Alabama	11,365,650	11,411,390	91.3	94.4
Tennessee	8,072,000	7,822,000	82.8	92.3
Virginia, Georgia, Florida, Louisiana, South Carolina	10,361,248	14,129,745	90.8	75.5
Iowa	8,953,515	9,349,570	82.8	89.5
Eastern Missouri, Minnesota, South Dakota	13,156,720	14,022,400	86.7	84.2
Kansas	9,465,385	9,510,984	91.0	89.5
Western Missouri, Nebraska, Oklahoma, Arkansas	8,786,759	9,205,781	93.3	94.6
Texas	18,656,000	21,356,000	91.9	84.9
Colorado, Arizona, Wyoming, Montana, Utah, Idaho	9,490,000	10,241,800	81.5	83.7
California	30,870,000	32,620,000	85.1	91.7
Oregon, Washington	8,095,216	8,247,825	84.0	93.0
Puerto Rico	3,850,000	4,107,220	83.6	103.2
Total	268,273,305	281,532,328	84.3	87.4

The percentages of capacity utilized in each of the first 7 months of 1951 were higher than during the corresponding months of 1950. After a slight drop in August, a peak figure of 100 percent of capacity was recorded in September. The percentage of capacity utilized was lower for each of the last 3 months of the year than in 1950.

The total capacity of both wet- and dry-process plants continued to increase, as shown in table 9. Wet-process plants made up slightly over 55 percent of the total productive capacity. The percentage of cement produced by wet-process plants in 1951 showed little change from 1950.

TABLE 8.—Percentage of capacity used in the finished portland-cement industry in the United States, 1950–51

Month	Monthly		12 months ended—		Month	Monthly		12 months ended—	
	1950	1951	1950	1951		1950	1951	1950	1951
January	70	79	82	88	July	94	98	82	90
February	67	76	82	88	August	99	98	83	89
March	66	82	81	87	September	98	100	84	90
April	85	91	80	88	October	102	99	85	90
May	90	96	81	89	November	95	93	86	90
June	93	99	81	89	December	87	85	87	90

TABLE 9.—Capacity of portland-cement plants in the United States,[1] December 31, 1949–51, by processes

Process	Capacity, Dec. 31						Percent of capacity utilized			Percent of total finished cement produced		
	Thousands of barrels			Percent of total								
	1949	1950	1951	1949	1950	1951	1949	1950	1951	1949	1950	1951
Wet	139,169	147,049	155,430	53.7	54.8	55.2	83.7	86.6	89.3	55.6	56.3	56.4
Dry	119,779	121,224	126,102	46.3	45.2	44.8	77.8	81.4	85.0	44.4	43.7	43.6
Total	258,948	268,273	281,532	100.0	100.0	100.0	81.0	84.3	87.4	100.0	100.0	100.0

[1] Includes Puerto Rico.

A grouping of the cement plants based on their annual capacity is shown below. Total number of plants is 156 instead of the 155 shown in table 6, because this listing includes 1 new plant, which was completed toward the end of the year. Gains of 5 plants and 1 plant, respectively, were made by the 2,000,000–3,000,000-barrel-capacity and the 1,000,000–2,000,000-barrel-capacity groups, whereas the number of large plants in the 3,000,000–10,000,000-barrel-per-year group remained unchanged. In 1951 there were 2 fewer plants in the less-than-1,000,000-barrel-capacity group than in 1950.

Number of portland-cement plants in the United States (including Puerto Rico) in 1951, by size group

Estimated annual capacity, December 31, barrels:	*Number of plants*
Less than 1,000,000	23
1,000,000 to 2,000,000	86
2,000,000 to 3,000,000	34
3,000,000 to 10,000,000	13
Total	156

CLINKER PRODUCTION

The output of clinker, the intermediate product between raw materials and the finished cement, was 10 percent higher in 1951 than in 1950. As in the preceding year, peak production was attained in October, whereas stocks reached their greatest accumulation in April. Stocks of clinker on December 31, 1951, were 20 percent greater than those reported at the end of 1950.

TABLE 10.—Production and stocks of portland-cement clinker at mills in the United States in 1951, by month and district, in thousands of barrels [1]

District	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
PRODUCTION												
Eastern Pennsylvania, Maryland	2,954	2,578	2,960	3,096	3,124	3,124	3,173	3,202	3,144	3,228	3,083	3,064
New York, Maine	1,254	929	1,208	1,235	1,294	1,285	1,343	1,307	1,367	1,374	1,263	1,251
Ohio	838	795	981	1,027	1,005	1,042	1,061	1,051	1,056	1,108	1,050	967
Western Pennsylvania, West Virginia	837	746	940	892	907	909	923	933	914	980	904	903
Michigan	1,004	912	962	1,196	1,396	1,341	1,373	1,398	1,348	1,445	1,370	1,239
Illinois	721	604	724	705	712	712	693	762	755	769	738	726
Indiana, Kentucky, Wisconsin	1,184	934	1,150	1,161	1,222	1,231	1,185	1,266	1,261	1,352	1,244	1,109
Alabama	928	827	934	899	951	926	922	890	881	933	878	922
Tennessee	572	487	603	636	666	658	647	540	628	686	613	644
Virginia, Georgia, Florida, Louisiana, South Carolina, Mississippi [2]	830	755	800	742	830	1,031	923	884	1,049	1,045	1,045	1,016
Iowa	696	625	517	592	723	629	720	868	804	804	791	788
Eastern Missouri, Minnesota, South Dakota	824	721	962	1,048	1,060	1,041	1,046	1,092	1,071	1,047	965	820
Kansas	617	624	754	761	766	737	618	721	758	807	686	726
Western Missouri, Nebraska, Oklahoma, Arkansas	698	655	552	672	722	792	745	826	753	810	767	803
Texas	1,393	1,241	1,522	1,487	1,572	1,521	1,572	1,609	1,553	1,589	1,564	1,682
Colorado, Arizona, Wyoming, Montana, Utah, Idaho	604	645	698	711	738	761	824	807	762	763	724	684
California	2,363	2,149	2,509	2,487	2,602	2,528	2,574	2,771	2,503	2,588	2,509	2,643
Oregon, Washington	547	489	642	697	685	706	749	717	688	700	641	478
Puerto Rico	268	279	332	349	366	353	349	366	355	368	329	315
United States: 1951	19,132	16,995	19,750	20,393	21,341	21,327	21,440	22,010	21,650	22,396	21,164	20,780
1950	16,858	14,508	15,740	18,141	19,627	19,395	19,767	20,568	20,177	21,431	20,394	20,180
STOCKS (END OF MONTH)												
Eastern Pennsylvania, Maryland	479	528	661	647	602	681	500	422	437	338	349	455
New York, Maine	479	612	840	772	642	529	436	294	247	185	250	289
Ohio	295	375	480	472	498	411	320	264	207	161	155	246
Western Pennsylvania, West Virginia	300	384	500	536	471	491	448	435	264	168	205	281
Michigan	693	1,190	1,257	1,238	1,103	858	720	513	335	279	229	391
Illinois	109	220	281	313	285	228	161	67	6	14	49	55
Indiana, Kentucky, Wisconsin	384	522	669	669	581	484	363	243	178	147	292	257
Alabama	135	157	179	170	151	121	133	108	73	97	96	74
Tennessee	126	126	143	141	159	168	135	134	105	122	102	86
Virginia, Georgia, Florida, Louisiana, South Carolina, Mississippi [2]	111	119	94	109	91	94	74	120	192	135	102	81
Iowa	165	248	335	409	430	438	339	310	315	170	243	287
Eastern Missouri, Minnesota, South Dakota	369	512	479	506	450	403	346	282	225	203	238	263
Kansas	132	127	92	98	89	85	81	114	80	115	118	104
Western Missouri, Nebraska, Oklahoma, Arkansas	130	208	190	153	128	114	114	130	117	147	168	225
Texas	39	82	67	93	125	94	62	72	95	86	83	157

For footnotes, see end of table.

TABLE 10.—Production and stocks of portland-cement clinker at mills in the United States in 1951, by month and district, in thousands of barrels [1]—Continued

District	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
STOCKS (END OF MONTH)—continued												
Colorado, Arizona, Wyoming, Montana, Utah, Idaho	228	403	410	385	291	203	167	144	130	129	171	262
California	809	777	739	827	791	718	617	619	630	592	564	731
Oregon, Washington	355	394	503	522	472	465	501	446	378	354	386	414
Puerto Rico	75	113	149	134	123	97	84	134	124	102	82	42
United States: 1951	5,473	7,097	8,068	8,194	7,482	6,682	5,601	4,851	4,138	3,544	3,882	4,700
1950	6,141	7,454	8,821	8,626	8,142	7,346	6,388	4,900	4,029	2,852	2,962	[3] 3,925

[1] Figures in this table are compiled from monthly estimates of producers.
[2] Mississippi included here for first time, as the new plant produced and had on hand a small quantity of clinker, December 1951.
[3] Revised figure.

TABLE 11.—Portland-cement clinker produced and in stock at mills in the United States,[1] 1950–51, by processes, in barrels [2]

Process	Plants		Production		Stocks on Dec. 31—	
	1950	1951	1950	1951	1950 [3]	1951 [4]
Wet	89	92	127,062,394	139,134,268	1,910,982	2,246,853
Dry	61	63	99,723,358	109,243,568	2,013,819	2,452,608
Total	150	155	226,785,752	248,377,836	3,924,801	4,699,461

[1] Including Puerto Rico.
[2] Compiled from monthly estimates of producers.
[3] Revised figures.
[4] Preliminary figures.

RAW MATERIALS

Among the raw materials used for manufacturing cement, the "limestone and clay or shale" classification represented 69 percent of the total output in 1951—a decline of 4 percentage points as compared to 1950. "Cement rock and pure limestone" were the raw materials used in manufacturing 20 percent of the total—1 percentage point less than in 1950. The percentage made from "blast-furnace slag and limestone" nearly doubled the 1950 figure and amounted to 10 percent of the output. The percentage of cement produced from "marl and clay" remained the same as in 1950 and represented 1 percent of the total output.

TABLE 12.—Production and percentage of total output of portland cement in the United States,[1] 1946–51, by raw material used

	Cement rock and pure limestone		Limestone and clay or shale [2]		Marl and clay		Blast-furnace slag and limestone	
	Barrels	Percent	Barrels	Percent	Barrels	Percent	Barrels	Percent
1946	39,070,643	23.8	112,142,154	68.3	2,720,500	1.7	10,130,891	6.2
1947	43,428,201	23.3	129,338,247	69.3	2,408,845	1.3	11,344,054	6.1
1948	47,559,783	23.1	144,855,487	70.5	2,620,060	1.3	10,412,933	5.1
1949	45,655,516	21.8	150,435,948	71.7	3,310,270	1.6	10,325,683	4.9
1950	47,120,142	20.8	164,811,547	73.0	2,596,962	1.1	11,497,198	5.1
1951	50,328,000	20.4	169,204,269	68.8	2,653,211	1.1	23,836,996	9.7

[1] Includes Puerto Rico, 1946–51; Hawaii, 1946. There has been no production in Hawaii since 1946.
[2] Includes output of 5 plants using oystershells and clay in 1946–49; 6 plants in 1950; and 7 plants in 1951.

The tonnages of raw materials (exclusive of fuels and explosives) required to produce portland cement in recent years are given in table 13. Limestone (including oystershells), cement rock, and clay and shale constitute 94 percent of the total materials consumed in 1951. Except for marl, which declined 2 percent, all types of raw materials consumed in 1951 showed gains over the quantities used in 1950. The quantity of limestone and oystershells used again increased over 4 million tons.

TABLE 13.—Raw materials used in producing portland cement in the United States,[1] 1949–51

Raw material	1949	1950	1951
	Short tons	*Short tons*	*Short tons*
Cement rock	12,628,494	12,981,679	13,927,428
Limestone (including oystershells)	44,968,739	49,035,439	53,564,633
Marl	722,606	640,462	627,013
Clay and shale [2]	6,698,408	7,169,015	7,857,584
Blast-furnace slag	847,375	971,125	1,071,749
Gypsum	1,543,198	1,660,466	1,863,018
Sand and sandstone (including silica and quartz)	724,624	769,806	920,183
Iron materials [3]	346,542	379,637	379,818
Miscellaneous [4]	140,999	148,290	173,902
Total	68,620,985	73,755,919	80,385,328
Average total weight required per barrel of finished cement	*Pounds* 654	*Pounds* 653	*Pounds* 653

[1] Including Puerto Rico.
[2] Includes bentonite, diatomaceous shale, and fuller's earth.
[3] Includes iron ore, pyrite cinders and ore, and mill scale.
[4] Includes diatomite, fluorspar, pumicite, flue dust, pitch, red mud and rock, hydrated lime, tufa, cinders, calcium chloride, sludge, grinding aids, and air-entraining compounds.

FUEL AND POWER

All of the types of fuel consumed in the portland-cement industry were used in greater quantity in 1951 than in 1950. The percentage gains for the various fuels were as follows: Coal, 7 percent; fuel oil, 21 percent; natural gas, 6 percent; and byproduct gas, 30 percent.

The number of plants using electric energy, the kilowatt-hours generated and purchased, and the average electric energy used per barrel of cement are shown in table 16. Although cement plants generated more electric energy than in 1950, the percentage generated at plants was 2 percent less of the overall total used than in the previous year. The quantity of electric energy used per barrel of cement produced declined slightly to 22.0 kilowatt-hours.

TABLE 14.—Finished portland cement produced and fuel consumed by the portland-cement industry in the United States,[1] 1950–51, by processes

Process	Finished cement produced			Fuel consumed [2]		
	Plants	Barrels	Percent of total	Coal (short tons)	Oil (barrels of 42 gallons)	Natural gas (M cubic feet)
1950						
Wet	89	127,315,811	56.3	3,735,896	4,074,038	67,384,771
Dry	61	98,710,038	43.7	4,207,267	1,187,190	[3] 29,779,788
Total	150	226,025,849	100.0	[4] 7,943,163	5,261,228	[3] 97,164,559
1951						
Wet	[5] 91	138,805,654	56.4	4,000,833	4,649,870	71,637,119
Dry	64	107,216,822	43.6	4,523,886	1,702,442	[3] 31,103,117
Total	155	246,022,476	100.0	[5] 8,524,719	6,352,312	[3] 102,740,236

[1] Includes Puerto Rico.
[2] Figures compiled from monthly estimates of producers.
[3] Includes byproduct gas: 1950—178,236 M cubic feet; 1951—231,996 M cubic feet.
[4] Comprises 22,034 tons of anthracite and 7,921,129 tons of bituminous coal.
[5] Comprises 18,081 tons of anthracite and 8,506,638 tons of bituminous coal.

TABLE 15.—Portland cement produced in the United States,[1] 1950–51, by kind of fuel

Fuel	Finished cement produced			Fuel consumed [2]		
	Number of plants	Barrels	Percent of total	Coal (short tons)	Oil (barrels of 42 gallons)	Natural gas (M cubic feet)
1950						
Coal	74	[3] 110,150,316	48.7	6,376,924		
Oil	12	[3] 17,167,298	7.6		3,493,368	
Natural gas	12	[3] 19,675,354	8.7			28,477,976
Coal and oil	13	16,596,069	7.3	774,820	965,778	
Coal and natural gas	19	26,361,132	11.7	683,407		[4] 23,921,835
Oil and natural gas	11	23,919,066	10.6		712,493	27,430,007
Coal, oil, and natural gas	9	12,156,614	5.4	108,012	89,589	17,334,741
Total	150	226,025,849	100.0	[5] 7,943,163	5,261,228	97,164,559
1951						
Coal	74	[3] 117,979,253	48.0	6,760,011		
Oil	14	[3] 22,127,409	9.0		4,562,162	
Natural gas	16	[3] 23,415,074	9.5			33,656,280
Coal and oil	12	17,004,568	6.9	824,485	726,936	
Coal and natural gas	19	28,188,353	11.5	633,417		[6] 27,960,369
Oil and natural gas	9	22,227,639	9.0		763,205	24,237,164
Coal, oil, and natural gas	11	15,080,180	6.1	306,806	300,009	16,886,423
Total	155	246,022,476	100.0	[7] 8,524,719	6,352,312	102,740,236

[1] Including Puerto Rico.
[2] Figures compiled from monthly estimates of producers.
[3] Average consumption of fuel per barrel of cement produced was as follows: 1950—Coal, 115.8 pounds; oil, 0.2035 barrel; natural gas, 1,447 cubic feet. 1951—Coal, 114.6 pounds; oil, 0.2062 barrel; natural gas, 1,437 cubic feet.
[4] Includes 178,236 M cubic feet of byproduct gas.
[5] Comprises 22,034 tons of anthracite and 7,921,129 tons of bituminous coal.
[6] Includes 231,996 M cubic feet of byproduct gas.
[7] Comprises 18,081 tons of anthracite and 8,506,638 tons of bituminous coal.

TABLE 16.—Electric energy used at portland-cement-producing plants in the United States,[1] 1950–51, by processes, in kilowatt-hours

Process	Electric energy used						Finished cement produced (barrels)	Average electric energy used per barrel of cement produced (kilowatt-hours)
	Generated at portland-cement plants		Purchased		Total			
	Active plants	Kilowatt-hours	Active plants	Kilowatt-hours	Kilowatt-hours	Percent		
1950								
Wet	32	838,489,412	77	1,901,290,175	2,739,779,587	54.9	127,515,811	21.5
Dry	33	1,276,603,619	52	976,005,492	2,252,609,111	45.1	98,510,038	22.9
Total	65	2,115,093,031	129	2,877,295,667	4,992,388,698	100.0	226,025,849	22.1
Percent of total electric energy used		42.4		57.6	100.0			
1951								
Wet	31	817,594,309	84	2,137,534,857	2,955,129,166	54.6	138,805,654	21.3
Dry	34	1,380,638,453	54	1,076,567,848	2,457,206,301	45.4	107,216,822	22.9
Total	65	2,198,232,762	138	3,214,102,705	5,412,335,467	100.0	246,022,476	22.0
Percent of total electric energy used		40.6		59.4	100.0			

[1] Including Puerto Rico.

EMPLOYMENT AND PRODUCTIVITY

Trends in employment and output per man in the cement industry over the period 1944–48 are shown in tables 17 through 19; table 20 gives a breakdown of output per man-hour on the basis of hours of labor per day for 1946–48, and tables 21 through 23 show breakdowns of employment figures on a producing district basis for 1947 and 1948.

TABLE 17.—Employment in the portland-cement industry, finished cement produced, and average output per man in the United States,[1] 1944–48

Year	Employment					Production			Percent of industry represented[2]
	Average number of men	Time employed				Finished portland cement (barrels)	Average per man (barrels)		
		Average number of days	Total man-shifts	Man-hours			Per shift	Per hour	
				Average per man per day	Total				
1944	20,376	278	5,670,147	8.0	45,236,906	89,883,262	15.85	1.99	[3] 100.0
1945	20,695	287	5,937,680	8.0	47,612,919	101,340,500	17.07	2.13	[3] 100.0
1946	25,044	313	7,836,818	8.0	62,384,279	162,296,274	20.71	2.60	[3] 100.0
1947	26,962	318	8,569,626	7.9	67,836,375	184,644,179	21.55	2.72	[3] 100.0
1948	27,648	329	9,088,519	8.0	72,291,915	203,007,875	22.34	2.81	100.0

[1] Exclusive of Puerto Rico and Hawaii. There has been no production in Hawaii since 1946.
[2] Calculated for each year by dividing quantity of finished cement produced at mills included in the employment survey by total production as determined by the production survey.
[3] Revised figure.

TABLE 18.—Mill employees in the portland-cement industry, finished cement produced, and average output per man in the United States,[1] 1944–48

Year	Employment—cement mills only					Production			Percent of industry represented
	Average number of men	Time employed				Finished portland cement (barrels)	Average per man (barrels)		
		Average number of days	Total man-shifts	Man-hours			Per shift	Per hour	
				Average per man per day	Total				
1944	15,566	289	4,501,364	8.0	35,826,375	89,883,262	19.97	2.51	[3] 100.0
1945	16,142	299	4,820,735	8.0	38,551,413	101,340,500	21.02	2.63	[3] 100.0
1946	18,101	325	5,874,801	7.9	46,610,834	162,296,274	27.63	3.48	[3] 100.0
1947	18,327	330	6,056,358	7.9	47,716,276	184,644,179	30.49	3.87	[3] 100.0
1948	18,060	345	6,235,094	7.9	49,437,335	203,007,875	32.56	4.11	100.0

[1] Exclusive of Puerto Rico and Hawaii. There has been no production in Hawaii since 1946.
[2] *See* footnote 2, table 17.
[3] Revised figure.

TABLE 19.—Quarry and crusher employees in the portland-cement industry, material handled, and average output of material per man in the United States,[1] 1944–48

Year	Employment—quarries and crushers only					Material handled—quarry rock			Percent of industry represented[2]
	Average number of men	Time employed		Man-hours		Short tons	Average per man (short tons)		
		Average number of days	Total man-shifts	Average per man per day	Total		Per shift	Per hour	
1944	3,489	245	855,934	8.2	7,001,742	28,307,328	33.07	4.04	91.6
1945	3,500	245	857,117	8.1	6,954,881	29,122,715	33.98	4.19	90.8
1946	4,307	271	1,166,537	8.0	9,370,921	45,065,371	38.63	4.81	90.9
1947	4,704	282	1,328,625	8.0	10,638,458	51,493,686	38.76	4.84	90.0
1948	4,631	287	1,330,780	8.0	10,664,655	57,344,472	43.09	5.38	89.3

[1] Exclusive of Puerto Rico and Hawaii. There has been no production in Hawaii since 1946.
[2] Calculated for each year by dividing quantity of finished cement produced at mills, for which quarry employment reported, by total production as determined by production survey.

TABLE 20.—Number of men employed in the portland-cement industry in the United States,[1] and output per man-hour, 1946–48, classified according to hours of labor per day

Hours per day	1946			1947			1948		
	Men employed		Production per man-hour (barrels)	Men employed		Production per man-hour (barrels)	Men employed		Production per man-hour (barrels)
	Number	Percent of total		Number	Percent of total		Number	Percent of total	
Less than 6				403	1.5	2.82	202	0.7	3.23
6 and less than 7	772	3.1	2.51	1,129	4.2	2.93	305	1.1	2.22
7 and less than 8	1,339	5.3	2.83	877	3.2	3.36	2,216	8.0	2.79
8 and less than 9	22,783	91.0	2.57	24,388	90.5	2.64	24,925	90.2	2.76
9 and less than 10	150	.6	3.73	165	.6	3.60			
10 and less than 11									
Total	25,044	100.0	2.60	26,962	100.0	2.72	27,648	100.0	2.81

[1] Exclusive of Puerto Rico and Hawaii. There has been no production in Hawaii since 1946.

TABLE 21.—Employment in the portland-cement industry, finished cement produced, and average output per man in the United States,[1] 1947–48, by districts

District	Employment					Production			Percent of industry represented[2]
	Average number of men	Time employed		Man-hours		Finished portland cement (barrels)	Average per man (barrels)		
		Average number of days	Total man-shifts	Average per man per day	Total		Per shift	Per hour	
1947									
Eastern Pennsylvania and Maryland	4,342	305	1,323,643	8.0	10,621,839	29,602,680	22.36	2.79	100.0
New York and Maine	2,147	294	631,940	7.5	4,735,609	12,132,952	19.20	2.56	100.0
Ohio	1,326	337	447,002	8.0	3,595,454	9,382,564	20.99	2.61	100.0
Western Pennsylvania and West Virginia	1,622	331	536,736	8.0	4,294,325	8,168,412	15.22	1.90	100.0
Michigan	1,249	332	414,571	8.0	3,329,432	10,211,809	24.63	3.07	100.0
Illinois	1,069	325	346,914	8.0	2,776,012	7,227,748	20.83	2.60	100.0
Indiana, Kentucky, and Wisconsin	2,075	328	680,576	8.0	5,456,150	11,636,308	17.10	2.13	100.0
Alabama	1,058	313	331,484	8.1	2,668,665	9,514,190	28.70	3.57	100.0
Tennessee	760	312	236,860	8.0	1,896,156	5,900,618	24.91	3.11	100.0
Virginia, Georgia, Florida, and Louisiana	1,231	290	357,033	7.7	2,741,531	6,118,256	17.14	2.23	100.0
Iowa	1,133	311	352,745	7.8	2,763,191	6,335,666	17.96	2.29	100.0
Eastern Missouri, Minnesota, and South Dakota	1,385	324	448,511	8.0	3,595,695	9,134,368	20.37	2.54	100.0
Kansas	1,153	299	345,006	7.7	2,661,099	7,131,802	20.67	2.68	100.0
Western Missouri, Nebraska, Oklahoma, and Arkansas	929	338	313,937	8.0	2,509,445	6,392,194	20.36	2.55	100.0
Texas	1,548	334	516,330	7.9	4,069,819	12,462,925	24.14	3.06	100.0
Colorado, Wyoming, Montana, Utah, and Idaho	586	345	202,263	8.0	1,617,988	4,586,069	22.67	2.83	100.0
California	2,381	329	782,713	8.0	6,281,952	22,788,173	29.11	3.63	100.0
Oregon and Washington	968	311	301,362	7.4	2,222,013	5,917,445	19.64	2.66	100.0
Total	26,962	318	8,569,626	7.9	67,836,375	184,644,179	21.55	2.72	[3] 100.0
1948									
Eastern Pennsylvania and Maryland	4,465	339	1,512,733	8.0	12,098,427	33,589,877	22.20	2.78	100.0
New York and Maine	1,927	325	626,641	7.8	4,889,335	13,504,096	21.55	2.76	100.0
Ohio	1,358	331	448,859	8.0	3,603,482	10,035,211	22.36	2.78	100.0
Western Pennsylvania and West Virginia	1,650	338	557,864	8.0	4,467,098	8,940,151	16.03	2.00	100.0
Michigan	1,456	318	462,869	7.7	3,552,662	11,410,085	24.65	3.21	100.0
Illinois	1,143	314	359,188	8.0	2,874,790	7,570,536	21.08	2.63	100.0
Indiana, Kentucky, and Wisconsin	1,981	343	680,027	8.0	5,455,390	12,333,325	18.14	2.26	100.0
Alabama	991	336	332,580	8.0	2,677,153	9,908,219	29.79	3.70	100.0
Tennessee	884	328	289,693	8.0	2,326,764	6,727,160	23.22	2.89	100.0
Virginia, Georgia, Florida, and Louisiana	1,156	329	379,766	8.0	3,041,951	7,134,091	18.79	2.35	100.0
Iowa	971	317	307,678	8.0	2,461,431	6,807,214	22.12	2.77	100.0
Eastern Missouri, Minnesota, and South Dakota	1,454	321	467,168	7.9	3,713,562	9,654,828	20.67	2.50	100.0
Kansas	1,226	307	376,294	7.6	2,867,129	7,933,899	21.08	2.77	100.0
Western Missouri, Nebraska, Oklahoma, and Arkansas	963	342	329,100	8.0	2,630,168	6,960,336	21.15	2.65	100.0
Texas	1,547	342	529,414	8.0	4,239,150	13,700,633	25.88	3.23	100.0
Colorado, Wyoming, Montana, Utah, and Idaho	761	350	266,679	7.8	2,092,572	5,456,272	20.46	2.61	100.0
California	2,787	312	869,623	8.0	6,952,039	24,601,892	28.29	3.54	100.0
Oregon and Washington	928	315	292,343	8.0	2,348,812	6,740,050	23.06	2.87	100.0
Total	27,648	329	9,088,519	8.0	72,291,915	203,007,875	22.34	2.81	100.0

[1] Exclusive of Puerto Rico.
[2] *See* footnote 2, table 17.
[3] Revised figure.

TABLE 22.—Mill employees in the portland-cement industry, finished cement produced, and average output per man in the United States,[1] 1947–48, by districts

District	Employment—cement mills only					Production			Percent of industry represented[2]
	Average number of men	Time employed		Man-hours		Finished portland cement (barrels)	Average per man (barrels)		
		Average number of days	Total man-shifts	Average per man per day	Total		Per shift	Per hour	
1947									
Eastern Pennsylvania and Maryland	2,911	313	910,813	8.0	7,292,416	29,602,680	.50	4.06	100.0
New York and Maine	1,397	305	425,831	7.3	3,117,922	12,132,952	28.49	3.89	100.0
Ohio	955	353	336,669	8.0	2,694,974	9,382,564	27.87	3.48	100.0
Western Pennsylvania and West Virginia	975	348	338,876	8.0	2,711,166	8,168,412	24.10	3.01	100.0
Michigan	873	353	308,180	8.0	2,478,302	10,211,809	33.14	4.12	100.0
Illinois	762	342	260,843	8.0	2,086,696	7,227,748	27.71	3.46	100.0
Indiana, Kentucky, and Wisconsin	1,618	337	544,458	8.0	4,355,652	11,636,308	21.37	2.67	100.0
Alabama	714	323	230,966	8.1	1,859,770	9,514,190	41.19	5.12	100.0
Tennessee	517	307	158,479	8.0	1,267,818	5,900,618	37.23	4.65	100.0
Virginia, Georgia, Florida, and Louisiana	883	287	253,509	7.6	1,925,043	6,118,256	24.13	3.18	100.0
Iowa	874	327	285,562	7.8	2,225,734	6,335,666	22.19	2.85	100.0
Eastern Missouri, Minnesota, and South Dakota	862	359	309,091	8.0	2,473,115	9,134,368	29.55	3.69	100.0
Kansas	740	304	224,802	7.6	1,707,093	7,131,802	31.72	4.18	100.0
Western Missouri, Nebraska, Oklahoma, and Arkansas	610	359	219,237	8.0	1,761,890	6,392,194	29.16	3.63	100.0
Texas	1,114	352	392,313	7.8	3,078,686	12,462,925	31.77	4.05	100.0
Colorado, Wyoming, Montana, Utah, and Idaho	387	353	136,498	8.0	1,091,974	4,586,069	33.60	4.20	100.0
California	1,547	339	524,044	8.0	4,189,395	22,788,173	43.49	5.44	100.0
Oregon and Washington	588	334	196,187	7.1	1,398,630	5,917,445	30.16	4.23	100.0
Total	18,327	330	6,056,358	7.9	47,716,276	184,644,179	30.49	3.87	[3] 100.0
1948									
Eastern Pennsylvania and Maryland	3,002	360	1,080,446	8.0	8,639,172	33,589,877	31.09	3.89	100.0
New York and Maine	1,265	332	420,193	7.7	3,219,007	13,504,096	32.14	4.20	100.0
Ohio	759	357	271,175	8.0	2,172,538	10,035,211	37.01	4.62	100.0
Western Pennsylvania and West Virginia	990	363	359,208	8.0	2,874,220	8,940,151	24.89	3.11	100.0
Michigan	1,040	338	351,870	7.4	2,597,260	11,410,085	32.43	4.39	100.0
Illinois	672	338	226,994	8.0	1,816,675	7,570,536	33.35	4.17	100.0
Indiana, Kentucky, and Wisconsin	1,602	359	574,692	8.0	4,607,536	12,333,325	21.46	2.68	100.0
Alabama	660	361	238,062	8.0	1,913,522	9,908,219	41.62	5.18	100.0
Tennessee	564	334	188,502	8.0	1,508,065	6,727,160	35.69	4.46	100.0
Virginia, Georgia, Florida, and Louisiana	844	338	285,431	7.9	2,263,997	7,134,091	24.99	3.15	100.0
Iowa	724	335	242,234	8.0	1,937,872	6,807,214	28.10	3.51	100.0
Eastern Missouri, Minnesota, and South Dakota	832	344	286,413	8.0	2,290,094	9,654,828	33.71	4.22	100.0
Kansas	790	324	256,338	7.6	1,955,107	7,933,899	30.95	4.06	100.0
Western Missouri, Nebraska, Oklahoma, and Arkansas	586	361	211,328	8.0	1,693,530	6,960,336	32.94	4.10	100.0
Texas	1,176	357	419,656	8.0	3,368,187	13,700,633	32.65	4.07	100.0
Colorado, Wyoming, Montana, Utah, and Idaho	498	351	174,598	8.0	1,396,802	5,456,272	31.25	3.91	100.0
California	1,432	309	441,805	8.0	3,534,436	24,601,892	55.68	6.96	100.0
Oregon and Washington	624	330	206,149	8.0	1,649,315	6,740,050	32.70	4.09	100.0
Total	18,060	345	6,235,094	7.9	49,437,335	203,007,875	32.56	4.11	100.0

[1] Exclusive of Puerto Rico.
[2] *See* footnote 2, table 17.
[3] Revised figure

TABLE 23.—Quarry and crusher employees in the portland-cement industry, material (quarry rock) handled, and average output of material per man in the United States,[1] 1947–48, by districts

District	Employment—quarry and crusher only					Material handled—quarry rock			Percent of industry represented[2]
	Average number of men	Time employed		Man-hours		Short tons	Average per man (short tons)		
		Average number of days	Total man-shifts	Average per man per day	Total		Per shift	Per hour	
1947									
Eastern Pennsylvania and Maryland	799	263	210,475	8.0	1,688,731	8,171,488	38.82	4.84	94.7
New York and Maine	307	255	78,195	7.9	615,834	2,911,060	37.23	4.73	100.0
Ohio	279	287	80,192	8.2	658,745	2,352,218	29.33	3.57	100.0
Western Pennsylvania and West Virginia	401	307	123,199	8.0	985,597	4,071,264	33.05	4.13	63.5
Michigan	67	288	19,308	8.0	154,465	744,236	38.55	4.82	54.0
Illinois	205	284	58,208	8.0	465,683	2,249,539	38.65	4.83	100.0
Indiana, Kentucky, and Wisconsin	199	280	55,691	8.2	457,082	2,047,128	36.76	4.48	59.8
Alabama	226	274	62,036	7.9	489,476	2,681,333	43.22	5.48	87.8
Tennessee	175	325	56,829	8.0	455,920	1,655,910	29.14	3.63	88.6
Virginia, Georgia, Florida, and Louisiana	268	284	76,147	7.9	600,231	2,140,863	28.11	3.57	100.0
Iowa	178	245	43,652	8.0	349,209	2,048,644	46.93	5.87	100.0
Eastern Missouri, Minnesota, and South Dakota	229	275	62,986	8.0	504,606	2,189,785	34.77	4.34	85.4
Kansas	184	269	49,464	8.1	401,306	2,134,796	43.16	5.32	100.0
Western Missouri, Nebraska, Oklahoma, and Arkansas	174	295	51,299	7.8	400,352	2,061,540	40.19	5.15	100.0
Texas	145	315	45,660	8.0	365,709	2,802,877	61.39	7.66	94.3
Colorado, Wyoming, Montana, Utah, and Idaho	91	333	30,282	8.0	242,148	1,463,052	48.31	6.04	100.0
California	525	297	155,723	8.0	1,248,231	7,867,396	50.52	6.30	97.3
Oregon and Washington	252	275	69,279	8.0	555,133	1,900,557	27.43	3.42	100.0
Total	4,704	282	1,328,625	8.0	10,638,458	51,493,686	38.76	4.84	90.0
1948									
Eastern Pennsylvania and Maryland	755	277	208,798	8.0	1,672,117	9,541,896	45.70	5.71	94.5
New York and Maine	272	275	74,773	8.2	616,260	3,339,706	44.66	5.42	100.0
Ohio	261	269	70,324	8.1	572,059	2,556,036	36.35	4.47	100.0
Western Pennsylvania and West Virginia	432	303	130,949	8.0	1,050,436	4,375,445	33.41	4.17	57.6
Michigan	64	274	17,535	8.5	148,387	748,159	42.67	5.04	51.9
Illinois	199	303	60,217	8.0	481,714	2,380,862	39.54	4.94	100.0
Indiana, Kentucky, and Wisconsin	207	284	58,754	8.1	478,728	2,342,773	39.87	4.89	58.1
Alabama	208	255	52,943	7.9	418,182	2,732,008	51.60	6.53	84.9
Tennessee	197	313	61,727	8.1	499,893	1,803,773	29.22	3.61	89.0
Virginia, Georgia, Florida, and Louisiana	251	301	75,602	8.1	614,517	2,472,577	32.71	4.02	100.0
Iowa	172	255	43,930	8.0	351,445	2,231,625	50.80	6.35	100.0
Eastern Missouri, Minnesota, and South Dakota	180	286	51,440	8.2	420,924	2,431,969	47.28	5.78	84.9
Kansas	190	268	50,925	7.9	401,843	2,445,030	48.01	6.08	100.0
Western Missouri, Nebraska, Oklahoma, and Arkansas	200	302	60,451	7.9	478,062	2,327,845	38.51	4.87	100.0
Texas	159	301	47,908	7.8	375,631	3,166,025	66.09	8.43	92.9
Colorado, Wyoming, Montana, Utah, and Idaho	122	360	43,962	7.1	311,228	1,835,368	41.75	5.90	96.3
California	524	295	154,605	8.0	1,235,786	8,360,586	54.08	6.77	97.6
Oregon and Washington	238	277	65,937	8.2	537,443	2,252,849	34.17	4.19	100.0
Total	4,631	287	1,330,780	8.0	10,664,655	57,344,472	43.09	5.38	89.3

[1] Exclusive of Puerto Rico.

[2] *See* footnote 2, table 19.

TRANSPORTATION

The quantity and proportion of cement shipped by each of the major methods of transportation for 1948–51 are listed in table 24. Owing to several revisions in the 1948 and 1949 figures it was considered advisable to include those years in the present table. The percentage shipped in bulk increased 6 percentage points from 1950 to 1951 to 61 percent of the total shipments. A 3-percentage-point increase in the proportion of shipments by truck was noted, whereas the proportion shipped by rail decreased 2 percentage points and the proportion shipped by boat decreased slightly.

TABLE 24.—Shipments of portland cement from mills in the United States,[1] 1948–51, in bulk and in containers, by type of carrier

Type of carrier	In bulk		In containers				Total shipments	
			Bags		Other containers[2] (barrels)	Total (barrels)	Barrels	Percent
	Barrels	Percent	Paper (barrels)	Cloth (barrels)				
1948								
Truck	[3][4] 16,966,945	[3] 19.9	16,242,337	1,329,250	--------	17,571,587	34,538,532	16.9
Railroad	[3] 66,769,925	[3] 78.4	82,889,312	16,513,115	15,850	99,418,277	166,188,202	81.3
Boat	1,440,323	1.7	2,103,000	34,605	--------	2,137,605	3,577,928	1.8
Total	85,177,193	100.0	101,234,649	17,876,970	15,850	119,127,469	204,304,662	100.0
Percent of total	41.7	--------	49.5	8.8	(5)	58.3	100.0	------
1949								
Truck	[4] 24,347,015	23.9	[3] 16,683,392	1,445,980	--------	[3] 18,129,372	42,476,387	20.6
Railroad	75,382,590	74.0	[3] 72,029,343	13,042,686	9,335	[3] 85,081,364	160,463,954	77.9
Boat	2,171,648	2.1	[3] 936,088	32,123	125	[3] 968,336	3,139,984	1.5
Total	101,901,253	100.0	89,648,823	14,520,789	9,460	104,179,072	206,080,325	100.0
Percent of total	49.5	--------	43.5	7.0	(5)	50.5	100.0	------
1950								
Truck	[4] 32,813,799	26.4	21,554,555	357,547	--------	21,912,102	54,725,901	24.0
Railroad	89,209,877	71.6	77,911,406	2,979,928	11,318	80,902,652	170,112,529	74.7
Boat	2,495,582	2.0	400,752	21,418	454	422,624	2,918,206	1.3
Total	124,519,258	100.0	99,866,713	3,358,893	11,772	103,237,378	227,756,636	100.0
Percent of total	54.7	--------	43.8	1.5	(5)	45.3	100.0	------
1951								
Truck	[4] 42,899,170	29.2	22,366,199	186,924	--------	22,553,123	65,452,293	27.2
Railroad	102,233,611	69.5	70,327,861	673,634	8,558	71,010,053	173,243,664	71.8
Boat	1,940,483	1.3	496,895	18,416	1,521	516,832	2,457,315	1.0
Total	147,073,264	100.0	93,190,955	878,974	10,079	94,080,008	241,153,272	100.0
Percent of total	61.0	--------	38.6	0.4	(5)	39.0	100.0	------

[1] Includes Puerto Rico.
[2] Includes steel drums and iron and wood barrels.
[3] Revised figure.
[4] Includes cement used at mills by producers as follows—1948: 645,420 barrels; 1949: 643,174 barrels; 1950: 929,451 barrels; 1951: 1,368,117 barrels.
[5] Less than 0.05 percent.

CONSUMPTION

Table 25 shows that the indicated consumption of portland cement in 1951 was higher in 29 States and lower in 19 States and the District of Columbia compared to 1950. Percentage increases ranged up to 29 percent in Maine and Oregon, with Ohio, Florida, Nevada, Colorado, Louisiana, and Virginia also showing substantial gains. Largest percentage decline was in South Dakota, where apparent consumption

was 25 percent lower than in 1950. California, Texas, New York, Pennsylvania, Ohio, Illinois, and Michigan, in that order, were the largest consumers of cement in 1951. These 7 States accounted for 47 percent of the total consumption in continental United States, and the 12 non-cement-producing States and the District of Columbia accounted for 12 percent.

TABLE 25.—Destination of shipments of finished portland cement from mills in the United States, 1949–51, by States

Destination	1949 (barrels)	1950 (barrels)	1951	
			Barrels	Change from 1950, percent
Continental United States:				
Alabama	2,910,444	3,395,505	3,736,413	+10.0
Arizona	1,262,378	1,572,137	1,681,846	+7.0
Arkansas	2,058,505	2,406,455	1,854,107	−23.0
California	19,943,561	23,508,046	25,191,516	+7.2
Colorado	2,041,456	2,432,616	2,858,840	+17.5
Connecticut [1]	2,381,551	2,629,280	2,770,756	+5.4
Delaware [1]	746,858	806,434	783,892	−2.8
District of Columbia [1]	1,345,897	1,484,834	1,457,896	−1.8
Florida	4,487,460	4,998,502	6,051,603	+21.1
Georgia	2,848,784	3,313,750	3,513,978	+6.0
Idaho	1,041,074	1,004,858	1,154,434	+14.9
Illinois	11,385,563	11,557,409	12,286,321	+6.3
Indiana	5,578,176	5,611,993	6,354,398	+13.2
Iowa	4,844,659	4,828,232	4,948,586	+2.5
Kansas	4,137,843	4,793,853	4,477,884	−6.6
Kentucky	2,402,306	2,559,713	2,925,136	+14.3
Louisiana	3,986,777	4,551,836	5,282,319	+16.0
Maine	638,383	549,577	711,192	+29.4
Maryland	3,498,499	4,406,182	4,398,730	−0.2
Massachusetts [1]	3,542,911	4,161,610	4,153,399	−0.2
Michigan	9,291,483	9,645,331	10,693,060	+10.9
Minnesota	4,441,401	4,896,145	4,520,518	−7.7
Mississippi [1]	1,787,000	1,676,409	1,670,933	−0.3
Missouri	4,541,405	5,852,265	5,663,459	−3.2
Montana	782,781	1,405,328	1,576,885	+12.2
Nebraska	2,537,791	2,538,361	2,356,433	−7.2
Nevada [1]	249,342	325,997	389,815	+19.6
New Hampshire [1]	542,685	520,977	442,168	−15.1
New Jersey [1]	6,109,668	7,239,023	8,231,613	+13.7
New Mexico [1]	1,291,189	2,101,080	1,745,162	−16.9
New York	16,353,001	15,537,337	16,248,279	+4.6
North Carolina [1]	3,048,417	3,699,380	3,683,471	−0.4
North Dakota [1]	725,855	928,766	1,004,990	+8.2
Ohio	10,057,975	10,307,833	12,967,938	+25.8
Oklahoma	3,884,555	4,425,102	3,781,008	−14.6
Oregon	2,559,215	2,603,223	3,349,725	+28.7
Pennsylvania	12,738,153	15,093,106	16,133,233	+6.9
Rhode Island [1]	728,803	845,092	956,077	+13.1
South Carolina	1,488,318	2,069,957	2,313,122	+11.7
South Dakota	1,093,465	1,354,744	1,012,080	−25.3
Tennessee	4,139,920	4,565,588	4,792,334	+5.0
Texas	13,183,797	16,671,621	16,518,808	−0.9
Utah	1,155,920	1,279,828	1,191,237	−6.9
Vermont [1]	445,759	317,345	330,400	+4.1
Virginia	3,832,190	4,068,441	4,719,467	+16.0
Washington	4,031,244	4,210,197	4,518,034	+7.3
West Virginia	2,803,256	1,898,334	1,802,919	−5.0
Wisconsin	4,540,926	5,274,002	5,226,527	−0.9
Wyoming	779,372	649,695	606,912	−6.6
Unspecified	52	35,049	7,536	−78.5
Total continental United States	200,248,023	222,608,378	235,047,389	+5.6
Outside continental United States [2]	5,832,302	5,148,258	6,105,883	+18.6
Total shipped from cement plants	206,080,325	227,756,636	241,153,272	+5.9

[1] Non-cement-producing State.
[2] Direct shipments by producers to foreign countries and to possessions and other areas administered by the United States (Alaska, Hawaii, Puerto Rico, etc.), including distribution from Puerto Rican mills.

TABLE 26.—Destination of shipments of finished portland cement from mills in the United States in 1951, by months, in barrels [1]

Destination	January	February	March	April	May	June	July	August	September	October	November	December
Alabama	262,379	229,067	298,407	314,666	357,953	338,477	322,695	338,703	315,112	371,682	325,075	229,156
Arizona	161,800	171,064	199,788	143,054	168,442	126,861	111,406	97,998	111,394	143,658	124,885	121,630
Arkansas	123,852	77,275	162,681	161,867	215,634	180,792	198,402	216,196	137,627	173,849	115,337	89,690
California	1,755,504	1,993,739	2,207,828	2,199,468	2,243,771	2,266,088	2,234,755	2,301,956	1,965,420	2,398,304	2,051,863	1,592,002
Colorado	137,456	126,027	222,188	214,873	276,996	239,065	255,627	337,931	333,129	346,199	224,835	145,043
Connecticut	117,239	114,018	201,751	261,686	291,193	275,507	277,104	307,616	283,625	304,301	202,763	137,264
Delaware	30,618	26,081	58,228	73,787	88,364	90,352	79,178	84,376	88,584	88,284	60,154	36,878
District of Columbia	161,216	88,519	158,292	134,222	139,755	126,963	129,446	129,248	130,733	125,912	103,240	69,663
Florida	420,512	454,608	475,581	473,243	517,792	513,250	495,464	482,446	370,888	486,317	732,153	442,109
Georgia	227,757	248,415	286,070	305,017	316,772	294,319	300,949	322,078	308,098	337,997	311,781	234,046
Idaho	68,794	57,251	98,879	154,066	106,254	113,487	107,329	112,798	104,207	101,709	77,225	52,349
Illinois	348,245	314,876	748,542	953,284	1,313,283	1,422,539	1,422,314	1,594,951	1,497,626	1,522,668	746,041	430,308
Indiana	214,576	205,386	479,089	581,966	706,167	720,833	717,183	737,612	658,292	686,143	416,571	195,832
Iowa	73,815	90,649	206,101	376,407	594,751	635,227	603,606	640,862	688,919	748,079	191,872	95,952
Kansas	200,072	164,356	315,915	407,251	380,366	320,584	305,860	413,427	440,643	677,873	542,714	307,314
Kentucky	109,034	98,887	186,864	245,739	305,069	294,485	295,746	354,509	297,256	383,872	231,726	129,891
Louisiana	356,314	256,972	381,535	401,526	490,420	527,632	470,720	538,285	458,761	540,722	491,289	347,969
Maine	13,531	13,264	28,334	47,201	82,101	93,755	84,696	84,708	80,738	94,164	67,795	20,842
Maryland	240,835	182,206	379,010	394,987	443,986	417,308	496,714	495,422	408,656	452,815	319,589	166,726
Massachusetts	172,243	168,652	317,903	367,331	442,055	431,562	383,630	443,374	414,543	452,037	349,444	210,954
Michigan	347,807	293,435	557,548	904,837	1,255,505	1,351,214	1,230,047	1,343,724	1,135,342	1,201,932	734,969	346,151
Minnesota	110,781	154,048	227,189	363,153	555,567	586,873	570,017	602,572	510,206	581,097	142,384	108,762
Mississippi	94,248	71,975	123,141	143,914	167,356	163,658	170,990	142,730	146,232	164,099	166,139	115,911
Missouri	271,837	194,564	410,491	494,429	595,709	534,525	506,110	701,145	627,317	707,239	394,259	222,326
Montana	26,141	26,712	42,069	156,796	218,895	217,132	224,250	223,681	200,018	173,396	46,835	20,832
Nebraska	75,477	75,808	143,063	212,983	259,340	252,086	255,839	261,673	265,194	340,512	161,334	52,921
Nevada	20,525	19,468	23,630	27,505	43,482	27,568	28,842	32,862	34,765	51,491	47,576	47,420
New Hampshire	14,029	16,055	32,659	40,424	38,335	45,018	39,333	45,003	50,377	45,186	38,452	16,386
New Jersey	427,032	380,713	688,338	782,803	829,896	811,157	777,256	844,777	792,989	891,564	597,836	414,762
New Mexico	130,507	122,739	175,183	182,938	176,989	185,552	173,360	132,751	121,630	137,285	111,551	94,654
New York	675,702	590,887	1,215,371	1,569,774	1,881,134	1,836,348	1,698,653	1,738,522	1,545,262	1,798,187	1,015,835	666,081
North Carolina	253,623	222,618	328,205	351,111	386,515	423,292	371,509	275,312	252,931	319,991	312,754	198,404
North Dakota	36,249	41,943	68,038	103,688	121,388	144,004	127,160	140,887	90,245	98,530	18,282	6,363
Ohio	431,052	376,560	724,010	915,859	1,368,602	1,476,476	1,521,925	1,648,393	1,412,933	1,586,530	970,820	450,630
Oklahoma	275,659	198,627	368,641	505,237	383,266	319,099	323,338	326,988	308,635	352,225	259,624	242,269
Oregon	182,354	186,391	242,698	266,379	298,123	312,788	335,553	326,089	374,599	284,448	313,190	228,458
Pennsylvania	584,359	565,922	1,036,735	1,310,420	1,672,853	1,799,820	1,767,389	1,988,898	1,747,362	1,948,281	1,077,638	634,498
Rhode Island	36,188	50,443	75,303	96,925	106,714	91,147	88,027	106,016	94,252	109,196	69,913	45,789
South Carolina	145,009	134,587	185,045	167,360	169,339	173,904	185,521	206,590	249,444	256,848	261,439	151,279
South Dakota	18,727	32,626	49,988	85,084	115,758	129,262	117,342	123,797	142,746	140,360	38,782	21,467
Tennessee	272,362	205,837	375,545	435,998	542,181	473,767	459,628	441,401	422,412	527,884	402,344	232,603
Texas	1,345,559	1,107,541	1,464,113	1,430,141	1,569,995	1,466,941	1,483,677	1,502,271	1,207,059	1,523,445	1,301,023	1,128,216
Utah	45,473	55,631	90,975	110,860	131,905	127,952	118,448	132,340	126,795	128,103	87,514	37,831
Vermont	5,339	3,402	16,572	32,445	46,184	36,456	26,793	35,538	30,900	39,599	31,982	7,398
Virginia	297,760	216,758	400,206	451,187	515,309	510,044	420,613	444,646	438,400	407,670	409,213	270,393
Washington	203,895	171,122	277,502	445,433	403,404	402,364	435,176	499,707	501,972	482,426	409,418	240,583

For footnotes, see end of table.

TABLE 26.—Destination of shipments of finished portland cement from mills in the United States in 1951, by months, in barrels [1]—Con.

Destination	January	February	March	April	May	June	July	August	September	October	November	December
West Virginia	82,920	77,083	129,840	142,807	177,501	169,796	198,740	213,077	192,054	217,767	150,917	67,771
Wisconsin	119,297	125,782	283,057	395,829	724,285	744,132	613,355	641,410	530,205	593,796	279,512	155,252
Wyoming	25,006	37,404	54,125	49,871	68,569	69,420	57,374	70,255	56,059	57,256	40,811	20,706
Unspecified	23,904	0	8,680	11,760	0	7,677	12,829	1,786	12,539	166	0	6,984
Continental United States	11,774,613	10,837,993	17,230,946	20,399,591	24,305,223	24,318,558	23,631,918	25,229,337	22,715,125	25,603,094	17,578,698	11,308,718
Outside continental United States [2]	461,387	456,007	447,054	521,409	561,777	597,442	627,082	611,663	537,875	530,906	415,302	482,282
Total	12,236,000	11,294,000	17,678,000	20,921,000	24,867,000	24,916,000	24,259,000	25,841,000	23,253,000	26,134,000	17,994,000	11,791,000

[1] Figures in this table are from monthly reports and have not been adjusted to add to final annual totals.
[2] Shipments by producers to foreign countries and to possessions and other areas administered by the United States (Alaska, Hawaii, Puerto Rico, etc.), including distribution from Puerto Rican mills.

LOCAL SUPPLY

The surplus or deficiency in the quantity of cement locally available is indicated in table 27. The comparison is based on shipments from mills and on consumption shown by State receipts of mill shipments. The 1951 deficiencies occurred in 2 States and in all 6 divisions.

The total surplus from producing States in 1951 was distributed as follows: 28,479,713 barrels to non-cement-producing States, Alaska, and Hawaii; 2,727,647 barrels to destinations outside continental United States (excluding local consumption of Puerto Rican production); and 7,536 barrels to unspecified destinations.

TABLE 27.—Estimated surplus or deficiency in local supply of portland cement in cement-producing States, 1950–51, in barrels

State or division	1950			1951		
	Shipments from mills	Estimated consumption	Surplus or deficiency	Shipments from mills	Estimated consumption	Surplus or deficiency
Alabama	10,574,955	3,395,505	+7,179,450	10,586,825	3,736,413	+6,850,412
California	26,685,004	23,508,046	+3,176,958	28,956,470	25,191,516	+3,764,954
Illinois	7,857,969	11,557,409	−3,699,440	8,377,387	12,286,321	−3,908,934
Iowa	7,231,807	4,828,232	+2,403,575	8,024,492	4,948,586	+3,075,906
Kansas	8,759,103	4,793,853	+3,965,250	8,163,916	4,477,884	+3,686,032
Michigan	12,854,423	9,645,331	+3,209,092	14,112,639	10,693,060	+3,419,579
Missouri	9,779,657	5,852,265	+3,927,392	10,217,421	5,663,459	+4,553,962
Ohio	10,512,004	10,307,833	+204,171	11,872,278	12,967,938	−1,095,660
Pennsylvania	39,450,611	15,093,106	+24,357,505	41,560,431	16,133,233	+25,427,198
Puerto Rico	3,187,451	1,711,217	+1,476,234	4,297,583	2,519,095	+1,778,488
Tennessee	6,663,427	4,565,588	+2,097,839	7,162,841	4,792,334	+2,370,507
Texas	17,281,521	16,671,621	+609,900	17,642,654	16,518,808	+1,123,846
Colorado, Arizona, Wyoming, Montana, Utah, and Idaho	7,886,861	8,344,462	−457,601	8,264,888	9,070,154	−805,266
Oregon and Washington	6,950,797	6,813,420	+137,377	7,589,484	7,867,759	−278,275
Georgia, Kentucky, Virginia, Florida, Louisiana, and South Carolina	10,732,533	21,562,199	−10,829,666	11,913,915	24,805,625	−12,891,710
Indiana, Wisconsin, Minnesota, Nebraska, Oklahoma, South Dakota, and Arkansas	22,041,790	26,506,802	−4,465,012	22,162,808	25,105,071	−2,942,263
Maryland and West Virginia	4,908,034	6,304,516	−1,396,482	5,148,419	6,201,649	−1,053,230
New York and Maine	14,398,689	16,086,914	−1,688,225	15,098,821	16,959,471	−1,860,650
Total	227,756,636	197,548,319	+30,208,317	241,153,272	209,938,376	+31,214,896

PRICES

The average net mill realization of all portland cement shipped from mills in 1951 advanced to $2.54 per barrel from $2.35 in 1950. The average net mill realization in each quarter of 1951 was: First, $2.53; second, $2.53; third, $2.54; and fourth, $2.55.

The composite wholesale price index (1926=100) of portland cement, f. o. b. plant, according to the Bureau of Labor Statistics, was 147.2 in 1951, whereas in 1950 it was 136.6.

Average mill value per barrel, in bulk, of portland cement in the United States,[1] 1946–51

1946	$1.72	1949	$2.30
1947	1.90	1950	2.35
1948	2.18	1951	2.54

[1] Includes Puerto Rico and Hawaii, 1946; Puerto Rico only, 1947–51. There has been no production in Hawaii since 1946.

FOREIGN TRADE [4]

Imports.—Imports of hydraulic cement amounted to 893,000 barrels in 1951, 37 percent less than in 1950. For the most part, purchases were made from Germany and the United Kingdom (England). Imports of all hydraulic cement, except white, nonstaining, and other special cements, for 1949–51 are listed by country of origin in table 29. Imports of white, nonstaining cement in 1951 amounted to 10,480 barrels valued at $54,270.

TABLE 28.—Hydraulic cement imported for consumption in the United States, 1946–51

[U. S. Department of Commerce]

Year	Barrels	Value	Year	Barrels	Value
1946	3,734	$15,531	1949	109,821	$329,969
1947	4,606	28,668	1950	[1] 1,409,974	3,610,056
1948	282,752	785,120	1951	892,703	3,162,960

[1] Revised figure.

TABLE 29.—Roman, portland, and other hydraulic cement imported for consumption in the United States, 1949–51, by countries [1]

[U. S. Department of Commerce]

Country	1949		1950		1951	
	Barrels	Value	Barrels	Value	Barrels	Value
Belgium-Luxembourg	37,412	$90,767	38,286	$102,774	10,856	$26,187
Canada	639	2,162	16,896	79,324	929	4,176
Colombia			42,510	146,439	12,449	26,632
Denmark					53	231
Dominican Republic	1,516	7,260				
France			7	35		
Germany	26,620	75,000	[2] 746,426	1,981,880	722,478	2,494,679
Japan			71,797	205,897	84	285
Mexico	16,017	40,722	77,118	153,717	2,567	5,326
Netherlands			6,250	12,564		
Norway	11,750	32,853				
United Kingdom	15,832	81,063	405,772	902,306	130,064	536,269
Yugoslavia					1,085	7,845
Total	109,786	329,827	[2] 1,405,062	3,584,936	880,565	3,101,630

[1] Excludes "white, nonstaining, and other special cements."
[2] Revised figure.

Exports.—For the first time in several years cement exports increased over the previous year. Total exports were 2,933,000 barrels valued at $9,964,000. Shipments to South America dropped sharply, but a revived demand from Canada, Mexico, Cuba, and other countries of North America resulted in export to this continent of about 1 million barrels more in 1951 than in 1950.

Shipments of hydraulic cement to possessions and other areas administered by the United States in 1949–51 are shown in table 32.

[4] Figures on imports and exports compiled by M. B. Price and E. D. Page, of the Bureau of Mines, from records of the U. S. Department of Commerce.

TABLE 30.—Hydraulic cement exported from the United States, 1947–51

[U. S. Department of Commerce]

Year	Barrels	Value	Percent of total shipments from mills
1947	[1] 6,771,250	[1] $21,826,718	3.6
1948	5,922,163	20,917,176	2.9
1949	4,561,899	15,960,954	2.2
1950	2,418,435	7,274,564	1.0
1951	2,932,787	9,963,721	1.2

[1] Exclusive of 198,723 barrels, valued at $839,916, exported under the Army Civilian Supply Program.

TABLE 31.—Hydraulic cement exported from the United States, 1949–51, by country of destination

[U. S. Department of Commerce]

Country	1949		1950		1951	
	Barrels	Value	Barrels	Value	Barrels	Value
North America:						
Bermuda	25	$110			1,324	$5,861
Canada	1,505,976	5,080,765	456,418	$1,598,622	971,824	3,767,895
Newfoundland-Labrador	1,550	3,900				
Central America:						
British Honduras	1,050	4,523	1,180	5,424	325	1,219
Canal Zone	36,293	90,500	132	881	514	2,501
Costa Rica	43,187	155,430	41,457	142,838	38,604	144,031
El Salvador	33,594	136,713	10,260	48,006	25,574	99,490
Guatemala	26,656	100,385	3,814	25,581	4,905	30,436
Honduras	80,200	277,092	40,904	141,971	74,866	267,561
Nicaragua	6,167	24,804	8,947	35,254	5,558	21,432
Panama	2,059	13,532	1,885	8,846	674	4,601
Mexico	126,381	490,670	141,795	560,791	218,845	878,481
West Indies:						
British:						
Bahamas	11,365	47,118	1,741	7,668	7,282	37,760
Jamaica	495	1,930	582	2,245	18,493	58,141
Leeward and Windward Islands	485	1,845	1,158	3,671	1,880	6,576
Trinidad and Tobago	1,927	8,253	1,078	4,644	3,050	11,260
Cuba	296,246	980,613	394,460	1,115,206	611,360	1,632,358
Dominican Republic	62,963	247,905	24,722	92,699	33,993	124,642
French West Indies	2,963	10,608	1,375	5,075	6,625	21,945
Haiti	27,058	99,909	42,448	116,683	102,220	266,691
Netherlands Antilles	78,404	259,116	72,734	179,311	99,036	249,297
Total North America	2,345,044	8,035,721	1,247,090	4,095,416	2,226,952	7,632,178
South America:						
Argentina	953	1,721	373	6,370	518	4,997
Bolivia	90	694	628	5,257	462	2,777
Brazil	33,021	187,209	3,892	16,285	10,558	85,763
Chile	2,591	21,593	4,340	27,480	2,695	21,082
Colombia	54,453	332,329	26,701	193,526	9,103	72,857
Ecuador	61,945	221,563	8,400	25,786	3,157	14,883
Paraguay	2,488	13,726	370	1,032	250	3,000
Peru	3,057	18,450	1,133	9,982	1,335	10,527
Surinam	8,525	27,257	1,172	3,827	1,368	5,007
Uruguay	472	4,044	22	625	50	693
Venezuela	1,751,951	6,072,034	1,027,011	2,444,041	558,721	1,597,675
Other South America	75	994				
Total South America	1,919,621	6,901,614	1,074,042	2,734,211	588,217	1,819,261
Europe:						
Belgium-Luxembourg	132	955	294	2,096	396	3,888
France	829	4,264	7	106	1,507	6,446
Italy			1,712	12,172	339	2,705
Spain					284	3,014
Turkey	479	1,259	39,862	123,184	59,532	206,830
Other Europe	391	5,403	529	4,298	643	6,264
Total Europe	1,831	11,881	42,404	141,856	62,701	229,147

TABLE 31.—Hydraulic cement exported from the United States, 1949–51, by country of destination—Continued

[U. S. Department of Commerce]

Country	1949		1950		1951	
	Barrels	Value	Barrels	Value	Barrels	Value
Asia:						
Bahrein	4,401	$26,903	3,154	$12,920	1,372	$7,276
India	17	400	15	1,512	9	230
Indonesia	80,075	254,534	4,902	19,200	6,249	30,043
Iran					2,980	13,000
Iraq	179	733	2,175	9,152	3,992	19,128
Israel	1,388	13,455	25,698	173,715	7,035	43,147
Japan	44,633	143,116	60	1,771		
Korea	61,843	201,592				
Kuwait	9,320	42,655	3,500	14,600		
Philippines	17,873	70,381	3,783	30,438	6,171	62,838
Saudi Arabia	47,682	153,131	8,503	27,363	18,323	72,451
Other Asia	652	4,525	79	1,147		
Total Asia	268,063	911,425	51,869	291,818	46,131	248,113
Africa:						
French West Africa	6,731	21,584				
Liberia	1,250	4,344			362	1,910
Nigeria	4,915	16,419				
Union of South Africa	2,005	9,065			198	1,809
Other Africa	1,420	4,973	92	387	135	1,018
Total Africa	16,321	56,385	92	387	695	4,737
Oceania:						
French Pacific Islands	4,036	14,934	1,094	4,107	3,693	13,582
New Zealand	4,198	17,922	856	2,998	3,499	12,460
Other Oceania	2,785	11,072	988	3,771	899	4,243
Total Oceania	11,019	43,928	2,938	10,876	8,091	30,285
Grand total	4,561,899	15,960,954	2,418,435	7,274,564	2,932,787	9,963,721

TABLE 32.—Hydraulic cement shipped to possessions and other areas administered by the United States, 1949–51

[U. S. Department of Commerce]

Area	1949		1950		1951 [1]	
	Barrels	Value	Barrels	Value	Barrels	Value
American Samoa	436	$1,687	280	$1,151	527	$2,209
Guam	2,189	10,510	3,750	22,794	6,550	38,383
Puerto Rico	94,955	315,311	14,939	91,125	6,915	41,791
Virgin Islands	31,074	123,471	36,043	123,340	16,123	55,065
Wake Island	83	359			463	1,632

[1] Data cover period January thru July; beginning in August 1951, not separately classified.

TECHNOLOGY

The Administrative Committee on Standards of the American Society for Testing Materials approved the following revised tentative specifications and methods, which had been recommended by Committee C–1 on Cement: (1) Methods of Chemical Analysis of Portland Cement (C 114–47); (2) Tentative Methods of Chemical Analysis of Portland Cement (C 114–48 T); (3) Tentative Specifications for Air-Entraining Additions for Use in the Manufacture of Air-Entraining Portland Cement (C 226–50 T); (4) Specifications for Portland Cement (C 150–49) and of Tentative Specifications for Air-Entraining Portland Cement (C 175–50 T); (5) Method of Test for Autoclave Expan-

sion of Portland Cement (C 151–49); and, (6) Tentative Definition of the Term Addition as Applied to Hydraulic Cement (C 219–48 T).

A technique for measuring with a porosimeter the degree of cement clinker burning was described. The authors believed that the method would be more satisfactory than the former practice of judging degree of burning by appearance, "feel," or measuring liter weight. The porosimeter method was said to be accurate and rapid, requiring less than 5 minutes per determination.[5]

A series of three articles translated from a French publication covered a detailed study of the thermal efficiency of the rotary cement kiln. Obtaining highest possible thermal efficiency in the manufacture of cement is of major concern to the producer because of resultant lower output unit cost. The author found that efficiency of cement kilns varied from 17 to 53 percent.[6]

Another series of articles dealing with all phases of the evaluation and development of maximum cement and lime kiln efficiencies appeared in a trade magazine.[7]

Published in a trade magazine were brief summaries of several reports on cement research in Japan. They dealt with such problems as determinations of fineness, free magnesia and sulfur trioxide, influence of grinding mediums, blast-furnace slag additions, puzzolans, and chemical reactions of cement and aggregates.[8]

Methods of testing for thickening time and rate of hardening, and stability of high-temperature oil-well cement in Mexico were described in an article.[9]

Other papers published included a description of an apparatus and method for quick determination of plasticity of masonry cement mortar [10] and a summary and analysis of research on the influence of cement particle size on strength of concrete.[11]

WORLD REVIEW

Available statistics on world production of cement in 1947–51 are shown in table 33.

[5] Yoshii, T., and Murakami, Y., Porosimeter Method for Measuring Degree of Clinker Burning: Rock Prod., vol. 54, No. 11, November 1951, pp. 88–89, 92.

[6] Jaspers, M. J. M., An Examination of the Thermal Efficiency of the Rotary Cement Kiln: Pit and Quarry, vol. 44, No. 1, July 1951, pp. 103–107; vol. 44, No. 4, October 1951, pp. 88–93; vol. 44, No. 5, November 1951, pp. 120–123.

[7] Azbe, V. J., Evaluation and Development of Kiln Efficiencies: Rock Prod., vol. 54, Nos. 4–12, April-December 1951; April, pp. 113–116, 126; May, pp. 73–75, 104; June, pp. 113–115, 140; July, pp. 65–68; August, pp. 161–164, 191; September, pp. 71–74; October, pp. 109–112; November, pp. 85–87, 109; December, pp. 99–101, 136.

[8] Rock Products, Japanese Cement Research: Vol. 54, No. 9, September 1951, pp. 98, 100, 102.

[9] Core, C. B., High-Temperature Oil-Well Cement: Rock Prod., vol. 54, No. 10, October 1951, pp. 142, 152.

[10] Wilsnack, G. C., Apparatus for Quick Determination of Plasticity of Masonry Cement Mortar: Rock Prod., vol. 54, No. 10, October 1951, pp. 114–117.

[11] Rock Products, Influence of Cement Particle Size on Strength of Concrete: Vol. 54, No. 5, May 1951. pp. 88–92.

TABLE 33.—World production of hydraulic cement, 1947–51, by countries, in thousands of metric tons [1]

[Compiled by Helen L. Hunt]

Country [1]	1947	1948	1949	1950	1951
North America:					
Canada (sold or used by producers)	1,895	2,243	2,527	[2] 2,658	2,687
Cuba	276	285	312	316	[3] 383
Dominican Republic	17	43	54	70	104
Guatemala	28	32	36	42	57
Mexico	[2] 999	[2] 1,080	1,228	[2] 1,528	1,615
Nicaragua	16	16	16	17	20
Panama		41	54	51	75
United States	32,315	35,626	36,313	39,273	42,548
South America:					
Argentina	1,363	1,252	1,452	[2] 1,572	1,543
Bolivia	39	39	42	[3] 36	33
Brazil	914	1,112	1,281	1,382	1,440
Chile	602	540	495	513	698
Colombia	346	364	475	580	641
Ecuador	33	40	52	58	79
Peru	256	282	281	331	367
Uruguay	281	287	293	305	301
Venezuela	146	215	285	501	621
Europe:					
Austria	281	721	1,091	[2] 1,289	1,475
Belgium	2,609	3,331	2,925	3,557	4,395
Bulgaria	[4]	[3] 325	[4]	[4]	[4]
Czechoslovakia	1,404	1,650	1,738	[4]	[4]
Denmark	634	769	834	873	985
Finland	418	556	656	743	829
France	[2] 3,855	[2] 5,379	6,443	7,208	8,125
Saar	76	160	206	208	234
Germany:					
West Germany	2,996	5,581	8,460	10,877	12,204
East Germany	[4]	765	1,000	[4]	[4]
Greece	182	288	[3] 326	352	432
Hungary	209	[3] 145	[3] 640	[4]	[4]
Ireland	291	398	[2] 431	444	[4]
Italy	2,754	3,144	4,037	5,004	5,578
Luxembourg	89	102	121	125	132
Netherlands	519	589	552	593	702
Norway	473	526	592	[2] 582	720
Poland	1,522	1,824	2,200	[2] 2,512	2,688
Portugal	428	498	521	573	644
Rumania	422	452	560	650	[4]
Spain	2,186	2,331	2,248	[2] 2,522	2,741
Sweden	1,550	1,486	1,698	[2] 1,936	2,012
Switzerland	995	[2] 1,022	[2] 977	1,078	1,315
U. S. S. R. [3]	4,800	6,600	8,000	10,500	12,400
United Kingdom	7,072	8,657	9,364	9,913	10,388
Yugoslavia	1,233	1,188	1,300	1,219	1,145
Asia:					63
Ceylon	416	[4]	[5] 218	[5] 430	[4]
China	34	53	59	68	72
Hong Kong	1,471	1,578	2,136	2,652	3,252
India [6]	40	97	154	144	212
Indochina	10	38	[4]	[4]	[3] 100
Indonesia	[3] 43	65	59	64	65
Iran [7]			7	66	[9] 75
Iraq	328	160	241	380	439
Israel	1,236	[2] 1,859	[2] 3,277	[2] 4,463	6,548
Japan					
Korea:					
Korea, Republic of	18	17	24	10	[4]
North Korea	[3] 150	[4]	[4]	[4]	[4]
Lebanon	167	209	233	263	303
Pakistan	[10]	[2] 228	[2] 429	421	507
Philippines	134	120	201	292	309
Syria	48	54	58	68	64
Taiwan (Formosa) [3]	193	[2] 236	281	332	389
Thailand	59	83	127	166	312
Turkey	350	345	[2] 377	[2] 396	369

For footnotes, see end of table.

TABLE 33.—World production of hydraulic cement, 1947–51, by countries, in thousands of metric tons[1]—Continued

[Compiled by Helen L. Hunt]

Country [1]	1947	1948	1949	1950	1951
Africa:					
Algeria	128	130	128	[2] 324	448
Belgian Congo	115	127	[2] 144	[2] 174	205
Egypt	648	768	[2] 889	[2] 900	1,145
Ethiopia [3]	[4]	8	8	[4]	[4]
French Morocco	219	262	264	321	377
Madagascar	7	4	6	5	5
Mozambique	36	37	46	50	77
Southern Rhodesia	71	[2] 71	83	156	163
Tunisia	115	162	168	169	187
Union of South Africa	1,252	1,308	1,363	1,847	1,953
Oceania:					
Australia [11]	896	1,030	[2] 1,076	[2] 1,278	1,236
New Zealand	219	247	254	256	163
Total [1]	[2] 85,800	[2] 102,200	[2] 115,000	131,500	147,200

[1] In addition to countries listed, hydraulic cement is produced in Albania and Eritrea, but production is believed to be negligible.
[2] Revised figure.
[3] Estimate.
[4] Data not available; estimate by senior author of chapter included in total.
[5] Manchuria only.
[6] Beginning September 1947, excludes Pakistan.
[7] Fiscal year ended March 20 of year following that stated.
[8] Production in Government-operated plants only.
[9] Fiscal year ended March 31 of year following that stated.
[10] Included in India.
[11] Fiscal year ended June 30 of year stated.

Chromium

By Norwood B. Melcher and John Hozik[1]

GENERAL SUMMARY

DOMESTIC production of chromite in 1951 was the highest since the end of World War II, imports were second only to those of 1948, and consumption by each of the three major industries—metallurgical, refractory, and chemical—was the largest on record. World production, with Turkey in the forefront, reached a new peak of 2.8 million metric tons.

Although the new supply of chromite available in 1951 was 10 percent higher than in 1950, the greater rise of 24 percent in domestic consumption caused the balance between new supply and actual consumption to be the closest since 1946. As a result, National Stockpile requirements were not satisfied. Consumers' stocks increased slightly in total but decreased in terms of months' supply.

To enlarge the supply of chromium ores, a depot was established at Grants Pass, Oreg., for purchasing up to 200,000 long tons of specification-grade domestic chromium ores at incentive prices. The program got under way in August and was responsible for the rise in annual output from 400 short tons in 1950 to over 7,000 tons in 1951; the number of operators increased from 1 to 34. At year end, negotiations were in progress between the Government and a private company to reactivate the Mouat mines in Montana.

Government regulations during 1951 included placing chromite and chromium alloys under export-license control. In August the Office of Price Stabilization exempted chromite from the General Ceiling Price Regulation, and the National Production Authority restricted the inventories of chromium ferroalloys to a 45-day supply and required users to submit proposed monthly melt schedules for approval.

Quoted prices for foreign chromite at Atlantic coast ports advanced 18 to 26 percent during the year.

TABLE 1.—Salient statistics of chromite in the United States, 1946–51, in short tons

	1946	1947	1948	1949	1950	1951
Domestic production (shipments)	4,107	948	3,619	433	404	7,056
Imports for consumption	757,391	1,106,180	1,542,125	1,203,852	1,303,713	1,429,020
Total new supply	761,498	1,107,128	1,545,744	1,204,285	1,304,117	1,436,076
Exports	2,158	3,435	2,894	2,382	2,044	2,030
Consumption	734,759	833,357	875,033	672,773	980,369	1,212,480
Stocks Dec. 31 (consumers')	326,982	411,067	602,491	756.995	606,271	637,453
World production	1,300,000	1,900,000	2,300,000	2,200,000	2,500,000	3,100,000

[1] Deceased.

DOMESTIC PRODUCTION

Although chromite was reported produced in the United States as early as 1827, the total output through 1951 (856,000 short tons) would be equivalent to less than 9 months' supply at the 1951 rate of consumption. For the most part, domestic deposits are small, high-cost operations, and the ores generally have a high iron-chromium ratio. As revealed in table 3, only during periods of national emergency is much consideration given to domestic deposits; at all other times United States users rely on the less expensive and more plentiful ores of Southern Rhodesia, Union of South Africa, Turkey, Philippines, New Caledonia, and Cuba.

Production of chromite was confined to one mine during 1950 and the first half of 1951, but opening of the purchase depot at Grants Pass, Oreg., on August 3, 1951, presented a real incentive to miners in Oregon and northern California. R. F. Helmke, operating the Lambert mine in California, shipped 1,975 short tons of 40–42 percent Cr_2O_3 during 1951 and was the only producer active in both years. By the end of 1951 chromite shipments had been recorded from 34 operations.

California.—Of the 14 shippers of chromite from California mines in 1951, the following 5 were the largest in both the State and the United States: Eugene R. Brown, operating the High Plateau mine in Del Norte County; R. F. Helmke (Lambert mine, Magalia, Butte County); Ruth Robertson (Cyclone Gap mine, Preston Peak mining district, Siskiyou County); J. & W. Mining Co. (mine of same name, Gasquet, Del Norte County); and Holliday Mines (mine of same name, High Dome, Del Norte County). Several smaller producers were active in Del Norte County as well as in Siskiyou, Fresno, and Shasta Counties. California mines supplied 89 percent of the United States production in 1951.

In 1951 the Bureau of Mines issued a report on several chromite deposits in San Luis Obispo County, Calif.[2] Reports containing historic descriptive data of individual mines and propects, based on published and unpublished information gathered during World Wars I and II by the United States Geological Survey, have been published in recent years by the California Division of Mines.[3]

Montana.—No chromite was mined in Montana in 1951 or in the 6 previous years. However, negotiations were under way between the American Chrome Corp. and the Federal Government (acting through the Defense Materials Procurement Agency) to reactivate the Mouat

[2] Smith, M. Clair, and Ricker, Spangler, Chromite Deposits; Sweetwater, Castro, Trinidad, New London, and Hilltop Mines, San Luis Obispo County, Calif.: Bureau of Mines Rept. of Investigations 4783, 1951, 7 pp.

[3] Wells, Francis G., Cater, Fred W., Jr., and Rynearson, Garn A., Chromite Deposits of Del Norte County, Calif.: California Div. Mines, Bull. 134, part I, chap. 1, November 1946, 76 pp.

Wells, Francis G. and Cater, Fred W., Jr., Chromite Deposits of Siskiyou County, Calif.: California Div. Mines, Bull. 134, part I, chap. 2, October 1950, pp. 77–127.

Dow, D. H., and Thayer, T. P., Chromite Deposits of the Northern Coast Ranges of California: California Div. Mines, Bull. 134, part II, chap. 1, December 1946, 38 pp.

Cater, Fred W., Jr., Chromite Deposits of Tuolumne and Mariposa Counties, Calif.: California Div. Mines, Bull. 134, part III, chap. 1, June 1948. pp. 1–32.

Cater, Fred W., Jr., Chromite Deposits of Calaveras and Amador Counties, Calif.: California Div. Mines, Bull. 134, part III, chap. 2, June 1948, pp. 33–60.

Rynearson, Garn A., Chromite Deposits of Tulare and Eastern Fresno Counties, Calif.: California Div. Mines, Bull. 134, part III, chap. 3, August 1948, pp.61–104.

Cater, Fred W., Jr., Rynearson, Garn A., and Dow, Donald H., Chromite Deposits of El Dorado County, Calif.; California Div. Mines, Bull. 134, part III, chap. 4, October 1951, pp. 107–167.

mines in Stillwater County. Three-fourths of the domestic chromite reserves are located in this area.

Oregon.—Of the 34 mines that made commercial shipments of chromite during 1951, 20 were in Oregon, principally in Josephine County—the site of Grants Pass Depot. Production was also reported from Curry, Jackson, and Grant Counties. Oregon mines supplied 11 percent of the domestic output.

TABLE 2.—Chromite production (shipments) in the United States, 1945–51, by States, in short tons

State	1945	1946	1947	1948	1949	1950	1951
California	9,607	[1] 4,107	948	274	433	404	6,302
Oregon	4,366			3,345			754
Total	13,973	4,107	948	3,619	433	404	7,056

[1] Combined to avoid disclosure of individual company operations.

TABLE 3.—Chromite shipped from mines in the United States, from before 1880 through 1951

Year	Short tons	Year	Short tons	Year	Short tons
Before 1880	224,000	1921–38 [1]	[1] 9,143	1947	948
1880–1913 [1]	[1] 45,215			1948	3,619
		1939	4,048	1949	433
1914	662	1940	2,982	1950	404
1915	3,675	1941	14,259	1951	7,056
1916	52,679	1942	112,876		
1917	48,972	1943	160,120	Grand total	855,612
1918	92,322	1944	45,629		
1919	5,688	1945	13,973		
1920	2,802	1946	4,107		
Total 1914–20	206,800	Total 1939–46	357,994		

[1] Annual totals published separately in Minerals Yearbooks, 1947–50.

GOVERNMENT ASSISTANCE

Chromite, with other minerals, benefited from the various types of assistance under the Defense Production Act administered by the Defense Minerals Administration, in the United States Department of the Interior, and its successor agencies established by Executive order on August 28, 1951—the Defense Minerals Exploration Administration, in the Interior Department, and the Defense Materials Procurement Agency. The DMEA had the particular function of stimulating exploration by grants-in-aid to mining companies; depending upon the essentiality of the particular mineral to the defense effort, these grants ranged from 50 to 90 percent of the cost of exploration projects, repayable from sales of the mineral if a project were certified as successful. The percentage fixed for chromite was 50. Although over 1,100 requests were received for Government aid during the year, only 5 applications pertained to chromite; 4 of these were withdrawn or denied, and 1 was still in process at the year end.

The Emergency Procurement Service of the General Services Administration announced in August 1951 opening of a depot at Grants Pass, Oreg., to which producers could ship chrome ores and concen-

trates for inspection and purchase by the Government. The program calls for purchasing 200,000 long tons of specification chromium ores and concentrates of domestic origin. Five tons of ore is the minimum shipment accepted, and no more than 2,000 tons a year may be accepted from any one source without prior written approval of the Government. Prices paid are based on the chromic oxide content of the ore and the chromium-iron ratio. The program will terminate either on June 30, 1955 or (1) on December 31, 1954, provided that 1 year's public notice is given in advance of that date or (2) when 200,000 tons of material is received and accepted. The following is abstracted from the GSA announcement:

Chemical Requirements.—No material will be accepted by the Government which does not meet the following specifications: Chromic oxide (Cr_2O_3) content, minimum 42 percent; silica (SiO_2), maximum 10 percent; and chrome-iron ratio, minimum 2 : 1.

Physical Requirements.—Lumpy ore shall be hard, dense, nonfriable material of which not more than 25 percent shall pass a 1-inch Tyler Standard screen. All lump material shall pass through a 12-inch ring. No size restrictions apply to fines or concentrates.

Prices.—The base price for domestic chromite, 48 percent chromic oxide, 3:1 chrome-iron ratio, delivered to the depot is $115 per long dry ton for lumpy material and $110 a ton for fines and concentrates. *Premiums* are paid for analyses exceeding base specifications at the following rates: $4 a ton for each 1 percent of Cr_2O_3 content above 48 percent, plus $4 a ton for each one-tenth increase in Cr-Fe ratio to but not exceeding 3.5 : 1. *Penalties* are assessed for material not meeting base specifications, as follows: $3 a ton for each 1 percent of chromic oxide below 48 percent down to and including 42 percent and $3 a ton for each one-tenth decrease in Cr-Fe ratio down to and including 2 : 1.

The effective prices resulting from the above premiums and penalties are shown in table 8.

CONSUMPTION AND USES

In 1951, for the first time, total chromite consumption exceeded 1,000,000 short tons, and new heights were reached by each of the 3 major chromite-consuming industries. Of the 1,212,480 tons used in 1951 (1950 percentages shown in parentheses), 47 percent (50) was consumed for metallurigcal purposes, 37 percent (36) for refractories, and 16 percent (14) for chemicals. The proportionately larger consumption of refractory and chemical ores reflects the increase in steel-furnace capacity and production, and greater demand for chrome plating, chromium metal, and leather-tanning chemicals. Consumption was remarkably steady at a high level throughout the year, each quarterly total being within the 300,000- to 305,000-ton range. The average chromic oxide content of all grades combined increased from 42.4 percent in 1950 to 42.6 percent in 1951.

Chromite used for metallurgical purposes (in the manufacture of ferrochromium, stainless steel, etc.) increased 17 percent over 1950 and exceeded the World War II record by 3 percent. Ore for refractory uses (in the manufacture of chromium brick, refractory cement, etc.) exceeded the 1950 record by 25 percent. The chemicals industry used 31 percent more chromite than in the previous peak year 1948. The bulk of chromite consumption in the United States is in

six adjoining States—New York, Pennsylvania, New Jersey, Maryland, West Virginia, and Ohio.

TABLE 4.—Consumption of chromite and tenor of ore used by primary consumer groups in the United States, 1942–51, in short tons

Year	Metallurgical		Refractory		Chemical		Total	
	Gross weight (short tons)	Average percent Cr_2O_3	Gross weight (short tons)	Average percent Cr_2O_3	Gross weight (short tons)	Average percent Cr_2O_3	Gross weight (short tons)	Average percent Cr_2O_3
1942	479,615	48.5	294,092	34.0	118,245	44.8	891,952	43.2
1943	555,259	48.5	282,178	34.0	127,163	44.7	964,600	43.8
1944	456,171	49.4	264,053	34.2	128,225	45.7	848,449	44.1
1945	429,644	49.1	252,407	34.2	126,069	45.0	808,120	43.8
1946	376,848	48.3	228,641	33.9	129,270	44.9	734,759	43.2
1947	385,983	47.4	311,018	35.2	136,356	44.7	833,357	41.1
1948	395,417	48.2	327,795	33.8	151,821	45.5	875,033	42.7
1949	288,518	47.6	268,925	33.5	115,330	44.1	672,773	41.3
1950	491,685	47.8	353,642	34.0	135,042	44.6	980,369	42.4
1951	573,075	48.1	440,771	34.7	198,634	44.3	1,212,480	42.6

Consumption of ferrochromium in the United States in 1951 was one-third larger than in 1950 and totaled 195,307 short tons. Additional tonnages of chromium were consumed in the form of chromium metal, briquets, Chrom-X, low-carbon ferrochrome silicon, and miscellaneous chromium alloys. The principal centers of consumption are located in five States—New York, Pennsylvania, Maryland, Ohio, and Michigan. It is estimated that, on a gross-weight basis, 60 percent of the chromium alloys and metal was consumed in making stainless steels (steels containing over 10 percent chrome), about 35 percent in other alloy steels, including high-speed, and the remaining 5 percent in high-temperature alloys and other uses.

National Production Authority Order M–80, issued August 15, 1951, restricted inventories of chromium alloys to a 45-day supply and required all melters and processors to file proposed melting or processing schedules monthly.

An article published in 1950 describes the various stages in the development of ferrochromium.[4] It explains the chemical composition of the three major classes of chromite and gives typical analyses of metallurgical-grade chromium ores from Southern Rhodesia, Turkey, New Caledonia, Russia, and Montana (as well as analyses of refractory ore from the Philippines and chemical ore from the Union of South Africa). It also describes the blending, smelting, and reduction of ores in the manufacture of ferrochromium, the composition and properties of the alloy produced, and the application of the high-carbon ferrochromium in the manufacture of cast iron and steel.

A summary of General Services Administration chromite purchase specifications, by grades, is given in table 5.

(For a detailed discussion of specifications and uses, see Minerals Yearbook, 1950, pp. 239, 240.)

[4] Franklin, F. F., High-Carbon Ferrochromium: Vancoram Review (published by the Vanadium Corp. of America), vol. 6, No. 3, 1950, pp. 9–11.

TABLE 5.—Chromite purchase specifications for National Stockpile in 1951

[General Services Administration, Emergency Procurement Service]

Grade	Percent by weight, dry basis						
	Cr_2O_3	Fe	Cr–Fe ratio	Al_2O_3+ Cr_2O_3	SiO_2	S	P
	Minimum	Maximum	Minimum	Minimum	Maximum	Maximum	Maximum
Metallurgical: [1]							
Low grade [2]	42	-------	1.5:1	-------	10	0.10	0.04
High grade	46	-------	2.7:1	-------	8	.08	.04
Refractory: [3]							
Masinloc	31	12	-------	60	5.5	-------	-------
Camaguey	30	12	-------	58	7	-------	-------
Moa Bay	34	12	-------	60	5.5	-------	-------
Chemical: [4]							
Friable ore	44	-------	-------	-------	5	-------	-------

[1] Specification P–11, June 13, 1951, covers chromite ore suitable for the manufacture of commercial ferrochromium and special chromium alloys. Lumpy ore shall be hard, dense, nonfriable material, of which not more than 25 percent shall pass a 1-inch Tyler Standard screen. Material of friable nature, regardless of an initially lumpy appearance, will be classified as fines. No size restrictions apply to fines or concentrates.

[2] Guaranteed analyses superior to that stated are desired, and no offers will be considered unless the chemical analyses are at least within the stated limits in all respects. The right is reserved to reject any proposal for which the proposed guaranteed analysis is inferior to that shown for high grade chromite.

[3] Specification P–12, October 31, 1950, covers refractory-grade chromium ore that is suitable for the production of all chromium-type refractories. Restricted to Philippine Islands and Cuba, although material from other sources will be considered. Material shall consist of "lump ore," of which not more than 20 percent shall pass a Tyler Standard 10-mesh screen.

[4] Specification P–65, June 1, 1949, covers chromium ore intended for the manufacture of chromium chemicals.

STOCKS

Consumers' stocks of all grades of chromite were 5 percent higher at the end of 1951 than in 1950. However, based on the annual rates of consumption in 1951 and 1950, respectively, the 1951 year-end inventories were equivalent to only a 6.3-month supply compared with 7.4 months in 1950.

TABLE 6.—Stocks of chromite at consumers' plants, December 31, 1946–51, in short tons

Grade	1946	1947	1948	1949	1950	1951
Metallurgical	157,281	191,104	256,770	325,881	248,872	305,134
Refractory	92,585	144,381	236,724	303,110	251,663	247,673
Chemical	77,116	75,582	108,997	128,004	105,736	84,646
Total	326,982	411,067	602,491	756,995	606,271	637,453

PRICES

Prices of foreign chromite moved upward during 1951 and on December 31 were 18 to 26 percent higher than at the beginning of the year, according to E&MJ Metal and Mineral Markets. Effective August 10, 1951, the Office of Price Stabilization exempted chromium ores and concentrates from price controls, because domestic buyers had little control over foreign prices.

Although the prices listed in table 7 are fairly representative for metallurgical- and chemical-grade chromite, apparently no quotations are included for refractory material, which represents about one-third

of the United States consumption. In 1951, 72 percent of the United States supply of refractory ore originated in the Philippines, 19 percent in Cuba, and the remaining 9 percent in the Union of South Africa and Southern Rhodesia.

Incentive prices paid to domestic producers shipping metallurgical-grade chromite to the Government depot at Grants Pass, Oreg., are listed in table 8. The 1951 base price of $115 a long ton for 48 percent Cr_2O_3 domestic ore with a 3:1 chrome-iron ratio compares with $52.80 paid by the Office of Metals Reserve for like specifications in 1944–45. Premiums paid and penalties assessed for material in variance with the base specifications were considerably lower in World War II than in 1951.

TABLE 7.—Price quotations for various grades of foreign chromite in 1951

[Engineering and Mining Journal]

Source	Cr_2O_3 (percent)	Cr-Fe ratio	Price per long ton [1]	
			Jan. 1	Dec. 31
Indian and Rhodesian	48	[2] 3:1	$36–$38	$43–$45
Do	48	2.8:1	34– 36	40– 42
Do	48	----------	25	31– 32
South African (Transvaal)	48	----------	27	34– 35
Do	44	----------	----------	27– 28
Turkish	48	[2] 3:1	43– 44	53– 54

[1] Quotations are on a dry basis, subject to penalties if guaranties are not met, f. o. b. cars New York, Philadelphia, and other Atlantic ports.
[2] Lump ore.

TABLE 8.—Prices offered by General Services Administration for domestic chromite (base, 48 percent Cr_2O_3, chrome-iron ratio, 3:1) delivered to Grants Pass, Oreg., per long dry ton [1]

Chrome-iron ratio	Chromic oxide (Cr_2O_3), percent												
	42	43	44	45	46	47	48	49	50	51	52	53	54
3.5 : 1	$117	$120	$123	$126	$129	$132	$135	$139	$143	$147	$151	$155	$159
3.4 : 1	113	116	119	122	125	128	131	135	139	143	147	151	155
3.3 : 1	109	112	115	118	121	124	127	131	135	139	143	147	151
3.2 : 1	105	108	111	114	117	120	123	127	131	135	139	143	147
3.1 : 1	101	104	107	110	113	116	119	123	127	131	135	139	143
3.0 : 1	97	100	103	106	109	112	115	119	123	127	131	135	139
2.9 : 1	94	97	100	103	106	109	112	116	120	124	128	132	136
2.8 : 1	91	94	97	100	103	106	109	113	117	121	125	129	133
2.7 : 1	88	91	94	97	100	103	106	110	114	118	122	126	130
2.6 : 1	85	88	91	94	97	100	103	107	111	115	119	123	127
2.5 : 1	82	85	88	91	94	97	100	104	108	112	116	120	124
2.4 : 1	79	82	85	88	91	94	97	101	105	109	113	117	121
2.3 : 1	76	79	82	85	88	91	94	98	102	106	110	114	118
2.2 : 1	73	76	79	82	85	88	91	95	99	103	107	111	115
2.1 : 1	70	73	76	79	82	85	88	92	96	100	104	108	112
2.0 : 1	67	70	73	76	79	82	85	89	93	97	101	105	109

[1] Prices for the various grades were calculated by Bureau of Mines on basis of the base price, premiums, and penalties prescribed by the Emergency Procurement Service of the General Services Administration. Prices shown are for lump ore; payments for fines and concentrates are $5 a ton lower. Fractions appearing on analysis reports are prorated in computing premiums and penalties.

According to Steel Magazine, quotations on chromium alloys and metal, bulk, carlots, remained steady during 1951—21.75 cents per pound of contained chromium in the form of high-carbon ferrochromium; 33.60 cents a pound of contained chromium for 0.03-percent

carbon grade down to 28.75 cents a pound for 2-percent low-carbon ferrochromium; and $1.08 a pound for chromium metal (97 percent Cr min., 1 percent Fe, 0.50 percent C max.). Basic chrome-brick prices were unchanged at $73–$78 per short ton for burned chrome brick and $77–$82 for chemical-bonded chrome brick, f. o. b. Baltimore, Md., or Chester, Pa.

FOREIGN TRADE [5]

The rapid rise in chromite requirements is indicated by the fact that less than 7 million tons of chromite were imported into the United States from 1900 through 1940, but over 12 million tons during the next 11 years; domestic production from 1900–51 totaled less than 600,000 tons.

Imports.—Chromite imports exceeded 1.4 million short tons in 1951, second only to the 1.5 million tons received in 1948. For the first time in 10 years, none was received from U. S. S. R., compared with nearly 400,000 tons supplied by Russia in 1948. The Union of South Africa provided the largest tonnage (25 percent of the total), followed by Turkey with 23 percent, Philippines 22 percent, Southern Rhodesia 16 percent, Cuba 6 percent, and New Caledonia 5 percent. The remaining 3 percent came from India, Sierra Leone, and Yugoslavia. The 1951 tonnages were valued at foreign ports at $25,505,809, an average of $17.85 a short ton, about the same as in 1950. However, in 1951 each of the three classes of ore averaged 1 percentage point lower in chromic oxide content than in 1950.

Chromite is generally classified into three grades as metallurgical, refractory, and chemical, corresponding to the chemical analysis of the ore and its intended use. An examination of the Bureau of Census import statistics as reported in table 9, as well as of the Bureau of Mines survey of actual users, reveals that, whereas metallurgical ore is received from many countries (principally Turkey, Southern Rhodesia, and New Caledonia), refractory ore is supplied by only 4 (Philippines, Cuba, Union of South Africa, and Southern Rhodesia), and chemical-grade by only 1 (Union of South Africa). Although most of the chemical ore shown in table 9 was imported for use by the chromium-chemicals industry and to meet National Stockpile requirements, a certain tonnage is used for metallurgical purposes (as in the manufacture of ferrochromium) by blending with lump ores having a high chromium-iron ratio, and some chemical-grade ore is used in refractory mixes. A small tonnage of refractory ore is also used for metallurgical purposes.

Ferrochromium imports in 1951 increased 18 percent to 27,291 short tons, containing 16,432 tons of Cr valued at $6,123,086. Canada supplied 22,711 tons, or 83 percent of the total.

Tariff.—Chromium ores enter the United States tariff free, but the duty on high-carbon ferrochromium is ⅝ cent per pound of contained chromium. The duty on low-carbon ferrochrome and ferrochrome silicon is 12½ percent ad valorem.

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[5] Figures on imports and exports compiled by M. B. Price and E. D. Page, of the Bureau of Mines, from records of the U. S. Department of Commerce.

TABLE 9.—Chromite imported for consumption in the United States, 1950–51, by country and grade

[U. S. Department of Commerce]

Country	Chemical grade			Metallurgical grade			Refractory grade			Total		
	Short tons		Value	Short tons		Value	Short tons		Value	Short tons		Value
	Gross weight	Cr_2O_3 content		Gross weight	Cr_2O_3 content		Gross weight	Cr_2O_3 content		Gross weight	Cr_2O_3 content	
1950												
Canada				851	409	$31,152				851	409	$31,152
Cuba				13,385	5,256	191,268	92,667	32,887	$1,294,394	106,052	38,143	1,485,662
Guatemala				784	423	35,000				784	423	35,000
India				1,979	952	63,382				1,979	952	63,382
Italy							2	1	20	2	1	20
New Caledonia [1]				64,674	33,822	1,469,167				64,674	33,822	[2] 1,469,167
Pakistan				8,956	4,471	167,791				8,956	4,471	167,791
Philippines	(3)	(3)	(3)	71,939	[2] 32,549	1,032,051	[2] 140,057	[2] 47,090	[2] 1,320,010	211,996	[2] 79,639	2,352,061 ●
Sierra Leone [4]	(3)	(3)	(3)	[2] 11,008	[2] 5,278	[2] 289,387				11,008	5,278	289,387
Southern Rhodesia	(3)	(3)	(3)	[2] 159,438	[2] 76,084	[2] 3,113,365	13,316	6,001	249,788	172,754	82,085	3,363,153 ●
Turkey	(3)	(3)	(3)	[2] 260,311	[2] 123,702	[2] 8,041,907				260,311	123,702	8,041,907 ●
Union of South Africa	[2] 315,360	[2] 142,635	[2] $2,861,911	42,348	19,837	582,222	24,795	10,849	147,875	[2] 382,503	[2] 173,321	[2] 3,592,008 ●
U. S. S. R.				71,556	34,795	2,172,578				71,556	34,795	2,172,578 ●
Yugoslavia				10,287	4,891	235,573				10,287	4,891	235,573
Total	[2] 315,360	[2] 142,635	[2] 2,861,911	[2] 717,516	[2] 342,469	[2] 17,424,843	[2] 270,837	[2] 96,828	[2] 3,012,087	1,303,713	[2] 581,932	[2] 23,298,841
1951												
Cuba				3,360	1,210	51,000	83,731	30,085	1,247,624	87,091	31,295	1,298,624
India				6,211	2,988	154,985				6,211	2,988	154,985
New Caledonia [1]				68,406	33,813	1,626,393				68,406	33,813	1,626,393
Philippines				2,016	968	37,381	316,845	106,895	3,372,131	318,861	107,863	3,409,512
Sierra Leone [4]				8,400	3,808	204,776				8,400	3,808	204,776
Southern Rhodesia				208,566	97,379	3,431.129	15,161	6,670	284,266	223,727	104,049	3,715,395
Turkey				336,045	159,039	11,279,797				336,045	159,039	11,279,797
Union of South Africa	275,846	121,713	2,348,882	53,430	24,542	476,297	26,160	11,351	222,568	355,436	157,606	3,047,747
Yugoslavia				24,843	10,275	768,580				24,843	10,275	768,580
Total	275,846	121,713	2,348,882	711,277	334,022	18,030,338	441,897	155,001	5,126,589	1,429,020	610,736	25,505,809

[1] Assumed source; classified in import statistics under "French Pacific Islands."
[2] Revised figure.
[3] Revised to none.
[4] Assumed source; classified in import statistics under "British West Africa."

Exports.—Shipments of chromium ores to foreign destinations totaled 2,030 short tons in 1951 (mostly to Canada), valued at $144,248, compared with 2,044 tons ($63,409) in 1950. Chromite exports reached a peak of 26,259 tons in 1943, but dropped to 1,019 tons in 1944.

Exports of ferrochromium totaled 240 short tons ($96,635), compared with 347 tons in 1950. The 1951 tonnage went to Canada and 12 other countries. Chromic acid exports amounted to 1,007,201 pounds ($301,823).

In April 1951 exports of chromite, chromium alloys, and metal were made subject to United States export-licensing control.

TECHNOLOGY

A description of the use of Chrom-X as a ladle addition in the manufacture of alloy steels was published.[6] The exothermic ferrochromium utilizes low-grade chromium ores and permits closer control of chromium content without chilling the steel bath. Chrom-X is a mixture of ferrochrome, carbon, and silicon and an oxidizing agent, sodium nitrate ($NaNO_3$), so compounded that it reacts exothermically when added to molten iron or steel. The reaction is rapid, with high recovery of chromium and a saving in fuel.

Five tons of ferrochromium prepared from low-grade domestic ores by smelting concentrates in the Bureau of Mines' Electrometallurgical Laboratory, Boulder City, Nev., was shipped in 1951 to the Massillon, Ohio, plant of Republic Steel Corp. for testing as provided for under cooperative agreement. Included was a 3-ton batch of ferrochromium made from typical mill concentrates obtained from the Mouat (Montana) stockpile and 2 tons from Oregon beach-sand concentrates. The ferrochrome produced by the Bureau averaged about 55 percent Cr compared with 68–70 percent for the standard commercial product. The object of the study by Republic was to summarize information covering the characteristics and use of the special ferrochromium in the production of commercial alloy steels. The Bureau of Mines ferrochrome was used in six 100-ton heats of open-hearth alloy steel. An abstract from a report on these tests dated December 22, 1951, and submitted to the Bureau by D. H. Ruhnke, chief metallurgist, Central Alloy district, Republic Steel Corp., follows:

> The average percentage of chromium recovery for the six heats was 84.9 percent, and compares favorably with recoveries obtained from high-carbon ferrochrome supplied by commercial producers. Nonmetallic inclusion testing and etch tests on billet products revealed acceptable material from all of the heats. These tests all compare favorably with tests performed on heats using commercial high-carbon ferrochrome.
>
> The only significant difference noted between the special ferrochrome and commercial ferrochrome was the increased amount of special ferrochrome needed to raise the chromium content of a heat. This was expected because the special alloy has a lower chrome content. The special ferrochrome differs somewhat in appearance from commercial alloy and is much more difficult to fracture. These unimportant differences are attributed to the relatively small batches in which the special ferrochrome was smelted and cast, rather than the difference in chemical composition.

[6] Grady, J. J., Ferrochromium From Low-Grade Ore Finds Wide Use: Iron Age, vol. 168, No. 16, Oct. 18, 1951, pp. 95–98.

The Carboloy department of General Electric Co. announced its series 600 chrome carbides at the World Metallurgical Congress and Metals Exposition in Detroit on October 15.[7] The new carbide series is said to contain about 70 percent chromium by weight and has a nickel binder, but no tungsten or cobalt. Outstanding properties include excellent resistance to abrasion, erosion, and corrosion, lighter weight, and resistance to oxidation at high temperatures. The coefficient of thermal expansion approximates that of steel. Resistance to sulfuric acid is reported to be 30 times that of 18–8 stainless steel and 3 times that of conventional carbides.

WORLD REVIEW

World output of chromite reached an unprecedented total of 2.8 million tons, one-half million tons greater than the previous high of 1950. One of the significant developments of the year was the emergence of Turkey as the world's largest producer. Before 1948 Turkey's greatest effort was 213,600 metric tons produced in 1938; in 1948 production rose to 286,000 tons; in 1949–50 over 420,000 tons was produced each year; and in 1951 Turkish mines produced 602,000 tons.

Afghanistan.—The rich Logar Valley is estimated to contain 50,000 to 100,000 tons of high-grade ore.[8] A small trial shipment was sent to a metallurgical firm in the United States.

Albania.—The Spanish publication, Minería y Metalurgia, reported that Albanian authorities announced discovery of important deposits of chrome ore near Lake Shkodra (Lake Scutari).[9] The deposit was estimated to contain 500,000 tons of ore, but the grade was not specified.

Cuba.—Production of chromite advanced 20 percent over 1950 but was still far below that of earlier years. Virtually all of the output is of refractory grade for export to the United States.

Guatemala.—The only chromite-mining activity in Guatemala is that conducted by the Vanadian Corp. of America and vividly described.[10] The deposits, all small and widely scattered, lie within a serpentine belt in the province of Jalapa. The ore is mined from tunnels and transported by mules over 20 miles of steep, mountainous roads to the railway that takes the ore to Puerto Barrios. The ore is of very high metallurgical grade, some shipments reportedly carrying 59 percent chromic oxide and a 4.3 : 1 Cr–Fe ratio, with average boatload shipments running 53 percent Cr_2O_3 and a Cr–Fe ratio of 3.4 : 1. The ore is used at the company's Niagara Falls, N. Y., plant.

New Caledonia.—The French Pacific Islands produce metallurgical-grade ore of high quality, principally for export to the United States; much smaller tonnages are shipped to France, Norway, Sweden, and Australia. Although output in 1951 was only a few hundred tons less than peak production in 1949—88,792 metric tons—the new Calmet operation, with financial assistance from ECA and concessions of the French Government, is expected to increase the supply for American and French industries.

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[7] Iron Age, vol. 168, No. 17, Oct. 25, 1951, p. 57.
[8] Mining World, vol. 13, No. 8, July 1951, p. 54.
[9] Metal Bulletin (London), No. 3575, Mar. 13, 1951, p. 21.
[10] Kett, F. F., Chrome-Ore Mining in Guatemala: Vancoram Rev. (published by Vanadium Corp. of America), vol. 5, No. 4, pp. 3–6, 20–21 (no date).

TABLE 10.—World poduction of chromite, 1945–51, by countries, in metric tons [1]

[Compiled by Pauline Roberts]

Country [1]	1945	1946	1947	1948	1949	1950	1951
North America:							
Canada	5,221	2,821	1,961	1,556	[2] 327		
Cuba	172,626	174,350	159,209	116,624	97,368	[2] 65,820	79,065
Guatemala	443	610	625	[2] 444	300	[2] 289	1,138
United States	12,676	3,726	860	3,283	393	367	6,401
South America:							
Argentina	3,000				([3])	([3])	([3])
Brazil (exports)	1,490	174		1,626	3	([3])	([3])
Europe: [4]							
Albania				[5] 16,500	([3])	([3])	([3])
Greece	2,413	9,062	2,640	1,500	3,381	12,631	25,333
Portugal	1,669	[2] 612	[2] 213	[2] 176	[2] 88	45	([3])
Yugoslavia (estimate)	6,000	68,000	55,000	[2] 38,000	[2] 66,000	[2] 115,200	107,000
Asia:							
Cyprus (exports)	1,070	1,158	5,283	6,899	14,875	18,441	12,653
India	[6] 31,642	[6] 45,511	35,274	22,917	19,728	16,998	[7] 11,000
Japan	28,539	7,079	2,407	9,340	27,003	31,953	40,407
Pakistan	([6])	([6])	22,040	18,160	[2] 17,194	[2] 18,416	18,006
Republic of the Philippines	([3])	58,930	195,185	256,854	246,744	250,511	334,571
Turkey	[2] 148,034	[2] 103,059	[2] 156,603	[2] 285,725	[2] 433,258	[2] 420,792	602,220
U. S. S. R. [4] [7]	300,000	300,000	500,000	600,000	350,000	500,000	600,000
Africa:							
Egypt	150		266	191	50	36	
Sierra Leone	578	10,301	16,769	7,886	22,101	7,518	([3])
Southern Rhodesia	186,318	151,433	155,149	230,703	243,506	291,525	300,267
Union of South Africa	99,090	212,253	373,094	412,783	404,351	496,324	545,306
Oceania:							
Australia	287					905	([3])
New Caledonia	59,828	24,946	50,530	75,021	88,792	84,801	88,386
Total (estimate)	1,100,000	1,200,000	1,700,000	[2] 2,100,000	[2] 2,000,000	2,300,000	2,800,000

[1] In addition to countries listed, Bulgaria, Indochina, Iran, Sweden, and United Kingdom produce chromite, but data on output are not available; estimates by author of chapter included in total.
[2] Revised figure.
[3] Data not available; estimate by author of chapter included in total.
[4] Output from U. S. S. R. in Europe included with U. S. S. R. in Asia.
[5] Planned production as reported.
[6] Pakistan included with India, 1945–46.
[7] Estimate.

Philippines.—Production of chromite was at an alltime high in 1951, with excellent prospects for greater output in 1952. Production in 1951 (1950 shown in parentheses) was: Refractory grade, 301,835 metric tons (208,665) and metallurgical grade, 32,736 tons (41,846). The sole producer of refractory chromite was the Benguet Consolidated Mining Co., operating the Consolidated Mines at Masinloc, Zambales. Increased mill capacity, new storage bins, improved wharf facilities, and brisk demand from United States markets were expected to boost output in 1952.

The decrease in output of metallurgical chromite was attributed to the exhaustion of reserves of Misamis Chromite and the March 26, 1951, raid of dissidents on the Acoje Mines causing an estimated destruction of over half a million pesos. Mining was resumed in May. At year end the Acoje Mines was completing construction of a 1,000-ton-a-day concentrating mill.[11]

Southern Rhodesia and Union of South Africa.—These two countries are discussed together because the chrome activities of both are similar in many respects. The chromite deposits of both countries are landlocked, and the ore must be transported by truck and rail hundreds of miles to ports in Mozambique (Portuguese East Africa).

[11] American Embassy, Manila, Dispatch 835, Dec. 18, 1951 (unpublished).

Railings from Southern Rhodesia terminate at the Port of Beira and those from the Union of South Africa at Lourenço Marques. Ore from Southern Rhodesia is principally of metallurgical grade; that from the Union is mostly chemical, but there is also some metallurgical and refractory.

Africa has the largest known chromite reserves in the world, but the quantity available to the United States and the free world is directly proportional to the rate of flow to the stockpiles at Beira and Lourenço Marques. Chrome railings from both Southern Rhodesia and South Africa are subject to curtailment during certain seasons in favor of coal, tobacco, and other agricultural products.

Turkey.—The 602,220 metric tons of chromite produced in Turkey in 1951 was an alltime high for all countries in the world. Independent operations accounted for 73 percent of the total output and the Turkish Government-owned Eti Bank 27 percent. Considerable interest and expansion in chromite mining have resulted from United States determination to develop alternative sources of metallurgical chromite to offset the 1950 Russian embargo on shipments to the United States. The war in Korea and efforts to fulfill minimum National Stockpile objectives have created a brisk market for all grades of chromium ores. ECA funds have been used to stimulate the chromite industry of Turkey, and a large part of the resulting output has gone into the National Stockpile.

Exports of chromite from Turkey in recent years are shown in table 11.

TABLE 11.—Exports of chromite from Turkey, 1935–39 (average) and 1947–51, by destination, in metric tons [1]

Destination	1935–39 (average)	1947	1948	1949	1950	1951
Austria	[2]	3,395	21,958	[3] 37,325	29,233	35,472
Belgium	[2]			390		
Canada	[2]		1,118		6,696	
Czechoslovakia	720		940			
France	17,272	32,632	24,596	17,676	10,729	27,288
Germany (Western)	67,180			8,196	8,743	38,828
Hungary	[2]			3,452	58	100
Italy	12,619	7,925	1,509	5,750	3,702	6,140
Norway	[2]	25,581	7,245	500	12,900	7,774
Sweden	34,716	44,650	2,681	16,280	23,128	12,821
Switzerland	210			50		2,595
United Kingdom	2,310	4,449	6,385	11,017	16,556	15,959
United States	22,803	65,146	239,675	252,610	241,415	356,246
Other	21,114				[4] 1,016	[5] 1,386
Total	178,944	183,778	306,107	[3] 353,246	354,176	504,609

[1] From U. S. consular reports, Ankara.
[2] Included with "Other."
[3] Revised figure.
[4] Greece.
[5] Netherlands (276 tons) and Spain (1,110 tons).

Clays

By Brooke L. Gunsallus and B. V. Russ [1]

GENERAL SUMMARY

TOTAL clay production in 1951 increased 10 percent over 1950. Record highs made in 1950 for all six major classifications—china clay or kaolin, ball clay, fire clay, bentonite, fuller's earth, and miscellaneous clays—were exceeded in 1951.

Production of kaolin and ball clay each increased 7 percent in 1951 over 1950. All of the principal kaolin uses showed substantial increases except pottery, stoneware, and kiln furniture which registered decreases. Production of kaolin continued its uptrend that started in 1945, and that of ball clay in 1951 broke the previous high set in 1950, with pottery manufacturers by far the principal consumers. All users of ball clay, as classified herein, showed increases over 1950.

TABLE 1.—Salient statistics of clay in the United States, 1950–51

	1950		1951	
	Short tons	Value	Short tons	Value
Domestic clay sold or used by producers:				
Kaolin or china clay	1,750,858	$23,943,782	1,866,299	$25,324,554
Ball clay	324,414	3,980,167	344,981	3,725,930
Fire clay, including stoneware clay	9,535,867	29,019,372	11,852,517	48,740,596
Bentonite	973,833	8,560,669	1,218,868	13,006,645
Fuller's earth	396,025	6,504,733	483,623	8,131,761
Miscellaneous clays	26,400,449	23,241,210	27,649,491	29,692,830
Total sold or used by producers	39,381,446	95,249,933	43,415,779	128,622,316
Imports:				
Kaolin or china clay	122,974	1,619,384	110,475	1,581,378
Common blue and Gross Almerode	34,974	345,274	35,613	360,319
Fuller's earth	237	3,685	405	7,929
Other clay	3,076	32,534	4,763	71,629
Total imports	161,261	2,000,877	151,256	2,021,255
Exports:				
Kaolin or china clay	28,261	509,376	36,435	671,058
Fire clay	74,693	704,016	101,146	1,028,719
Other clay (including fuller's earth)	135,166	3,784,343	185,963	5,744,490
Total exports	238,120	4,997,735	323,544	7,444,267

Except for a small decrease in 1949, bentonite output has increased each successive year for the past 13 years. In 1951 tonnage increased 25 percent and value 52 percent over 1950. The foundry and petroleum industries consumed most of the total tonnage, and use for rotary-

[1] Figures on imports and exports compiled by M. B. Price and E. D. Page, of the Bureau of Mines, from records of the U. S. Department of Commerce.

drilling mud, filtering and decolorizing oils, and foundry-sand bond increased.

Total production of fuller's earth increased 22 percent in 1951 over 1950, the previous record year. Mineral-oil refining, absorbent uses, insecticides, and rotary-drilling mud were all represented in the upward trend.

The production of fire clay in 1951 was 24 percent greater than in 1950 owing to the expansion of steel-mill and foundry facilities and the pent-up civilian and industrial demand for heavy clay products.

Price quotations of clay and clay products in 1951, as shown in trade papers, remained steady in most instances, but some followed a general uptrend.

Imports of kaolin in 1951 fell 10 percent below comparable 1950 figures and represented less than 6 percent of the total domestic consumption in 1951 compared to 7 percent in 1950.

Imports of ball clay (including common blue and Gross Almerode clays) increased less than 2 percent in tonnage and 4 percent in value. By far the greater part of the imports of kaolin and ball clay originated in the United Kingdom, although small quantities were imported from Canada and a very small amount of ball clay from Germany.

Exports of kaolin or china clay in 1951 (36,435 short tons) rose 29 percent over 1950, the same increase as in 1950 over 1949; 86 percent was shipped to Canada. Exports of fire clay in 1951 exceeded those in 1950 by 35 percent in tonnage and 46 percent in value, totaling 101,146 short tons valued at $1,028,719. Of the total, 78 percent was shipped to Canada; the remainder was distributed throughout the world.

CONSUMPTION AND USES

Heavy clay products in 1951 consumed 5 percent more clay than in 1950 and represented 55 percent of the total clay produced. Clays used in portland and other hydraulic cements in 1951 amounted to 18 percent of the output of all clays; refractories, 17 percent; paper filler and coating clays and rotary-drilling mud, 2 percent each; and filtering and decolorizing oils and pottery 1 percent each. The remainder was consumed for a large number of miscellaneous purposes.

Although most uses of clay increased in tonnage in 1951 compared with 1950, the following uses decreased: High-grade tile (13 percent), rubber (15 percent), chemicals (8 percent), filler other than paper or paint (5 percent), and plaster and plaster products (31 percent). Many uses showed substantial gains in 1951 over figures reported in 1950. The increases for some of the more important classifications were as follows: Paper filler and coating 7 percent, heavy clay products 5 percent, pottery 5 percent, refractories 33 percent, cement 10 percent, rotary-drilling mud 27 percent, insecticides and fungicides 13 percent, and filtering and decolorizing oils 25 percent.

TABLE 2.—Clay sold or used by producers in the United States in 1951, by kind and use, in short tons

Use	Kaolin	Ball clay	Fire clay and stoneware clay	Bentonite	Fuller's earth	Miscellaneous clay, including slip clay	Total
Pottery and stoneware:							
Whiteware, etc	133,098	260,832					393,930
Stoneware, including chemical stoneware	1,120	510	39,738				41,368
Art pottery and flower pots	6,615	6,240	45,593			21,296	79,744
Slip for glazing	900					1,606	2,506
Total	141,733	267,582	85,331			22,902	517,548
Tile, high-grade	33,729	42,333	120,939			254	197,255
Kiln furniture:							
Saggers, pins, stilts	6,508	2,230	19,980				28,718
Wads			2,267				2,267
Total	6,508	2,230	22,247				30,985
Architectural terra cotta		1,295	8,398				9,693
Paper:							
Filler	533,490						533,490
Coating	431,111						431,111
Total	964,601						964,601
Rubber	231,331					864	232,195
Linoleum	36,163		11,743				47,906
Paints:							
Filler or extender	21,398					1,380	22,778
Calcimine	1,321						1,321
Total	22,719					1,380	24,099
Portland and other hydraulic cements	77,486		5,488	1,539		7,718,923	7,803,436
Refractories:							
Firebrick and block	178,401	16,979	5,635,296				5,830,676
Bauxite, high-alumina brick			52,020				52,020
Fire-clay mortar, including clay processed for laying firebrick	9,657	2,002	236,396				248,055
Clay crucibles			1,152				1,152
Glass refractories	905		1,299				2,204
Zinc retorts and condensers			36,634				36,634
Foundries and steelworks	9,789	880	899,312	282,753		22,655	1,215,389
Other refractories	1,484		30,613				32,097
Total	200,236	19,861	6,892,722	282,753		22,655	7,418,227
Heavy clay products: Common brick, face brick paving brick, drain tile, sewer pipe, and kindred products			4,615,634			19,126,414	23,742,048
Miscellaneous:							
Rotary-drilling mud			606	460,261	79,469	123,246	663,582
Filtering and decolorizing oils (raw and activated earths)				397,940	[1]195,599		593,539
Other filtering and clarifying	52,633			4,793	4,435		61,861
Artificial abrasives	5,272		56				5,328
Absorbent uses (oily floors, etc.)					97,465		97,465
Asbestos products	2,559						2,559
Chemicals	17,349		86,818	539			104,706
Enameling	2,300	1,650					3,950
Fertilizers	4,874					2,477	7,351
Filler (other than paper or paint)	2	10,030			11,856	6,039	27,927
Insecticides and fungicides	39,883			4,043	86,339	256	130,521
Plaster and plaster products	5,507						5,507
Concrete admixture, sealing dams, etc				2,176			2,176
Other uses	21,414		2,535	64,824	8,460	624,081	721,314
Total	151,793	11,680	90,015	934,576	483,623	756,099	2,427,786
Grand total:							
1951	1,866,299	344,981	11,852,517	1,218,868	483,623	27,649,491	43,415,779
1950	1,750,858	324,414	9,535,867	973,833	396,025	26,400,449	39,381,446

[1] Comprises the following: Mineral oils, 175,348 tons; vegetable oils, 20,251 tons.

CHINA CLAY OR KAOLIN

The upward trend in kaolin production that began in 1945 continued in 1951. Tonnage increased 7 percent over 1950, the previous record year. The value increase was 6 percent.

As has been the pattern for the past several years, the paper, rubber, pottery, and refractory industries were the principal consumers. Paper consumed 964,601 short tons (52 percent of the total kaolin) including 533,490 short tons for filler and 431,111 for coating. The rubber industry consumed 231,331 short tons (12 percent), refractories 200,236 short tons (11 percent), and pottery 141,733 (8 percent). The remainder (17 percent) was consumed for a wide variety of purposes, including cement, high-grade tile, fertilizers, chemicals, insecticides, paint filler or extender, calcimine, and linoleum. The following users reported increases: Paper filler 21 percent, refractories 28 percent, filtering and clarifying oils 78 percent, high-grade tile 18 percent, linoleum 3 percent, and paint 40 percent. Decreased consumption was reported for paper coating (7 percent), rubber (12 percent), chemicals (23 percent), insecticides and fungicides (4 percent), and plastic coating (31 percent).

TABLE 3.—Kaolin sold or used by producers in the United States, 1950–51, by States

State	Sold by producer		Used by producer		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1950						
Alabama, Florida, and North Carolina	59,049	$1,163,079			59,049	$1,163,079
California	(1)	(1)	(1)	(1)	22,657	309,995
Georgia	1,146,100	16,961,781	74,555	$378,747	1,220,655	17,340,528
Pennsylvania	(1)	(1)	(1)	(1)	62,626	250,383
South Carolina	(1)	(1)	(1)	(1)	348,948	4,505,022
Other States [2]	430,593	5,311,841	40,561	128,334	36,923	374,775
Total	1,635,742	23,436,701	115,116	507,081	1,750,858	23,943,782
1951						
Alabama, Florida, and North Carolina	65,776	1,227,365			65,776	1,227,365
California	(1)	(1)	(1)	(1)	24,285	381,650
Georgia	1,191,767	17,840,265	132,043	859,470	1,323,810	18,699,735
Pennsylvania	(1)	(1)	(1)	(1)	75,415	306,045
South Carolina	(1)	(1)	(1)	(1)	322,208	4,095,912
Other States [2]	434,937	5,273,176	41,776	124,278	54,805	613,847
Total	1,692,480	24,340,806	173,819	983,748	1,866,299	25,324,554

[1] Included with "Other States."
[2] Includes States indicated by footnote 1 and Illinois, Nevada (1950 only), Utah, and Virginia.

Ten States reported kaolin sold or used by producers in 1951 compared with eleven in 1950; Nevada did not report in 1951. As has been the case for several years, Georgia ranked first with 70 percent of the total, the same as in 1950, South Carolina was second with 17 percent, and Pennsylvania was third with 4 percent. All States or groups of States for which statistics are published in table 3 show substantial gains in output in 1951 compared with 1950.

TABLE 4.—Georgia kaolin sold or used by producers, 1947–51, by uses

Year	China clay, paper clay, etc.			Refractory uses			Total kaolin		
	Short tons	Value		Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per ton		Total	Average per ton
1947	902, 554	$12, 034, 383	$13. 33	129, 459	$721, 658	$5. 57	1, 032, 013	$12, 756, 041	$12. 36
1948	1, 006, 325	13, 866, 799	13. 78	129, 115	775, 899	6. 01	1, 135, 440	14, 642, 698	12. 90
1949	902, 433	13, 229, 888	14. 66	100, 958	576, 448	5. 71	1, 003, 391	13, 806, 336	13. 76
1950	1, 087, 174	16, 533, 582	15. 21	133, 481	806, 946	6. 05	1, 220, 655	17, 340, 528	14. 21
1951	1, 147, 865	17, 615, 634	15. 34	175, 945	1, 084, 101	6. 16	1, 323, 810	18, 699, 735	14. 13

Quotations on Georgia kaolin, as reported in E&MJ Metal and Mineral Markets, for filler and ceramic grades were given in June 1951 (the last quotation in 1951) as $8.50 to $9.50 per short ton, depending upon grade, for crushed material and $13 to $17 for pulverized, in paper bags. North Carolina china clays, ceramic grades in bulk, carlots, were quoted at $20.25 to $22.25 per ton. Florida kaolins were quoted by the same source at $18.75 per ton for purified and crushed; $24.75 for washed and air-floated clays; and $38.50 for air-floated enamel grade. Crude Pennsylvania kaolin was quoted at $5 to $7.50 per ton and "purified" kaolin at $21 to $24. These prices were the same as those quoted in December 1950 and are substantially the same as those quoted in 1949.

Prices of imported china clay in December 1951 were quoted by the Oil, Paint and Drug Reporter as follows: White lump, carlots, ex dock (Philadelphia, Pa., and Portland, Maine), $20 to $40 per long ton; powdered, ex dock, in bags, $45 per net ton; and powdered, l. c. l., ex warehouse, $56. There has been very little change in price since October 1949. The average value of domestic kaolin sold or used as reported to the Bureau of Mines in 1951 was $13.57 per short ton compared with $13.68 for 1950 and $13.43 for 1949.

Imports of kaolin for 1951 decreased 10 percent from 1950 and represented only 6 percent of total domestic consumption in 1951 compared with 7 percent in 1950 and 5 percent in 1949. Of 1951 imports, totaling 110,475 short tons, 99 percent came from the United Kingdom and the remainder from Canada, France, Italy, and Australia.

Exports of kaolin or china clay in 1951 rose 29 percent over 1950 to 36,435 short tons, of which 86 percent was shipped to Canada. Small tonnages also were sent to Mexico, Central and South America, Europe, Union of South Africa, Japan, Indonesia, and Australia.

J. M. Huber Corp. published a book on the properties and industrial uses of kaolin, with emphasis on the applications of kaolin to synthetic rubber and machine coating of paper. Reference also is made to other important applications, such as ceramics and insecticides.[2]

Viscosity control of concentrated clay suspensions was discussed, giving special attention to kaolins. The viscosity of clays in concentrated suspension depends to a large extent on the shape of the particles and on the composition with respect to particle size.[3]

[2] J. M. Huber Corp., Kaolin Clays and Their Industrial Uses: New York, N. Y., 1949, 141 pp.
[3] Millman, N., Viscosity Control of Concentrated Clay Suspensions: Ceram. Age, vol. 58, No. 3, September 1951, pp. 34–38.

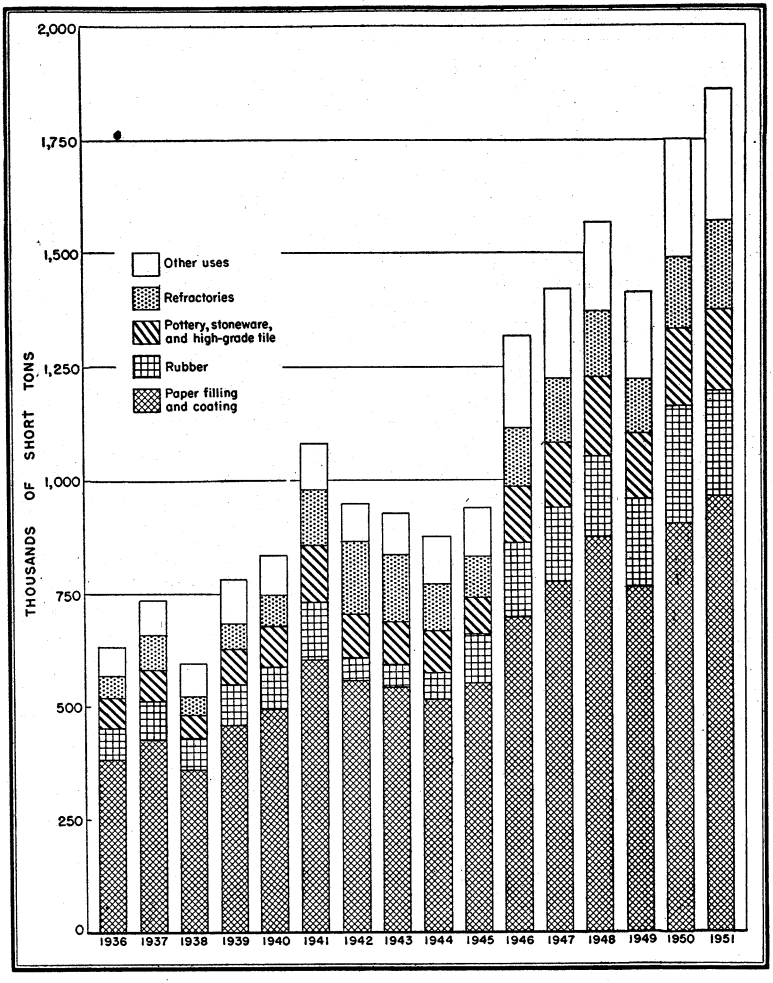

FIGURE 1.—Kaolin sold or used by domestic producers for specified uses, 1936–51.

BALL CLAY

Ball-clay production in 1951 set a record for tonnage, although the value decreased 6 percent compared with 1950. For the ninth consecutive year, Tennessee was the leader in tons produced, with 56 percent of the United States total. Kentucky ranked second, with 32 percent. Other leading States, in order of tons produced, were Maryland, Mississippi, and New Jersey. Compared to 1950 Kentucky and Tennessee each increased tonnage produced 5 percent in 1951.

The pottery industry consumed 78 percent of the ball clay produced in 1951 compared to 79 percent in 1950. Ball clay used in making whiteware increased 5 percent, and the quantities used in high-grade tile, architectural terra cotta, and enameling increased over the

previous year. In 1951 high-grade tile was 12 percent, refractories 6 percent, and miscellaneous smaller uses 4 percent of the total national output.

TABLE 5.—Ball clay sold by producers in the United States, 1949–51, by States

State	1949		1950		1951	
	Short tons	Value	Short tons	Value	Short tons	Value
Kentucky	89, 281	$1, 076, 531	105, 690	$1, 325, 161	111, 215	$1, 411, 175
Maryland, Mississippi, and New Jersey	27, 265	327, 427	34, 290	424, 480	39, 575	532, 113
Tennessee	132, 337	1, 660, 481	184, 434	2, 230, 526	194, 191	1, 782, 642
Total	248, 883	3, 064, 439	324, 414	3, 980, 167	344, 981	3, 725, 930

Price quotations appearing in E&MJ Metal and Mineral Markets in 1951, unchanged from 1950 and 1949 quotations, were as follows: Tennessee crude ball clay, $10 per short ton, and air-floated and pulverized, $19.50 per ton; Maryland—shredded, in bulk, $7 to $9, and air-floated, in bags, $14 to $17.50 per ton. No quotations on Kentucky ball clay in 1951 or 1950 were given in E&MJ Metal and Mineral Markets. In 1951 the average value per ton for ball clay as reported by producers to the Bureau of Mines was $10.80 compared with $12.27 in 1950 and $12.31 in 1949. In 1951 the average price per ton for Tennessee was $9.18; for Kentucky, $12.69, and for Maryland, Mississippi, and New Jersey, $13.45.

Imports of common blue and ball clay and Gross Almerode clays in 1951 increased less than 2 percent in tonnage and 4 percent in value compared with 1950. Unmanufactured blue and ball clays represented the major share of imports; United Kingdom supplied 84 percent of this classification and virtually all the imports of manufactured blue and ball clay. Small tonnages of imports of blue and ball clays came from Canada and Germany. Imports of Gross Almerode clays from United Kingdom and Germany totaled 80 and 15 tons, respectively. Exports, if any, are not separately shown in official foreign trade returns.

FIRE CLAY

The largest annual tonnage in the history of the fire-clay industry was sold or used in 1951, exceeding the previous high year of 1948 by 20 percent and 1950 by 24 percent. An expanded national economy and increased activity in the refractory and construction industries beginning in 1950 and carrying over into 1951 were the governing factors effecting the increase.

The principal uses of fire clay in 1951 were in refractories manufacture—6,892,722 short tons (34-percent increase over 1950)—and heavy clay products—4,615,634 short tons (15-percent increase over 1950). Refractories and heavy clay products use, combined, comprised 97 percent of the total tonnage output in 1951 compared with 96 percent in 1950. About 1 percent was consumed in manufacturing high-grade tile, a similar amount in chemicals, and the remainder in a wide variety of uses. The principal refractory use of fire clay is for the

manufacture of fire brick and block; this took 5,635,296 tons in 1951, a 45-percent increase over 1950. Several less important uses, such as high-grade tile, architectural terra cotta, and chemicals, decreased in 1951 compared with 1950. No consumption of fire clay by the rubber industry was reported in 1951.

TABLE 6.—Fire clay, including stoneware clay, sold or used by producers in the United States, 1950–51, by States [1]

State	Sold by producer		Used by producer		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1950						
Alabama	116,714	$211,180	51,065	$84,584	167,779	$295,764
Arkansas	(2)	(2)	(2)	(2)	256,042	789,876
California	206,567	527,476	198,612	473,362	405,179	1,000,838
Colorado	155,707	314,407	64,690	211,933	220,397	526,340
Illinois	220,040	980,250	213,383	451,122	433,423	1,431,372
Indiana	372,259	526,776	131,402	274,342	503,661	801,118
Kentucky	73,459	399,126	349,439	1,690,968	422,898	2,090,094
Maryland	10,743	60,317	156,702	560,005	167,445	620,322
Missouri [3]	377,598	1,071,298	843,578	2,960,049	1,221,176	4,031,347
New Jersey	66,370	595,483	244,772	396,404	311,142	991,887
Ohio	793,697	2,177,968	1,969,109	4,946,634	2,762,806	7,124,602
Pennsylvania	265,288	1,010,591	1,466,567	6,138,998	1,731,855	7,149,589
Tennessee	(2)	(2)	(2)	(2)	20,574	182,692
Texas	3,778	27,148	303,248	647,622	307,026	674,770
Utah	11,913	42,246	24,246	68,846	36,159	111,092
Washington	15,030	19,108	52,996	115,026	68,026	134,134
West Virginia	(2)	(2)	(2)	(2)	309,100	735,285
Other States [4]	83,758	358,893	693,137	1,677,210	191,179	328,250
Total	2,772,921	8,322,267	6,762,946	20,697,105	9,535,867	29,019,372
1951						
Alabama	128,781	239,201	74,558	467,829	203,339	707,030
Arkansas	(2)	(2)	(2)	(2)	319,941	1,022,326
California	209,070	567,777	301,151	868,595	510,221	1,436,372
Colorado	201,746	422,065	131,679	406,246	333,425	828,311
Illinois	248,482	1,187,344	243,645	587,526	492,127	1,774,870
Indiana	358,292	517,792	141,431	303,880	499,723	821,672
Kentucky	140,466	622,838	442,825	3,037,788	583,291	3,660,626
Maryland	10,812	51,381	169,490	580,798	180,302	632,179
Missouri [3]	401,057	1,250,331	1,171,465	8,448,387	1,572,522	9,698,718
New Jersey	81,403	702,209	344,658	1,070,522	426,061	1,772,731
Ohio	939,822	2,789,217	2,214,130	8,351,767	3,153,952	11,140,984
Pennsylvania	327,381	1,322,847	1,878,413	10,330,887	2,205,794	11,653,734
Tennessee	(2)	(2)	(2)	(2)	23,759	226,009
Texas	2,845	19,607	317,393	744,621	320,238	764,228
Utah	5,375	28,125	29,968	80,130	35,343	108,255
Washington	18,109	24,505	47,368	117,828	65,477	142,333
West Virginia	(2)	(2)	(2)	(2)	732,492	1,923,872
Other States [4]	86,026	441,365	1,184,676	3,157,188	194,510	426,346
Total	3,159,667	10,186,604	8,692,850	38,553,992	11,852,517	48,740,596

[1] Includes stoneware clay as follows: 1950—105,147 tons, $235,063; 1951—85,331 tons, $271,625.
[2] Included with "Other States."
[3] Includes diaspore and burley clay as follows: 1950—diaspore, 40,750 tons, $488,464; burley, 53,571 tons, $334,299. 1951—diaspore, 45,020 tons, $704,151; burley, 73,781 tons, $745,032.
[4] Includes States indicated by footnote 2 above and Delaware (1950 only), Idaho, Iowa, Kansas, Massachusetts, Michigan, Minnesota, Mississippi, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oregon, and South Carolina.

In 1951 Ohio ranked first in fire-clay output, followed by Pennsylvania, Missouri, West Virginia, Kentucky, California, and Indiana. These 7 States supplied 78 percent of the total. The remainder was produced in 24 States in 1951 (25 in 1950; Delaware did not report in 1951). Of the 17 principal producing States shown in table 6, Indiana, Utah, and Washington reported decreases, and the other 14 reported increases.

Price quotations on fire clay do not appear in trade journals; however, the average realization per ton from sales reported to the Bureau

of Mines by producers indicated that the average value of fire clay sold in 1951 was $3.22 compared with $3 in 1950 and $2.91 in 1949. The average value of all fire clay, including sales and captive tonnage, was $4.11 in 1951 compared to $3.04 in 1950, and $2.96 in 1949. Quotations on brick manufactured from fire clay were reported in 1951 in E&MJ Metal and Mineral Markets (1950 price in parentheses) as follows: Missouri, Kentucky, and Pennsylvania, first quality, $116.50 per thousand ($116.60), and second quality, $99.60 per thousand ($99.60); and Ohio firebrick, intermediate grade, $88 per thousand ($83), and second grade $79.20 per thousand ($79.20).

Imports of fire clay are not shown separately in foreign trade statistics. Exports of fire clay in 1951 were greater by 35 percent in tonnage and 46 percent in value than in 1950 and totaled 101,146 short tons valued at $1,028,719. Canada took 88 percent of the total exports and Mexico 7 percent. The remainder (5 percent) comprised small tonnages to 40 destinations in Central and South America, Europe, Asia, and Africa.

The geology, mineralogy, petrography, known deposits, and present and potential reserves of refractory clays of Maryland were discussed.[4]

BENTONITE

Bentonite production broke all records in 1951. According to reports of producers, there was a 25-percent tonnage increase and 52-percent value increase in 1951 over 1950. Increased activity in oil-well drilling and overall expansion in the foundry industry were responsible for the large output of bentonite.

The foundry and petroleum industries consumed 94 percent of the total tonnage; of this, rotary-drilling mud represented 38 percent (460,261 short tons), filtering and decolorizing oils 33 percent (397,940 short tons), and foundry-sand bond 23 percent (282,753 short tons). The remainder (77,914 short tons) went into a wide variety of uses. Bentonite used for rotary-drilling mud increased 29 percent in 1951 over 1950, filtering and decolorizing oils 34 percent, and foundry-sand bond 12 percent.

The same 9 States reported bentonite production in 1951 as in 1950. Increases in tonnage were noted for Arizona, California, Colorado, Mississippi, South Dakota, Texas and Wyoming, and decreases for Idaho and Utah.

TABLE 7.—Bentonite sold or used by producers in the United States, 1949–51, by States

State	1949		1950		1951	
	Short tons	Value	Short tons	Value	Short tons	Value
South Dakota	137,376	$1,515,927	192,591	$2,194,894	246,585	$2,926,756
Texas	27,598	302,384	24,574	321,345	38,425	212,670
Wyoming	350,644	3,556,480	394,939	4,091,571	465,254	5,981,655
Other States [1]	351,625	1,563,961	361,729	1,952,859	468,604	3,885,564
Total	867,243	6,938,752	973,833	8,560,669	1,218,868	13,006,645

[1] Arizona, California, Colorado (1950–51 only), Idaho, Mississippi, Montana (1949 only), and Utah.

[4] Waage, Karl M., Refractory Clays of the Maryland Coal Measures: Econ. Geol., vol. 46, No. 8, December 1951, pp. 926–927.

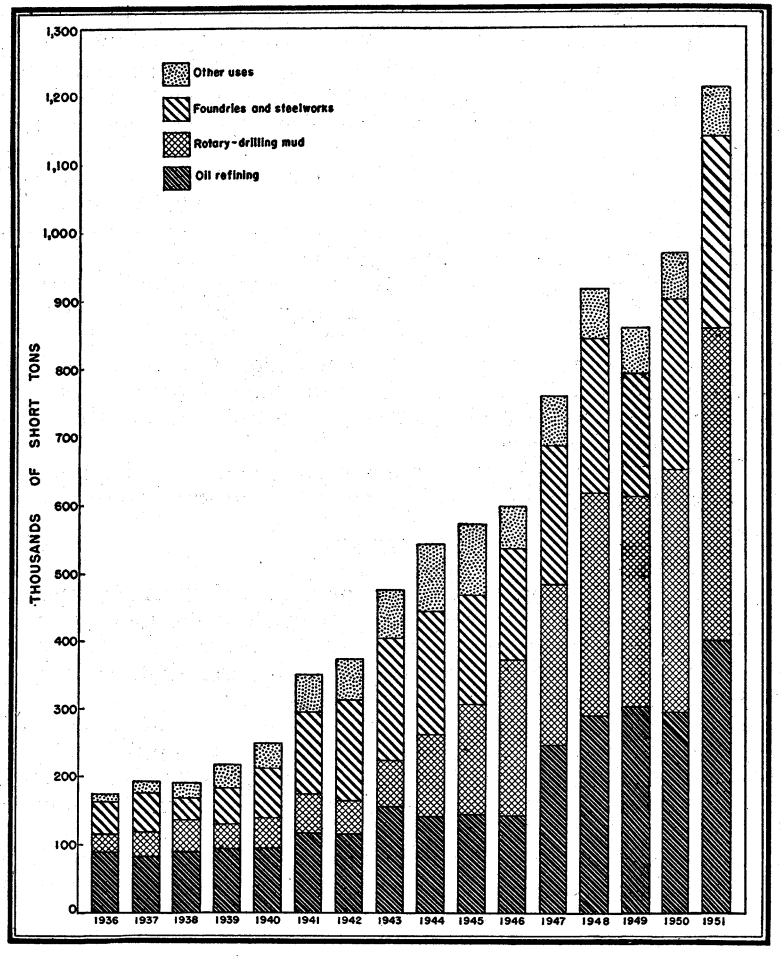

FIGURE 2.—Bentonite sold or used by domestic producers for specified uses, 1936–51.

The Wyoming-South Dakota district supplied 58 percent of the total bentonite production in 1951 (Wyoming 38 percent and South Dakota 20 percent) compared with 60 percent in 1950. Texas furnished 3 percent of the total, the same as it had each year since 1948. Trends in sales for principal uses are shown in figure 2.

In 1951 Wyoming bentonite was quoted in E&MJ Metal and Mineral Markets as follows: Dried, crushed, in bulk, $9 per ton; and 200-mesh, pulverized, in 100-pound bags, $12.50. Oil-well grade was quoted at $14 per ton. The average value per ton as reported by producers to the Bureau of Mines in 1951 increased to $10.67 compared with $8.79 in 1950 and $8 in 1949.

Less than 50 tons of bentonite was imported in 1951, mostly from Canada, with a token amount from Italy.

Exports of bentonite are not shown separately in foreign trade statistics but are included under the blanket classification of "Other clays or earths, not specifically provided for." It is understood, however, that some domestic producers export part of their production to destinations throughout the world.

Control tests for the gel-forming properties of bentonite as well as bentonite determination in ceramic mixtures were discussed.[5]

FULLER'S EARTH

The production of fuller's earth continued to rise in 1951, increasing 22 percent over 1950, the previous record year.

In 1951 mineral-oil refining was still the largest single consumer, although it did not pace the overall rise in national output. Consumption for this use in 1951 represented 36 percent of total production compared with 40 percent in 1950 and 47 percent in 1949. It was the consensus of opinion that this trend resulted, in part, from improved methods of oil refining and marketing of a higher quality of fuller's earth.

Absorbent uses took 97,465 tons (20 percent of the total compared with 21 percent in 1950 and 22 percent in 1949); insecticides 86,339 tons (18 percent compared with 18 percent in 1950 and 12 percent in 1949); rotary-drilling mud 79,469 tons (16 percent compared with 10 percent in 1950 and 9 percent in 1949); and vegetable-oil refining 20,251 tons (4 percent compared with 5 percent in 1950 and 6 percent in 1949). The remainder was used in other filtering and clarifying, binders, and other unspecified uses.

Nevada was the only State that showed a tonnage decrease in 1951 over 1950. The Florida-Georgia area furnished 62 percent of the total tonnage produced in 1951, the same as in 1950, while production in Texas supplied 29 percent compared with 28 percent in 1950.

As reported by E&MJ Metal and Mineral Markets in 1951, quotations on Georgia and Florida fuller's earth remained unchanged in 1951 from those of 1950 and 1949. Prices were as follows: 14- to 30-mesh, $14 per short ton; 30- to 60-mesh, $14.50; 100-mesh up, $7; and 200-mesh up, $10. The average value of fuller's earth sold or used, as reported to the Bureau of Mines by producers, was $16.81 per ton in 1951 compared with $16.42 in 1950 and $16.20 in 1949.

TABLE 8.—Fuller's earth sold or used by producers in the United States, 1949–51, by States

State	1949		1950		1951	
	Short tons	Value	Short tons	Value	Short tons	Value
Florida and Georgia	181,993	$3,194,551	247,390	$4,273,890	299,071	$5,258,330
Illinois	9,104	118,647				
Texas	100,745	1,242,558	112,466	1,393,773	142,273	1,952,304
Other States [1]	29,064	643,886	36,169	837,070	42,279	921,127
Total	320,906	5,199,642	396,025	6,504,733	483,623	8,131,761

[1] Includes California, Mississippi, Nevada, Tennessee, and Utah.

[5] Bartos, Leon H., Control Tests for the Gel-Forming Properties of Bentonites: Ceram. Age, vol. 57, No. 5, May 1951, pp. 20–22.

Imports of fuller's earth in 1951 totaled 405 short tons, all from the United Kingdom except a small amount from Canada. Exports are not given separately in official foreign statistics. Reports from the producers to the Bureau of Mines, however, indicated exports of approximately 35,000 short tons in 1951 compared with 16,400 tons in 1950. Destinations reported include North America, Central and South America, West Indies, several European nations, Bahrein Island, Saudi Arabia, and the Philippines.

The characteristics, activation and uses of fuller's earth were discussed.[6]

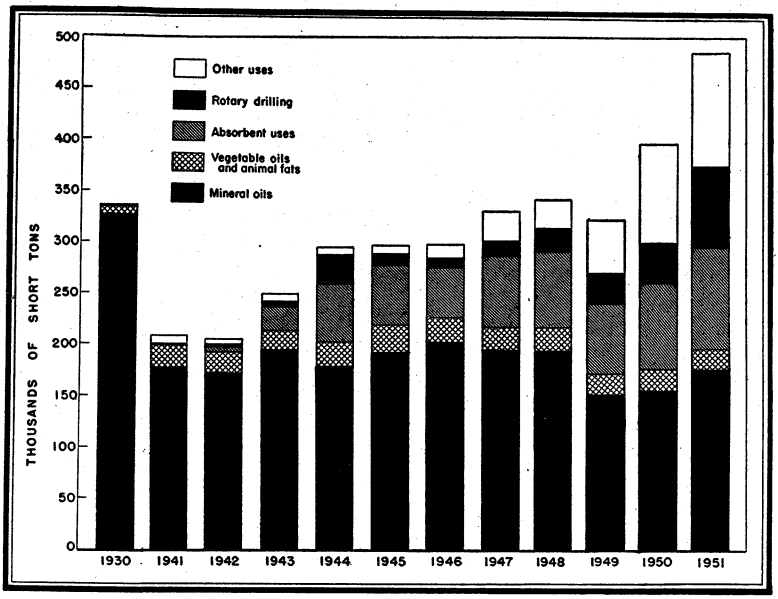

FIGURE 3.—Fuller's earth sold or used by producers for specified uses, 1930 and 1941–51.

MISCELLANEOUS CLAYS

This section includes statistics for the large-tonnage clays and shales, other than those discussed in the preceding pages, that are used in the manufacture of heavy clay products and portland cement. With these clays are grouped small tonnages of slip clay, oil-well drilling mud, pottery clay, and other clays that cannot be clearly identified with one of the types discussed separately in this chapter.

The demand for clay products and cement in the construction field that was evident in 1950 carried over into 1951. For this reason production of miscellaneous clays increased 5 percent in tonnage over 1950. In 1951, 69 percent of the total miscellaneous clays were used in manufacturing heavy clay products and 28 percent in cement. Tonnage consumed in heavy clay products was 3 percent more than

[6] Mineral Information Service, Department of Natural Resources, State of California, Absorbent Clay: Vol. 5, No. 7, July 1951, pp. 1–2.

in 1950, and quantities used in cement manufacture rose 10 percent. Captive tonnage, or clay produced by the mine operators for their own use in manufacturing brick, tile, cement and other end products and marketed for the first time as such, amounted to 96 percent (the same as for the past 5 years) of all miscellaneous clays and shales (figures for which are given in this section). The average value per ton of the miscellaneous clays sold as crude or prepared clay in 1951 was $2.05. Some special types of clay included under the "miscellaneous" clay classification, however, sold for much higher amounts. The value of the captive tonnage was computed from individual estimates that generally were around $1 per ton.

Miscellaneous clays, including shales and the so-called common or surface clays, are of widespread occurrence, and workable commercial deposits were reported in all States in 1951 except Nevada and Rhode Island. Three States—California, Illinois, and Ohio—reported tonnage production exceeding 2 million short tons each. Other States reporting a production of over 1 million tons were, in order of output:

TABLE 9.—Miscellaneous clays, including shale and slip clay, sold or used by producers in the United States, 1950–51, by States

State	Sold by producers [1]		Used by producers [2]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1950						
Alabama	(3)	(3)	(3)	(3)	1,170,153	$900,329
Arkansas			219,117	$217,127	219,117	217,127
California	124,389	$468,616	1,722,993	1,454,109	1,847,382	1,922,725
Colorado	(3)	(3)	(3)	(3)	281,238	231,740
Connecticut			292,367	236,317	292,367	236,317
Georgia			1,024,095	804,190	1,024,095	804,190
Illinois	(3)	(3)	(3)	(3)	2,086,008	1,966,336
Indiana	93,775	89,981	815,297	714,320	909,072	804,301
Iowa	4,890	79,330	834,514	749,512	839,404	828,842
Kansas			706,615	563,670	706,615	563,670
Kentucky			189,624	180,710	189,624	180,710
Louisiana	(3)	(3)	(3)	(3)	327,067	273,116
Maine			31,917	26,561	31,917	26,561
Maryland	(3)	(3)	(3)	(3)	558,888	435,493
Massachusetts			148,420	115,318	148,420	115,318
Michigan	(3)	(3)	(3)	(3)	1,425,493	1,135,740
Minnesota	(3)	(3)	(3)	(3)	110,962	97,385
Mississippi	(3)	(3)	(3)	(3)	268,690	247,467
Missouri	(3)	(3)	(3)	(3)	725,551	624,921
Montana			33,817	33,817	33,817	33,817
Nebraska	(3)	(3)	(3)	(3)	152,880	148,017
New Hampshire	(3)	(3)	(3)	(3)	22,719	17,115
New Jersey			286,885	234,943	286,885	234,943
New Mexico	(3)	(3)	(3)	(3)	44,364	43,994
New York	(3)	(3)	(3)	(3)	1,443,129	1,155,656
North Carolina			1,413,314	1,269,381	1,413,314	1,269,381
Ohio	86,387	94,851	2,127,937	1,835,769	2,214,324	1,930,620
Oklahoma	(3)	(3)	(3)	(3)	555,910	493,659
Oregon			159,049	123,163	159,049	123,163
Pennsylvania	25,934	60,784	1,661,779	1,354,562	1,687,713	1,415,346
South Carolina			638,852	508,223	638,852	508,223
Tennessee	(3)	(3)	(3)	(3)	877,659	634,652
Texas	16,395	297,126	1,578,816	1,328,377	1,595,211	1,625,503
Utah			234,450	543,552	234,450	543,552
Washington	(3)	(3)	(3)	(3)	215,433	167,647
West Virginia			366,001	269,135	366,001	269,135
Wisconsin	(3)	(3)	(3)	(3)	162,611	132,056
Wyoming			18,332	10,551	18,332	10,551
Undistributed [4]	474,307	466,047	11,070,181	9,111,168	1,115,733	871,892
Total	826,077	1,556,735	25,574,372	21,684,475	26,400,449	23,241,210

For footnotes, see end of table.

TABLE 9.—Miscellaneous clays, including shale and slip clay, sold or used by producers in the United States, 1950-51, by States—Continued

State	Sold by producers [1]		Used by producers [2]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1951						
Arkansas			171,518	$184,532	171,518	$184,532
California	117,142	$644,775	1,927,134	1,947,648	2,044,276	2,592,423
Colorado	(3)	(3)	(3)	(3)	323,808	340,558
Connecticut			275,900	252,725	275,900	252,725
Georgia			1,083,952	978,727	1,083,952	978,727
Illinois	(3)	(3)	(3)	(3)	2,097,013	2,249,324
Indiana	87,250	95,321	937,758	997,464	1,025,008	1,092,785
Iowa	3,302	57,963	877,752	955,550	881,054	1,013,513
Kansas			708,910	680,821	708,910	680,821
Kentucky			185,734	202,484	185,734	202,484
Louisiana	(3)	(3)	(3)	(3)	306,542	306,542
Maine			21,885	21,885	21,885	21,885
Maryland	(3)	(3)	(3)	(3)	558,083	558,083
Massachusetts			143,023	143,023	143,023	143,023
Michigan	(3)	(3)	(3)	(3)	1,509,712	1,579,065
Minnesota	(3)	(3)	(3)	(3)	111,984	127,206
Missouri	(3)	(3)	(3)	(3)	782,335	859,720
Montana			34,431	34,431	34,431	34,431
Nebraska	(3)	(3)	(3)	(3)	114,845	114,845
New Hamsphire			(3)	(3)	28,501	28,501
New Jersey			253,159	277,368	253,159	277,368
New Mexico	(3)	(3)	(3)	(3)	56,780	89,918
New York	(3)	(3)	(3)	(3)	1,559,472	1,632,878
North Carolina	875	1,312	1,432,505	1,564,717	1,433,380	1,566,029
Ohio	115,351	127,944	2,417,327	2,495,129	2,532,678	2,623,073
Oklahoma	(3)	(3)	(3)	(3)	551,200	561,841
Oregon			143,479	148,479	143,479	148,479
Pennsylvania	21,466	31,738	1,927,892	2,096,033	1,949,358	2,127,771
South Carolina			619,272	620,022	619,272	620,022
Texas	28,554	326,200	1,687,563	1,689,563	1,716,117	2,015,763
Utah			203,809	567,869	203,809	567,869
Washington	(3)	(3)	(3)	(3)	220,887	224,475
West Virginia			371,154	371,154	371,154	371,154
Wisconsin	(3)	(3)	(3)	(3)	141,746	141,746
Wyoming			17,796	17,796	17,796	17,796
Undistributed [4]	615,799	740,659	11,217,799	11,419,498	3,470,690	3,345,455
Total	989,739	2,025,912	26,659,752	27,666,918	27,649,491	29,692,830

[1] Includes slip clay as follows: 1950-51—Indiana, Michigan, and New York; figures cannot be shown separately. Purchases by portland-cement companies of common clay and shale: 1950—555,910 tons, estimated at $466,600; 1951—658,450 tons, estimated at $660,936.

[2] Includes the following: Common clay and shale used by portland-cement companies: 1950—6,453,777 tons, estimated at $4,840,342; 1951—7,060,473 tons, estimated at $7,205,289.

[3] Included under "Undistributed."

[4] Figures include Alabama (1951 only), Arizona, Delaware, District of Columbia, Florida, Idaho, Mississippi (1951 only), Nevada (1950 only), North Dakota, South Dakota, Tennessee (1951 only), Vermont, Virginia, and States indicated by footnote 3.

Pennsylvania, Texas, New York, Michigan, North Carolina, Georgia, Alabama, and Indiana. Of the States for which data are shown in table 9, 21 reported increases and 17 decreases in output in 1951 compared with 1950.

Increased manufacturing capacity resulting from new plants and efficient alterations in existing plants of the vitrified clay sewer pipe industry helped to increase the demand for miscellaneous clays and shales.[7]

[7] Brick and Clay Record, vol. 118, No. 3, March 1951, pp. 30-36.
Ceramic Age, New Dickey Plant: Vol. 56, No. 5, November 1951, p. 11.
Hawley, Addison, Jr., Increased and Cheaper Production of Clay Pipe: Am. Ceram. Soc. Bull., vol. 30, No. 6, June 1951, pp. 206-207.

HEAVY CLAY PRODUCTS

The demand for structural clay products in 1951 with relation to 1950 was varied; some products showed increases and others decreases. The increases in shipments in 1951 over 1950 were as follows: Drain tile, 4 percent; hollow facing tile, 8 percent; glazed and unglazed floor and wall tile, 11 percent. The decreases were: Unglazed brick (common and face), 3 percent; unglazed structural tile, 11 percent; vitrified clay sewer pipe, 1 percent.

The total value of the principal structural clay products in 1951 increased 8 percent to $352,000,000 from $327,000,000 in 1950.

TABLE 10.—Shipments of principal structural clay products in the United States, 1949–51 [1]

Product and unit of quantity	1949		1950		1951	
	Quantity	Value (thousand dollars)	Quantity	Value (thousand dollars)	Quantity	Value (thousand dollars)
Unglazed brick (common and face) M stand. brick	5,251,633	129,179	6,486,332	164,470	6,306,561	170,743
Unglazed structural tile short tons	1,259,445	14,060	1,316,972	14,896	1,166,879	14,098
Vitrified clay sewer pipe do	1,349,598	44,641	1,567,664	53,402	1,554,711	58,238
Drain tile do	688,010	11,084	627,545	10,191	655,757	11,387
Hollow facing tile, glazed and unglazed M brick equiv.	357,461	18,717	432,027	22,438	467,767	25,984
Glazed and unglazed floor and wall tile and accessories, including quarry tile M square feet	93,115	43,905	127,302	61,579	141,322	71,277

[1] Compiled from information furnished by the Bureau of the Census, U. S. Department of Commerce.

The value of shipments of all branches of the clay-refractories industry shown in table 11 followed the same pattern of increases in 1951 over 1950 as 1950 had shown over 1949. Overall expansion in the steel and foundry industries (due for the most part to the national emergency) augmented the demand for clay refractories. The value of shipments of firebrick (except superduty) was $78,562,000, 37 percent over 1950; superduty fire-clay brick, $16,158,000, 60 percent over 1950; and ladle brick, $14,652,000, 21 percent over 1950.

A new trade association, the Refractories Institute, was formed by the members of the refractory industry to promote demand for the products of the industry and to spur additional research with the objective of further improving products and processes. The headquarters are in Pittsburgh, Pa.[8]

[8] Brick and Clay Record, vol. 119, No. 1, July 1951, pp. 48–49.

TABLE 11.—Production and shipments of refractories in the United States, 1950–51, by kind

[Bureau of the Census]

Product	Unit of quantity	1950			1951		
		Production (quantity)	Shipments		Production (quantity)	Shipments	
			Quantity	Value (thousands of dollars)		Quantity	Value (thousands of dollars)
Clay refractories:							
Fire-clay brick, standard and special shapes, except superduty.	1,000 9-in. equiv.	560,492	565,103	57,489	725,659	710,289	78,562
Superduty fire-clay brick, standard and special shapes.	do	63,105	64,046	10,108	94,916	92,783	16,158
High-alumina brick, standard and special shapes (50 percent Al_2O_3 and over, except fused alumina and mullite).	do	17,620	17,670	4,757	23,643	23,414	6,825
Insulating firebrick, standard and special shapes.	do	40,986	43,204	7,635	56,052	56,605	11,076
Ladle brick	do	196,869	198,230	12,075	229,694	226,918	14,652
Hot-top refractories	do	41,847	42,640	4,489	56,047	54,944	5,517
Sleeves, nozzles, runner brick and tuyeres.	do	53,076	53,106	6,895	65,809	65,581	8,879
Glass-house pots, tank blocks, upper structure, and floaters.	Short tons	19,919	21,294	3,177	25,601	25,763	3,819
High-temperature bonding mortars	do	65,146	65,517	5,494	83,027	82,745	6,877
Plastic refractories (including wet and dry ramming mixtures).	do	90,687	91,455	4,511	100,089	99,577	5,529
Cast and castables (hydraulic setting)	do	57,743	57,300	4,396	69,534	69,138	5,628
Ground crude fire-clay and high-alumina material.	do	380,385	381,163	3,611	446,426	444,970	4,877
Other clay refractories				2,049			2,687
Total clay refractories				126,686			171,086
Nonclay refractories:							
Silica brick, standard and special shapes.	1,000 9-in. equiv.	312,334	309,353	38,222	368,653	374,237	51,686
Magnesite and magnesite-chrome (magnesite predominating) brick, standard and special shapes.	do	28,135	27,779	14,415	39,846	39,132	21,800
Chrome and chrome-magnesite (chrome predominating) brick, standard and special shapes.	do	46,528	45,489	19,672	57,133	55,949	27,343
Graphite and other carbon crucibles and retorts.	Short tons	10,116	10,329	5,690	13,737	13,343	7,425
Other graphite and carbon refractories	do	1,269	1,206	503	1,543	1,527	677
Silicon carbide				7,957			10,940
Mullite and kyanite				3,509			4,461
Sillimanite				238			379
Fused alumina and bauxite				2,255			3,538
Zirconia, forsterite, fused magnesia, pyrophyllite, and other nonclay shapes.				3,995			5,995
High-temperature bonding mortars	Short tons	38,101	38,175	4,345	47,136	46,787	5,644
Plastic refractories (including wet and dry ramming mixtures)	do	98,721	98,858	7,175	133,608	133,292	10,522
Other nonclay refractory materials, sold in lump or ground form (including ground silica and nonclay cast and castables).				3,995			5,346
Total nonclay refractories [1]				111,971			155,756
Grand total refractories [1]				238,657			326,842

[1] Data for dead-burned magnesia or magnesite excluded to avoid duplication in other refractory products covered in this table (such as magnesite brick and shapes). Quantity and value of shipment of dead-burned magnesia or magnesite totaled 283,000 tons valued at $11,901,000 in 1950, and 372,000 tons valued at $16,620,000 in 1951.

Harbison-Walker Refractories Co. approved plans for a new plant at Fairfield, near Birmingham, Ala., for the production of fire brick and other refractories for steel plant service. It was reported the cost would approximate 4 million dollars.[9]

Expansion and plant modernization in the refractories industry kept pace with the demand for all types of refractory products.[10]

Plant modernization and improved manufacturing methods were described in several published articles, especially for structural clay products,[11] and pottery.[12] The expansion of the ceramic industry helped to increase the consumption of clays and shales.

TECHNOLOGY

Since January 1, 1950, the Structural Clay Products Research Foundation had been engaged in a full-scale industry-wide research program on new and improved clay products, and new methods of manufacture and construction.[13]

The National Clay Pipe Research Corp. was conducting a general research program on the production of vitrified clay pipe. One phase of this program was a study by the Ohio State University Research Foundation in reference to firing and cooling shrinkage behavior of structural clay bodies. Many materials tested are used in the production of heavy clay products other than vitrified clay pipe.[14]

An investigation was carried out at the Department of Ceramic Engineering, University of Illinois, designed to determine the effects of different heating ratio upon the shrinkage characteristics of clays and shales. The results showed a similarity in the shrinkage behavior of shales and fire clays.[15]

A study was conducted to determine the thermal reactions taking place during the firing of brick made from fire clays and shales. The object of the study was to obtain fundamental data needed for a better understanding of reactions that occur within a brick during firing.[16]

The corrosion resistance of high-purity refractories when exposed to molten glass of ordinary colorless bottle-glass composition was investigated. The refractory mixtures were made from kaolin, calcined alumina, and flint.[17]

[9] Ceramic Age, vol. 57, No. 4, April 1951, p. 12.

[10] Brick and Clay Record, vol. 118, No. 2, February 1951, pp. 50, 60; No. 3, March 1951, p. 23; No. 5, May 1951, p. 54; vol. 119, No. 3, September 1951, pp. 57–58; No. 4, October 1951, p. 73; No. 5, pp. 57–58.
Ceramic Age, vol. 57, No. 3, March 1951, p. 36.

[11] Brick and Clay Record, vol. 118, No. 2, February 1951, p. 60; No. 3, March 1951, pp. 41–47, 49–51, 53–55, 80; No. 4, April 1951, pp. 36–38, 41–43, 45–49, 88–92; No. 5, May 1951, pp. 26–27, 29. Vol. 119, No. 2, August 1951, pp. 34–36, 40–42; No. 3, September 1951, pp. 36–52; No. 4, October 1951, pp. 32, 36, 39, 40–47; No. 5, November 1951, pp. 29–31.
Ceramic Age, vol. 57, No. 2, February 1951, p. 14.

[12] Ceramic Industry, vol. 56, No. 3, March 1951, pp. 86–89, 112; vol. 56, No. 5, May 1951, pp. 80–86; No. 6, June 1951, pp. 90 and 91; vol. 57, No. 1, July 1951, p. 67; No. 3, September 1951, pp. 66 and 67; No. 2, August 1951, pp. 68–71; No. 4, October 1951, pp. 113–117; No. 5, November 1951, pp. 80 and 81, 85–87; No. 6, December 1951, pp. 88–90.

[13] Brick and Clay Record, vol. 118, No. 5, May 1951, pp. 31 and 48.

[14] Van Der Beck, Roland R., and Eberhart, J. O., Firing and Cooling Shrinkage Behavior of Structural Clay Bodies: Am. Ceram. Soc. Jour., vol. 34, No. 12, December 1951, pp. 361–365.

[15] Meid, W. J., and Hursh, R. K., Effect of Heating Rate on Shrinkage of Clays and Shales in Firing: Am. Ceram. Soc. Jour., vol. 34, No. 9, September 1951, pp. 287–290.

[16] Grim, R. E., and Johns, W. D., Jr., Reactions Accompanying the Firing of Brick: Am. Ceram. Soc. Jour., vol. 34, No. 3, March 1951, pp. 71–76.

[17] Moore, H., and Heeley, R., An Experimental Investigation of Alumina Silicate Refractories of High Purity for Use in Glass Making: Glass Ind., vol. 32, No. 8, August 1951, pp. 417 and 431.

A completely new clay-preparation system was installed in the pottery industry that reduced the cost of preparation 20 to 25 percent.[18]

Barium carbonate as a means of preventing the formation of scum and efflorescence on brick was discussed, along with the sulfide content of clay which must be considered in calculations for barium treatment.[19]

The Hanley Co., with executive offices in New York City and structural clay-products plants in Pennsylvania, established a research fellowship at the Mellon Institute in Pittsburgh, Pa. It is long-range in character and has for its purpose fundamental research and development work in the technology of structural clay products.[20]

Data on refractory materials in southern Ohio and northeastern Kentucky were given, such as geology, analyses, uses, and estimated reserves.[21]

The American Iron and Steel Institute and the American Ceramic Society published a comprehensive refractories bibliography, covering the literature and United States and foreign patents from 1928 to 1947, inclusive.[22]

A new laboratory was built at the Armour Research Foundation, Illinois Institute of Technology, for research to develop stronger, cheaper, and lighter concrete block. Concrete units using expanded clay and shale lightweight aggregates developed by the foundation were to be studied.[23]

New lightweight aggregate plants were built to utilize residual clay in North Carolina [24] and shale in Tennessee.[25]

The Minnesota Geological Survey conducted investigations on the possibilities of using Minnesota clays and shales as raw materials for production of lightweight concrete aggregates.[26] Relation of chemical properties to the bloating of clay was discussed.[27]

It was estimated that extraction of a million tons per year from the known deposits of china clay or kaolin in Devon and Cornwall, England, would not exhaust the supply in a century.[28]

Data on the economic importance of Philippine clays were outlined as to classification, composition and uses in ceramic products.[29]

Fire-clay resources of Japan were summarized for the General Headquarters, Supreme Commander for the Allied Powers. Supply and demand of fire clay, by kinds, were discussed, as well as potential reserves.[30]

[18] Ceramic Industry, vol. 56, No. 6, June 1951, p. 90.
[19] Hammer, A. J., Sulfide Content of Clays and Its Bearing on Calculations for Barium Treatment: Ceram. Age, vol. 57, No. 4, April 1951, pp. 17–18, 60.
[20] Ceramic Age, vol. 58, No. 6, December 1951, p. 14.
[21] Bole, G. A., Bowen, C. H., and Everhart, J. O., Refractory Material of Southern Ohio and Northeastern Kentucky: Am. Ceram. Soc. Bull., vol. 30, No. 10, October 1951, pp. 323–327.
[22] American Iron and Steel Institute and The American Ceramic Society, Inc., Refractories Bibliography: Columbus, Ohio, 1950, 2109 pp.
[23] Rock Products, vol. 54, No. 11, November 1951, p. 119.
[24] Lenhart, Walter B., Sintering Clay Into Lightweight Aggregates: Rock Products, vol. 54, No. 8, August 1951, pp. 108–110.
[25] Lenhart, Walter B., Sintering Clay Into Lightweight Aggregates: Rock Products, vol. 54, No. 6, June 1951, pp. 103–105.
[26] Riley, C. M., Possibilities of Bloating Clays in Minnesota: Minnesota Geol. Survey, Summary Rept. 5, July 1950, 10 pp.
[27] Riley, C. M., Relation of Chemical Properties to the Bloating of Clays: Am. Ceram. Soc. Jour., vol. 34, No. 4, April 1951, pp. 121–128.
[28] South African Mining and Engineering Journal, vol. 62, part II, No. 3063, Oct. 27, 1951, p. 10.
[29] Opiana, Gil O., and Olayao, I., The Economic Importance of Philippine Clays and Other Local Ceramic Materials: Philippine Geol., vol. 6, No. 1, December 1951, pp. 5–14.
[30] Lee, Donald E., Fire-Clay Resources: Refrac. Jour., No. 8, August 1951, pp. 314–318.

Coal—Bituminous and Lignite[1]

By W. H. Young, R. L. Anderson, and E. M. Hall

GENERAL SUMMARY

THE BITUMINOUS-COAL and lignite industry showed signs of considerable improvement in 1951; production, consumption, exports, average value, mechanization, and productivity increased over 1950.

Production.—The output of soft coal in 1951—534 million tons[2]—was 3 percent higher than the 516 million tons produced in 1950. The smaller amount of time lost by strikes in 1951, compared to 1950, largely explains the increase. According to the Bureau of Labor Statistics, 887,000 man-days were lost due to strikes in 1951 compared to 9,320,000 man-days in 1950.

There was virtually no seasonal decline in production in 1951, owing largely to increased exports to Europe. Throughout most of the year production exceeded 10 million tons a week, except when output was reduced because of holidays. The man-days lost by strike was the lowest since 1942.

Trend of Men Working Daily.—The average number of men working daily at bituminous-coal and lignite mines in 1951 decreased to 372,897 from 415,582 in 1950.

Index to Capacity.—As it is not possible for all mines to operate every working day in the year, a conservative figure of 280 days for calculating potential capacity was suggested some years ago by the coal committee of the American Institute of Mining and Metallurgical Engineers. (*See* Minerals Yearbook, 1935, pp. 631–632.) The average output per day worked in 1951 was 2,628,890 tons, which (if applied to 280 days) gives an annual potential output of 736 million tons, compared with the actual production of 534 million.

Mechanization.—More coal was loaded mechanically at underground mines in the United States in 1951 than in 1950; the percentage mechanically loaded increased from 69 percent of total underground output in 1950 to 73 percent in 1951. Sales of underground loading equipment, in terms of capacity, were approximately the same as in 1950.

Mechanical Cleaning.—The total capacity of mechanical-cleaning equipment sold for use at bituminous-coal mines in 1951 was estimated at 13,900 tons of cleaned coal per hour, a 14-percent increase over the previous year.

[1] Data for both 1950 and 1951 are final.
[2] Throughout this chapter, "tons" refers to net tons of 2,000 pounds, except that the world table is in metric tons of about 2,205 pounds.

TABLE 1.—Salient statistics of the bituminous-coal and lignite industry in the United States,[1] 1950–51

[All tonnage figures represent net tons of marketable coal and excludes washery and other refuse]

	1950	1951	Change from 1950 (percent)
Production	516,311,053	533,664,732	+3.4
Consumption in the United States	454,202,000	468,904,000	+3.2
Stocks at end of year:			
Industrial consumers and retail yards	72,516,000	76,636,000	+5.7
Stocks on upper Lake docks	6,206,997	5,542,891	−10.7
Imports and exports:[2]			
Imports	346,706	291,536	−15.9
Exports	25,468,403	56,726,155	+122.7
Price indicators (average per net ton):			
Average cost of railroad fuel purchased, f. o. b. mines[3]	$4.49	$4.54	+1.1
Average cost of coking coal at merchant coke ovens	$9.39	$9.51	+1.3
Average retail price[4]	$16.48	$16.87	+2.4
Average railroad freight charge per net ton[3]	$3.09	$3.16	+2.3
Average value f. o. b. mines	$4.84	$4.92	+1.7
Underground loading machinery sold:			
Mobile loading machines (number)	289	287	−.7
Scrapers (number)	1	4	+300.0
Conveyors, including those equipped with duckbills (units)	316	297	−6.0
"Mother" conveyors (units)	132	114	−13.6
Surface stripping	123,466,564	117,617,676	−4.7
Mechanically loaded underground	272,724,612	304,255,921	+11.6
Mechanically cleaned	198,698,518	240,009,808	+20.8
Number of mines	9,429	8,009	−15.1
Average number of days worked	183	203	+10.9
Average number of men working daily[5]	415,582	372,897	−10.3
Production per man per day	6.77	7.04	+4.0
Fuel efficiency indicator:			
Pounds of coal per kw.-hr. at electric power plants[6]	1.19	1.14	−4.2

[1] Includes Alaska. There was no recorded production in Hawaii and Puerto Rico.
[2] U. S. Department of Commerce.
[3] Interstate Commerce Commission.
[4] Bureau of Labor Statistics, U. S. Department of Labor.
[5] Equals man-shifts divided by number of active days.
[6] Federal Power Commission.

Consumption.—Seven classes of consumers used more coal in 1951 than in 1950, whereas two classes decreased their consumption. The total consumption in 1951 was approximately 15 million tons more than in 1950. Table 44 shows trends in consumption for the major classes of consumers.

Trends of Fuel Efficiency.—During 1951 electric public-utility power plants attained increased fuel efficiency.

Competition With Oil and Gas.—Soon after World War II, increased competition developed among the fuels, with numerous reports of conversion from coal to fuel oil and gas.

Electric-power utilities consumed 15 percent more bituminous coal, 15 percent less fuel oil, and 21 percent more gas in 1951 than in 1950.

Class I railroads decreased their consumption of coal 11 percent in 1951 from 1950 and increased their purchases of fuel oil and Diesel oil 5 percent during the same period.

The manufacture of domestic coal-burning equipment is reflected in statistics published by the Bureau of the Census. Factory sales

of domestic stokers for burning bituminous coal decreased from 13,102 (revised figure) in 1950 to 12,386 in 1951. Shipments of domestic oil burners, boiler-burner units, and furnace-burner units decreased from 879,922 (revised figure) in 1950 to 658,714 in 1951.

Stocks.—The reserve supply of bituminous coal and lignite in the hands of industrial consumers and retail coalyards increased from 72.5 million tons at the beginning of 1951 to 76.6 million tons at the close. The day's suppply of stocks increased from 50 to 56. Stocks on the upper Lake docks decreased 664,106 tons from January 1 to December 31, 1951.

SOURCES OF DATA

Data for 1951 are final and are based upon detailed annual reports of production and mine operation furnished by the producers. As in previous years, all but a small percentage of the output was covered by the reports submitted. For the remaining output not directly reported—consisting chiefly of small mines—it has been possible to obtain reasonably accurate data from the records of the State mine departments, which have statutory authority to require such reports, or, in a few instances, from railroad carloadings. Production includes all marketable coal and excludes washery and other refuse.

In accordance with the practice followed by the Bureau of Mines in previous years, the statistics in this report relate to mines having an output of 1,000 tons a year or more and do not attempt to include many small mines producing less than 1,000 tons a year.

As in previous years, these data include all coal produced in Alaska and all that produced in the United States except Pennsylvania anthracite.

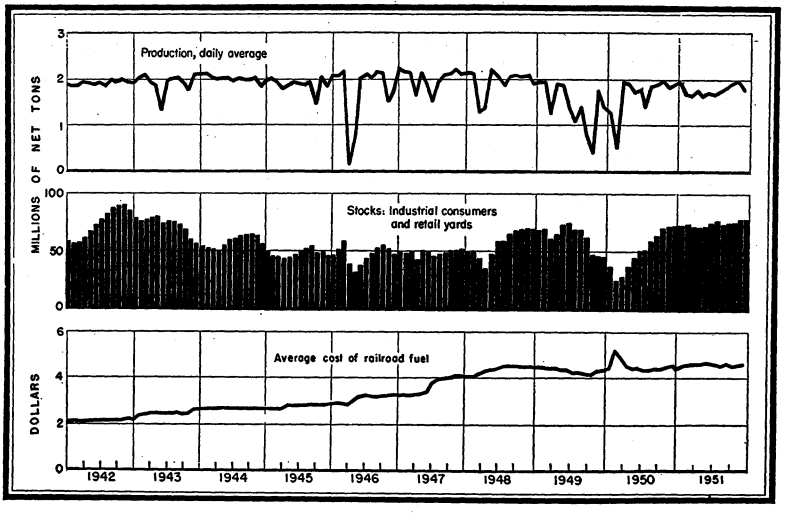

FIGURE 1.—Production, stocks, and prices of bituminous coal and lignite in the United States, 1942–51.

RESERVES [3]

TABLE 2.—Coal reserves of the United States, Jan. 1, 1950, by States

[In thousands of short tons]

State	Estimated original reserves					Reserves depleted to Jan. 1, 1950		Remaining reserves, Jan. 1, 1950	Recoverable reserves, Jan. 1, 1950, assuming 50-percent recovery
	Bituminous coal	Subbituminous coal	Lignite	Anthracite and semianthracite	Total	Produced [1]	Produced and lost in mining, assuming past losses equal production		
Alabama	67,570,000				67,570,000	821,590	1,643,180	65,926,820	32,963,410
Arkansas	1,396,000		90,000	230,000	1,716,000	91,894	183,788	1,532,212	766,106
Colorado	213,071,000	104,175,000		100,000	317,346,000	471,146	942,292	316,403,708	158,201,854
Georgia	933,000				933,000	11,533	23,066	909,934	454,967
Illinois	171,905,000				171,905,000	3,131,997	6,263,994	165,641,006	82,820,503
Indiana	53,051,000				53,051,000	984,137	1,968,274	51,082,726	25,541,363
Iowa	29,160,000				29,160,000	343,162	686,324	28,473,676	14,236,838
Kansas	[2] 17,574,000				[2] 17,574,000	[2] 9,800	[2] 19,600	17,554,400	8,777,200
Kentucky	123,327,000				123,327,000	1,951,803	3,903,606	119,423,394	59,711,697
Maryland	8,043,000				8,043,000	259,943	519,886	7,523,114	3,761,557
Michigan	296,900				296,900	[4] 46,240	[5] 77,000	219,900	109,950
Missouri	79,362,016				79,362,016	257,787	515,574	78,846,442	39,423,221
Montana	2,362,610	132,151,060	87,533,270		222,046,940	157,248	314,496	221,732,444	110,866,222
New Mexico	10,947,700	50,801,200		5,700	61,754,600	121,507	243,014	61,511,586	30,755,793
North Carolina	110,462				110,462	1,054	2,108	108,354	54,177
North Dakota			600,000,000		600,000,000	67,856	135,712	599,864,288	299,932,144
Ohio	86,497,000				86,497,000	1,694,259	3,388,518	83,108,482	41,554,241
Oklahoma	54,951,000				54,951,000	158,846	317,692	54,633,308	27,316,654
Pennsylvania	75,093,459			22,805,000	97,898,459	12,332,962	24,665,924	73,232,535	36,616,268
South Dakota			1,020,000		1,020,000	921	1,842	1,018,158	509,079
Tennessee	25,665,000				25,665,000	324,718	649,436	25,015,564	12,507,782
Texas	8,000,000		23,000,000		31,000,000	62,047	124,094	30,875,906	15,437,953
Utah	88,184,000	5,156,000			93,340,000	198,665	397,330	92,942,670	46,471,335
Virginia	21,149,000			500,000	21,649,000	548,479	1,096,958	20,552,042	10,276,021
Washington	11,413,000	52,442,000		23,000	63,878,000	142,904	285,808	63,592,192	31,796,096
West Virginia	116,618,447				116,618,447	4,979,385	9,958,770	106,659,677	53,329,838
Wyoming	13,234,950	[6] 108,318,900	([6])		121,553,850	362,375	724,750	120,829,100	60,414,550
Other States	[7] 820,000	[8] 15,500,000	[9] 49,963		16,369,963	8,789	17,578	16,352,385	8,176,193
Total	1,280,735,544	468,544,160	711,693,233	23,663,700	2,484,636,637	29,543,047	59,070,614	2,425,566,023	1,212,783,012

[1] Production, 1800 through 1885, from Eavenson, H. N., The First Century and a Quarter of American Coal Industry: 1942, 701 pp.; production, 1886 through 1949, from Geological Survey Mineral Resources of the United States and Bureau of Mines Minerals Yearbooks, unless otherwise indicated.
[2] Remaining reserves, Jan. 1, 1946.
[3] Production, Jan. 1, 1946, to Jan. 1, 1950.
[4] Michigan Geological Survey Division, as cited in Geol. Circular 77, 1950, p. 56.
[5] Past losses assumed to be 40 percent of coal originally in the ground.
[6] Small reserves of lignite included under subbituminous coal.
[7] Includes Arizona, California, Idaho, and Oregon.
[8] Includes Arizona, California, and Oregon.
[9] Includes California and Louisiana.

[3] Averitt, Paul, and Berryhill, Louise R., Coal Resources of the United States: Geol. Survey Circ. 94, 1950, p. 5.

DOMESTIC PRODUCTION

Average production of bituminous coal and lignite per working day in 1942–51 is illustrated in figures 1 and 5.

Production statistics for lignite are listed separately from those for bituminous coal in tables 48 and 49.

PRODUCTION BY YEARS

Production, realization, capacity, and net income of bituminous-coal and lignite mines in 1905–51 are shown graphically in figure 2.

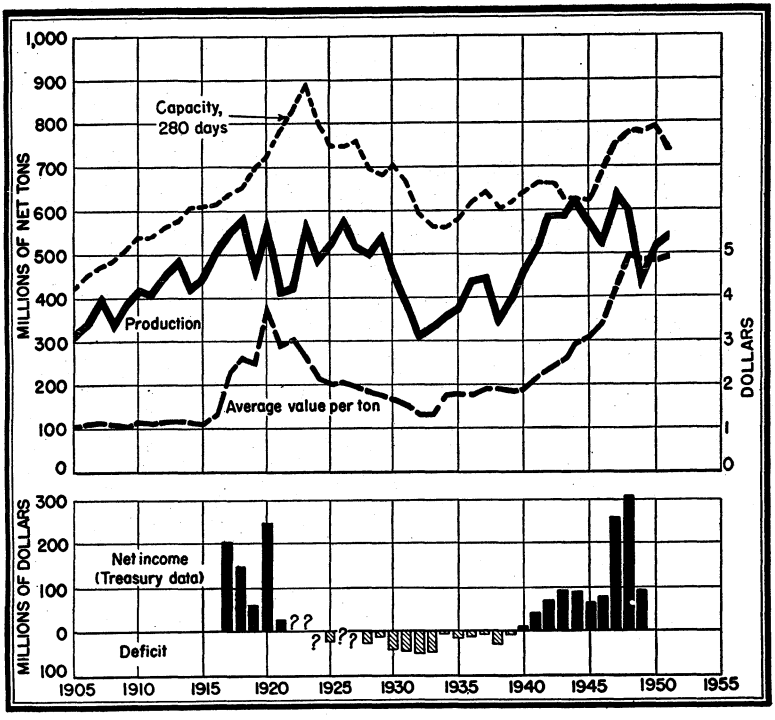

FIGURE 2.—Bituminous-coal and lignite production, realization, mine capacity, and net income or deficit in the United States, 1905–51.

TABLE 3.—Growth of the bituminous-coal and lignite-mining industry in the United States,[1] 1900–1951

Year	Production (net tons)	Value of production [2]		Number of mines	Capacity at 280 days (millions of tons)
		Total	Average per ton		
1900	212,316,112	$220,930,313	1.04	(3)	255
1901	225,828,149	236,422,049	1.05	(3)	281
1902	260,216,844	290,858,483	1.12	(3)	316
1903	282,749,348	351,687,933	1.24	(3)	350
1904	278,659,689	305,397,001	1.10	4,650	386
1905	315,062,785	334,658,294	1.06	5,060	417
1906	342,874,867	381,162,115	1.11	4,430	451
1907	394,759,112	451,214,842	1.14	4,550	473
1908	332,573,944	374,135,268	1.12	4,730	482
1909	379,744,257	405,486,777	1.07	5,775	510
1910	417,111,142	469,281,719	1.12	5,818	538
1911	405,907,059	451,375,819	1.11	5,887	538
1912	450,104,982	517,983,445	1.15	5,747	566
1913	478,435,297	565,234,952	1.18	5,776	577
1914	422,703,970	493,309,244	1.17	5,592	608
1915	442,624,426	502,037,688	1.13	5,502	610
1916	502,519,682	665,116,077	1.32	5,726	613
1917	551,790,563	1,249,272,837	2.26	6,939	636
1918	579,385,820	1,491,809,940	2.58	8,319	650
1919	465,860,058	1,160,616,013	2.49	8,994	669
1920	568,666,683	2,129,933,000	3.75	8,921	725
1921	415,921,950	1,199,983,600	2.89	8,038	781
1922	422,268,099	1,274,820,000	3.02	9,299	832
1923	564,564,662	1,514,621,000	2.68	9,331	885
1924	483,686,538	1,062,626,000	2.20	7,586	792
1925	520,052,741	1,060,402,000	2.04	7,144	748
1926	573,366,985	1,183,412,000	2.06	7,177	747
1927	517,763,352	1,029,657,000	1.99	7,011	759
1928	500,744,970	933,774,000	1.86	6,450	691
1929	534,988,593	952,781,000	1.78	6,057	679
1930	467,526,299	795,483,000	1.70	5,891	700
1931	382,089,396	588,895,000	1.54	5,642	669
1932	309,709,872	406,677,000	1.31	5,427	594
1933	333,630,533	445,788,000	1.34	5,555	559
1934	359,368,022	628,383,000	1.75	6,258	565
1935	372,373,122	658,063,000	1.77	6,315	582
1936	439,087,903	770,955,000	1.76	6,875	618
1937	445,531,449	864,042,000	1.94	6,548	646
1938	348,544,764	678,653,000	1.95	5,777	602
1939	394,855,325	728,348,366	1.84	5,820	621
1940	460,771,500	879,327,227	1.91	6,324	639
1941	514,149,245	1,125,362,836	2.19	6,822	666
1942	582,692,937	1,373,990,608	2.36	6,972	663
1943	590,177,069	1,584,644,477	2.69	6,620	626
1944	619,576,240	1,810,900,542	2.92	6,928	624
1945	577,617,327	1,768,204,320	3.06	7,033	620
1946	533,922,068	1,835,539,476	3.44	7,333	699
1947	630,623,722	2,622,634,946	4.16	8,700	755
1948	599,518,229	2,993,267,021	4.99	9,079	774
1949	437,868,036	2,136,870,571	4.88	8,559	781
1950	516,311,053	2,500,373,779	4.84	9,426	790
1951	533,664,732	2,626,030,137	4.92	8,009	736

[1] Includes Alaska.
[2] Figures for 1900 to 1936 and 1939 exclude selling expense. Figures for 1937–38 and 1940–51 include selling expense.
[3] Data not available.

PRODUCTION BY MONTHS AND WEEKS

Tables 4 to 7 summarize the statistics of monthly and weekly production of bituminous coal and lignite. The estimates given are based upon the latest information available and differ in some instances from the current figures published in the Weekly Coal Reports.

TABLE 4.—Bituminous-coal and lignite production in the United States,[1] 1950–51, with estimates by months

Month	1950			1951		
	Production (thousands of net tons)	Maximum number of working days	Average production per working day (thousands of net tons)	Production (thousands of net tons)	Maximum number of working days	Average production per working day (thousands of net tons)
January	31,351	25	1,254	51,531	26	1,982
February	12,337	24	514	39,990	24	1,666
March	54,049	27	2,002	44,713	27	1,656
April	47,004	24.5	1,919	41,888	24.2	1,731
May	46,162	26.5	1,742	43,281	26.4	1,639
June	46,213	26	1,777	43,448	25.5	1,704
July	35,396	25	1,416	34,007	20.2	1,684
August	50,487	27	1,870	47,072	27	1,743
September	47,653	25	1,906	42,853	24	1,786
October	51,805	26	1,993	51,675	27	1,914
November	45,906	25	1,836	49,207	24.8	1,984
December	47,948	25	1,918	44,000	25	1,760
Total	516,311	306.0	1,687	533,665	301.1	1,772

[1] Includes Alaska.

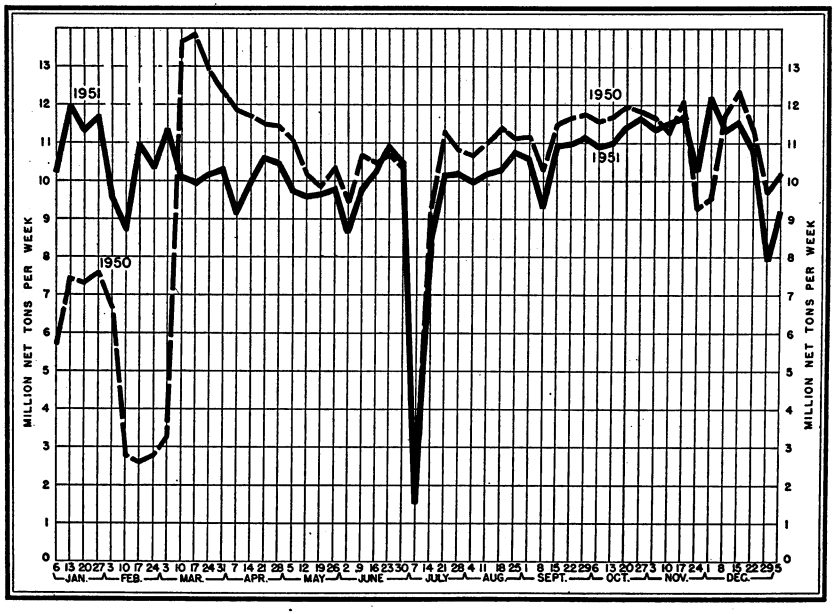

FIGURE 3.—Production of bituminous coal and lignite in the United States 1950–51, by weeks.

TABLE 5.—Coal production in the United States, 1950, by States, with estimates by months, in thousands of net tons

[Totals for year are based on final complete returns from all operators known to have produced 1,000 tons and over per year. In most cases monthly apportionment is based on current records of railway carloadings and waterway shipments; in some States upon direct tonnage reports by operators to State mine departments]

State	January	February	March	April	May	June	July	August	September	October	November	December	Total
Alabama	776	176	1,401	1,426	1,455	1,416	996	1,365	1,352	1,285	1,358	1,416	14,422
Alaska	48	39	66	37	28	17	10	22	27	50	34	34	412
Arkansas	131	98	139	52	59	66	56	111	120	116	106	115	1,169
Colorado	429	125	446	232	272	215	179	377	449	455	549	531	4,259
Illinois	3,495	1,197	5,833	4,917	4,666	5,018	3,621	5,290	5,269	5,713	5,447	5,825	56,291
Indiana	1,163	165	2,102	1,689	1,813	1,804	1,335	1,822	1,918	2,082	2,006	2,058	19,957
Iowa	173	182	271	181	120	130	96	123	116	136	169	194	1,891
Kansas	191	141	204	148	146	134	129	167	183	191	226	265	2,125
Kentucky:													
Eastern	3,698	1,962	5,907	4,751	4,740	4,747	3,734	5,291	5,158	5,455	4,539	4,480	54,462
Western	1,768	1,612	2,587	1,910	1,877	1,868	1,542	2,165	2,010	2,268	2,149	2,277	24,033
Total Kentucky	5,466	3,574	8,494	6,661	6,617	6,615	5,276	7,456	7,168	7,723	6,688	6,757	78,495
Maryland	105	62	113	56	30	39	38	49	40	47	31	38	648
Missouri	266	196	283	206	204	189	182	231	254	267	314	371	2,963
Montana:													
Bituminous	216	227	274	153	167	167	159	220	170	244	233	238	2,468
Lignite	4	5	6	3	4	4	3	5	4	5	4	5	52
Total Montana	220	232	280	156	171	171	162	225	174	249	237	243	2,520
New Mexico	60	12	84	55	44	49	42	77	70	72	77	85	727
North Dakota (lignite)	345	307	262	198	158	163	161	233	257	398	404	375	3,261
Ohio	2,192	1,397	4,314	3,561	3,386	3,568	2,840	3,805	3,063	3,547	2,925	3,163	37,761
Oklahoma	300	226	314	120	134	149	129	257	274	264	249	263	2,679
Pennsylvania (bituminous)	4,707	1,635	10,815	10,359	10,118	10,371	7,609	10,710	9,766	10,767	9,254	9,759	105,870
South Dakota (lignite)	4	3	3	2	2	2	2	3	3	4	4	4	36
Tennessee	409	203	649	451	413	423	289	488	433	468	406	438	5,070
Utah	425	48	680	723	557	516	439	737	678	630	664	573	6,670
Virginia	1,226	529	1,965	1,571	1,461	1,548	1,194	1,738	1,620	1,812	1,418	1,585	17,667
Washington	68	30	67	77	80	78	51	83	74	89	95	82	874
West Virginia	8,702	1,628	14,695	13,679	13,700	12,992	10,218	14,568	13,756	14,654	12,502	13,022	144,116
Wyoming	441	123	562	441	522	536	338	545	584	779	734	743	6,348
Other States [1]	9	9	7	6	6	4	4	5	5	7	9	9	80
Total bituminous coal and lignite	31,351	12,337	54,049	47,004	46,162	46,213	35,396	50,487	47,653	51,805	45,906	47,948	516,311
Pennsylvania anthracite	2,893	2,563	4,847	3,331	4,228	4,166	2,855	4,386	3,835	4,282	3,355	3,336	44,077
Grand total, 1950	34,244	14,900	58,896	50,335	50,390	50,379	38,251	54,873	51,488	56,087	49,261	51,284	560,388

[1] Comprises Arizona, California (lignite), Georgia, Michigan, North Carolina, Oregon, and Texas (lignite).

TABLE 6.—Coal production in the United States, 1951, by States, with estimates by months, in thousands of net tons

[Totals for year are based on final complete returns from all operators known to have produced 1,000 tons and over per year. In most cases monthly apportionment is based on current records of railway carloadings and waterway shipments; in some States upon direct tonnage reports by operators to State mine departments]

State	January	February	March	April	May	June	July	August	September	October	November	December	Total
Alabama	1,475	1,254	1,151	1,115	1,144	1,146	797	1,116	1,012	1,199	1,024	1,164	13,597
Alaska	48	39	40	42	34	34	28	45	44	38	60	42	494
Arkansas	125	94	82	63	59	64	56	102	109	127	118	108	1,107
Colorado	519	382	314	255	196	196	162	273	320	471	509	506	4,103
Illinois	5,978	4,657	4,684	4,248	3,948	4,265	3,024	4,319	4,232	5,126	5,237	4,482	54,200
Indiana	2,223	1,605	1,897	1,471	1,338	1,370	1,103	1,597	1,492	1,807	1,851	1,697	19,451
Iowa	187	180	179	121	86	74	91	105	107	146	170	184	1,630
Kansas	245	200	132	150	141	136	97	157	146	184	187	186	1,961
Kentucky:													
Eastern	4,829	3,662	3,832	3,799	4,500	4,517	3,569	4,945	4,492	5,481	5,019	4,437	53,082
Western	2,215	1,691	1,849	1,660	1,675	1,688	1,473	1,902	1,665	2,080	2,088	1,904	21,890
Total Kentucky	7,044	5,353	5,681	5,459	6,175	6,205	5,042	6,847	6,157	7,561	7,107	6,341	74,972
Maryland	81	64	57	40	44	52	26	41	44	53	45	42	589
Michigan	1	1						1	1	1	1	1	7
Missouri	407	333	221	251	235	227	163	263	245	307	305	312	3,269
Montana:													
Bituminous	193	197	235	186	181	146	117	195	173	234	251	202	2,310
Lignite	3	3	3	3	3	3	2	3	3	3	3	3	35
Total Montana	196	200	238	189	184	149	119	198	176	237	254	205	2,345
New Mexico	82	55	65	57	55	57	41	71	65	74	80	81	783
North Dakota (lignite)	354	286	257	206	171	158	162	211	251	422	404	342	3,224
Ohio	3,628	2,431	3,119	3,375	3,125	3,332	2,576	3,297	3,065	3,693	3,477	2,831	37,949
Oklahoma	252	189	162	128	118	130	111	204	221	255	238	215	2,223
Pennsylvania (bituminous)	10,276	8,941	9,685	8,616	8,919	8,933	6,779	9,439	8,489	10,157	9,378	8,552	108,164
Tennessee	594	413	422	411	454	470	288	432	381	536	527	473	5,401
Utah	629	366	417	342	390	445	318	615	564	617	717	716	6,136
Virginia	1,947	1,512	1,652	1,688	1,809	1,706	1,506	1,961	1,815	2,112	1,938	1,754	21,400
Washington	91	68	74	60	66	64	42	84	67	74	80	87	857
West Virginia	14,563	10,903	13,668	13,155	14,146	13,799	11,159	15,099	13,327	15,761	14,767	12,963	163,310
Wyoming	578	458	512	442	439	432	313	590	518	712	726	710	6,430
Other States:													
Arizona, Georgia, and North Carolina	5	3	2	2	2	2	2	2	2	3	3	3	31
California and South Dakota (lignite)	3	3	2	2	3	2	2	3	3	2	4	3	32
Total bituminous coal and lignite	51,531	39,990	44,713	41,888	43,281	43,448	34,007	47,072	42,853	51,675	49,207	44,000	533,665
Pennsylvania anthracite	4,316	3,621	2,244	2,675	3,723	3,848	2,847	3,612	3,267	4,675	4,129	3,713	42,670
Grand total, 1951	55,847	43,611	46,957	44,563	47,004	47,296	36,854	50,684	46,120	56,350	53,336	47,713	576,335

TABLE 7.—Bituminous-coal and lignite production in the United States,[1] 1950–51, with estimates by weeks

Week ended—	1950 Production (thousands of net tons)	1950 Maximum number of working days	1950 Average production per working day (thousands of net tons)	Week ended—	1951 Production (thousands of net tons)	1951 Maximum number of working days	1951 Average production per working day (thousands of net tons)
Jan. 7	5,636	5	1,127	Jan. 6	10,150	5	2,030
14	7,411	6	1,235	13	11,981	6	1,997
21	7,292	6	1,215	20	11,314	6	1,886
28	7,529	6	1,255	27	11,568	6	1,928
Feb. 4	6,661	6	1,110	Feb. 3	9,564	6	1,594
11	2,734	6	456	10	8,665	6	1,444
18	2,538	6	423	17	10,936	6	1,823
25	2,755	6	459	24	10,330	6	1,722
Mar. 4	3,237	6	540	Mar. 3	11,330	6	1,888
11	13,595	6	2,266	10	10,053	6	1,676
18	13,792	6	2,299	17	9,954	6	1,659
25	12,867	6	2,145	24	10,156	6	1,693
Apr. 1	12,290	5.5	2,235	31	10,233	6	1,706
8	11,821	6	1,970	Apr. 7	9,106	5.2	1,751
15	11,684	6	1,947	14	9,947	6	1,658
22	11,483	6	1,914	21	10,598	6	1,766
29	11,416	6	1,903	28	10,431	6	1,739
May 6	11,075	6	1,846	May 5	9,671	6	1,612
13	10,176	6	1,696	12	9,587	6	1,598
20	9,826	6	1,638	19	9,620	6	1,603
27	10,306	6	1,718	26	9,722	6	1,620
June 3	9,397	5.5	1,709	June 2	8,645	5.4	1,601
10	10,619	6	1,770	9	9,749	6	1,625
17	10,452	6	1,742	16	10,208	6	1,701
24	10,639	6	1,773	23	10,876	6	1,813
July 1	10,270	6	1,712	30	10,457	5.5	1,901
8	1,639	5	328	July 7	1,476	1	1,476
15	9,138	6	1,523	14	8,337	5.2	1,603
22	11,275	6	1,879	21	10,128	6	1,688
29	10,794	6	1,799	28	10,125	6	1,688
Aug. 5	10,650	6	1,775	Aug. 4	9,928	6	1,655
12	10,986	6	1,831	11	10,149	6	1,692
19	11,395	6	1,899	18	10,249	6	1,708
26	11,093	6	1,849	25	10,714	6	1,786
Sept. 2	11,149	6	1,858	Sept. 1	10,578	6	1,763
9	10,249	5	2,050	8	9,278	5	1,856
16	11,472	6	1,912	15	10,893	6	1,816
23	11,619	6	1,937	22	10,970	6	1,828
30	11,692	6	1,949	29	11,107	6	1,851
Oct. 7	11,574	6	1,929	Oct. 6	10,894	6	1,816
14	11,672	6	1,945	13	11,003	6	1,834
21	11,930	6	1,988	20	11,399	6	1,900
28	11,824	6	1,971	27	11,603	6	1,934
Nov. 4	11,631	6	1,939	Nov. 3	11,310	6	1,885
11	11,248	6	1,875	10	11,498	6	1,916
18	12,104	6	2,017	17	11,602	5.8	2,000
25	9,257	5	1,851	24	10,160	5	2,032
Dec. 2	9,482	6	1,580	Dec. 1	12,189	6	2,032
9	11,679	6	1,947	8	11,280	6	1,880
16	12,311	6	2,052	15	11,513	6	1,919
23	11,318	6	1,886	22	10,732	6	1,789
30	9,629	5	1,926	29	7,906	5	1,581
				Jan. 5	[2] 1,793	[2] 1	[3] 1,839
Total	516,311	306.0	1,687	Total	533,665	301.1	1,772

[1] Includes Alaska.
[2] Figures represent output and number of working days in that part of the week included in calendar year shown. Total production for the week ended Jan. 5, 1952, was 9,195,000 net tons.
[3] Average daily output for the entire week and not for working days in the calendar year shown.

SUMMARY BY STATES [4]

TABLE 8.—Coal produced in the United States, by States, 1942–51, with production of maximum year and cumulative production from earliest record to end of 1951, in thousands of net tons

State	Maximum production		Production by years										Total production from earliest record to end of 1951
	Year	Quantity	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	
Alabama	1926	21,001	19,301	17,160	18,752	18,236	16,183	19,048	18,801	12,934	14,422	13,597	850,297
Arkansas	1907	2,670	1,985	1,718	1,972	1,854	1,631	1,871	1,662	962	1,169	1,107	93,652
Colorado	1917	12,483	8,086	8,324	8,168	7,621	5,914	6,358	5,631	4,636	4,259	4,103	479,483
Georgia	1903	416	31	14	24	43	114	7	20	(1)	(1)	(1)	(1)
Illinois	1918	89,291	65,071	72,631	76,792	73,011	63,469	67,860	65,342	47,208	56,291	54,200	3,241,774
Indiana	1918	30,679	25,388	25,065	27,962	25,183	21,697	25,449	23,849	16,550	19,957	19,451	1,024,696
Iowa	1917	8,966	2,948	2,771	2,141	2,046	1,788	1,684	1,670	1,725	1,891	1,630	341,254
Kansas	1918	7,562	4,230	3,437	3,369	3,228	2,493	2,745	2,538	2,031	2,125	1,961	270,137
Kentucky	1947	84,241	62,231	63,211	71,356	69,593	66,553	84,241	82,084	62,583	78,495	74,972	2,109,241
Maryland	1907	5,533	2,001	1,933	1,870	1,763	2,003	2,051	1,661	668	648	589	261,062
Michigan	1907	2,036	231	169	140	126	80	14	13	12	11	7	46,391
Missouri	1917	5,671	3,520	4,310	4,779	3,983	3,733	4,236	4,023	3,647	2,963	3,269	263,700
Montana (bituminous and lignite)	1944	4,844	3,829	4,833	4,844	4,467	3,723	3,178	2,898	2,766	2,520	2,345	162,128
New Mexico	1918	4,023	1,669	1,851	1,744	1,484	1,280	1,443	1,364	1,004	727	783	122,950
North Carolina	1922	79								(1)	(1)	(1)	(1)
North Dakota (lignite)	1950	3,261	2,537	2,500	2,366	2,522	2,555	2,760	2,961	2,967	3,261	3,224	74,125
Ohio	1920	45,878	32,764	32,255	33,877	32,737	32,314	37,548	38,708	30,961	37,761	37,949	1,773,392
Oklahoma	1920	4,849	2,387	2,838	3,209	2,909	2,647	3,421	3,462	3,022	2,679	2,223	163,677
Pennsylvania (bituminous)	1918	178,551	144,073	141,050	146,052	132,965	125,497	147,079	134,542	89,215	105,870	108,164	7,579,825
Tennessee	1942	8,158	8,158	7,179	7,266	6,271	5,618	6,258	6,483	4,172	5,070	5,401	334,783
Texas (bituminous and lignite)	1913	2,429	304	153	[2] 109	[2] 80	[2] 56	[2] 61	[2] 57	[2] 49	[2] 18		60,929
Utah	1947	7,429	5,517	6,666	7,119	6,679	5,994	7,429	6,813	6,160	6,670	6,136	210,672
Virginia	1951	21,400	20,136	20,280	19,514	17,235	15,527	20,171	17,999	14,584	17,667	21,400	593,190
Washington	1918	4,082	1,953	1,528	1,524	1,357	991	1,118	1,220	899	874	857	144,180
West Virginia	1947	176,157	155,882	158,804	164,704	152,035	144,020	176,157	168,862	122,610	144,116	163,310	5,269,169
Wyoming	1945	9,847	8,133	9,155	9,540	9,847	7,635	8,051	6,412	6,001	6,348	6,430	376,239
Other States [3]			328	342	383	342	407	386	443	502	499	557	67,035
Total bituminous and lignite	1947	630,624	582,693	590,177	619,576	577,617	533,922	630,624	599,518	437,868	516,311	533,665	25,913,981
Pennsylvania anthracite	1917	99,612	60,328	60,644	63,701	54,934	60,507	57,190	57,140	42,702	44,077	42,670	4,985,690
Grand total			643,021	650,821	683,277	632,551	594,429	687,814	656,658	480,570	560,388	576,335	30,899,671

[1] Included with "Other States."

[2] Lignite only.

[3] Includes Alaska.

[4] Details on the bituminous-coal and lignite industry, by States and counties, are presented in other parts of this chapter, notably in table 41.

TABLE 9.—Number of mines, production, value, men working daily, days active, man-days, and output per day at bituminous-coal and lignite mines in the United States, 1950, by States

[Exclusive of mines producing less than 1,000 tons]

State	Number of active mines	Disposition of coal produced (net tons)					Average value per ton [3]	Average number of men working daily				Average number of days worked	Number of man-days worked	Average tons per man per day
		Shipped by rail or water [1]	Trucked to railroad or waterway for further shipment	Shipped by truck	Used at mine [2]	Total quantity		Underground	Surface		Total			
									In strip pits	All others				
Alabama	378	11,684,422	1,173,381	991,057	572,950	14,421,810	$6.13	14,585	754	3,024	18,363	182	3,345,061	4.31
Alaska	7	403,697		3,885	4,873	412,455	7.35	134	67	77	278	245	68,131	6.05
Arizona	1			4,446		4,446	6.00	10			10	204	2,037	2.18
Arkansas	53	1,037,603	73,323	56,045	2,097	1,169,068	7.60	1,576	239	326	2,141	121	258,306	4.53
Colorado	173	2,821,929	277,765	1,049,984	108,822	4,258,500	5.09	3,545	88	1,005	4,638	168	777,544	5.48
Illinois	298	48,294,547	548,863	6,512,597	934,914	56,290,921	4.05	20,551	2,290	8,409	31,250	185	5,775,246	9.75
Indiana	100	17,651,219	102,716	1,712,557	490,537	19,957,029	3.97	5,393	2,011	2,185	9,589	189	1,811,991	11.01
Iowa	121	574,626	344,813	970,725	1,247	1,891,411	3.69	1,024	318	281	1,623	195	315,880	5.99
Kansas	48	1,917,172	60,470	142,881	4,457	2,124,980	3.87	289	471	331	1,091	168	183,448	11.58
Kentucky	3,259	54,249,820	9,045,773	14,777,946	422,064	78,495,603	5.01	57,505	2,333	11,422	71,260	172	12,282,047	6.39
Maryland	105	217,366	86,152	343,927	478	647,923	4.84	964	155	207	1,326	112	148,884	4.35
Michigan	1			9,890	1,610	11,500	10.12	33		2	35	166	5,810	1.98
Missouri	87	2,216,186	29,825	708,274	8,796	2,963,081	4.17	713	529	388	1,630	186	302,923	9.78
Montana:														
Bituminous	16	2,348,252	25,697	84,487	9,600	2,468,036	2.30	480	69	230	779	165	128,877	19.15
Lignite	7			51,930	200	52,130	3.37	31	3	9	43	165	7,093	7.35
Total Montana	23	2,348,252	25,697	136,417	9,800	2,520,166	2.33	511	72	239	822	165	135,970	18.53
New Mexico	25	635,943	43,923	28,284	18,808	726,958	5.39	777		179	956	143	136,679	5.32
North Dakota (lignite)	44	2,465,596	60,331	576,359	158,687	3,260,973	2.38	119	276	229	624	234	146,096	22.32
Ohio	688	24,660,668	3,280,953	9,608,392	211,078	37,761,091	3.81	10,684	4,447	4,348	19,479	190	3,696,876	10.21
Oklahoma	63	2,154,624	302,599	212,708	8,640	2,678,571	5.44	1,284	596	412	2,292	180	412,786	6.49
Oregon	1			1,376	8	1,384	6.08	3		1	4	240	959	1.44
Pennsylvania	1,932	70,045,425	13,335,929	15,641,730	6,847,037	105,870,121	5.00	69,428	9,730	14,023	93,181	191	17,791,961	5.95
Tennessee	133	4,272,836	308,810	443,355	44,799	5,069,800	5.40	5,293	259	912	6,464	168	1,084,767	4.67
Texas (lignite)	1	17,959			210	18,169	1.69		8	6	14	281	3,934	4.62
Utah	67	5,736,462	362,998	507,103	63,333	6,669,896	4.81	3,640		1,220	4,860	188	913,107	7.30
Virginia	327	13,997,666	2,703,034	660,146	305,801	17,666,647	5.49	14,547	443	2,637	17,627	181	3,189,351	5.54
Washington	26	646,382	33,938	172,714	20,955	873,989	6.67	782	47	270	1,099	201	220,440	3.96
West Virginia	1,411	127,847,983	10,634,011	2,790,133	2,843,556	144,115,683	5.23	95,439	4,553	20,896	120,888	186	22,472,153	6.41
Wyoming	45	5,977,926	92,575	149,390	128,358	6,348,249	3.79	2,761	253	916	3,930	186	730,547	8.69
Other States:														
California and South Dakota (lignite)	4	300		35,839	2,555	38,694	3.82	2	16	1	19	210	3,991	9.70
Georgia and North Carolina	8		3,550	38,135	250	41,935	6.74	77		12	89	269	23,939	1.75
Total	9,429	401,876,609	42,931,429	58,286,295	13,216,720	516,311,053	4.84	311,669	29,955	73,958	415,582	183	76,240,864	6.77

[1] Includes coal loaded at mine directly into railroad cars or river barges.

[2] Includes coal used by mine employees, taken by locomotive tenders at tipple, used at mine for power and heat, coal transported from mine to point of use by conveyor or tram, coal made into beehive coke at mine and all other uses at mine.

[3] Value received or charged for coal, f. o. b. mine, including selling cost. (Includes a value for coal not sold but used by producer, such as mine fuel and coal coked [not coke] as estimated by producer at average prices that might have been received if such coal had been sold commercially.)

TABLE 10.—Number of mines, production, value, men working daily, days active, man-days, and output per day at bituminous-coal and lignite mines in the United States, 1951, by States

[Exclusive of mines producing less than 1,000 tons]

State	Number of active mines	Disposition of coal produced (net tons)					Average value per ton [3]	Average number of men working daily				Average number of days worked	Number of man-days worked	Average tons per man per day
		Shipped by rail or water [1]	Trucked to railroad or waterway for further shipment	Shipped by truck	Used at mine [2]	Total quantity		Underground	Surface		Total			
									In strip pits	All others				
Alabama	298	11,013,170	742,025	1,000,721	841,066	13,596,982	$6.06	10,740	710	2,372	13,822	197	2,721,296	5.00
Alaska	6	486,678		3,900	3,755	494,333	7.62	120	58	75	253	243	61,371	8.05
Arizona	1			4,969		4,969	6.00	8		1	9	242	2,177	2.28
Arkansas	58	952,915	122,795	30,041	954	1,106,705	7.85	1,350	195	275	1,820	138	251,220	4.41
California (lignite)	1				3,657	3,657	10.25		3		3	125	375	9.75
Colorado	151	2,775,062	249,974	985,961	91,642	4,102,639	5.16	3,249	68	873	4,190	178	747,320	5.49
Illinois	264	46,503,367	907,785	6,051,058	737,665	54,199,875	4.07	19,555	1,966	7,295	28,816	170	4,909,521	11.04
Indiana	94	17,087,074	94,065	1,775,136	494,170	19,450,445	4.04	5,188	1,746	2,067	9,001	192	1,724,684	11.28
Iowa	102	580,627	265,083	770,118	14,470	1,630,298	3.75	808	316	219	1,343	179	240,194	6.79
Kansas	45	1,737,371	45,453	173,079	5,198	1,961,101	3.94	212	468	286	966	173	167,175	11.73
Kentucky	2,309	57,285,024	4,466,791	12,704,454	516,066	74,972,335	4.89	49,055	1,906	9,117	60,078	183	10,992,698	6.82
Maryland	101	100,038	104,086	382,926	1,589	588,639	4.73	503	140	69	712	180	130,028	4.53
Michigan	1			6,267	1,080	7,347	10.19	28		2	30	151	4,530	1.62
Missouri	75	2,673,784	6,186	585,219	4,094	3,269,283	4.10	544	506	371	1,421	193	274,367	11.92
Montana:														
Bituminous	14	2,216,646	18,410	66,211	9,081	2,310,348	2.61	422	55	204	681	200	136,454	16.93
Lignite	6			34,901	169	35,070	3.51	17	4	4	25	190	4,762	7.36
Total Montana	20	2,216,646	18,410	101,112	9,250	2,345,418	2.63	439	59	208	706	200	141,216	16.61
New Mexico	30	662,337	47,798	60,629	11,934	782,698	5.75	703		122	825	179	147,761	5.30
North Dakota (lignite)	54	2,503,025	10,631	446,104	264,267	3,224,027	2.41	110	301	265	676	238	160,742	20.06
Ohio	639	25,160,447	1,806,318	10,811,709	170,218	37,948,692	3.87	9,633	4,076	3,784	17,493	210	3,667,764	10.35
Oklahoma	50	1,820,391	278,271	118,412	6,155	2,223,229	6.24	1,159	457	329	1,945	193	375,615	5.92
Pennsylvania	1,772	72,759,986	12,102,446	15,924,946	7,376,465	108,163,843	5.29	63,173	8,149	12,987	84,309	213	17,994,682	6.01
South Dakota (lignite)	2			28,325	25	28,350	3.49		13	1	14	222	3,109	9.12
Tennessee	256	3,798,526	374,490	1,191,490	36,440	5,400,946	4.99	5,449	234	831	6,514	169	1,102,232	4.90
Utah	61	5,143,873	353,049	422,058	216,977	6,135,957	5.32	3,138		923	4,061	204	828,361	7.41
Virginia	262	17,636,433	2,271,235	1,102,743	389,458	21,399,869	5.42	14,749	379	2,555	17,683	209	3,699,716	5.78
Washington	25	604,129	85,893	151,064	15,940	857,026	7.04	724	53	179	956	211	201,771	4.25
West Virginia	1,289	145,671,442	10,673,406	3,141,881	3,823,093	163,309,822	5.23	88,862	4,054	18,970	111,886	219	24,530,251	6.66
Wyoming	41	6,154,575	18,204	130,964	125,890	6,429,633	4.19	2,330	245	742	3,317	199	661,377	9.72
Other States:														
Georgia and North Carolina	2			26,614		26,614	6.71	39		9	48	277	13,305	2.00
Total	8,009	425,326,920	35,044,394	58,131,900	15,161,518	533,664,732	4.92	281,868	26,102	64,927	372,897	203	75,754,858	7.04

[1] Includes coal loaded at mine directly into railroad cars or river barges.

[2] Includes coal used by mine employees, taken by locomotive tenders at tipple, used at mine for power and heat, coal transported from mine to point of use by conveyor or tram, coal made into beehive coke at mine, and all other uses at mines.

[3] Value received or charged for coal, f. o. b. mine, including selling cost. (Includes a value for coal not sold but used by producer, such as mine fuel and coal coked as estimate by producer at average prices that might have been received if such coal had been sold commercially.)

NUMBER AND SIZE OF MINES

TABLE 11.—Number and production of bituminous-coal and lignite mines in the United States, 1950, by State and size of output

[Exclusive of mines producing less than 1,000 tons]

State	Class 1A—500,000 tons and over				Class 1B—200,000 to 500,000 tons				Class 2—100,000 tons to 200,000 tons			
	Mines		Production		Mines		Production		Mines		Production	
	Number	Percent	Net tons	Percent	Number	Percent	Net tons	Percent	Number	Percent	Net tons	Percent
Alabama	6	1.6	4,473,365	31.0	12	3.2	3,498,322	24.3	15	4.0	2,225,606	15.4
Alaska									2	28.5	281,718	68.3
Arkansas					1	1.9	252,808	21.6				
Colorado					1	.6	490,022	11.5	8	4.6	1,248,636	29.3
Illinois	45	15.1	41,369,220	73.5	28	9.4	8,964,279	16.0	13	4.4	1,923,936	3.4
Indiana	17	17.0	11,714,052	58.7	16	16.0	5,677,557	28.4	7	7.0	1,015,222	5.1
Iowa					2	1.7	478,570	25.3				
Kansas	1	2.1	685,375	32.3	3	6.2	851,696	40.1	1	2.1	148,518	7.0
Kentucky	22	.7	18,157,662	23.1	66	2.0	20,306,678	25.9	92	2.8	12,900,042	16.4
Missouri	1	1.2	585,250	19.8	3	3.5	1,127,669	38.1	4	4.6	622,261	21.0
Montana (bituminous) [1]	1	6.2	1,708,149	69.2	1	6.2	270,828	11.0	2	12.5	306,544	12.4
New Mexico					1	4.0	467,020	64.3				
Ohio	15	2.2	14,178,641	37.5	26	3.8	7,596,571	20.1	40	5.8	5,390,340	14.3
Oklahoma					2	3.2	562,727	21.0	8	12.7	1,240,492	46.3
Pennsylvania	40	2.1	38,100,689	36.0	74	3.8	20,767,828	19.6	118	6.1	15,926,054	15.1
Tennessee					4	3.0	993,800	19.6	15	11.3	1,929,763	38.1
Utah	3	4.5	2,363,531	35.4	6	8.9	2,528,727	37.9	6	8.9	876,395	13.1
Virginia	7	2.2	5,003,867	28.3	17	5.2	5,002,971	28.3	22	6.7	3,141,305	17.8
Washington					1	3.9	228,864	26.2	1	3.8	189,818	21.7
West Virginia	56	4.0	43,954,765	30.5	179	12.7	55,159,401	38.3	152	10.8	21,894,730	15.2
Wyoming	3	6.7	2,436,352	38.4	8	17.8	2,524,887	39.8	7	15.5	934,007	14.7
Other States: California, Montana, North Dakota, South Dakota, and Texas (lignite only)	1	1.7	591,022	17.5	5	8.9	1,931,344	57.3	1	1.8	174,831	5.2
Total	218	2.3	185,321,940	35.9	456	4.8	139,682,569	27.1	514	5.5	72,370,218	14.0

State	Class 3—50,000 to 100,000 tons				Class 4—10,000 to 50,000 tons				Class 5—Less than 10,000 tons				All classes		
	Mines		Production		Mines		Production		Mines		Production		Mines	Production (net tons)	
	Number	Percent	Net tons	Percent	Number	Percent	Net tons	Percent	Number	Percent	Net tons	Percent		Total	Average per mine
Alabama	24	6.3	1,651,344	11.5	61	16.1	1,519,609	10.5	260	68.8	1,053,564	7.3	378	14,421,810	38,153
Alaska	1	14.3	93,315	22.6	2	28.6	26,545	6.4	2	28.6	10,877	2.7	7	412,455	58,922
Arizona									1	100.0	4,446	100.0	1	4,446	4,446
Arkansas	5	9.4	331,078	28.3	20	37.7	482,399	41.3	27	51.0	102,783	8.8	53	1,169,068	22,058
Colorado	14	8.1	1,057,465	24.8	41	23.7	1,078,898	25.4	109	63.0	383,479	9.0	173	4,258,500	24,616
Illinois	18	6.0	1,210,709	2.1	94	31.5	2,360,719	4.2	100	33.6	462,058	.8	298	56,290,921	188,896
Indiana	11	11.0	838,293	4.2	26	26.0	590,613	3.0	23	23.0	121,292	.6	100	19,957,029	199,570
Iowa					49	40.5	1,080,856	57.1	70	57.8	331,985	17.6	121	1,891,411	15,631
Kansas	2	4.2	186,033	8.7	8	16.7	124,278	5.8	33	68.7	129,080	6.1	48	2,124,980	44,270
Kentucky	100	3.1	7,129,820	9.1	552	16.9	10,734,279	13.7	2,427	74.5	9,267,122	11.8	3,259	78,495,603	24,086
Maryland	1	1.0	50,349	7.8	12	11.4	294,161	45.4	92	87.6	303,413	46.8	105	647,923	6,171
Michigan					1	100.0	11,500	100.0					1	11,500	11,500
Missouri	1	1.1	81,309	2.7	15	17.2	305,475	10.3	63	72.4	241,117	8.1	87	2,963,081	34,058
Montana (bituminous) [1]	1	6.3	75,000	3.1	6	37.5	84,809	3.4	5	31.3	22,706	.9	16	2,468,036	154,252
New Mexico	1	4.0	66,263	9.1	6	24.0	143,352	19.7	17	68.0	50,323	6.9	25	726,958	29,078
Ohio	66	9.6	4,797,457	12.7	198	28.8	4,444,845	11.8	343	49.8	1,353,237	3.6	688	37,761,091	54,885
Oklahoma	6	9.5	432,496	16.2	11	17.5	313,818	11.7	36	57.1	129,038	4.8	63	2,678,571	42,517
Oregon									1	100.0	1,384	100.0	1	1,384	1,384
Pennsylvania	176	9.1	12,216,970	11.5	659	34.1	14,922,651	14.1	865	44.8	3,935,929	3.7	1,932	105,870,121	54,798
Tennessee	16	12.0	1,190,771	23.5	30	22.6	695,595	13.7	68	51.1	259,871	5.1	133	5,069,800	38,119
Utah	4	6.0	311,096	4.7	19	28.4	457,986	6.9	29	43.3	132,161	2.0	67	6,669,896	99,551
Virginia	22	6.7	1,543,009	8.7	75	22.9	1,712,571	9.7	184	56.3	1,262,924	7.2	327	17,666,647	54,026
Washington	2	7.7	160,750	18.4	7	26.9	212,512	24.3	15	57.7	82,045	9.4	26	873,989	33,615
West Virginia	145	10.2	10,491,078	7.3	454	32.2	10,531,548	7.3	425	30.1	2,084,161	1.4	1,411	144,115,683	102,137
Wyoming	4	8.9	305,754	4.8	4	8.9	77,029	1.2	19	42.2	70,220	1.1	45	6,348,249	141,072
Other States:															
Georgia and North Carolina					1	12.5	23,935	57.1	7	87.5	18,000	42.9	8	41,935	5,242
California, Montana, North Dakota, South Dakota and Texas (lignite only)	2	3.6	163,402	4.8	16	28.6	382,457	11.4	31	55.4	126,910	3.8	56	3,369,966	60,178
Total	622	6.6	44,383,761	8.6	2,367	25.1	52,612,440	10.2	5,252	55.7	21,940,125	4.2	9,429	516,311,053	54,758

[1] Lignite included with "Other States."

TABLE 12.—Number and production of bituminous-coal and lignite mines in the United States, 1951, by State and size of output

[Exclusive of mines producing less than 1,000 tons]

State	Class 1A—500,000 tons and over				Class 1B—200,000 to 500,000 tons				Class 2—100,000 to 200,000 tons			
	Mines		Production		Mines		Production		Mines		Production	
	Number	Percent	Net tons	Percent	Number	Percent	Net tons	Percent	Number	Percent	Net tons	Percent
Alabama	6	2.0	5,262,480	38.7	11	3.7	3,061,511	22.5	14	4.7	1,876,744	13.8
Alaska									2	33.3	327,486	66.2
Arkansas					1	1.7	202,869	18.3	1	1.7	114,472	10.4
Colorado	1	.7	501,430	12.2	1	.7	237,794	5.8	7	4.6	1,000,586	24.4
Illinois	47	17.8	40,869,352	75.4	20	7.6	7,223,184	13.3	21	8.0	3,048,006	5.6
Indiana	16	17.0	11,393,364	58.6	15	16.0	5,560,702	28.6	10	10.6	1,310,319	6.7
Iowa					1	1.0	294,174	18.1	1	1.0	112,384	6.9
Kansas					3	6.7	1,061,467	54.1	4	8.9	615,986	31.4
Kentucky	30	1.3	23,415,991	31.2	72	3.1	21,355,132	28.5	71	3.1	9,539,986	12.7
Missouri	1	1.3	726,720	22.2	5	6.7	1,726,136	52.8	2	2.7	332,393	10.2
Montana (bituminous) [1]	1	7.1	1,488,300	64.4	1	7.1	405,204	17.5	2	14.3	275,756	11.9
New Mexico	1	3.3	535,430	68.4								
Ohio	18	2.8	16,916,938	44.6	20	3.1	5,955,022	15.7	41	6.4	5,367,209	14.1
Oklahoma					2	4.0	513,748	23.1	7	14.0	930,089	41.8
Pennsylvania	48	2.7	46,059,494	42.6	64	3.6	18,857,735	17.4	105	5.9	14,761,055	13.7
Tennessee					3	1.2	843,077	15.6	11	4.3	1,631,758	30.2
Utah	3	4.9	2,139,548	34.9	6	9.8	2,202,359	35.9	5	8.2	726,725	11.8
Virginia	11	4.2	8,834,543	41.3	12	4.6	3,451,711	16.1	28	10.7	4,074,429	19.0
Washington					2	8.0	436,946	51.0				
West Virginia	77	6.0	64,751,647	39.7	182	14.1	57,797,985	35.4	122	9.5	17,788,555	10.9
Wyoming	4	9.7	3,102,984	48.3	6	14.6	2,118,923	33.0	7	17.1	901,936	14.0
Other States: California, Montana, North Dakota, and South Dakota (lignite only)					7	11.1	2,398,974	72.9	3	4.7	424,747	12.9
Total	264	3.3	225,998,221	42.4	434	5.4	135,704,653	25.4	464	5.8	65,160,621	12.2

State	Class 3—50,000 to 100,000 tons				Class 4—10,000 to 50,000 tons				Class 5—Less than 10,000 tons				All classes		
	Mines		Production		Mines		Production		Mines		Production		Mines	Production (net tons)	
	Number	Percent	Net tons	Percent	Number	Percent	Net tons	Percent	Number	Percent	Net tons	Percent		Total	Average per mine
Alabama	20	6.7	1,409,550	10.4	55	18.5	1,254,722	9.2	192	64.4	731,975	5.4	298	13,596,982	45,627
Alaska	1	16.7	84,517	17.1	3	50.0	82,330	16.7					6	494,333	82,389
Arizona									1	100.0	4,969	100.0	1	4,969	4,969
Arkansas	3	5.2	219,169	19.8	20	34.5	467,104	42.2	33	56.9	103,091	9.3	58	1,106,705	19,081
Colorado	16	10.6	1,153,752	28.1	37	24.5	873,790	21.3	89	58.9	335,287	8.2	151	4,102,639	27,170
Illinois	14	5.3	925,118	1.7	69	26.1	1,730,624	3.2	93	35.2	403,591	.8	264	54,199,875	205,303
Indiana	9	9.6	519,963	2.6	25	26.6	596,415	3.1	19	20.2	69,682	.4	94	19,450,445	206,920
Iowa	4	4.0	228,778	14.0	33	32.3	724,322	44.4	63	61.7	270,640	16.6	102	1,630,298	15,983
Kansas	1	2.2	57,970	3.0	4	8.9	82,290	4.2	33	73.3	143,388	7.3	45	1,961,101	43,580
Kentucky	90	3.9	6,430,938	8.6	396	17.1	8,304,148	11.1	1,650	71.5	5,926,140	7.9	2,309	74,972,335	32,470
Maryland					15	14.9	310,365	52.7	86	85.1	278,274	47.3	101	588,639	5,828
Michigan									1	100.0	7,347	100.0	1	7,347	7,347
Missouri	1	1.3	68,021	2.1	8	10.7	192,083	5.9	58	77.3	223,930	6.8	75	3,269,283	43,590
Montana (bituminous) [1]					3	21.5	88,893	3.9	7	50.0	52,195	2.3	14	2,310,348	165,025
New Mexico					6	20.0	179,811	23.0	23	76.7	67,457	8.6	30	782,698	26,090
Ohio	54	8.5	4,045,660	10.6	184	28.8	4,371,124	11.6	322	50.4	1,292,739	3.4	639	37,948,692	59,388
Oklahoma	8	16.0	528,373	23.8	6	12.0	168,477	7.6	27	54.0	82,542	3.7	50	2,223,229	44,465
Pennsylvania	165	9.3	11,603,705	10.7	580	32.8	13,327,546	12.3	810	45.7	3,554,308	3.3	1,772	108,163,843	61,041
Tennessee	18	7.0	1,385,949	25.7	43	16.8	907,400	16.8	181	70.7	632,762	11.7	256	5,400,946	21,097
Utah	7	11.5	529,915	8.6	19	31.2	460,619	7.5	21	34.4	76,791	1.3	61	6,135,957	100,589
Virginia	26	9.9	1,683,584	7.9	86	32.8	2,588,625	12.1	99	37.8	766,977	3.6	262	21,399,869	81,679
Washington	3	12.0	174,365	20.3	11	44.0	208,678	24.4	9	36.0	37,037	4.3	25	857,026	34,281
West Virginia	161	12.5	11,464,766	7.0	427	33.1	9,844,788	6.0	320	24.8	1,662,081	1.0	1,289	163,309,822	126,695
Wyoming	2	4.9	156,222	2.4	5	12.2	88,572	1.4	17	41.5	60,996	.9	41	6,429,633	156,820
Other States:															
Georgia and North Carolina					1	50.0	25,414	95.5	1	50.0	1,200	4.5	2	26,614	13,307
California, Montana, North Dakota, and South Dakota (lignite only)	1	1.6	71,420	2.2	10	15.9	220,956	6.7	42	66.7	175,007	5.3	63	3,291,104	52,240
Total	604	7.5	42,741,735	8.0	2,046	25.6	47,099,096	8.8	4,197	52.4	16,960,406	3.2	8,009	533,664,732	66,633

[1] Lignite included with "Other States."

EMPLOYMENT AND PRODUCTIVITY

TABLE 13.—Growth of the bituminous-coal- and lignite-mining industry in the United States, 1900–1951

Year	Men employed	Average number of days worked	Average days lost per man on strike	Net tons per man—		Percent of underground production—		Percent of total production—	
				Per day	Per year	Cut by machines [1]	Mechanically loaded	Mechanically cleaned [2]	Mined by stripping
1900	304,375	234	43	2.98	697	24.9	[3]	[3]	[3]
1901	340,235	225	35	2.94	664	25.6	[3]	[3]	[3]
1902	370,056	230	44	3.06	703	26.8	[3]	[3]	[3]
1903	415,777	225	28	3.02	680	27.6	[3]	[3]	[3]
1904	437,832	202	44	3.15	637	28.2	[3]	[3]	[3]
1905	460,629	211	23	3.24	684	32.8	[3]	[3]	[3]
1906	478,425	213	63	3.36	717	34.7	[3]	2.7	[3]
1907	513,258	234	14	3.29	769	35.1	[3]	2.9	[3]
1908	516,264	193	38	3.34	644	37.0	[3]	3.6	[3]
1909	543,152	209	29	3.34	699	37.5	[3]	3.8	[3]
1910	555,533	217	89	3.46	751	41.7	[3]	3.8	[3]
1911	549,775	211	27	3.50	738	43.9	[3]	[3]	[3]
1912	548,632	223	35	3.68	820	46.8	[3]	3.9	[3]
1913	571,882	232	36	3.61	837	50.7	[3]	4.6	[3]
1914	583,506	195	80	3.71	724	51.8	[3]	4.8	0.3
1915	557,456	203	61	3.91	794	55.3	[3]	4.7	.6
1916	561,102	230	26	3.90	896	56.9	[3]	4.6	.8
1917	603,143	243	17	3.77	915	56.1	[3]	4.6	1.0
1918	615,305	249	7	3.78	942	56.7	[3]	3.8	1.4
1919	621,998	195	37	3.84	749	60.0	[3]	3.6	1.2
1920	639,547	220	22	4.00	881	60.7	[3]	3.3	1.5
1921	663,754	149	23	4.20	627	66.4	[3]	3.4	1.2
1922	687,958	142	117	4.28	609	64.8	[3]	[3]	2.4
1923	704,793	179	20	4.47	801	68.3	0.3	3.8	2.1
1924	619,604	171	73	4.56	781	71.5	.7	[3]	2.8
1925	588,493	195	30	4.52	884	72.9	1.2	[3]	3.2
1926	593,647	215	24	4.50	966	73.8	1.9	[3]	3.0
1927	593,918	191	153	4.55	872	74.9	3.3	5.3	3.6
1928	522,150	203	83	4.73	959	76.9	4.5	5.7	4.0
1929	502,993	219	11	4.85	1,064	78.4	7.4	6.9	3.8
1930	493,202	187	43	5.06	948	81.0	10.5	8.3	4.3
1931	450,213	160	35	5.30	849	83.2	13.1	9.5	5.0
1932	406,380	146	120	5.22	762	84.1	12.3	9.8	6.3
1933	418,703	167	30	4.78	797	84.7	12.0	10.4	5.5
1934	458,011	178	15	4.40	785	84.1	12.2	11.1	5.8
1935	462,403	179	[4] 7	4.50	805	84.2	13.5	12.2	6.4
1936	477,204	199	21	4.62	920	84.8	16.3	13.9	6.4
1937	491,864	193	[4] 19	4.69	906	[3]	20.2	14.6	7.1
1938	441,333	162	13	4.89	790	87.5	26.7	18.2	8.7
1939	421,788	178	36	5.25	936	87.9	31.0	20.1	9.6
1940	439,075	202	8	5.19	1,049	88.4	35.4	22.2	9.4
1941	456,981	216	27	5.20	1,125	89.0	40.7	22.9	10.7
1942	461,991	246	7	5.12	1,261	89.7	45.2	24.4	11.5
1943	416,007	264	[4] 15	5.38	1,419	90.3	48.9	24.7	13.5
1944	393,347	278	[4] 5	5.67	1,575	90.5	52.9	25.6	16.3
1945	383,100	261	[4] 9	5.78	1,508	90.8	56.1	25.6	19.0
1946	[5] 396,434	214	[4] 23	6.30	1,347	90.8	58.4	26.0	21.1
1947	[5] 419,182	234	[4] 5	6.42	1,504	90.0	60.7	27.7	22.1
1948	[5] 441,631	217	[4] 16	6.26	1,358	90.7	64.3	30.2	23.3
1949	[5] 433,698	157	[4] 15	6.43	1,010	91.4	67.0	35.1	24.2
1950	[5] 415,582	183	[4] 56	6.77	1,239	92.6	69.4	38.5	23.9
1951	[5] 372,897	203	[4] 4	7.04	1,429	94.9	73.1	45.0	22.0

[1] Percentages for 1900 to 1913, inclusive, are of total production, as a separation of strip and underground production is not available for those years.
[2] For 1906 to 1926, inclusive, these percentages are exclusive of coal cleaned at central washeries operated by consumers.
[3] Data not available.
[4] Bureau of Labor Statistics, U. S. Department of Labor.
[5] Average number of men working daily.

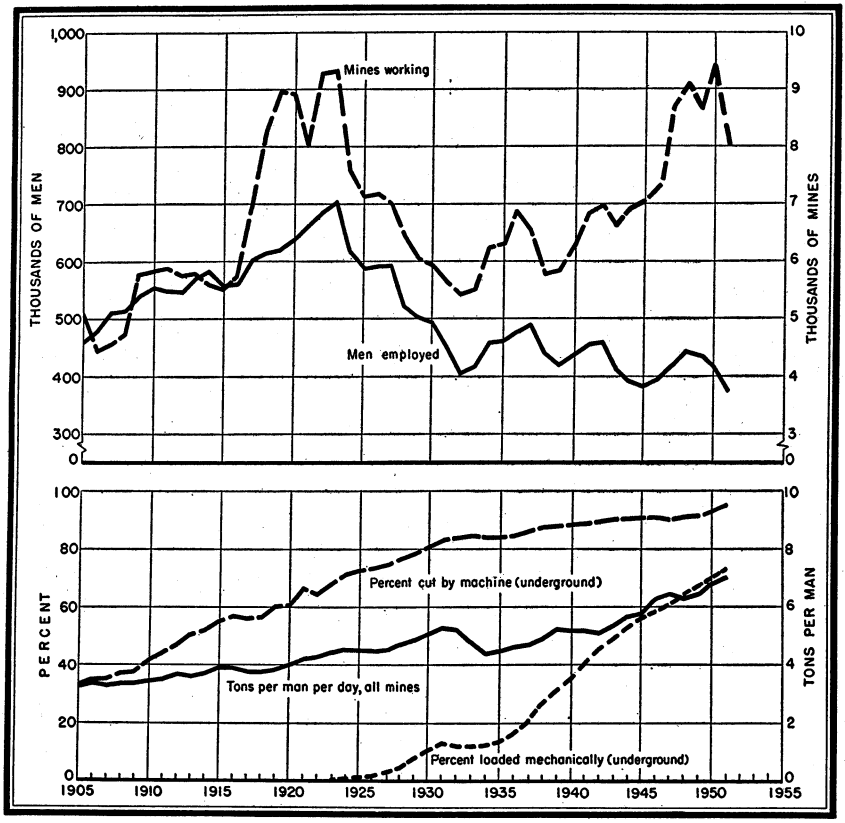

FIGURE 4.—Employment, mechanization, and output per man at bituminous-coal and lignite mines in the United States, 1905–51.

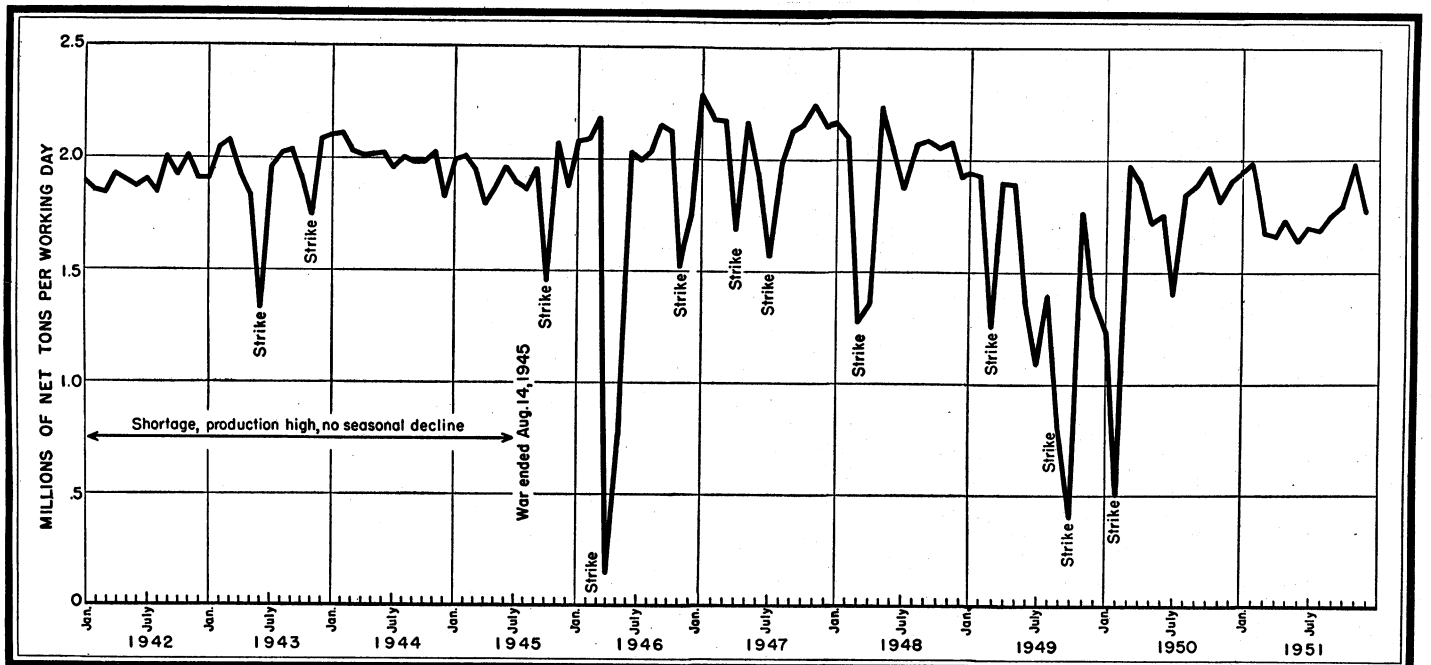

FIGURE 5.—Average production of bituminous coal and lignite in the United States per working day in each month, 1942–51.

TABLE 14.—Average output per man per day at bituminous-coal and lignite mines in the United States, 1950, by State and method of mining

State	Mined underground					Mined by stripping			Total production	
	Hand-loaded (net tons)	Mechanically loaded (net tons)	Total			Net tons	Percent of grand total	Average tons per man per day	Net tons	Average tons per man per day
			Net tons	Percent of grand total	Average tons per man per day					
Alabama	3,055,088	9,478,684	12,533,772	86.9	3.98	1,888,038	13.1	9.64	14,421,810	4.31
Alaska	266,001	15,717	281,718	68.3	5.10	130,737	31.7	10.11	412,455	6.05
Arizona	4,446		4,446	100.0	2.18				4,446	2.18
Arkansas	104,803	559,319	664,122	56.8	3.14	504,946	43.2	10.79	1,169,068	4.53
Colorado	1,300,632	2,551,155	3,851,787	90.4	5.13	406,713	9.6	15.08	4,258,500	5.48
Illinois	2,934,462	35,744,036	38,678,498	68.7	8.00	17,612,423	31.3	18.70	56,290,921	9.75
Indiana	384,829	8,832,633	9,217,462	46.2	7.88	10,739,567	53.8	16.71	19,957,029	11.01
Iowa	659,558	41,342	700,900	37.1	3.28	1,190,511	62.9	11.67	1,891,411	5.99
Kansas	100,628		100,628	4.7	2.45	2,024,352	95.3	14.22	2,124,980	11.58
Kentucky	33,121,385	31,396,575	64,517,960	82.2	5.59	13,977,643	17.8	19.12	78,495,603	6.39
Maryland	350,540	136,329	486,869	75.1	3.71	161,054	24.9	9.08	647,923	4.35
Michigan	11,500		11,500	100.0	1.98				11,500	1.98
Missouri	327,657		327,657	11.1	2.56	2,635,424	88.9	15.04	2,963,081	9.78
Montana:										
Bituminous	41,302	718,585	759,887	30.8	6.88	1,708,149	69.2	92.78	2,468,036	19.15
Lignite	31,917	11,183	43,100	82.7	7.03	9,030	17.3	9.41	52,130	7.35
Total Montana	73,219	729,768	802,987	31.9	6.89	1,717,179	68.1	88.65	2,520,166	18.53
New Mexico	153,001	573,957	726,958	100.0	5.32				726,958	5.32
North Dakota (lignite)	26,485	406,432	432,917	13.3	10.05	2,828,056	86.7	27.45	3,260,973	22.32
Ohio	3,091,259	11,894,639	14,985,898	39.7	6.35	22,775,193	60.3	17.04	37,761,091	10.21
Oklahoma	129,437	821,960	951,397	35.5	3.74	1,727,174	64.5	10.90	2,678,571	6.49
Oregon	1,384		1,384	100.0	1.44				1,384	1.44
Pennsylvania	28,513,728	50,929,796	79,443,524	75.0	5.07	26,426,597	25.0	12.49	105,870,121	5.95
Tennessee	2,578,549	1,907,185	4,485,734	88.5	4.35	584,066	11.5	10.68	5,069,800	4.67
Texas (lignite)						18,169	100.0	4.62	18,169	4.62
Utah	141,985	6,527,911	6,669,896	100.0	7.30				6,669,896	7.30
Virginia	8,580,297	7,520,704	16,101,001	91.1	5.21	1,565,646	8.9	16.11	17,666,647	5.54
Washington	253,319	550,130	803,449	91.9	3.79	70,540	8.1	8.09	873,989	3.96
West Virginia	33,851,819	97,277,710	131,129,529	91.0	6.07	12,986,154	9.0	14.78	144,115,683	6.41
Wyoming	60,720	4,828,630	4,889,350	77.0	7.42	1,458,899	23.0	20.29	6,348,249	8.69
Other States:										
California and South Dakota (lignite)	1,211		1,211	3.1	5.05	37,483	96.9	9.99	38,694	9.70
Georgia and North Carolina	41,935		41,935	100.0	1.75				41,935	1.75
Total	120,119,877	272,724,612	392,844,489	76.1	5.75	123,466,564	23.9	15.66	516,311,053	6.77

TABLE 15.—Average output per man per day at bituminous-coal and lignite mines in the United States, 1951, by State and method of mining

State	Mined underground					Mined by stripping			Total production	
	Hand-loaded (net tons)	Mechanically loaded (net tons)	Total			Net tons	Percent of grand total	Average tons per man per day	Net tons	Average tons per man per day
			Net tons	Percent of grand total	Average tons per man per day					
Alabama	1,677,266	10,025,694	11,702,960	86.1	4.60	1,894,022	13.9	10.77	13,596,982	5.00
Alaska	253,524	8,450	261,974	53.0	5.48	232,359	47.0	17.10	494,333	8.05
Arizona	4,969		4,969	100.0	2.28				4,969	2.28
Arkansas	106,310	592,376	698,686	63.1	3.03	408,019	36.9	10.73	1,106,705	4.41
California (lignite)						3,657	100.0	9.75	3,657	9.75
Colorado	1,189,289	2,547,298	3,736,587	91.1	5.14	366,052	8.9	18.47	4,102,639	5.49
Illinois	1,852,125	34,051,234	35,903,359	66.2	9.01	18,296,516	33.8	19.75	54,199,875	11.04
Indiana	418,557	8,034,618	8,453,175	43.5	8.23	10,997,270	56.5	15.76	19,450,445	11.28
Iowa	435,771	43,341	479,112	29.4	3.30	1,151,186	70.6	12.14	1,630,298	6.79
Kansas	73,826		73,826	3.8	2.75	1,887,275	96.2	13.45	1,961,101	11.73
Kentucky	27,429,306	35,815,851	63,245,157	84.4	6.08	11,727,178	15.6	19.96	74,972,335	6.82
Maryland	345,239	77,312	422,551	71.8	3.80	166,088	28.2	8.82	588,639	4.53
Michigan	7,347		7,347	100.0	1.62				7,347	1.62
Missouri	255,614		255,614	7.8	2.58	3,013,669	92.2	17.20	3,269,283	11.92
Montana:										
Bituminous	36,664	785,384	822,048	35.6	6.81	1,488,300	64.4	94.32	2,310,348	16.93
Lignite	20,607	8,150	28,757	82.0	7.33	6,313	18.0	7.52	35,070	7.36
Total Montana	57,271	793,534	850,805	36.3	6.83	1,494,613	63.7	89.93	2,345,418	16.61
New Mexico	162,452	620,246	782,698	100.0	5.30				782,698	5.30
North Dakota (lignite)	26,250	224,651	250,901	7.8	7.57	2,973,126	92.2	23.30	3,224,027	20.06
Ohio	2,421,476	13,917,555	16,339,031	43.1	6.81	21,609,661	56.9	17.06	37,948,692	10.35
Oklahoma	174,491	825,917	1,000,408	45.0	3.83	1,222,821	55.0	10.71	2,223,229	5.92
Pennsylvania	26,547,780	58,259,720	84,807,500	78.4	5.24	23,356,343	21.6	12.82	108,163,843	6.01
South Dakota (lignite)						28,350	100.0	9.12	28,350	9.12
Tennessee	2,952,271	1,970,341	4,922,612	91.1	4.65	478,334	8.9	10.68	5,400,946	4.90
Utah	132,164	6,003,793	6,135,957	100.0	7.41				6,135,957	7.41
Virginia	10,426,890	9,599,497	20,026,387	93.6	5.55	1,373,482	6.4	15.42	21,399,869	5.78
Washington	199,215	583,860	783,075	91.4	4.08	73,951	8.6	7.48	857,026	4.25
West Virginia	34,565,606	115,716,327	150,281,933	92.0	6.35	13,027,889	8.0	14.85	163,309,822	6.66
Wyoming	49,512	4,544,306	4,593,818	71.4	7.93	1,835,815	28.6	22.32	6,429,633	9.72
Other States: Georgia and North Carolina	26,614		26,614	100.0	2.00				26,614	2.00
Total	111,791,135	304,255,921	416,047,056	78.0	6.08	117,617,676	22.0	16.02	533,664,732	7.04

METHOD OF MINING

TABLE 16.—Underground production of bituminous coal and lignite in the United States, 1950, by State and method of cutting

State	Cut by hand		Shot from solid		Cut by machines [1]				Total underground (net tons)
	Net tons	Percent of total underground	Net tons	Percent of total underground	Net tons	Percent of total underground	Number of coal-cutting machines in use	Average output per machine (net tons)	
Alabama	34,370	0.3	1,940,821	15.5	10,558,581	84.2	512	20,622	12,533,772
Alaska			281,718	100.0					281,718
Arizona			4,446	100.0					4,446
Arkansas	2,100	.3	33,661	5.1	628,361	94.6	75	8,398	664,122
Colorado	573,730	14.9	94,486	2.5	3,183,571	82.6	450	7,075	3,851,787
Illinois			585,025	1.5	38,093,473	98.5	689	55,288	38,678,498
Indiana	12,005	.1	86,913	1.0	9,118,544	98.9	215	42,412	9,217,462
Iowa	40,487	5.8	386,937	55.2	273,476	39.0	40	6,837	700,900
Kansas	5,716	5.7	5,835	5.8	89,077	88.5	20	4,454	100,628
Kentucky	301,903	.5	12,142,398	18.8	52,073,659	80.7	2,142	24,311	64,517,960
Maryland	189,485	38.9	56,027	11.5	241,357	49.6	69	3,498	486,869
Michigan					11,500	100.0	3	3,833	11,500
Missouri	19,076	5.8	20,669	6.3	287,912	87.9	41	7,022	327,657
Montana:									
Bituminous					759,887	100.0	42	18,042	759,887
Lignite			43,100	100.0					43,100
Total Montana			43,100	5.4	759,887	94.6	42	18,042	802,987
New Mexico	5,893	.8	71,119	9.8	649,946	89.4	56	11,606	726,958
North Dakota (lignite)			25,025	5.8	407,892	94.2	5	81,578	432,917
Ohio	28,672	.2	76,237	.5	14,880,989	99.3	720	20,668	14,985,898
Oklahoma	1,249	.1	25,774	2.7	924,374	97.2	105	8,804	951,397
Oregon					1,384	100.0	1	1,384	1,384
Pennsylvania	4,268,662	5.4	1,495,727	1.9	73,679,135	92.7	3,322	22,179	79,443,524
Tennessee	98,614	2.2	374,162	8.3	4,012,958	89.5	252	15,924	4,485,734
Texas (lignite)									
Utah	11,730	.2	104,137	1.6	6,554,029	98.2	242	27,083	6,669,896
Virginia	88,250	.5	692,405	4.3	15,320,346	95.2	548	27,957	16,101,001
Washington	83,299	10.4	237,460	29.5	482,690	60.1	46	10,493	803,449
West Virginia	1,017,364	.8	3,428,307	2.6	126,683,858	96.6	4,437	28,552	131,129,529
Wyoming	2,849	.1	18,928	.4	4,867,573	99.5	278	17,509	4,889,350
Other States:									
California and South Dakota (lignite)			1,211	100.0					1,211
Georgia and North Carolina			18,000	42.9	23,935	57.1	5	4,787	41,935
Total	6,785,454	1.7	22,250,528	5.7	363,808,507	92.6	14,315	25,414	392,844,489

[1] Includes continuous mining machines.

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TABLE 17.—Underground production of bituminous coal and lignite in the United States, 1951, by State and method of cutting

State	Cut by hand		Shot from solid		Cut by machines [1]				Total underground (net tons)
	Net tons	Percent of total underground	Net tons	Percent of total underground	Net tons	Percent of total underground	Number of coal-cutting machines in use	Average output per machine (net tons)	
Alabama	36,268	0.3	1,188,896	10.2	10,477,796	89.5	395	26,526	11,702,960
Alaska			261,974	100.0					261,974
Arizona			1,946	39.2	3,023	60.8	1	3,023	4,969
Arkansas	8,815	1.3	43,680	6.2	646,191	92.5	83	7,785	698,686
Colorado	569,457	15.2	96,845	2.6	3,070,285	82.2	454	6,763	3,736,587
Illinois			415,832	1.2	35,487,527	98.8	641	55,363	35,903,359
Indiana	14,582	.2	31,225	.4	8,407,368	99.4	216	38,923	8,453,175
Iowa	3,753	.8	264,662	55.2	210,697	44.0	41	5,139	479,112
Kansas	1,800	2.4	6,209	8.4	65,817	89.2	16	4,114	73,826
Kentucky	323,928	.5	6,209,372	9.8	56,711,857	89.7	2,129	26,638	63,245,157
Maryland	192,255	45.5	38,020	9.0	192,276	45.5	36	5,341	422,551
Michigan					7,347	100.0	3	2,449	7,347
Missouri	14,038	5.5	23,830	9.3	217,746	85.2	36	6,049	255,614
Montana:									
Bituminous					822,048	100.0	42	19,573	822,048
Lignite			28,757	100.0					28,757
Total Montana			28,757	3.4	822,048	96.6	42	19,573	850,805
New Mexico	16,046	2.1	66,917	8.5	699,735	89.4	42	16,660	782,698
North Dakota (lignite)			24,910	9.9	225,991	90.1	4	56,498	250,901
Ohio	31,964	.2	30,041	.2	16,277,026	99.6	655	24,850	16,339,031
Oklahoma			29,476	2.9	970,932	97.1	114	8,517	1,000,408
Pennsylvania	3,477,558	4.1	1,251,772	1.5	80,078,170	94.4	3,179	25,190	84,807,500
Tennessee	68,385	1.4	739,198	15.0	4,115,029	83.6	245	16,796	4,922,612
Utah	9,911	.2	33,416	.5	6,092,630	99.3	206	29,576	6,135,957
Virginia	57,058	.3	797,225	4.0	19,172,104	95.7	549	34,922	20,026,387
Washington	56,074	7.2	220,242	28.1	506,759	64.7	41	12,360	783,075
West Virginia	1,283,927	.9	3,342,895	2.2	145,655,111	96.9	4,382	33,239	150,281,933
Wyoming	2,590	.1	23,431	.5	4,567,797	99.4	245	18,644	4,593,818
Other States: Georgia and North Carolina			1,200	4.5	25,414	95.5	6	4,236	26,614
Total	6,168,409	1.5	15,171,971	3.6	394,706,676	94.9	13,761	28,683	416,047,056

[1] Includes continuous mining machines and augers.

TABLE 18.—Use of power drills for shot holes in underground bituminous-coal and lignite mines, 1950–51, by States

State	Number of mines using power drills	Number of power drills		Net tons produced in working places where shot holes were power-drilled			Total production from mines using power drills (net tons)
		Electric	Compressed air	Electric drills	Compressed air drills	Total	
1950							
Alabama	90	728	54	10,449,925		10,449,925	11,214,552
Alaska	2	20	25	118,717	163,001	281,718	281,718
Arkansas	17	29	29	105,399	45,076	150,475	548,329
Colorado	104	434	50	2,384,473		2,384,473	3,586,039
Illinois	147	1,219	3	36,905,880		36,905,880	37,359,950
Indiana	44	310	7	9,085,056	10,141	9,095,197	9,098,198
Iowa	22	44		240,700		240,700	264,092
Kansas	2	2		6,687		6,687	11,612
Kentucky	1,102	2,455	123	38,900,216		38,900,216	50,860,999
Maryland	10	44	2	94,601		94,601	206,044
Michigan	1	2		11,500		11,500	11,500
Missouri	9	13		169,310		169,310	169,310
Montana:							
Bituminous	14	42		749,612		749,612	749,612
Lignite	6	16		43,100		43,100	43,100
Total Montana	20	58		792,712		792,712	792,712
New Mexico	6	50	5	577,212		577,212	577,212
North Dakota (lignite)	6	13		421,280		421,280	422,740
Ohio	211	628	4	12,062,089		12,062,089	13,881,230
Oklahoma	9	87	1	841,320		841,320	851,151
Oregon	1	2		1,384		1,384	1,384
Pennsylvania	403	2,421	444	52,616,995	667,919	53,284,914	67,062,306
Tennessee	42	202	29	2,572,011	182,768	2,754,779	3,699,638
Utah	58	302	3	6,606,104	20,023	6,626,127	6,633,321
Virginia	160	505	37	10,467,795		10,467,795	14,507,691
Washington	19	116	90	299,789	83,032	382,821	729,718
West Virginia	596	4,177	366	94,317,154	580,136	94,897,290	118,115,433
Wyoming	27	416	2	4,855,494		4,855,494	4,876,130
Other States: Georgia and North Carolina	4		8		5,000	5,000	28,935
Total	3,112	14,277	1,282	284,903,803	1,757,096	286,660,899	345,791,944
1951							
Alabama	90	562	35	10,432,495		10,432,495	10,967,228
Alaska	2	20	25	84,517	177,457	261,974	261,974
Arizona	1	1		3,023		3,023	4,969
Arkansas	18	30	31	84,244	44,227	128,471	562,176
Colorado	99	403	60	2,375,577	4,884	2,380,461	3,429,449
Illinois	152	1,040	3	34,118,558		34,118,558	34,635,311
Indiana	43	293	5	8,296,146		8,296,146	8,315,262
Iowa	17	31		152,959		152,959	175,076
Kansas	1	1		7,780		7,780	7,780
Kentucky	943	2,608	110	49,646,003	6,125	49,652,128	55,954,333
Maryland	7	13		27,260		27,260	101,931
Michigan	1	2		7,347		7,347	7,347
Missouri	8	12		138,690		138,690	138,690
Montana:							
Bituminous	13	43		822,048		822,048	822,048
Lignite	5	13		28,757		28,757	28,757
Total Montana	18	56		850,805		850,805	850,805
New Mexico	5	45		625,036		625,036	625,036
North Dakota (lignite)	6	12		237,432		237,432	237,432
Ohio	217	628	3	12,533,393		12,533,393	15,192,180
Oklahoma	7	85	3	823,507		823,507	917,126
Oregon							
Pennsylvania	442	2,519	433	60,282,536	553,949	60,836,485	74,853,488
Tennessee	50	203	26	2,482,859	324,587	2,807,446	3,811,496
Utah	55	261	4	6,114,339	371	6,114,710	6,117,044
Virginia	202	546	41	13,193,535		13,193,535	18,064,021
Washington	19	81	127	193,261	561,245	754,506	768,316
West Virginia	599	4,384	432	115,060,204	627,416	115,687,620	138,564,721
Wyoming	23	394	2	4,572,337		4,572,337	4,574,799
Other States: Georgia and North Carolina	2	1	5	1,200		1,200	26,614
Total	3,027	14,231	1,345	322,345,043	2,300,261	324,645,304	379,164,604

TABLE 19.—Number of underground bituminous-coal mines and number of haulage units in use, in the United States, in selected years [1]

Units	1924	1946	1948	1949	1950	1951
Underground mines	7,352	5,888	7,108	6,798	7,559	6,225
Locomotives:						
Trolley	[2] 12,765	14,110	14,617	14,090	13,822	13,327
Battery	1,515	1,011	904	928	949	900
Other types	443	110	74	59	62	51
Total	14,723	15,231	15,595	15,077	14,833	14,278
Rope haulage units:						
Portable	(3)	4,084	3,886	3,904	4,225	3,875
Stationary	(3)	1,009	1,044	1,073	1,037	916
Total	649	5,093	4,930	4,977	5,262	4,791
Shuttle cars:						
Cable reel	(3)	(3)	(3)	2,144	2,782	3,191
Battery	(3)	(3)	(3)	623	512	567
Total	(3)	(3)	(3)	2,767	3,294	3,758
Mother conveyors	(3)	457	755	860	1,013	1,094
Animals	36,352	10,185	10,834	10,313	10,033	7,478

[1] Exclusive of lignite and Virginia semianthracite mines in 1946, 1948, and 1949. Detailed data, by States, published in Bureau of Mines Mineral Market Report 2102, Oct. 27, 1952.
[2] Includes combination trolley and battery locomotives.
[3] Data not available.

TABLE 20.—Growth of strip mining at bituminous-coal and lignite mines in the United States, 1925–51

Year	Production (thousand net tons)			Percent of total mined by stripping	Average tons per man per day			Average value per ton, f. o. b. mine			Number of strip mines	Number of power shovels and draglines
	Underground mines	Strip mines	Total		Underground mines [1]	Strip mines [2]	Total	Underground mines [1]	Strip mines [2]	Total		
1925	503,182	16,871	520,053	3.2	4.45	11.18	4.52	$2.05	$1.84	$2.04	227	389
1926	556,444	16,923	573,367	3.0	4.42	11.13	4.50	2.07	1.89	2.06	237	410
1927	499,385	18,378	517,763	3.6	4.47	11.06	4.55	1.99	1.90	1.99	255	455
1928	480,956	19,789	500,745	4.0	4.61	13.02	4.73	1.87	1.69	1.86	250	415
1929	514,721	20,268	534,989	3.8	4.73	14.08	4.85	1.79	1.57	1.78	200	411
1930	447,684	19,842	467,526	4.3	4.93	16.21	5.06	1.71	1.54	1.70	218	341
1931	363,157	18,932	382,089	5.0	5.12	17.68	5.30	1.54	1.51	1.54	235	314
1932	290,069	19,641	309,710	6.3	4.99	16.95	5.22	1.31	1.32	1.31	255	332
1933	315,360	18,270	333,630	5.5	4.60	13.59	4.78	1.34	1.33	1.34	289	389
1934	338,578	20,790	359,368	5.8	4.23	13.28	4.40	1.76	1.49	1.75	344	458
1935	348,726	23,647	372,373	6.4	4.32	12.01	4.50	1.79	1.47	1.77	368	507
1936	410,962	28,126	439,088	6.4	4.42	13.91	4.62	1.77	1.49	1.76	381	562
1937	413,780	31,751	445,531	7.1	[3]	[3]	4.69	[3]	[3]	1.94	449	[3]
1938	318,138	30,407	348,545	8.7	4.60	15.00	4.89	[3]	[3]	1.95	465	737
1939	357,133	37,722	394,855	9.6	4.92	14.68	5.25	1.88	1.49	1.84	537	914
1940	417,604	43,167	460,771	9.4	4.86	15.63	5.19	1.94	1.56	1.91	638	1,071
1941	459,078	55,071	514,149	10.7	4.83	15.59	5.20	2.23	1.79	2.19	769	1,321
1942	515,490	67,203	582,693	11.5	4.74	15.52	5.12	2.41	1.90	2.36	834	1,438
1943	510,492	79,685	590,177	13.5	4.89	15.15	5.38	2.75	2.26	2.69	1,004	1,839
1944	518,678	100,898	619,576	16.3	5.04	15.89	5.67	3.01	2.48	2.92	1,240	2,312
1945	467,630	109,987	577,617	19.0	5.04	15.46	5.78	3.16	2.65	3.06	1,370	2,439
1946	420,958	112,964	533,922	21.1	5.43	15.73	6.30	3.59	2.87	3.44	1,445	2,744
1947	491,229	139,395	630,624	22.1	5.49	15.93	6.42	4.35	3.47	4.16	1,750	3,254
1948	460,012	139,506	599,518	23.3	5.31	15.28	6.26	5.26	4.11	4.99	1,971	3,712
1949	331,823	106,045	437,868	24.2	5.42	15.33	6.43	5.18	3.94	4.88	1,761	3,576
1950	392,844	123,467	516,311	23.9	5.75	15.66	6.77	5.15	3.87	4.84	1,870	3,877
1951	416,047	117,618	533,665	22.0	6.08	16.02	7.04	5.21	3.88	4.92	1,784	3,810

[1] Computed by deducting "Strip mines" data from "Total."
[2] Includes power strip pits proper and excludes horse stripping operations and mines combining stripping and underground in the same operation for the years 1925–42, inclusive. The years 1943–51, inclusive, include data on all strip mines.
[3] Data not available.

TABLE 21.—Stripping and loading equipment in use at bituminous-coal and lignite strip mines in the United States,[1] 1941–51

Year	Number of power shovels and draglines							Number of carry-all scrapers
	By capacity (in cubic yards) of dipper or bucket				By type		Total	
	Less than 3	3–5, inclusive	6–12, inclusive	More than 12	Power shovels	Dragline excavators		
1941	1,009	153	95	64	(2)	(2)	1,321	(2)
1942	1,114	159	97	68	(2)	(2)	1,438	(2)
1943	1,488	173	106	72	(2)	(2)	1,839	(2)
1944	1,900	225	113	74	(2)	(2)	2,312	(2)
1945	2,004	243	117	75	(2)	(2)	2,439	(2)
1946	2,256	302	112	74	2,406	338	2,744	263
1947	2,685	362	123	84	2,822	432	3,254	275
1948	3,048	446	130	88	3,177	535	3,712	362
1949	2,931	367	168	110	3,011	565	3,576	320
1950	3,182	416	170	109	3,247	630	3,877	286
1951	3,088	420	187	115	3,164	646	3,810	220

[1] Includes Alaska.
[2] Data not available.

TABLE 22.—Summary of operations at bituminous-coal and lignite strip mines using power drills in bank or overburden in the United States, 1946–51 [1]

Year	Number of mines	Production		Number of power drills
		Quantity (net tons)	Percent of total strip production	
1946	514	75,375 841	66.7	764
1947	598	95,915,246	68.8	875
1948	728	98,809,393	72.3	1,195
1949	756	78,146,655	73.7	1,256
1950	692	87,205,280	70.6	1,201
1951	650	85,331,204	72.5	1,125

[1] Detailed data, by States, published in Bureau of Mines Mineral Market Rept. 2102, Oct. 27, 1952.

TABLE 23.—Summary of method of haulage from bituminous-coal and lignite strip mines to tipple or ramp, in the United States, 1948–51 [1]

	1948	1949	1950	1951
MINES USING TRUCKS ONLY				
Number of mines	726	692	705	730
Percent of total strip production	40.7	37.6	35.6	35.4
Average distance from mine to tipple or ramp—miles	4.1	4.2	4.5	4.7
Number of trucks	6,121	5,576	5,308	5,127
Average capacity per truck—tons	7.7	8.0	8.0	8.3
Average number of trips per haulage unit per shift	6.6	6.3	6.3	5.6
Average distance each haulage unit traveled per shift—miles	54.5	53.0	56.7	52.9
Coal hauled per shift—ton-miles	1,290,504	1,182,279	1,216,382	1,129,703
MINES USING TRACTOR-TRAILERS ONLY				
Number of mines	59	61	72	74
Percent of total strip production	20.2	21.8	26.6	32.1
Average distance from mine to tipple or ramp—miles	2.8	2.7	2.7	3.2
Number of tractor-trailers	479	472	589	616
Average capacity per tractor-trailer	26.6	30.2	28.3	28.3
Average number of trips per haulage unit per shift	9.8	9.1	9.5	9.4
Average distance each haulage unit traveled per shift—miles	54.0	49.7	51.3	60.9
Coal hauled per shift—ton-miles	344,123	354,242	431,647	531,731
MINES USING BOTH TRUCKS AND TRACTOR-TRAILERS				
Number of mines	47	65	45	35
Percent of total strip production	9.0	9.6	9.7	6.8
Average distance from mine to tipple or ramp—miles	3.9	4.0	4.0	3.6
Number of trucks	406	393	438	258
Average capacity per truck—tons	10.0	10.9	8.6	8.8
Number of tractor-trailers	208	253	229	172
Average capacity per tractor-trailer	19.0	18.2	20.3	19.2
Average number of trips per haulage unit per shift	7.0	6.6	6.9	6.7
Average distance each haulage unit traveled per shift—miles	54.1	52.4	55.2	47.4
Coal hauled per shift—ton-miles	217,062	233,080	233,895	131,736
RAIL AND RAIL AND TRUCK OR TRACTOR-TRAILER				
Number of mines	11	9	5	3
Percent of total strip production	4.5	5.1	3.5	2.1
MINES NOT REPORTING METHOD OF HAULAGE				
Number of mines	1,128	934	1,043	942
Percent of total strip production	25.6	25.9	24.6	23.6
TOTAL				
Number of mines	1,971	1,761	1,870	1,784
Annual production	139,505,920	106,045,299	123,466,564	117,617,676

[1] Excludes lignite in 1948 and 1949. Detailed data, by States, published in Bureau of Mines Mineral Market Rept. 2102, Oct. 27, 1952.

TABLE 24.—Stripping operations in the bituminous-coal and lignite fields of the United States, 1950, by State and by county [1]

State and county	Number of strip pits	Number of power shovels and dragline excavators				Mined by stripping (net tons)	Average number of men working daily			Average number of days worked	Number of man-days worked	Average tons per man per day
		Steam	Electric	Diesel	Gasoline		In strip pits	All others	Total			
Alabama:												
Blount	5	2	1	8	1	248,825	102	35	137	249	34,050	7.31
Cullman	2	1		1		8,584	26	4	30	120	3,601	2.38
DeKalb	1			1		5,480	9	1	10	62	618	8.87
Jefferson	10			20	2	335,497	138	57	195	202	39,476	8.50
St. Clair	3			1	3	70,589	41	10	51	188	9,574	7.37
Tuscaloosa	9			22	2	440,450	139	38	177	215	38,135	11.55
Walker	16		6	33	2	778,613	299	121	420	168	70,464	11.05
Total Alabama	46	3	7	86	10	1,888,038	754	266	1,020	192	195,918	9.64
Alaska	5			6		130,737	67	31	98	132	12,927	10.11
Arkansas:												
Franklin	4	2		3	1	28,451	27	15	42	122	5,132	5.54
Johnson	4		1	6	1	378,704	108	16	124	219	27,203	13.92
Logan	1					2,100	8		8	40	320	6.56
Scott	1			3		70,000	47	18	65	125	8,125	8.62
Sebastian	5			3	1	25,691	49	9	58	104	6,020	4.27
Total Arkansas	15	2	1	15	3	504,946	239	58	297	158	46,800	10.79
California and South Dakota: Lignite	3			2	1	37,483	16	1	17	221	3,751	9.99
Colorado:												
El Paso	1			1		7,547	6		6	201	1,206	6.26
Fremont	1				1	17,446	4		4	257	1,028	16.97
Jackson	2				2	18,324	14		14	142	1,992	9.20
Routt	3		1	3		324,259	52	59	111	181	20,096	16.14
Weld	1		1	1		39,137	12	6	18	147	2,646	14.79
Total Colorado	8		2	5	3	406,713	88	65	153	176	26,968	15.08

Illinois:												
Bureau	3		5	2		710,629	67	110	177	201	35,572	19.98
Fulton	15		21	15	3	5,149,349	454	669	1,123	215	241,016	21.37
Grundy and Will	3		10	1	1	1,312,962	334	128	462	228	105,494	12.45
Hancock	1			2	3	40,446	15	8	23	146	3,368	12.01
Jackson	5		6	2	1	671,355	157	74	231	188	43,437	15.46
Knox	3		9			1,900,182	155	281	436	217	94,408	20.13
La Salle	4		1		2	17,410	17	1	18	165	2,976	5.85
Livingston	1				2	6,352	6		6	142	852	7.46
Marshall	1				1	1,103	5		5	60	300	3.68
Mercer	1				1	2,844	7		7	30	210	13.54
Morgan	2				2	9,069	12	3	15	107	1,608	5.64
Peoria	8			2	6	59,258	42	11	53	92	4,893	12.11
Perry	4		12	4	2	3,036,930	436	408	844	208	175,405	17.31
Randolph	1		4		2	1,073,177	59	74	133	265	35,308	30.39
St. Clair	3		7	5	2	1,556,902	138	116	254	282	71,734	21.70
Saline	1		2	3		347,435	105	137	242	180	43,459	7.99
Schuyler	4				2	24,108	23	2	25	209	5,215	4.62
Vermilion	9		2	7	4	611,684	72	48	120	239	28,624	21.37
Williamson	12		4	13	5	1,081,228	186	79	265	181	48,017	22.52
Total Illinois	81		83	56	39	17,612,423	2,290	2,149	4,439	212	941,896	18.70
Indiana:												
Clay	10	1	10	16	13	1,199,396	340	125	465	188	87,237	13.75
Daviess	1		4	1		388,889	52	48	100	255	25,500	15.25
Fountain	1		1	1		69,858	25	5	30	227	6,810	10.26
Gibson	1			3		70,267	18	24	42	152	6,390	11.00
Greene	4		3	3	1	434,559	90	36	126	170	21,407	20.30
Knox	1		3	1		546,118	105	66	171	218	37,269	14.65
Owen	2		3		2	189,307	45	10	55	209	11,520	16.43
Pike	7		18	14	1	3,127,263	500	234	734	249	183,098	17.08
Spencer	2			4	1	74,732	67	17	84	95	8,015	9.32
Sullivan	5		9	3		1,038,350	205	139	344	196	67,345	15.42
Vermillion	3		4	4		335,193	54	28	82	273	22,418	14.95
Vigo	3		3	2	2	628,639	150	49	199	201	40,011	15.71
Warrick	4		11	5	1	2,636,996	360	225	585	215	125,721	20.97
Total Indiana	44	1	69	57	21	10,739,567	2,011	1,006	3,017	213	642,741	16.71
Iowa:												
Davis	2			3	1	32,026	10	3	13	236	3,072	10.43
Mahaska	11			12	10	173,030	72	15	87	233	20,239	8.55
Marion	16		3	16	10	778,136	168	61	229	250	57,320	13.58
Van Buren	3			5	2	72,382	28	14	42	162	6,805	10.64
Wapello	5			7	2	134,937	40	15	55	266	14,620	9.23
Total Iowa	37		3	43	25	1,190,511	318	108	426	240	102,056	11.67

For footnote, see end of table.

TABLE 24.—Stripping operations in the bituminous-coal and lignite fields of the United States, 1950, by State and by county [1]—Continued

State and county	Number of strip pits	Number of power shovels and dragline excavators				Mined by stripping (net tons)	Average number of men working daily			Average number of days worked	Number of man-days worked	Average tons per man per day
		Steam	Electric	Diesel	Gasoline		In strip pits	All others	Total			
Kansas:												
Bourbon	6	4	2		2	117,780	51	19	70	151	10,578	11.13
Cherokee	9		4	8	3	503,841	157	94	251	157	39,334	12.81
Coffey	1					3,000	9	1	10	110	1,100	2.73
Crawford	9	4	9	2	3	694,822	196	98	294	187	54,880	12.66
Labette	2				1	3,158	5		5	183	914	3.46
Linn	1		3			685,375	35	77	112	289	32,407	21.15
Osage	4			2	1	16,376	18	2	20	160	3,191	5.13
Total Kansas	32	8	18	12	10	2,024,352	471	291	762	187	142,404	14.22
Kentucky:												
Bell	8		1	11	1	202,657	84	16	100	171	17,062	11.88
Boyd	2			6		215,330	59	13	72	298	21,488	10.02
Breathitt	1		4			617,119	82	57	139	226	31,444	19.63
Butler	3			3		71,238	16	6	22	167	3,676	19.38
Clay	8			7		141,388	60	16	76	154	11,704	12.08
Crittenden	4			5		56,024	17	13	30	221	6,630	8.45
Daviess	5			7	2	286,861	49	17	66	250	16,491	17.40
Edmonson	1			1		6,728	4		4	250	1,000	6.73
Grayson	2			4		154,694	35	10	45	250	11,250	13.75
Hancock	4			7		207,542	41	26	67	206	13,799	15.04
Harlan	1				1	2,888	11	3	14	17	238	12.13
Hopkins	24		17	45	8	7,110,278	768	640	1,408	204	287,054	24.77
Jackson	6			2	1	69,314	49	9	58	167	9,662	7.17
Knott	2		4			37,833	14	4	18	174	3,124	12.11
Knox	5			2		32,588	23	7	30	132	3,960	8.23
Laurel	8			7		148,907	104	21	125	151	18,875	7.89
Lee	2			2		37,750	13	3	16	197	3,152	11.98
Letcher	2			7	1	159,478	51	9	60	199	11,928	13.37
Madison	1					3,871	7		7	95	665	5.82
Martin	1					3,000	4		4	147	588	5.10
McCreary	2			3		34,811	17	4	21	160	3,366	10.34
Morgan	3			7		394,235	128	42	170	250	42,500	9.28
Muhlenberg	6		6	13	4	1,503,306	271	163	434	188	81,511	18.44

Ohio	11		8	20	1	1,938,676	210	237	447	177	79,152	24.49
Powell	2			2		18,774	8	2	10	187	1,870	10.04
Pulaski	4			4		147,463	55	11	66	195	12,870	11.46
Rockcastle	5			5		97,100	40	14	54	181	9,774	9.93
Union	3			6		113,138	23	21	44	146	6,440	17.57
Wayne	1			1		11,100	8		8	125	1,000	11.10
Webster	1			2		18,800	11	5	16	60	960	19.58
Whitley	4			7		87,239	50	12	62	203	12,585	6.93
Wolfe	4			2		47,513	21	6	27	196	5,305	8.96
Total Kentucky	136		40	188	19	13,977,643	2,333	1,387	3,720	197	731,123	19.12
Maryland:												
Allegany	15			4	5	95,533	87	12	99	110	10,887	8.77
Garrett	7			2	5	65,521	68	15	83	82	6,846	9.57
Total Maryland	22			6	10	161,054	155	27	182	97	17,733	9.08
Missouri:												
Barton	3		4			223,408	50	35	85	183	15,562	14.36
Bates	5		2		3	238,966	33	26	59	229	13,493	17.71
Boone	2			2		45,135	18	4	22	240	5,284	8.54
Callaway	3			3	2	126,870	41	13	54	277	14,978	8.47
Dade	1				1	7,769	7		7	300	2,100	3.70
Henry	14		7	3	3	658,185	154	51	205	200	41,054	16.03
Jasper	1	1				2,020	5		5	170	850	2.38
Johnson	1					1,289	2		2	152	304	4.24
Macon	2		4		1	587,740	67	74	141	258	36,367	16.16
Monroe	1				1	3,393	6		6	188	1,128	3.01
Ralls	1			1		10,093	9	4	13	277	3,600	2.80
Randolph	1		3			475,387	46	42	88	238	20,946	22.70
St. Clair	2			1	1	22,699	18	4	22	172	3,776	6.01
Vernon	6	2	4	2	1	232,470	73	25	98	161	15,735	14.77
Total Missouri	43	3	24	12	13	2,635,424	529	278	807	217	175,177	15.04
Montana:												
Bituminous coal: Rosebud	1		6	1		1,708,149	69	15	84	219	18,410	92.78
Lignite	1				1	9,030	3	3	6	160	960	9.41
Total Montana	2		6	1	1	1,717,179	72	18	90	215	19,370	88.65
North Dakota: Lignite	37		16	14	17	2,828,056	276	185	461	223	103,023	27.45

For footnote, see end of table.

TABLE 24.—Stripping operations in the bituminous-coal and lignite fields of the United States, 1950, by State and by county [1]—Continued

State and county	Number of strip pits	Number of power shovels and dragline excavators				Mined by stripping (net tons)	Average number of men working daily			Average number of days worked	Number of man-days worked	Average tons per man per day
		Steam	Electric	Diesel	Gasoline		In strip pits	All others	Total			
Ohio:												
Athens	7			14	4	243,194	110	103	213	117	24,835	9.79
Belmont	18		2	34	7	2,113,412	286	143	429	292	86,582	24.41
Carroll	8			16	4	215,563	87	22	109	205	22,363	9.64
Columbiana	52			58	18	1,281,133	403	83	486	200	97,332	13.16
Coshocton	12			27	6	661,922	169	58	227	227	51,583	12.83
Gallia	5			9	1	425,393	102	33	135	240	32,336	13.16
Guernsey	6			17	1	617,298	121	35	156	279	43,555	14.17
Harrison	15		15	25	7	4,583,741	540	733	1,273	150	190,322	24.08
Hocking	3			3	3	33,990	26	9	35	124	4,339	7.83
Holmes	3			2	2	92,929	43	6	49	235	11,512	8.07
Jackson	11			6	1	112,885	68	4	72	209	15,017	7.52
Jefferson	33	4	5	59	6	3,323,816	534	269	803	227	182,450	18.22
Lawrence	3			3	1	100,958	24	4	28	269	7,529	13.41
Mahoning	15			26	8	638,890	151	34	185	247	45,659	13.99
Meigs	9			16	1	300,212	106	26	132	169	22,277	13.48
Morgan	3			8		144,193	51	9	60	220	13,199	10.92
Muskingum	13		3	19	9	1,289,972	161	71	232	202	46,904	27.50
Noble	10		3	28		2,000,382	252	119	371	236	87,716	22.81
Perry	20		4	41	4	1,701,335	449	227	676	171	115,371	14.75
Portage	3			5	1	153,701	35	14	49	282	13,834	11.11
Scioto	1					7,380	4		4	201	804	9.18
Stark	17			41	15	947,669	260	52	312	225	70,198	13.50
Tuscarawas	24	2	3	36	19	1,268,984	299	97	396	257	101,941	12.45
Vinton	8			9	5	163,789	98	11	109	254	27,656	5.92
Washington	3			5		233,469	49	18	67	181	12,120	19.26
Wayne	1			4	1	118,983	19	10	29	303	8,787	13.54
Total Ohio	303	6	35	511	124	22,775,193	4,447	2,190	6,637	201	1,336,221	17.04
Oklahoma:												
Coal	2		2	3		77,733	33	17	50	207	10,336	7.52
Craig	4	1		4		85,214	54	8	62	179	11,115	7.67
Haskell	5	1		6		200,554	85	7	92	201	18,465	10.86

LeFlore	7		1	8		306,040	123	38	161	132	21,296	14.37
Muskogee	1	3		1		151,010	42	15	57	241	13,726	11.00
Okmulgee	3		2	5		339,656	46	50	96	171	16,371	20.75
Pittsburg	1			1		1,333	10	1	11	15	165	8.08
Rogers	4	3	3	4		456,096	171	89	260	222	57,760	7.90
Sequoyah	1			4		106,628	23	6	29	298	8,652	12.32
Wagoner	1					2,910	9		9	61	549	5.30
Total Oklahoma	29	8	8	36		1,727,174	596	231	827	192	158,435	10.90
Pennsylvania:												
Allegheny	67			101	17	2,461,053	775	194	969	177	171,407	14.36
Armstrong	49			76	20	1,810,662	629	153	782	168	131,026	13.82
Beaver	7			13	2	266,108	70	26	96	256	24,547	10.84
Bedford	3			3	1	59,732	58	4	62	80	4,965	12.03
Blair	5			8		303,986	63	18	81	206	16,726	18.17
Bradford	2			1	1	11,903	9		9	187	1,680	7.09
Butler	43			83	19	2,161,232	570	158	728	219	159,627	13.54
Cambria	36			71	6	1,019,885	488	81	569	159	90,584	11.26
Cameron	2			4		98,501	33	5	38	274	10,420	9.45
Centre	21	1		61	5	920,565	371	84	455	207	94,344	9.76
Clarion	45			99	12	2,626,657	809	312	1,121	195	218,085	12.04
Clearfield	89	2	10	203	33	3,954,827	1,587	386	1,973	181	356,717	11.09
Clinton	11	2		20	5	596,227	239	52	291	166	48,328	12.34
Elk	16			25	7	416,571	197	56	253	136	34,517	12.07
Fayette	48	2		31	17	550,732	317	35	352	123	43,161	12.76
Fulton and Huntingdon	4			17	1	316,248	138	18	156	139	21,711	14.57
Greene	10			13	4	87,671	72	13	85	91	7,703	11.38
Indiana	41		1	90	7	1,356,286	592	149	741	162	120,060	11.30
Jefferson	35	1		58	13	960,241	460	114	574	147	84,613	11.35
Lawrence	9		1	14	3	439,771	97	16	113	255	28,775	15.28
Lycoming	1			2		20,650	8		8	256	2,048	10.08
McKean	3			4	1	61,257	25	5	30	202	6,046	10.13
Mercer	11		1	25		385,600	125	53	178	141	25,049	15.39
Somerset	50		1	106	14	1,720,452	694	203	897	155	139,015	12.38
Tioga	2			4		62,029	22	9	31	135	4,176	14.85
Venango	8			18	3	452,667	79	23	102	270	27,571	16.42
Washington	46	1	6	66	12	2,190,281	663	212	875	180	157,899	13.87
Westmoreland	62			61	26	1,114,803	540	88	628	134	84,212	13.24
Total Pennsylvania	726	9	20	1,277	229	26,426,597	9,730	2,467	12,197	173	2,115,012	12.49

For footnote, see end of table.

TABLE 24.—Stripping operations in the bituminous-coal and lignite fields of the United States, 1950, by State and by county [1]—Continued

State and county	Number of strip pits	Number of power shovels and dragline excavators				Mined by stripping (net tons)	Average number of men working daily			Average number of days worked	Number of man-days worked	Average tons per man per day
		Steam	Electric	Diesel	Gasoline		In strip pits	All others	Total			
Tennessee:												
Anderson	1				1	9,054	8		8	128	1,024	8.84
Campbell	2		2	2	1	190,295	60	29	89	176	15,675	12.14
Claiborne	4			8		117,034	75	15	90	154	13,900	8.42
Grundy and Marion	2			7	4	141,019	61	17	78	175	13,688	10.30
Morgan	2			4		35,684	13	2	15	149	2,240	15.93
Overton	1			3		7,392	7	2	9	80	723	10.22
Scott	2			4	1	40,751	20	2	22	177	3,896	10.46
White	2			4		42,837	15	3	18	197	3,541	12.10
Total Tennessee	16		2	32	7	584,066	259	70	329	166	54,687	10.68
Texas: Lignite	1	1			1	18,169	8	6	14	281	3,934	4.62
Virginia:												
Buchanan	8		3	21	1	623,570	191	62	253	159	40,229	15.50
Dickenson	2		2	6	1	397,651	125	18	143	163	23,339	17.04
Russell	1			4		148,640	21	7	28	272	7,616	19.52
Tazewell	1			3		37,531	9	2	11	197	2,172	17.28
Wise	7		1	17		358,254	97	33	130	183	23,838	15.03
Total Virginia	19		6	51	2	1,565,646	443	122	565	172	97,194	16.11
Washington:												
King	2		1		1	11,449	8		8	231	1,849	6.19
Kittitas	1				2	37,819	19	2	21	213	4,483	8.44
Thurston	1			1	1	21,272	20	3	23	104	2,388	8.91
Total Washington	4		1	1	4	70,540	47	5	52	168	8,720	8.09
West Virginia:												
Barbour	18		3	40	3	1,469,511	302	206	508	145	73,635	19.96
Boone	6		1	6	1	192,269	117	17	134	136	18,270	10.52
Braxton	1			4		74,054	21	7	28	216	6,055	12.23
Brooke	10			14	3	596,917	213	62	275	166	45,713	13.06
Clay	1			2		40,839	25	1	26	102	2,652	15.40

Fayette	16			39	4	849,869	355	92	447	132	59,044	14.39
Grant	2				2	12,199	12		12	138	1,650	7.39
Greenbrier	6			17	2	231,913	119	30	149	180	26,791	8.66
Hancock	2			3	1	161,856	28	4	32	247	7,912	20.46
Harrison	47			100	8	3,610,778	1,004	396	1,400	153	213,675	16.90
Kanawha	9			12	4	358,337	156	33	189	140	26,463	13.54
Lewis	6			11	1	315,856	83	31	114	149	16,963	18.62
Logan	2			4	1	212,761	71	11	82	200	16,410	12.97
Marion	2			2	1	37,096	25	4	29	84	2,450	15.14
McDowell	12			30	3	842,613	352	71	423	167	70,601	11.93
Mercer	11			24	3	545,384	222	48	270	158	42,781	12.75
Mineral	5			5	2	57,322	34	5	39	98	3,810	15.05
Mingo	3			7		302,766	94	20	114	159	18,177	16.66
Monongalia	12			19	2	378,702	150	47	197	131	25,746	14.71
Nicholas	7			14	1	193,370	120	35	155	118	18,288	10.57
Pleasants	1			2		28,218	21	7	28	105	2,942	9.59
Pocahontas	1			3		96,475	23	4	27	256	6,915	13.95
Preston	20			23	5	412,251	237	60	297	128	38,108	10.82
Putnam	1			3		72,712	20		20	312	6,240	11.65
Raleigh	13			14	3	190,401	119	20	139	126	17,465	10.90
Randolph	9			12	3	407,128	167	49	216	140	30,169	13.49
Taylor	9			16	1	309,939	161	44	205	92	18,862	16.43
Tucker	1			5		88,010	47	13	60	105	6,300	13.97
Upshur	8			14	5	537,745	134	47	181	153	27,728	19.39
Webster	2			2	1	22,899	16	4	20	76	1,518	15.08
Wyoming	6			10	1	335,964	105	33	138	184	25,372	13.24
Total West Virginia	249		4	457	61	12,986,154	4,553	1,401	5,954	148	878,705	14.78
Wyoming:												
Campbell	1		3			349,559	8	38	46	277	12,719	27.48
Carbon	4	1		6	2	503,492	75	41	116	206	23,922	21.05
Converse	2			1		10,148	7		7	242	1,691	6.00
Lincoln	1			2		145,593	100	53	153	47	7,191	20.25
Sheridan	4			3	5	450,107	63	40	103	256	26,376	17.07
Total Wyoming	12	1	3	12	7	1,458,899	253	172	425	169	71,899	20.29
Total United States	1,870	42	348	2,880	607	123,466,564	29,955	12,534	42,489	186	7,886,694	15.66

[1] On returns from mines combining stripping and underground methods in same operation, tonnage has been separated and figures on employment prorated so that this table includes only data pertaining to strip mining.

TABLE 25.—Stripping operations in the bituminous-coal and lignite fields of the United States, 1951, by State and by county [1]

State and county	Number of strip pits	Number of power shovels and dragline excavators				Mined by stripping (net tons)	Average number of men working daily			Average number of days worked	Number of man-days worked	Average tons per man per day
		Steam	Electric	Diesel	Gasoline		In strip pits	All others	Total			
Alabama:												
Blount	4	2	1	7	1	156,325	78	27	105	208	21,864	7.15
Cherokee	1				1	6,242	6		6	192	1,152	5.42
Cullman	1	1		2		38,916	27	11	38	198	7,531	5.17
Jefferson	4			8	2	263,368	96	47	143	220	31,529	8.35
St. Clair	1					1,856	2		2	192	384	4.83
Shelby	1			2		21,696	11	4	15	192	2,880	7.53
Tuscaloosa	13			35	2	545,656	186	40	226	214	48,304	11.30
Walker	14		2	33	1	859,963	304	86	390	159	62,167	13.83
Total Alabama	39	3	3	87	7	1,894,022	710	215	925	190	175,811	10.77
Alaska	4			6		232,359	58	39	97	140	13,586	17.10
Arkansas:												
Franklin	1	1		2		29,622	14	5	19	222	4,213	7.03
Johnson	4		1	6		325,498	86	18	104	221	22,936	14.19
Pope	1					2,324	4		4	150	600	3.87
Sebastian	7			2	2	50,575	91	21	112	92	10,268	4.93
Total Arkansas	13	1	1	10	2	408,019	195	44	239	159	38,017	10.73
California (lignite):												
Amador	1			1		3,657	3		3	125	375	9.75
Colorado:												
El Paso	1			1		7,582	5		5	194	970	7.82
Fremont	2			1		6,169	8		8	72	576	10.71
Jackson	2					3,354	8		8	155	1,236	2.71
Routt	2		1	3		319,917	35	42	77	201	15,479	20.67
Weld	1		1	1		29,030	12	7	19	82	1,558	18.63
Total Colorado	8		2	6		366,052	68	49	117	169	19,819	18.47
Illinois:												
Bureau	1		5			804,932	44	92	136	285	38,760	20.77
Fulton	13		21	14	4	5,350,882	447	492	939	243	228,080	23.46
Gallatin	2			3		57,188	20	15	35	85	2,992	19.11
Grundy	2		3		3	411,107	88	36	124	258	32,013	12.84
Hancock	1			2	2	41,030	12	3	15	163	2,446	16.77
Jackson	3		6	5		665,800	113	89	202	221	44,551	14.94
Kankakee	1		3	1		757,515	159	56	215	262	56,338	13.45
Knox	3		9			2,033,134	155	276	431	247	106,526	19.09

La Salle	4				3	8,938	13	1	14	145	2,026	4.41
Livingston	1				2	2,695	5		5	125	625	4.31
Peoria	6			5	3	148,474	52	16	68	155	10,565	14.05
Perry	4		12	3	1	2,798,851	306	365	671	224	150,373	18.61
Randolph	1		4	2		1,081,812	55	79	134	287	38,474	28.12
St. Clair	3		6	8		1,559,793	142	113	255	269	68,709	22.70
Saline	1		2	3		317,294	95	145	240	166	39,768	7.98
Schuyler	3				2	9,646	13	1	14	116	1,628	5.93
Vermilion	7		3	5	4	922,499	89	41	130	280	36,398	25.34
Will	1		3		1	166,004	24	19	43	254	10,923	15.20
Williamson	6		4	12	2	1,158,922	134	63	197	281	55,357	20.94
Total Illinois	63		82	63	27	18,296,516	1,966	1,902	3,868	240	926,552	19.75
Indiana:												
Clay	11	1	11	19	11	1,304,993	371	99	470	246	115,389	11.31
Daviess	1		4			416,913	59	47	106	299	31,694	13.15
Fountain	1		2	1		66,821	25	5	30	252	7,560	8.84
Gibson	1		2			58,777	32	25	57	106	6,059	9.70
Greene	1		2	1		383,747	50	26	76	269	20,411	18.80
Knox	1		3	1		482,181	67	49	116	228	26,504	18.19
Owen	2		2		2	159,625	35	5	40	230	9,180	17.39
Pike	6		19	14		3,204,345	466	229	695	272	188,743	16.98
Spencer	1			1	1	45,350	14	6	20	190	3,800	11.93
Sullivan	4		9	5		1,227,912	178	139	317	287	91,038	13.49
Vermillion	1		3			210,789	24	15	39	346	13,494	15.62
Vigo	3		3	2	2	770,906	118	50	168	255	42,818	18.00
Warrick	5		10	6	1	2,664,911	307	267	574	246	141,109	18.89
Total Indiana	38	1	70	50	17	10,997,270	1,746	962	2,708	258	697,799	15.76
Iowa:												
Davis	2			4	2	69,165	14	6	20	273	5,468	12.65
Jasper	1					1,575	4	1	5	55	275	5.73
Mahaska	12			11	13	98,735	51	6	57	227	12,936	7.63
Marion	17		4	17	16	834,152	189	61	250	235	58,854	14.17
Van Buren	4			5	3	40,941	23	11	34	160	5,450	7.51
Wapello	5			7	2	106,618	35	15	50	237	11,856	8.99
Total Iowa	41		4	44	36	1,151,186	316	100	416	228	94,839	12.14
Kansas:												
Bourbon	5	4	2		2	80,131	45	16	61	141	8,604	9.31
Cherokee	8		4	7	3	613,332	168	107	275	165	45,471	13.49
Coffey	1					3,406	9		9	120	1,080	3.15
Crawford	11	2	9	2	4	711,010	180	85	265	230	60,831	11.69
Labette	2				1	2,993	6		6	199	1,191	2.51
Linn	1		3			457,324	37	47	84	233	19,555	23.39
Osage	4			2	2	19,079	23	1	24	148	3,561	5.36
Total Kansas	32	6	18	11	12	1,887,275	468	256	724	194	140,293	13.45

For footnote, see end of table.

TABLE 25.—Stripping operations in the bituminous-coal and lignite fields of the United States, 1951, by State and by county [1]—Continued

State and county	Number of strip pits	Number of power shovels and dragline excavators				Mined by stripping (net tons)	Average number of men working daily			Average number of days worked	Number of man-days worked	Average tons per man per day
		Steam	Electric	Diesel	Gasoline		In strip pits	All others	Total			
Kentucky:												
Bell	7		1	10	1	218,165	87	11	98	162	15,861	13.75
Boyd	1			4		185,820	61	14	75	245	18,375	10.11
Breathitt	1			3		693,628	47	75	122	231	28,239	24.56
Butler	1			1		9,852	5		5	248	1,239	7.95
Christian	1				1	1,275	2		2	45	90	14.17
Clay	3			5		28,133	18		18	130	2,339	12.03
Daviess	3			8		304,681	39	17	56	260	14,548	20.94
Elliott	7		5	11		266,361	72	16	88	258	22,670	11.75
Grayson	1				1	4,000	5		5	65	325	12.31
Greenup	1			4		110,485	20	5	25	300	7,500	14.73
Hancock	1			2		48,308	15	10	25	136	3,406	14.18
Harlan	1			1		62,364	34	7	41	172	7,033	8.87
Hopkins	23		15	43	5	5,125,553	590	436	1,026	195	199,714	25.66
Jackson	5			6	1	65,430	45	5	50	154	7,710	8.49
Knox	5			2	3	56,972	36	3	39	143	5,565	10.24
Laurel	1				1	3,500	3		3	192	576	6.08
Lee	1			2		25,400	8		8	225	1,800	14.11
Letcher	2			6	1	126,100	46	10	56	207	11,592	10.88
Madison	1					1,400	4		4	58	232	6.03
Magoffin	1			3		128,961	44	6	50	193	9,630	13.39
McCreary	4			9		162,023	51	12	63	212	13,353	12.13
Morgan	3			5		70,380	30	9	39	181	7,050	9.98
Muhlenberg	7		5	14	2	1,402,737	270	175	445	168	74,851	18.74
Ohio	7		8	8	1	2,060,917	137	212	349	245	85,479	24.11
Pulaski	6			8	2	180,130	58	6	64	207	13,219	13.63
Rockcastle	4			7		89,529	37	4	41	202	8,290	10.80
Webster	2			4		139,245	27	13	40	172	6,860	20.30
Whitley	4			8		148,668	105	24	129	146	18,805	7.91
Wolfe	4				2	7,161	10		10	130	1,303	5.05
Total Kentucky	108		34	174	21	11,727,178	1,906	1,070	2,976	197	587,654	19.96
Maryland:												
Allegany	13			6	2	69,953	65	4	69	128	8,817	7.93
Garrett	12			8	8	96,135	75	14	89	112	10,007	9.61
Total Maryland	25			14	10	166,088	140	18	158	119	18,824	8.82

Missouri:												
Barton	5		4		1	288,034	58	33	91	216	19,633	14.67
Bates	3		2		2	371,290	36	38	74	228	16,853	22.03
Boone	2			2		33,028	13	4	17	227	3,867	8.54
Callaway	2			3	1	141,957	36	13	49	277	13,571	10.46
Dade	1				1	7,150	7		7	200	1,400	5.11
Henry	10		8	4	2	678,056	136	69	205	191	39,215	17.29
Johnson	1					2,012	3		3	194	582	3.46
Macon	2		4	1		729,998	70	59	129	263	33,986	21.48
Ralls	1			1		2,102	7	3	10	93	930	2.26
Randolph	1		3			455,282	49	37	86	263	22,592	20.15
St. Clair	4		3		1	225,485	57	21	78	195	15,181	14.85
Vernon	4	2		1	2	79,275	34	9	43	171	7,365	10.76
Total Missouri	36	2	24	12	10	3,013,669	506	286	792	221	175,175	17.20
Montana:												
Bituminous coal: Rosebud	1		6	1		1,488,300	55	15	70	225	15,780	94.32
Lignite: Sheridan	1				1	6,313	4	2	6	140	840	7.52
Total Montana	2		6	1	1	1,494,613	59	17	76	219	16,620	89.93
North Dakota (lignite):												
Adams	1			1		30,839	12		12	166	1,992	15.48
Bowman	1			2		124,511	6	5	11	276	3,032	41.07
Burke	3		3		2	431,062	27	41	68	265	18,016	23.93
Burleigh	1			1		22,582	6		6	240	1,440	15.68
Divide	1		2		1	318,744	18	22	40	271	10,848	29.38
Dunn	2				2	15,800	6		6	181	1,084	14.58
Grant	4			1		27,180	12		12	137	1,650	16.47
Hettinger	3				2	17,333	10	1	11	161	1,771	9.79
McKenzie	1					1,640	2		2	200	400	4.10
McLean	3		3		2	328,169	36	33	69	239	16,506	19.88
Mercer	5		5	4		948,362	67	68	135	233	31,429	30.18
Morton	5			3	1	30,773	16		16	151	2,414	12.75
Mountrail	1			1		5,604	2		2	120	240	23.35
Oliver	1			1		6,920	3		3	108	324	21.36
Stark	4			3		119,951	24	6	30	256	7,671	15.64
Ward	3		4	3		533,431	48	57	105	265	27,811	19.18
Williams	2				2	10,225	6	1	7	139	972	10.52
Total North Dakota	41		17	20	12	2,973,126	301	234	535	239	127,600	23.30

For footnote, see end of table.

TABLE 25.—Stripping operations in the bituminous-coal and lignite fields of the United States, 1951, by State and by county [1]—Continued

State and county	Number of strip pits	Number of power shovels and dragline excavators				Mined by stripping (net tons)	Average number of men working daily			Average number of days worked	Number of man-days worked	Average tons per man per day
		Steam	Electric	Diesel	Gasoline		In strip pits	All others	Total			
Ohio:												
Athens	4			9	1	146,422	47	45	92	130	11,926	12.28
Belmont	17		1	30	9	1,082,337	197	86	283	175	49,457	21.88
Carroll	7			9	6	184,031	74	9	83	204	16,948	10.86
Columbiana	46			72	10	1,289,631	375	76	451	230	103,787	12.43
Coshocton	13		1	31	8	810,112	182	78	260	228	59,178	13.69
Gallia	4			10		266,926	94	32	126	141	17,825	14.97
Guernsey	8			18	2	468,595	121	36	157	201	31,550	14.85
Harrison	17		22	33	6	5,855,187	560	607	1,167	220	256,739	22.81
Hocking	8			4	6	77,660	47	7	54	129	6,978	11.13
Holmes	1			1		7,937	6		6	160	960	8.27
Jackson	13		3	10	4	246,428	112	28	140	191	26,701	9.23
Jefferson	27		3	61	4	2,782,214	447	232	679	233	158,193	17.59
Lawrence	5			8	1	167,895	51	12	63	237	14,951	11.23
Mahoning	17		1	28	6	761,567	196	36	232	239	55,501	13.72
Meigs	3			10		279,118	60	13	73	232	16,935	16.48
Morgan	3			7	1	143,028	42	6	48	221	10,584	13.51
Muskingum	16		3	25	7	1,138,504	180	75	255	180	45,886	24.81
Noble	7		3	21		1,462,788	177	93	270	215	57,939	25.25
Perry	17		4	31	3	1,666,732	358	189	547	183	100,214	16.63
Portage	2			3	1	182,910	29	15	44	320	14,080	12.99
Scioto	1					1,618	4		4	74	296	5.47
Stark	17			43	10	898,558	261	58	319	209	66,517	13.51
Tuscarawas	27	1	2	42	20	1,286,721	300	112	412	249	102,622	12.54
Vinton	9			14	5	191,230	112	11	123	206	25,342	7.55
Washington	1			2		106,563	21	8	29	191	5,536	19.25
Wayne	1			4	1	104,949	23	10	33	306	10,098	10.39
Total Ohio	291	1	43	526	111	21,609,661	4,076	1,874	5,950	213	1,266,743	17.06
Oklahoma:												
Coal	2		1	3		69,197	34	14	48	160	7,662	9.03
Craig	2	1	1	2		58,704	33	5	38	217	8,252	7.11
Haskell	5	1		8		196,822	98	11	109	181	19,680	10.00

Le Flore	4		1	4	1	207,077	91	30	121	158	19,163	10.81
McIntosh	2	2		1		101,837	29	10	39	172	6,707	15.18
Muskogee	1					1,195	4		4	100	400	2.99
Okmulgee	2		2	2		114,363	36	38	74	111	8,224	13.91
Rogers	2	2	3	2		334,654	96	37	133	257	34,192	9.79
Sequoyah	1		1	5		137,093	28	7	35	265	9,275	14.78
Wagoner	1					1,879	8		8	76	608	3.09
Total Oklahoma	22	6	9	27	1	1,222,821	457	152	609	187	114,163	10.71
Pennsylvania:												
Allegheny	53			81	16	1,361,812	480	127	607	163	98,691	13.80
Armstrong	50			85	13	1,774,401	576	165	741	169	125,136	14.18
Beaver	14		1	23	2	368,565	122	40	162	223	36,170	10.19
Bedford	3			5		75,185	52	6	58	114	6,597	11.40
Blair	3			8		158,214	43	10	53	262	13,896	11.39
Bradford	1			1	1	7,240	5	2	7	171	1,200	6.03
Butler	48			91	11	1,743,477	516	157	673	195	131,172	13.29
Cambria	32			65	5	764,803	345	55	400	154	61,611	12.41
Cameron	2			4		72,565	25	3	28	241	6,745	10.76
Centre	22			59	13	904,461	327	54	381	213	81,108	11.15
Clarion	40			97	13	2,481,050	663	241	904	223	202,037	12.28
Clearfield	88	2		209	26	3,601,174	1,356	345	1,701	183	311,227	11.57
Clinton	9			23	3	670,122	165	38	203	254	51,641	12.98
Elk	18			24	4	436,057	186	40	226	154	34,795	12.53
Fayette	48	1		38	16	498,114	329	48	377	104	39,373	12.65
Fulton and Huntingdon	4			17	1	325,488	135	11	146	140	20,396	15.96
Greene	7	1		11	1	65,822	39	8	47	126	5,908	11.14
Indiana	42		1	67	11	1,132,964	450	93	543	160	87,003	13.02
Jefferson	37			61	12	994,260	383	99	482	169	81,678	12.17
Lawrence	15		1	25	3	503,021	140	20	160	204	32,647	15.41
Lycoming	1			2		18,118	9		9	258	2,322	7.80
McKean	3			4	3	80,657	24	2	26	247	6,428	12.55
Mercer	8		1	11	1	333,789	84	24	108	189	20,415	16.35
Somerset	45		1	100	14	1,887,364	605	145	750	187	139,958	13.49
Tioga	2			4		60,646	22	9	31	144	4,453	13.62
Venango	11			21	5	445,940	97	22	119	257	30,540	14.60
Washington	35	1	6	67	8	1,978,432	568	168	736	193	141,718	13.96
Westmoreland	58			57	18	612,602	403	45	448	104	46,547	13.16
Total Pennsylvania	699	5	11	1,260	200	23,356,343	8,149	1,977	10,126	180	1,821,412	12.82
South Dakota (lignite):												
Darson and Dewey	2			1	2	28,350	13	1	14	222	3,109	9.12

For footnote, see end of table.

TABLE 25.—Stripping operations in the bituminous-coal and lignite fields of the United States, 1951, by State and by county [1]—Continued

State and county	Number of strip pits	Number of power shovels and dragline excavators				Mined by stripping (net tons)	Average number of men working daily			Average number of days worked	Number of man-days worked	Average tons per man per day
		Steam	Electric	Diesel	Gasoline		In strip pits	All others	Total			
Tennessee:												
Anderson	2				2	6,751	9		9	97	873	7.73
Campbell	2		1	1		107,286	48	21	69	145	9,993	10.74
Claiborne	4			9		108,295	65	13	78	150	11,664	9.28
Grundy	4		3	4		74,953	26	14	40	160	6,399	11.71
Hamilton	3			1	2	24,594	15	2	17	112	1,908	12.89
Marion	1			5	4	30,983	21	4	25	150	3,750	8.26
Morgan	2			4		34,236	13	2	15	168	2,520	13.59
Overton	2			5		20,969	8	3	11	165	1,820	11.52
Scott	3			6		67,420	25	4	29	178	5,166	13.05
White	1			2		2,847	4		4	171	684	4.16
Total Tennessee	24		4	37	8	478,334	234	63	297	151	44,777	10.68
Virginia:												
Buchanan	11		6	19		503,693	148	47	195	168	32,667	15.42
Dickenson	1		3	3		319,846	71	10	81	231	18,751	17.06
Russell	2			4	1	21,134	16	6	22	51	1,120	18.87
Tazewell	1			1	1	12,676	6		6	194	1,164	10.89
Wise	16		7	14		516,133	138	40	178	199	35,397	14.58
Total Virginia	31		16	41	2	1,373,482	379	103	482	185	89,099	15.42
Washington:												
King	2			3	1	32,544	24	9	33	163	5,367	6.06
Kittitas	1				2	31,339	17	3	20	180	3,600	8.71
Thurston	1			1	1	10,068	12	2	14	66	924	10.90
Total Washington	4			4	4	73,951	53	14	67	148	9,891	7.48
West Virginia:												
Barbour	16		2	37	2	1,822,877	371	232	603	180	108,749	16.76
Boone	5			9	1	193,214	94	14	108	176	19,041	10.15
Braxton and Webster	2			5		101,582	28	9	37	198	7,321	13.88
Brooke	9			19		714,743	203	59	262	212	55,455	12.89

Fayette	23			41	7	905,860	328	83	411	170	70,001	12.94
Grant	1				1	12,769	5		5	287	1,435	8.90
Greenbrier	12			21	5	411,118	198	45	243	152	36,980	11.12
Hancock	2			2	1	133,665	28	4	32	250	7,996	16.72
Harrison	49			93	11	2,773,919	783	302	1,085	149	161,273	17.20
Kanawha	9			12	2	448,461	152	31	183	162	29,573	15.16
Lewis	6			13	1	446,092	77	21	98	233	22,836	19.53
Marion	2			1	1	34,646	20	4	24	94	2,264	15.30
McDowell	14			50		1,051,801	294	55	349	212	74,043	14.21
Mercer	17			36	4	704,011	268	53	321	167	53,653	13.12
Mineral	3			6		60,600	35	5	40	110	4,392	13.80
Mingo	3			5		212,363	92	22	114	131	14,982	14.17
Monongalia	8			15	1	322,886	101	42	143	133	19,049	16.95
Nicholas	5			10		372,802	101	30	131	218	28,588	13.04
Ohio	1					4,004	8		8	72	576	6.95
Pocahontas	1			3		83,908	36	6	42	313	13,157	6.38
Preston	16			23		243,878	174	38	212	110	23,407	10.42
Putnam	1			3		50,000	16		16	180	2,880	17.36
Raleigh	12			21	3	307,075	134	21	155	151	23,430	13.11
Randolph	12			19	3	522,898	164	45	209	158	32,941	15.87
Taylor	7			15		232,190	119	34	153	115	17,532	13.24
Tucker	1			5		24,761	26	7	33	54	1,782	13.90
Upshur	7			16	3	489,570	98	34	132	154	20,333	24.08
Wyoming	5			12		346,196	101	29	130	183	23,777	14.56
Total West Virginia	249		2	492	46	13,027,889	4,054	1,225	5,279	166	877,446	14.85
Wyoming:												
Campbell	1					307,074	16	20	36	291	10,464	29.35
Carbon	4	1		8	2	505,964	81	43	124	197	24,437	20.70
Converse	1					2,778	2		2	262	524	5.30
Lincoln	1			4		549,557	85	45	130	184	23,920	22.97
Sheridan	3			2	2	340,369	37	19	56	294	16,464	20.67
Sweetwater	1			4		130,073	24	14	38	169	6,433	20.22
Total Wyoming	11	1		18	4	1,835,815	245	141	386	213	82,242	22.32
Total United States	1,784	26	346	2,905	533	117,617,676	26,102	10,742	36,844	199	7,341,846	16.02

[1] On returns from mines combining stripping and underground methods in same operation, tonnage has been separated and figures on employment prorated so that this table includes only data pertaining to strip mining.

MECHANICAL LOADING

Bituminous coal and lignite mechanically loaded in underground mines amounted to 304.3 million tons in 1951, or 73 percent of the total underground output.

Mechanical loading equipment used in underground bituminous-coal and lignite mines is divided into two types, "machines" and "conveyors." Machines are devices that virtually eliminate hand shoveling; they include mobile loaders, continuous mining machines, augers, scrapers, and conveyors equipped with duckbills or other self-loading heads. Conveyors are devices that greatly reduce the labor in hand shoveling; they include hand-loaded face conveyors and pit-car loaders.

Sales of Mechanical Loading Equipment.—Shipments of mechanical loading equipment for underground use in coal mines in the United States, in terms of capacity, were approximately the same in 1951 as in 1950. Table 27 shows the reported sales of mechanical loading equipment to bituminous-coal and lignite operators, by type of equipment and the number of manufacturers reporting for 1944–51.

Table 28 shows loading equipment, "mother" conveyors, and shuttle cars sold in 1950–51 for use in bituminous-coal and lignite mines, by States.

Extent of Mechanical Loading.—Mobile loaders, continuous mining machines, and augers handled 83 percent of the underground tonnage that was mechanically loaded in 1951. Table 29 shows the tons and percentage handled by each type of equipment in 1950 and 1951.

During 1951, in underground bituminous-coal and lignite mines, a combined total of 4,410 mobile loaders, continuous mining machines, and augers was in use, and the average annual output per machine was 57,293 tons; self-loading conveyors averaged 11,178; scrapers, 5,734; and hand-loaded face conveyors, 9,627 tons per unit per year.

Mechanical Loading by States.—West Virginia has been the leading producer of mechanically loaded coal since 1939. During 1951 West Virginia produced 115.7 million tons of mechanically loaded coal or 38 percent of the total bituminous coal and lignite mechanically loaded in the United States. Pennsylvania was second in production of coal mechanically loaded, followed by Kentucky, Illinois, and Ohio. These 5 States produced 85 percent of the total output of underground, mechanically loaded bituminous coal in the United States in 1951.

Detailed data, by States, on the number of mines, mechanical loading units, and production of coal mechanically loaded compared with the total production at mines using mechanical loading devices are given in tables 31 and 32. Comparative changes in underground mechanical loading in 1950–51, by States, are shown in table 30.

Table 15 shows bituminous-coal and lignite tonnage mined by stripping compared with underground hand-loaded and machine-loaded tonnage, as well as productivity and percent mined at strip and underground mines, by States, for 1951.

TABLE 26.—Units of mechanical loading equipment in use in underground bituminous-coal and lignite mines in the United States, 1946–51

Type of equipment	1946	1947	1948	1949	1950	1951	Change from 1950 (percent)
Mobile loaders	3,200	3,569	[1] 3,980	[1] 4,205	[1] 4,318	[2] 4,410	+2.1
Scrapers	75	67	56	46	39	22	−43.6
Pit-car loaders	93	71	37	17	12	[3]	
Conveyors equipped with duckbills or other self-loading heads	1,521	1,531	1,632	1,483	1,329	1,242	−6.5
Hand-loaded conveyors	3,470	3,979	4,125	4,312	4,434	3,904	−12.0
Total	8,359	9,217	9,830	10,063	10,132	9,578	−5.5

[1] Includes continuous mining machines.
[2] Includes continuous mining machines and augers.
[3] Canvass of pit-car loaders discontinued in 1951.

TABLE 27.—Units of mechanical loading equipment sold to bituminous-coal and lignite mines for underground use in the United States, as reported by manufacturers, 1944–51

Type of equipment	1944	1945	1946	1947	1948	1949	1950	1951	Change from 1950 (percent)
Mobile loaders	282	349	490	485	[1] 723	[1] 286	[1] 289	[1] 287	−0.7
Scrapers	20	6	3	12	17	8	1	4	+300.0
Conveyors [2]	580	738	838	846	1,025	394	316	297	−6.0
Pit-car loaders		[3]	[3]	[3]	[3]	[3]	[3]	[3]	
Total	882	1,093	1,331	1,343	1,765	688	606	588	−3.0
Number of manufacturers reporting	22	25	24	23	22	22	20	21	

[1] Includes continuous mining machines.
[2] Includes hand-loaded conveyors and those equipped with duckbills or other self-loading heads.
[3] Canvass of sales of pit-car loaders discontinued in 1945.

TABLE 28.—Units of mechanical loading equipment, "mother" conveyors, and shuttle cars sold for use in underground bituminous-coal and lignite mines in the United States, as reported by manufacturers, 1950–51, by States

State	Mechanical loading equipment								"Mother" conveyors [4]		Shuttle cars	
	Mobile loaders [1]		Scrapers		Room conveyors [2]		Face conveyors [3]					
	1950	1951	1950	1951	1950	1951	1950	1951	1950	1951	1950	1951
Alabama	13	5				1					7	26
Arkansas	1				2				1			
Colorado	2	7	1	2	1	17		2		6	5	6
Illinois	20	27			15	3	2		16	19	75	70
Indiana	5	1									15	4
Kentucky	55	38			51	47	20	24	24	18	94	46
Maryland					1							
New Mexico		1										
Ohio	12	13			12		8		8	2	24	20
Oklahoma		1				2			4	3	7	
Pennsylvania	76	58			73	73	18	19	29	24	111	131
Tennessee	2	3			4	3	2			1		6
Utah	10	6				2			2	2	20	8
Virginia		5			4	3	2	6	4	3	2	8
Washington	1	2										
West Virginia	89	119			153	146	64	60	41	36	99	197
Wyoming	3	1							3		6	2
Total	289	287	1	2	316	297	116	111	132	114	465	524

[1] Includes continuous mining machines.
[2] Includes hand-loaded conveyors and those equipped with duckbills or other self-loading heads.
[3] Includes bridge conveyors.
[4] Includes all haulage conveyors with capacity over 500 feet, except main slope conveyors.

TABLE 29.—Bituminous coal and lignite mechanically loaded underground in the United States, 1950–51, by type of loading equipment

Type of equipment	1950		1951	
	Net tons	Percent of total	Net tons	Percent of total
Mobile loaders, continuous mining machines, and augers:				
Loading direct into mine cars [1]	103, 005, 244	37. 8	102, 591, 251	33. 7
Loading onto conveyors [2]	10, 561, 900	3. 9	11, 229, 016	3. 7
Loading into shuttle cars [3]	109, 408, 384	40. 1	138, 842, 852	45. 6
Scrapers	318, 133	.1	126, 148	
Pit-car loaders	39, 265		[4]	[4]
Conveyors equipped with duckbills or other self-loading heads	13, 985, 399	5. 1	13, 883, 389	4. 6
Hand-loaded conveyors	35, 406, 287	13. 0	37, 583, 265	12. 4
Total loaded mechanically	272, 724, 612	100. 0	304, 255, 921	100. 0

[1] Includes mobile loaders only.
[2] Includes mobile loaders only in 1950 and mobile loaders and augers in 1951.
[3] Includes mobile loaders and continuous mining machines.
[4] Canvass of pit-car loaders discontinued in 1951.

TABLE 30.—Comparative changes in underground mechanical loading of bituminous coal and lignite by principal types of loading devices in the United States, 1950–51, by States

State	Net tons						Handled by each class (percent)				Underground output mechanically loaded (percent)	
	1950			1951			1950		1951			
	Loaded by machines [1]	Handled by conveyors [2]	Total	Loaded by machines [1]	Handled by conveyors	Total	Loaded by machines [1]	Handled by conveyors [2]	Loaded by machines [1]	Handled by conveyors	1950	1951
Alabama	7,262,987	2,215,697	9,478,684	8,227,286	1,798,408	10,025,694	76.6	23.4	82.1	17.9	75.6	85.7
Alaska	15,717		15,717	8,450		8,450	100.0		100.0		5.6	3.2
Arkansas	13,923	545,396	559,319	13,000	579,376	592,376	2.5	97.5	2.2	97.8	84.2	84.8
Colorado	2,289,192	261,963	2,551,155	2,198,350	348,948	2,547,298	89.7	10.3	86.3	13.7	66.2	68.2
Illinois	35,686,781	57,255	35,744,036	34,041,599	9,635	34,051,234	99.8	.2	100.0		92.4	94.8
Indiana	8,788,405	44,228	8,832,633	7,988,762	45,856	8,034,618	99.5	.5	99.4	0.6	95.8	95.0
Iowa	36,088	5,254	41,342	43,341		43,341	87.3	12.7	100.0		5.9	9.0
Kentucky	26,783,853	4,612,722	31,396,575	30,854,223	4,961,628	35,815,851	85.3	14.7	86.1	13.9	48.7	56.6
Maryland	50,206	86,123	136,329	53,815	23,497	77,312	36.8	63.2	69.6	30.4	28.0	18.3
Montana:												
Bituminous	718,585		718,585	785,384		785,384	100.0		100.0		94.6	95.5
Lignite	11,183		11,183	8,150		8,150	100.0		100.0		25.9	28.3
Total Montana	729,768		729,768	793,534		793,534	100.0		100.0		90.9	93.3
New Mexico	573,957		573,957	620,246		620,246	100.0		100.0		79.0	79.2
North Dakota (lignite)	406,432		406,432	224,651		224,651	100.0		100.0		93.9	89.5
Ohio	11,723,658	170,981	11,894,639	13,769,185	148,370	13,917,555	98.6	1.4	98.9	1.1	79.4	85.2
Oklahoma	45,100	776,860	821,960	49,200	776,717	825,917	5.5	94.5	6.0	94.0	86.4	82.6
Pennsylvania	44,679,010	6,250,786	50,929,796	51,247,197	7,012,523	58,259,720	87.7	12.3	88.0	12.0	64.1	68.7
Tennessee	1,193,848	713,337	1,907,185	1,278,613	691,728	1,970,341	62.6	37.4	64.9	35.1	42.5	40.0
Utah	6,454,340	73,571	6,527,911	5,941,516	62,277	6,003,793	98.9	1.1	99.0	1.0	97.9	97.8
Virginia	6,369,294	1,151,410	7,520,704	8,181,989	1,417,508	9,599,497	84.7	15.3	85.2	14.8	46.7	47.9
Washington	101,690	448,440	550,130	124,598	459,262	583,860	18.5	81.5	21.3	78.7	68.5	74.6
West Virginia	79,384,046	17,893,664	97,277,710	96,567,751	19,148,576	115,716,327	81.6	18.4	83.5	16.5	74.2	77.0
Wyoming	4,690,765	137,865	4,828,630	4,445,350	98,956	4,544,306	97.1	2.9	97.8	2.2	98.8	98.9
Total	237,279,060	35,445,552	272,724,612	266,672,656	37,583,265	304,255,921	87.0	13.0	87.6	12.4	69.4	73.1

[1] Includes mobile loaders, continuous mining machines, scrapers, conveyors equipped with duckbills and other self-loading heads, and augers.
[2] Includes hand-loaded conveyors and pit-car loaders.

TABLE 31.—Mechanical loading underground in bituminous-coal and lignite mines in the United States, 1950, by States

State	Number of mines				Number of loading devices					Production mechanically loaded (net tons)			Total underground production at mines using mechanical loading devices (net tons)			
	Using loading machines only [1]	Using conveyors only [2]	Using both loading machines and conveyors	Total	Mobile loading machines [3]	Scrapers	Conveyors equipped with duckbills or other self-loading heads	Pit-car loaders	Hand-loaded conveyors (number of units)	Loaded by machines [1]	Handled by conveyors [2]	Total	Mines using loading machines only [1]	Mines using conveyors only [2]	Mines using both loading machines and conveyors	Total
Alabama	18	26	10	54	136	7	18		341	7,262,987	2,215,697	9,478,684	5,615,330	1,945,401	2,901,176	10,461,907
Alaska	1			1			1			15,717		15,717	118,717			118,717
Arkansas		17	1	18			2		72	13,923	545,396	559,319		542,396	16,923	559,319
Colorado	42	24	5	71	45	1	219		79	2,289,192	261,963	2,551,155	2,663,934	231,527	187,725	3,083,186
Illinois	80	2	1	83	487		12	12	3	35,686,781	57,255	35,744,036	35,764,042	47,255	32,569	35,843,866
Indiana	23	2		25	164				4	8,788,405	44,228	8,832,633	8,816,203	45,728		8,861,931
Iowa	2	2		4	2		3		2	36,088	5,254	41,342	31,088	13,254		44,342
Kentucky	139	40	24	203	508		159		510	26,783,853	4,612,722	31,396,575	27,238,519	3,382,487	7,879,785	38,500,791
Maryland	2	5		7			3		31	50,206	86,123	136,329	60,094	94,597		154,691
Montana:																
Bituminous	11			11	28		14			718,585		718,585	722,850			722,850
Lignite	1			1	2					11,183		11,183				11,183
Total Montana	12			12	30		14			729,768		729,768	734,033			734,033
New Mexico	5			5	17		2			573,957		573,957	573,957			573,957
North Dakota (lignite)	1			1	4					406,432		406,432	406,432			406,432
Ohio	42	9	2	53	198		85		29	11,723,658	170,981	11,894,639	11,791,259	178,301	64,401	12,033,961
Oklahoma		8	1	9	5				148	45,100	776,860	821,960		682,079	139,881	821,960
Pennsylvania	126	87	41	254	1,032	10	80		850	44,679,010	6,250,786	50,929,796	45,286,868	5,735,039	9,682,443	60,704,350
Tennessee	15	11	7	33	28		39		106	1,193,848	713,337	1,907,185	1,459,371	936,161	809,527	3,205,059
Utah	34	6	3	43	123	1	76		18	6,454,340	73,571	6,527,911	6,330,892	62,315	149,231	6,542,438
Virginia	31	12	9	52	134		56		132	6,369,294	1,151,410	7,520,704	7,726,928	1,281,325	2,357,834	11,366,087
Washington	4	2	3	9		8	6		84	101,690	448,440	550,130	45,289	71,461	449,543	566,293
West Virginia	237	109	103	449	1,373		328		1,993	79,384,046	17,893,664	97,277,710	71,574,379	13,235,452	26,369,152	111,178,983
Wyoming	15	2	2	19	32	12	226		32	4,690,765	137,865	4,828,630	4,664,836	7,683	160,794	4,833,313
Total	829	364	212	1,405	4,318	39	1,329	12	4,434	237,279,060	35,445,552	272,724,612	230,902,171	28,492,461	51,200,984	310,595,616
Change 1950 from 1949 (percent)	+4.5	−1.9	−4.9	+1.3	+2.7	−15.2	−10.4	−29.4	+2.8	+23.9	+15.1	+22.6	+21.9	+14.1	+18.4	+20.6

[1] Includes mobile loaders, continuous mining machines, scrapers, and conveyors equipped with duckbills or other self-loading heads.
[2] Includes hand-loaded conveyors and pit-car loaders.
[3] Includes continuous mining machines.

TABLE 32.—Mechanical loading underground in bituminous-coal and lignite mines in the United States, 1951, by States

State	Number of mines				Number of loading devices				Production mechanically loaded (net tons)			Total underground production at mines using mechanical loading devices (net tons)			
	Using loading machines only [1]	Using conveyors only	Using both loading machines and conveyors	Total	Mobile loading machines [2]	Scrapers	Conveyors equipped with duckbills or other self-loading heads	Hand-loaded conveyors (number of units)	Loaded by machines [1]	Handled by conveyors	Total	Mines using loading machines only [1]	Mines using conveyors only	Mines using both loading machines and conveyors	Total
Alabama	21	12	7	40	144	1	13	222	8,227,286	1,798,408	10,025,694	7,955,243	1,106,430	1,514,924	10,576,597
Alaska	1			1			2		8,450		8,450	84,517			84,517
Arkansas		17	1	18			2	83	13,000	579,376	592,376		578,074	14,302	592,376
Colorado	43	27	3	73	40	1	184	95	2,198,350	348,948	2,547,298	2,711,475	329,927	58,018	3,099,420
Illinois	87	1		88	475		16	4	34,041,599	9,635	34,051,234	34,160,259	9,635		34,169,894
Indiana	23	2		25	158			4	7,988,762	45,856	8,034,618	7,988,762	45,856		8,034,618
Iowa	3			3	2		4		43,341		43,341	43,341			43,341
Kentucky	129	37	24	190	500		146	459	30,854,223	4,961,628	35,815,851	31,522,950	4,027,796	7,508,150	43,058,896
Maryland	6	2		8	4		3	15	53,815	23,497	77,312	58,737	23,497		82,234
Montana:															
Bituminous	9			9	28		14		785,384		785,384	785,584			785,584
Lignite	1			1	2				8,150		8,150	8,150			8,150
Total Montana	10			10	30		14		793,534		793,534	793,734			793,734
New Mexico	3			3	16		1		620,246		620,246	620,246			620,246
North Dakota (lignite)	1			1	3				224,651		224,651	224,651			224,651
Ohio	50	13	2	65	229		60	35	13,769,185	148,370	13,917,555	13,820,334	310,985	54,014	14,185,333
Oklahoma		6	1	7	5			131	49,200	776,717	825,917		716,898	109,019	825,917
Pennsylvania	139	100	33	272	1,015	12	61	834	51,247,197	7,012,523	58,259,720	54,869,434	6,282,581	8,080,343	69,232,358
Tennessee	16	8	5	29	36		38	72	1,278,613	691,728	1,970,341	1,536,663	679,827	676,922	2,893,412
Utah	35	6		41	127		70	15	5,941,516	62,277	6,003,793	5,962,987	62,277		6,025,264
Virginia	33	13	9	55	131	1	52	156	8,181,989	1,417,508	9,599,497	9,634,933	1,521,161	3,344,910	14,501,004
Washington	4	2	3	9	1	6	9	84	124,598	459,262	583,860	78,774	28,615	496,242	603,631
West Virginia	257	109	89	455	1,462		362	1,668	96,567,751	19,148,576	115,716,327	93,200,079	14,003,690	23,194,895	130,398,664
Wyoming	14	1	1	16	32	1	205	27	4,445,350	98,956	4,544,306	4,425,350	3,934	115,022	4,544,306
Total	875	356	178	1,409	4,410	22	1,242	3,904	266,672,656	37,583,265	304,255,921	269,692,469	29,731,183	45,166,761	344,590,413
Change, 1951 from 1950 (percent)	+5.5	−2.2	−16.0	+0.3	+2.1	−43.6	−6.5	−12.0	+12.4	+6.0	+11.6	+16.8	+4.3	−11.8	+10.9

[1] Includes mobile loaders, continuous mining machines, scrapers, conveyors equipped with duckbills or other self-loading heads, and augers.
[2] Includes continuous mining machines and augers.

MECHANICAL CLEANING

Bituminous coal mechanically cleaned in 1951 totaled 240.0 million tons, or 45 percent of the entire output.

Mechanical cleaning by wet methods includes jigs, concentrating tables, classifiers, launders, dense-medium processes, flotation, and any combinations of these six methods.

Pneumatic methods of coal cleaning include air tables, air flow, air sand, and any combination of these three methods.

Tables 33, 34, 37, and 38 include mechanical-cleaning data on all coal mined in the United States except Pennsylvania anthracite. Tables 35 and 36 are on the same basis but do not include consumer-operated plants. The percentage of total production mechanically cleaned in 1906–51 is shown in table 13.

Consumer-operated plants include those owned by steel companies that receive coal (usually from affiliated companies), clean it, and then consume it directly at the plant.

Types of Cleaning Equipment.—The tonnage of bituminous coal cleaned by wet-washing methods was 221.4 million tons in 1951—a 21-percent increase over 1950. The quantity cleaned by pneumatic methods was 18.5 million tons—a 20-percent increase.

Table 34 compares the number of cleaning plants and the tons of cleaned coal, by types of equipment, for 1950 and 1951. During 1951, 608 wet-washing and 94 pneumatic cleaning plants were in operation. Seventy-one tipples used both wet and dry methods at the same plant; deducting these duplications gives a net total of 631 plants that cleaned coal in 1951, an increase of 19 plants over 1950.

Mines served by cleaning plants (exclusive of those that ship to washeries operated by steel companies) produced 302.3 million tons, or 57 percent of the total bituminous output in 1951. In this same group of mines, 232.4 million tons was cleaned mechanically; therefore, 77 percent of the coal produced at mines with cleaning plants in 1951 was cleaned at the mine. The remainder of the output from these piines (23 percent) presumably represents the larger sizes commonly mcked by hand. (*See* tables 36, 38, and 39.)

Relation Between Raw Coal, Clean Coal, and Refuse.—For every 100 tons of raw coal cleaned during 1951 at the mines, 83 tons of clean merchantable coal, on an average, was obtained, and 17 tons of refuse was discarded. Table 39 shows the total production of mines with cleaning plants and the results of cleaning operations, by States.

Methods of Mining at Mines Served by Cleaning Plants.—Underground mechanical loading appears to be closely related to mechanical cleaning. Underground coal loaded mechanically in 1951 totaled 304.3 million tons, of which 217.3 million tons (71 percent) passed through tipples equipped with mechanical cleaning devices. Production of coal from strip mines in 1951 was 117.6 million tons, of which 50.7 million tons (43 percent) came from strip mines having mechanical cleaning tipples. Hand-loaded underground coal production in 1951 totaled 111.8 million tons, of which 31 percent passed through tipples equipped with cleaning plants. (*See* tables 15 and 37.)

TABLE 33.—Bituminous coal mechanically cleaned by wet and pneumatic methods in the United States, 1948–51, in net tons of clean coal

Method of cleaning	1948	1949	1950	1951	
				Quantity	Change from 1950 (percent)
Wet methods:					
At mines	154,262,590	132,658,984	174,776,675	213,806,870	+22.3
At consumer-operated plants	10,401,932	8,049,004	8,393,528	7,623,530	−9.2
Total wet methods	164,664,522	140,707,988	183,170,203	221,430,400	+20.9
Pneumatic methods	16,215,801	12,943,915	15,528,315	18,579,408	+19.6
Grand total	180,880,323	153,651,903	198,698,518	240,009,808	+20.8

TABLE 34.—Bituminous coal cleaned in the United States, 1950–51, by type of equipment in actual operation

[Includes consumer-operated plants]

Type of equipment	Plants in operation		Net tons of clean coal		Cleaned by each type (percent of total)	
	1950	1951	1950	1951	1950	1951
Wet methods:						
Jigs	296	308	94,161,108	101,746,501	47.4	42.4
Concentrating tables	18	19	4,693,434	5,810,626	2.4	2.4
Classifiers	83	84	18,058,760	23,174,005	9.1	9.7
Launders	13	13	11,630,018	10,362,595	5.8	4.3
Dense-media	124	120	28,947,797	33,840,174	14.6	14.1
Jigs and concentrating tables	19	21	6,152,924	7,612,636	3.1	3.2
Other combinations and methods	36	43	19,526,162	38,883,863	9.8	16.2
Total wet methods	589	608	183,170,203	221,430,400	92.2	92.3
Pneumatic methods	90	94	15,528,315	18,579,408	7.8	7.7
Grand total	[1] 679	[1] 702	198,698,518	240,009,808	100.0	100.0

[1] Number of plants using both wet and pneumatic methods was 67 in 1950 and 71 in 1951.

TABLE 35.—Total production from bituminous-coal mines served by cleaning plants in the United States, 1950–51, by type of equipment, in net tons

[Excludes consumer-operated plants]

Type of equipment	1950	1951	Change 1951 from 1950 (per cent)
Wet methods:			
Jigs	128,228,369	134,597,871	+5.0
Concentrating tables	3,185,851	3,826,081	+20.1
Classifiers	35,007,774	39,166,788	+11.9
Launders	9,465,165	8,063,056	−14.8
Dense-media	52,496,861	55,483,670	+5.7
Jigs and concentrating tables	10,200,875	9,463,836	−7.2
Other combinations and methods	23,344,457	46,039,830	+97.2
Total wet methods	261,929,352	296,641,132	+13.3
Pneumatic methods	47,691,984	46,159,758	−3.2
Grand total	309,621,336	342,800,890	+10.7
Less duplications [1]	42,932,206	40,535,788	−5.6
Net total	266,689,130	302,265,102	+13.3
United States total production [2]	516,311,053	533,664,732	+3.4
Percent produced at mines having cleaning plants	51.7	56.6	

[1] Mines using both wet and pneumatic methods.
[2] Includes all coal except Pennsylvania anthracite. There are no mechanical cleaning plants at lignite mines.

TABLE 36.—Total production from bituminous-coal mines served by cleaning plants in the United States, 1948–51, by method of mining

[Excludes consumer-operated plants]

Method of mining	1948		1949		1950		1951	
	Thousand tons	Percent	Thousand tons	Percent	Thousand tons	Percent	Thousand tons	Percent
Mined from strip pits	44,305	17.6	38,972	18.9	47,701	17.9	50,675	16.8
Mechanically loaded underground	171,346	68.1	142,797	69.2	188,732	70.8	217,257	71.9
Hand-loaded underground	36,061	14.3	24,553	11.9	30,256	11.3	34,333	11.3
Total	251,712	100.0	206,322	100.0	266,689	100.0	302,265	100.0

TABLE 37.—Bituminous coal mechanically cleaned by wet and pneumatic methods in the United States, 1950–51, by States

[Includes consumer-operated plants]

State	Plants in operation		Net tons of clean coal		Output mechanically cleaned (percent)	
	1950	1951	1950	1951	1950	1951
Alabama	52	48	11,548,036	11,069,682	80.1	81.4
Alaska	2	2	175,783	195,241	42.6	39.5
Arkansas	2	2	27,600	17,916	2.4	1.6
Colorado	6	7	1,277,747	1,649,012	30.0	40.2
Illinois	68	67	35,695,520	39,606,748	63.4	73.1
Indiana	27	27	14,101,094	14,060,674	70.7	72.3
Kansas	5	5	1,303,614	1,189,092	61.3	60.6
Kentucky	68	75	21,198,829	26,923,389	27.0	35.9
Maryland	2		30,343		4.7	
Missouri	10	10	2,397,442	2,865,138	80.9	87.6
Montana	2	2	160,550	126,115	6.4	5.4
New Mexico	2	1	74,290	59,635	10.2	7.6
Ohio	21	29	10,708,879	13,939,962	28.4	36.7
Oklahoma	6	6	896,344	692,692	33.5	31.2
Pennsylvania [1]	83	88	38,547,253	46,325,054	36.4	42.8
Tennessee	6	9	353,514	607,392	7.0	11.2
Utah	6	6	2,312,384	2,039,335	34.7	33.2
Virginia	21	29	4,796,515	7,356,766	27.2	34.4
Washington	17	17	781,346	809,619	89.4	94.5
West Virginia [2]	206	201	52,311,435	70,476,346	36.3	43.2
Total	[3] 612	[4] 631	198,698,518	240,009,808	38.5	45.0

[1] Includes some coal mined in Pennsylvania and cleaned in Ohio and a small tonnage mined in other States and cleaned at a consumer-operated plant in Pennsylvania.
[2] Includes some coal mined in West Virginia and cleaned in Pennsylvania.
[3] Represents 67 plants using both wet and pneumatic methods of cleaning and 545 plants using only 1 cleaning method.
[4] Represents 71 plants using both wet and penumatic methods of cleaning and 560 plants using only 1 cleaning method.

TABLE 38.—Operations at bituminous-coal-cleaning plants in the United States, 1950, by States, in net tons

State	Total raw coal moved to cleaning plants	Coal obtained in cleaning process	Refuse resulting in cleaning process	Ratio of refuse to raw coal (percent) [1]	Total production from mines served by cleaning plants
Alabama	15,958,304	11,543,036	4,410,268	27.6	11,971,009
Alaska	206,782	175,783	30,999	15.0	175,783
Arkansas	34,000	27,600	6,400	18.8	111,281
Colorado	104,664	97,173	7,491	7.2	481,234
Illinois	42,417,219	35,695,520	6,721,699	15.8	47,468,876
Indiana	16,296,961	14,101,094	2,195,867	13.5	16,416,701
Kansas	1,563,304	1,303,614	259,690	16.6	1,363,022
Kentucky	25,125,489	21,198,829	3,926,660	15.6	27,567,454
Maryland	36,267	30,343	5,924	16.3	66,444
Missouri	3,118,386	2,397,442	720,944	23.1	2,473,648
Montana	173,250	160,550	12,700	7.3	196,624
New Mexico	77,486	74,290	3,196	4.1	533,283
Ohio	13,417,909	10,708,879	2,709,030	20.2	16,114,904
Oklahoma	1,033,628	896,344	137,284	13.3	1,015,978
Pennsylvania [2]	38,201,570	31,334,299	6,867,271	18.0	40,261,530
Tennessee	394,903	353,514	41,389	10.5	844,646
Utah	2,535,763	2,312,384	223,379	8.8	3,087,272
Virginia	5,376,664	4,796,515	580,149	10.8	8,798,173
Washington	983,852	781,346	202,506	20.6	799,748
West Virginia [3]	62,099,425	52,311,435	9,787,990	15.8	86,941,520
Total at mines only [4]	229,155,826	190,304,990	38,850,836	17.0	266,689,130
Consumer plants [5]	9,235,010	8,393,528	841,482	9.1	----------
Grand total	238,390,836	198,698,518	39,692,318	16.7	----------

[1] In Alabama (for example) for every 100 tons of raw coal cleaned in 1950, an average of 27.6 tons of refuse was discarded and 72.4 tons of clean marketable coal was obtained.
[2] Includes some coal that was mined in Pennsylvania and cleaned in Ohio.
[3] Includes some coal that was mined in West Virginia and cleaned in Ohio and Pennsylvania.
[4] Includes all mechanical cleaning other than washeries operated by consumer steel companies.
[5] Includes central washeries in Colorado and Pennsylvania operated by consumer steel companies.

TABLE 39.—Operations at bituminous-coal-cleaning plants in the United States, 1951, by States, in net tons

State	Total raw coal moved to cleaning plants	Coal obtained in cleaning process	Refuse resulting in cleaning process	Ratio of refuse to raw coal (percent) [1]	Total production from mines served by cleaning plants
Alabama	15,288,106	11,069,682	4,218,424	27.6	11,805,039
Alaska	229,181	195,241	33,940	14.8	195,241
Arkansas	21,216	17,916	3,300	15.6	76,578
Colorado	216,612	197,278	19,334	8.9	419,352
Illinois	47,166,343	39,606,748	7,559,595	16.0	46,098,866
Indiana	16,522,813	14,060,674	2,462,139	14.9	16,179,093
Kansas	1,470,674	1,189,092	281,582	19.1	1,240,936
Kentucky	31,683,044	26,923,389	4,759,655	15.0	32,602,090
Missouri	3,593,259	2,865,138	728,121	20.3	2,883,209
Montana	136,468	126,115	10,353	7.6	149,913
New Mexico	65,359	59,635	5,724	8.8	535,430
Ohio	17,559,941	13,939,962	3,619,979	20.6	18,863,205
Oklahoma	794,992	692,692	102,300	12.9	822,192
Pennsylvania [2]	50,529,961	40,153,258	10,376,703	20.5	48,577,287
Tennessee	684,413	607,392	77,021	11.3	1,293,422
Utah	2,302,158	2,039,335	262,823	11.4	3,027,590
Virginia	8,134,453	7,356,766	777,687	9.6	12,116,825
Washington	1,034,477	809,619	224,858	21.7	833,008
West Virginia [3]	83,962,969	70,476,346	13,486,623	16.1	104,545,826
Total at mines only [4]	281,396,439	232,386,278	49,010,161	17.4	302,265,102
Consumer plants [5]	8,441,061	7,623,530	817,531	9.7	
Grand total	289,837,500	240,009,808	49,827,692	17.2	

[1] In Alabama (for example) for every 100 tons of raw coal cleaned in 1951, an average of 27.6 tons of refuse was discarded and 72.4 tons of clean marketable coal was obtained.
[2] Includes some coal that was mined in Pennsylvania and cleaned in Ohio.
[3] Includes some coal that was mined in West Virginia and cleaned in Pennsylvania.
[4] Includes all mechanical cleaning other than washeries operated by consumer steel companies.
[5] Includes central washeries in Colorado and Pennsylvania operated by consumer steel companies.

BY STATES AND COUNTIES

Detailed production statistics are given in table 41 for each coal-producing county in the United States from which three or more operators submitted reports for 1951. Statistics on counties with less than three reporting producers have been combined with data for other counties in the same State to avoid disclosing individual figures, unless the operators have granted permission to publish them separately. Production of mines on the border between two States has been credited to the State from which the coal was extracted rather than to that in which the tipple was situated. If the coal is mined from lands in both States, the tonnage has been apportioned accordingly.

The data in this report, as in those published for many years by the Bureau of Mines, relate only to mines with an annual output of 1,000 tons or more. That fact should be borne in mind when the statistics in this report are compared with similar data compiled by State mine departments. Differences arise largely from variations in coverage by State reports, some of which include data for all mines regardless of size and others only data for mines employing more than a specified minimum number, ranging from 2 to 10 men.

Because of a change in the method of reporting, beginning with 1946, statistics of average production per man per day are not precisely comparable with those for other years. The figures since 1946 are based on the average number of men working daily, whereas the figures for previous years were based on the average number of men on the rolls per pay period.

TABLE 40.—Production, value, men working daily, days active, man-days, and output per man per day at bituminous-coal and lignite mines in the United States, 1950, by State and by county

[Exclusive of mines producing less than 1,000 tons]

County	Production (net tons)				Average value per ton [3]	Average number of men working daily				Average number of days worked	Number of man-days worked	Average tons per man per day [4]
	Shipped by rail or water [1]	Shipped by truck	Used at mine [2]	Total		Underground	Surface		Total			
							In strip pits	All others				
ALABAMA												
Bibb	334,140	42,264	8,193	384,597	$6.97	692	-------	154	846	143	120,856	3.18
Blount	299,538	94,354	-------	393,892	6.21	278	102	72	452	166	74,925	5.26
Cherokee	-------	3,523	-------	3,523	6.24	4	-------	-------	4	185	740	4.76
Cullman	-------	38,116	-------	38,116	6.62	58	26	15	99	156	15,447	2.47
De Kalb	-------	5,480	-------	5,480	4.26	-------	9	1	10	62	618	8.87
Jackson	-------	9,490	-------	9,490	5.65	15	-------	3	18	185	3,330	2.85
Jefferson	8,544,103	176,290	47,593	8,767,986	6.26	9,302	138	1,892	11,332	194	2,198,181	3.99
Marion	121,692	127,687	1,789	251,168	8.07	491	-------	87	578	159	91,958	2.73
St. Clair	486,966	27,153	3,718	517,837	6.06	766	41	103	910	184	167,092	3.10
Shelby	180,383	81,475	1,275	263,133	6.68	415	-------	71	486	175	85,169	3.09
Tuscaloosa	669,782	104,140	1,198	775,120	4.93	362	139	123	624	186	115,876	6.69
Walker	2,220,099	278,658	509,184	3,007,941	5.73	2,187	299	503	2,989	157	469,744	6.40
Winston	1,100	2,427	-------	3,527	6.02	15	-------	-------	15	75	1,125	3.14
Total Alabama	12,857,803	991,057	572,950	14,421,810	6.13	14,585	754	3,024	18,363	182	3,345,061	4.31
ALASKA												
Total Alaska	403,697	3,885	4,873	412,455	$7.35	134	67	77	278	245	68,131	6.05
ARIZONA												
Total Arizona	-------	4,446	-------	4,446	$6.00	10	-------	-------	10	204	2,037	2.18

For footnotes, see end of table.

TABLE 40.—Production, value, men working daily, days active, man-days, and output per man per day at bituminous-coal and lignite mines in the United States, 1950, by State and by county—Continued

County	Production (net tons)				Average value per ton [3]	Average number of men working daily				Average number of days worked	Number of man-days worked	Average tons per man per day [4]
	Shipped by rail or water [1]	Shipped by truck	Used at mine [2]	Total		Underground	Surface		Total			
							In strip pits	All others				
ARKANSAS												
Franklin	63,003	4,187	1,108	68,298	$7.02	182	27	38	247	92	22,828	2.99
Johnson	474,353	10,262	488	485,103	7.02	234	108	63	405	135	54,474	8.91
Logan	171,084	14,606	192	185,882	9.42	546	8	100	654	100	65,177	2.85
Pope	41,666			41,666	8.00	79		22	101	146	14,714	2.83
Scott	70,000			70,000	5.33		47	18	65	125	8,125	8.62
Sebastian	290,820	26,990	309	318,119	7.99	535	49	85	669	139	92,988	3.42
Total Arkansas	1,110,926	56,045	2,097	1,169,068	7.60	1,576	239	326	2,141	121	258,306	4.53
COLORADO												
Boulder	20,193	86,935	2,917	110,045	$5.03	122		28	150	152	22,774	4.83
Delta	37,166	33,759	872	71,797	5.11	66		19	85	167	14,217	5.05
Elbert		1,020		1,020	3.62	1		1	2	182	364	2.80
El Paso	29,262	61,325	22,397	112,984	4.41	77	6	18	101	225	22,752	4.97
Fremont	50,229	212,546	7,687	270,462	4.87	156	4	60	220	210	46,238	5.85
Garfield	9,445	35,227		44,672	4.89	32		4	36	237	8,526	5.24
Gunnison	322,576	66,807	10,392	399,775	5.19	348		125	473	150	70,742	5.65
Huerfano	254,483	46,882	2,462	303,827	5.65	409		110	519	142	73,617	4.13
Jackson	11,906	6,418		18,324	5.19		14		14	142	1,992	9.20
Jefferson		11,235		11,235	4.96	68		13	81	29	2,337	4.81
La Plata	16,959	25,507	740	43,206	3.68	40		7	47	209	9,826	4.40
Las Animas	896,229	51,673	19,470	967,372	6.15	1,138		199	1,337	202	269,853	3.58
Mesa	55,637	28,681	453	84,771	4.97	63		13	76	190	14,420	5.88
Moffat	103,934	20,474		124,408	5.01	52		28	80	157	12,546	9.92
Montezuma		1,105		1,105	5.30	2			2	179	358	3.09
Montrose		32,252		32,252	4.99	23		4	27	161	4,359	7.40
Pitkin	6,798			6,798	4.45	3		2	5	203	1,017	6.68
Rio Blanco	21,730	17,013	39	38,782	5.11	22		10	32	169	5,411	7.17
Routt	768,483	39,358	25,013	832,854	4.92	406	52	253	711	149	106,094	7.85
Weld	494,664	271,767	16,380	782,811	3.98	517	12	111	640	141	90,101	8.69
Total Colorado	3,099,694	1,049,984	108,822	4,258,500	5.09	3,545	88	1,005	4,638	168	777,544	5.48

Bureau	642,981	67,381	267	710,629	$4.24	--------	67	110	177	201	35,572	19.98
Christian	7,822,457	69,821	49,045	7,941,323	3.21	2,539	--------	785	3,324	226	750,129	10.59
Clinton	81,562	156,212	9,557	247,331	3.98	206	--------	54	260	221	57,552	4.30
Douglas	74,856	14,426	1,197	90,479	4.45	48	--------	12	60	174	10,440	8.67
Edgar	----------	16,291	1,514	17,805	5.47	28	--------	3	31	156	4,844	3.68
Franklin	8,173,506	186,151	294,002	8,653,659	4.71	5,018	--------	1,995	7,013	176	1,237,564	6.99
Fulton	4,860,522	530,047	10,661	5,401,230	3.75	206	454	703	1,363	213	289,908	18.63
Gallatin	11,860	54,334	2,990	69,184	3.51	77	--------	21	98	135	13,273	5.21
Grundy	----------	44,873	335	45,208	7.23	9	12	7	28	168	4,704	9.61
Hancock	4,498	35,788	160	40,446	5.38	--------	15	8	23	146	3,368	12.01
Henry	93,538	79,766	1,121	174,425	4.61	81	--------	22	103	249	25,609	6.81
Jackson	1,057,342	102,293	7,282	1,166,917	3.80	220	157	133	510	200	102,160	11.42
Jefferson	438,730	28,115	32,186	499,031	4.23	373	--------	242	615	188	115,425	4.32
Knox	1,901,081	109,564	2,236	2,012,881	3.93	84	155	299	538	218	117,218	17.17
La Salle	----------	34,678	3,390	38,068	6.47	14	17	4	35	201	7,030	5.42
Livingston	----------	6,352	----------	6,352	5.59	--------	6	--------	6	142	852	7.46
Logan	----------	49,920	----------	49,920	5.84	34	--------	10	44	181	7,984	6.25
Macoupin	3,007,723	142,172	148,984	3,298,879	3.86	2,091	--------	522	2,613	167	436,815	7.55
Madison	652,457	744,946	55,422	1,452,825	4.12	1,101	--------	316	1,417	157	223,089	6.51
Marion	167,927	27,750	6,778	202,455	4.08	100	--------	41	141	212	29,892	6.77
Marshall	----------	1,103	----------	1,103	3.99	--------	5	--------	5	60	300	3.68
Menard	----------	28,986	440	29,426	5.95	46	--------	11	57	242	13,820	2.13
Mercer	----------	2,844	----------	2,844	3.99	--------	7	--------	7	30	210	13.54
Montgomery	600,016	24,329	53,375	677,720	3.89	248	--------	76	324	210	68,040	9.96
Morgan	----------	9,054	15	9,069	4.09	--------	12	3	15	107	1,608	5.64
Peoria	338,491	292,603	3,745	634,839	3.83	379	42	75	496	183	90,754	7.00
Perry	4,811,676	120,092	48,860	4,980,628	3.80	980	436	637	2,053	184	378,088	13.17
Randolph	1,551,253	111,792	11,491	1,674,536	3.75	479	59	281	819	119	97,322	17.21
St. Clair	1,922,869	1,672,004	54,077	3,648,950	3.83	842	138	299	1,279	221	283,171	12.89
Saline	3,904,578	71,248	68,200	4,044,026	4.78	2,059	105	665	2,829	183	517,333	7.82
Sangamon	878,092	601,893	23,395	1,503,380	4.27	1,046	--------	206	1,252	167	209,180	7.19
Schuyler	----------	43,141	130	43,271	4.93	27	23	10	60	202	12,138	3.56
Tazewell	----------	72,918	796	73,714	5.56	66	--------	11	77	218	16,791	4.39
Vermilion	461,740	295,337	3,508	760,585	4.51	169	72	71	312	165	51,618	14.74
Warren	----------	2,976	20	2,996	5.50	5	--------	1	6	300	1,800	1.66
Washington	12,180	27,695	891	40,766	4.25	59	--------	12	71	154	10,935	3.73
Will	1,023,570	248,090	4,084	1,275,744	4.74	--------	322	123	445	231	102,728	12.42
Williamson	4,347,905	376,141	33,410	4,757,456	4.30	1,869	186	634	2,689	163	437,952	10.86
Woodford	----------	9,471	1,350	10,821	3.99	48	--------	7	55	146	8,030	1.35
Total Illinois	48,843,410	6,512,597	934,914	56,290,921	4.05	20,551	2,290	8,409	31,250	185	5,775,246	9.75

For footnotes, see end of table.

TABLE 40.—Production, value, men working daily, days active, man-days, and output per man per day at bituminous-coal and lignite mines in the United States, 1950, by State and by county—Continued

County	Production (net tons)				Average value per ton [3]	Average number of men working daily				Average number of days worked	Number of man-days worked	Average tons per man per day [4]
	Shipped by rail or water [1]	Shipped by truck	Used at mine [2]	Total		Underground	Surface		Total			
							In strip pits	All others				
INDIANA												
Clay	1,021,358	168,378	9,660	1,199,396	$4.22	-------	340	125	465	188	87,237	13.75
Daviess	377,287	33,891	-------	411,178	4.28	19	52	51	122	238	29,004	14.18
Dubois	7,900	-------	-------	7,900	3.59	13	-------	3	16	80	1,280	6.17
Fountain	-------	69,858	-------	69,858	5.57	-------	25	5	30	227	6,810	10.26
Gibson	547,735	102,062	19,611	669,408	4.51	480	18	105	603	154	92,787	7.21
Greene	429,254	33,861	1,740	464,855	4.39	41	90	43	174	153	26,637	17.45
Knox	2,549,040	551,225	27,761	3,128,026	3.69	1,136	105	364	1,605	198	318,508	9.82
Martin	-------	1,047	-------	1,047	4.54	2	-------	2	4	160	640	1.64
Owen	176,288	11,951	1,068	189,307	4.70	-------	45	10	55	209	11,520	16.43
Parke	-------	19,200	-------	19,200	5.35	30	-------	6	36	99	3,564	5.39
Pike	3,065,515	42,588	19,160	3,127,263	3.80	-------	500	234	734	249	183,098	17.08
Spencer	76,245	8,038	-------	84,283	4.65	21	67	22	110	95	10,469	8.05
Sullivan	2,370,805	111,351	14,789	2,496,945	4.24	995	205	332	1,532	167	255,614	9.77
Vermillion	333,218	58,269	2,232	393,719	4.00	55	54	40	149	206	30,759	12.80
Vigo	3,781,802	264,940	379,601	4,426,343	4.01	2,170	150	462	2,782	194	538,840	8.21
Warrick	3,017,488	235,898	14,915	3,268,301	3.76	431	360	381	1,172	184	215,224	15.19
Total Indiana	17,753,935	1,712,557	490,537	19,957,029	3.97	5,393	2,011	2,185	9,589	189	1,811,991	11.01
IOWA												
Appanoose	42,022	132,405	705	175,132	$5.00	362	-------	53	415	168	69,712	2.51
Boone	-------	23,620	-------	23,620	5.54	52	-------	8	60	122	7,300	3.24
Davis	6,093	45,885	56	52,034	3.40	30	10	8	48	176	8,439	6.17
Greene	-------	6,296	20	6,316	4.31	6	-------	1	7	233	1,633	3.87
Guthrie	-------	3,771	100	3,871	8.06	13	-------	2	15	148	2,220	1.74
Jasper	-------	29,926	-------	29,926	4.30	54	-------	9	63	184	11,590	2.58
Lucas	8,454	19,007	-------	27,461	5.11	52	-------	10	62	119	7,381	3.72
Mahaska	85,338	125,312	171	210,821	3.43	44	72	29	145	211	30,572	6.90
Marion	636,395	295,902	175	932,472	3.21	155	168	86	409	234	95,877	9.73
Monroe	69,179	99,813	-------	168,992	4.20	178	-------	31	209	201	42,085	4.02
Page	-------	8,971	-------	8,971	6.68	15	-------	3	18	190	3,420	2.62

Van Buren	18,125	71,063	----------	89,188	3.79	30	28	19	77	162	12,504	7.13
Wapello	53,833	95,228	20	149,081	3.86	15	40	19	74	254	18,760	7.95
Warren	----------	13,526	----------	13,526	4.56	18	--------	3	21	209	4,387	3.08
Total Iowa	919,439	970,725	1,247	1,891,411	3.69	1,024	318	281	1,623	195	315,880	5.99
KANSAS												
Bourbon	89,269	28,011	500	117,780	$3.97	--------	51	19	70	151	10,578	11.13
Cherokee	476,977	32,354	226	509,557	3.75	19	157	97	273	151	41,094	12.40
Coffey	----------	3,000	----------	3,000	5.00	--------	9	1	10	110	1,100	2.73
Crawford	720,321	43,674	3,618	767,613	3.88	183	196	125	504	157	79,108	9.70
Franklin	----------	2,300	----------	2,300	6.50	6	--------	1	7	140	980	2.35
Labette	----------	3,158	----------	3,158	5.16	--------	5	--------	5	183	914	3.46
Linn	673,936	12,546	----------	686,482	3.81	7	35	78	120	278	33,375	20.57
Osage	17,139	17,838	113	35,090	6.20	74	18	10	102	160	16,299	2.15
Total Kansas	1,977,642	142,881	4,457	2,124,980	3.87	289	471	331	1,091	168	183,448	11.58
KENTUCKY												
Eastern Kentucky:												
Bath	----------	1,580	----------	1,580	$5.74	5	--------	--------	5	140	700	2.26
Bell	1,930,731	430,950	13,299	2,374,980	5.73	2,798	84	388	3,270	158	516,988	4.59
Boyd	108,010	390,933	1,454	500,397	4.64	286	59	58	403	217	87,498	5.72
Breathitt	843,069	372,831	21,242	1,237,142	5.28	802	82	211	1,095	156	170,893	7.24
Carter	96,667	310,480	2,123	409,270	5.26	389	--------	70	459	185	84,720	4.83
Clay	421,328	354,495	----------	775,823	5.49	851	60	174	1,085	187	203,364	3.81
Clinton	----------	64,280	----------	64,280	4.36	72	--------	12	84	165	13,898	4.63
Elliott	20,000	116,234	----------	136,234	4.37	137	--------	23	160	222	35,509	3.84
Floyd	5,439,407	592,872	9,001	6,041,280	5.91	5,847	--------	1,115	6,962	160	1,116,356	5.41
Greenup	----------	136,041	----------	136,041	4.67	150	--------	24	174	206	35,866	3.79
Harlan	10,211,218	139,938	133,202	10,484,358	6.25	11,259	11	1,601	12,871	188	2,427,846	4.32
Jackson	----------	610,232	600	610,832	5.23	602	49	111	762	181	137,742	4.43
Johnson	421,894	419,044	1,672	842,610	5.99	1,588	--------	256	1,844	127	233,792	3.60
Knott	878,129	939,398	1,987	1,819,514	5.27	1,459	14	263	1,736	141	245,576	7.41
Knox	274,858	376,078	1,148	652,084	5.75	672	23	104	799	168	134,174	4.86
Laurel	85,347	223,130	1,251	309,728	5.18	185	104	56	345	169	58,409	5.30
Lawrence	----------	58,299	----------	58,299	4.10	75	--------	16	91	208	18,885	3.09
Lee	93,550	222,308	----------	315,858	5.39	290	13	60	363	177	64,130	4.93
Leslie	2,058,953	430,965	1,334	2,491,252	5.69	1,432	--------	251	1,683	191	320,957	7.76
Letcher	4,503,599	1,627,862	43,093	6,174,554	5.71	4,793	51	829	5,673	173	983,081	6.28
Madison	----------	6,392	----------	6,392	5.25	5	7	--------	12	101	1,215	5.26
Magoffin	99,777	71,141	----------	170,918	4.90	168	--------	26	194	169	32,810	5.21
Martin	256,227	32,608	550	289,385	5.12	374	4	72	450	114	51,506	5.62
McCreary	478,886	158,843	4,244	641,973	5.46	992	17	148	1,157	133	153,999	4.17
Menefee	----------	29,020	----------	29,020	5.74	50	--------	8	58	160	9,280	3.13

For footnotes, see end of table.

TABLE 40.—Production, value, men working daily, days active, man-days, and output per man per day at bituminous-coal and lignite mines in the United States, 1950, by State and by county—Continued

County	Production (net tons)				Average value per ton [3]	Average number of men working daily				Average number of days worked	Number of man-days worked	Average tons per man per day [4]
	Shipped by rail or water [1]	Shipped by truck	Used at mine [2]	Total		Underground	Surface		Total			
							In strip pits	All others				
KENTUCKY—Continued												
Eastern Kentucky—Continued												
Morgan	2,000	501,097	----------	503,097	$4.85	144	128	63	335	202	67,700	7.43
Owsley	----------	23,047	----------	23,047	5.87	31	--------	5	36	185	6,660	3.46
Perry	6,064,262	311,642	64,545	6,440,449	5.58	5,399	--------	1,030	6,429	174	1,116,395	5.77
Pike	7,879,534	1,336,428	90,563	9,306,525	5.07	8,715	--------	1,536	10,251	168	1,721,383	5.41
Powell	----------	20,616	----------	20,616	5.00	3	8	2	13	173	2,245	9.18
Pulaski	67,200	448,264	----------	515,464	4.85	392	55	75	522	172	89,840	5.74
Rockcastle	65,950	267,006	----------	332,956	4.72	256	40	56	352	170	59,880	5.56
Wayne	----------	108,507	----------	108,507	4.07	130	8	21	159	151	23,952	4.53
Whitley	290,622	53,916	658	345,196	5.70	397	50	81	528	169	89,226	3.87
Wolfe	----------	292,561	----------	292,561	5.33	267	21	50	338	186	62,840	4.66
Total Eastern Kentucky	42,591,218	11,479,038	391,966	54,462,222	5.62	51,015	888	8,795	60,698	171	10,379,315	5.25
Western Kentucky:												
Butler	----------	295,051	----------	295,051	4.13	137	16	29	182	177	32,129	9.18
Christian	32,350	26,353	----------	58,703	4.31	46	--------	8	54	162	8,728	6.73
Crittenden	----------	58,524	----------	58,524	3.73	3	17	13	33	219	7,230	8.09
Daviess	136,311	464,630	----------	600,941	3.80	246	49	59	354	171	60,589	9.92
Edmonson	----------	29,728	----------	29,728	3.96	15	4	2	21	188	3,950	7.53
Grayson	----------	154,694	----------	154,694	4.23	--------	35	10	45	250	11,250	13.75
Hancock	83,543	147,619	----------	231,162	3.75	18	41	29	88	197	17,369	13.31
Henderson	50,000	323,886	----------	373,886	3.22	329	--------	50	379	201	76,061	4.92
Hopkins	12,889,002	507,087	15,615	13,411,704	3.62	2,793	768	1,340	4,901	192	942,257	14.23
McLean	5,900	75,588	----------	81,488	4.29	67	--------	9	76	179	13,608	5.99
Muhlenberg	4,887,362	571,808	9,313	5,468,483	3.50	1,972	271	671	2,914	163	475,282	11.51
Ohio	1,864,568	405,931	1,598	2,272,097	3.98	370	210	293	873	167	145,662	15.60

Union	524,081	210,898	3,572	738,551	3.76	285	23	82	390	198	77,087	9.58
Webster	231,258	27,111	----------	258,369	3.82	209	11	32	252	125	31,530	8.19
Total Western Kentucky	20,704,375	3,298,908	30,098	24,033,381	3.65	6,490	1,445	2,627	10,562	180	1,902,732	12.63
Total Kentucky	63,295,593	14,777,946	422,064	78,495,603	5.01	57,505	2,333	11,422	71,260	172	12,282,047	6.39
MARYLAND												
Allegany	125,465	207,718	----------	333,183	$4.77	399	87	96	582	140	81,432	4.09
Garrett	178,053	136,209	478	314,740	4.91	565	68	111	744	91	67,452	4.67
Total Maryland	303,518	343,927	478	647,923	4.84	964	155	207	1,326	112	148,884	4.35
MICHIGAN												
Total Michigan	----------	9,890	1,610	11,500	$10.12	33	--------	2	35	166	5,810	1.98
MISSOURI												
Adair	----------	92,109	6,218	98,327	$4.69	162	--------	35	197	157	30,883	3.18
Barton	177,389	45,075	944	223,408	4.07	--------	50	35	85	183	15,562	14.36
Bates	227,191	11,775	----------	238,966	3.81	--------	33	26	59	229	13,493	17.71
Boone	----------	45,035	100	45,135	4.25	--------	18	4	22	240	5,284	8.54
Callaway	----------	126,870	----------	126,870	4.72	--------	41	13	54	277	14,978	8.47
Clay	----------	33,924	766	34,690	7.58	124	--------	14	138	124	17,124	2.03
Dade	----------	7,769	----------	7,769	3.99	--------	7	--------	7	300	2,100	3.70
Daviess	----------	5,602	----------	5,602	8.30	13	--------	2	15	170	2,550	2.20
Harrison	----------	4,526	----------	4,526	5.90	22	--------	3	25	125	3,128	1.45
Henry	571,462	86,684	39	658,185	3.91	--------	154	51	205	200	41,054	16.03
Jasper	----------	2,020	----------	2,020	4.28	--------	5	--------	5	170	850	2.38
Johnson	----------	1,289	----------	1,289	4.04	--------	2	--------	2	152	304	4.24
Lafayette	----------	30,069	595	30,664	6.45	96	--------	11	107	148	15,802	1.94
Linn	----------	7,796	----------	7,796	6.02	28	--------	4	32	168	5,376	1.45
Macon	547,276	56,099	134	603,509	4.06	19	67	79	165	252	41,566	14.52
Monroe	----------	3,393	----------	3,393	5.39	--------	6	--------	6	188	1,128	3.01
Putnam	----------	23,922	----------	23,922	4.99	63	--------	7	70	141	9,885	2.42
Ralls	----------	12,074	----------	12,074	5.25	5	9	4	18	256	4,600	2.62
Randolph	495,904	69,609	----------	565,513	4.27	125	46	61	232	209	48,525	11.65
Ray	----------	14,254	----------	14,254	7.80	56	--------	10	66	140	9,220	1.55
St. Clair	15,596	7,103	----------	22,699	3.53	--------	18	4	22	172	3,776	6.01
Vernon	211,193	21,277	----------	232,470	3.63	--------	73	25	98	161	15,735	14.77
Total Missouri	2,246,011	708,274	8,796	2,963,081	4.17	713	529	388	1,630	186	302,923	9.78

For footnotes, see end of table.

TABLE 40.—Production, value, men working daily, days active, man-days, and output per man per day at bituminous-coal and lignite mines in the United States, 1950, by State and by county—Continued

County	Production (net tons)				Average value per ton [3]	Average number of men working daily				Average number of days worked	Number of man-days worked	Average tons per man per day [4]
	Shipped by rail or water [1]	Shipped by truck	Used at mine [2]	Total		Underground	Surface		Total			
							In strip pits	All others				
MONTANA												
Bituminous coal:												
Blaine		10,155	120	10,275	$6.32	8			8	298	2,382	4.31
Carbon	183,368	12,749	507	196,624	4.68	97		34	131	175	22,979	8.56
Cascade	4,834	16,471		21,305	5.47	9		2	11	248	2,730	7.80
Fergus		2,142		2,142	3.61	2		2	4	201	804	2.66
Musselshell	480,913	42,970	5,658	529,541	4.45	364		177	541	151	81,572	6.49
Rosebud	1,704,834		3,315	1,708,149	1.30		69	15	84	219	18,410	92.78
Total bituminous coal	2,373,949	84,487	9,600	2,468,036	2.30	480	69	230	779	165	128,877	19.15
Lignite:												
Custer		16,332		16,332	3.27	14		2	16	138	2,205	7.41
Dawson		3,001		3,001	3.29	3		1	4	156	624	4.81
Richland		11,183		11,183	3.78	6		1	7	200	1,400	7.99
Roosevelt		4,066		4,066	4.25	4		1	5	120	600	6.78
Sheridan		17,348	200	17,548	3.00	4	3	4	11	206	2,264	7.75
Total lignite		51,930	200	52,130	3.37	31	3	9	43	165	7,093	7.35
Total Montana	2,373,949	136,417	9,800	2,520,166	2.33	511	72	239	822	165	135,970	18.53
NEW MEXICO												
Bernalillo		1,235	20	1,255	$4.75	2		1	3	145	435	2.89
Colfax	580,516		708	581,224	5.31	531		127	658	147	97,042	5.99
McKinley	50,723	9,473	18,080	78,276	6.39	158		35	193	105	20,280	3.86
Rio Arriba	24,055			24,055	4.20	20		4	24	224	5,378	4.47
Sandoval	6,348			6,348	5.37	7		2	9	189	1,701	3.73
San Juan	2,528			2,528	5.37	7		1	8	76	608	4.16
Santa Fe	15,696	15,696		31,392	5.37	47		8	55	189	10,395	3.02
Socorro		1,880		1,880	5.37	5		1	6	140	840	2.24
Total New Mexico	679,866	28,284	18,808	726,958	5.39	777		179	956	143	136,679	5.32

NORTH DAKOTA (LIGNITE)

Adams	25,357	27,888	----------	53,245	$2.97	4	11	1	16	182	2,915	18.27
Bowman	34,610	5,130	1,238	40,978	1.86	--------	9	4	13	142	1,846	22.20
Burke	365,661	46,830	67,059	479,550	2.39	--------	27	38	65	259	16,817	28.52
Burleigh	----------	23,546	----------	23,546	3.31	--------	5	--------	5	171	855	27.54
Divide	262,077	2,655	934	265,666	2.51	--------	34	6	40	256	10,252	25.91
Dunn	----------	13,770	238	14,008	2.04	--------	7	--------	7	182	1,275	10.99
Golden Valley	----------	2,942	65	3,007	2.74	3	--------	1	4	136	544	5.53
Grant	----------	25,266	23	25,289	3.12	--------	15	--------	15	100	1,505	16.80
Hettinger	300	17,098	10	17,408	2.93	--------	6	3	9	217	1,956	8.90
McKenzie	----------	2,844	----------	2,844	3.56	2	2	--------	4	90	360	7.90
McLean	340,213	61,352	225	401,790	2.39	--------	32	32	64	248	15,896	25.28
Mercer	1,058,864	124,731	2,464	1,186,059	2.28	91	56	85	232	247	57,320	20.69
Morton	----------	37,801	30	37,831	2.59	4	16	1	21	147	3,093	12.23
Mountrail	----------	2,620	40	2,660	3.14	3	--------	--------	3	100	300	8.87
Oliver	----------	6,110	----------	6,110	2.50	--------	2	--------	2	190	380	16.08
Stark	----------	18,736	86,267	105,003	1.46	--------	15	5	20	265	5,292	19.84
Ward	438,845	138,620	50	577,515	2.52	4	36	48	88	259	22,755	25.38
Williams	----------	18,420	44	18,464	3.16	8	3	5	16	171	2,735	6.75
Total North Dakota	2,525,927	576,359	158,687	3,260,973	2.38	119	276	229	624	234	146,096	22.32

OHIO

Athens	680,119	223,299	3,222	906,640	$4.76	719	110	258	1,087	134	145,598	6.23
Belmont	8,155,945	271,551	19,818	8,447,314	3.99	3,827	286	956	5,069	187	948,524	8.91
Carroll	354,516	199,359	2,103	555,978	4.17	300	87	60	447	204	91,086	6.10
Columbiana	169,936	1,184,692	76,459	1,431,087	3.88	141	403	106	650	203	132,226	10.82
Coshocton	446,473	436,227	229	882,929	3.98	203	169	95	467	208	97,343	9.07
Gallia	567,104	179,747	25	746,876	3.48	325	102	91	518	208	107,513	6.95
Guernsey	630,562	86,297	154	717,013	3.34	109	121	50	280	268	75,011	9.56
Harrison	5,356,675	87,887	8,158	5,452,720	3.95	529	540	829	1,898	160	304,061	17.93
Hocking	102,421	46,088	10	148,519	4.11	158	26	29	213	151	32,073	4.63
Holmes	64,919	28,010	----------	92,929	4.14	--------	43	6	49	235	11,512	8.07
Jackson	48,909	123,257	5,544	177,710	4.38	109	68	25	202	171	34,635	5.13
Jefferson	4,276,721	1,267,037	24,029	5,567,787	3.79	1,412	534	669	2,615	197	514,607	10.82
Lawrence	----------	174,143	----------	174,143	3.82	127	24	22	173	195	33,793	5.15
Mahoning	16,065	619,293	6,000	641,358	3.87	5	151	35	191	244	46,637	13.75
Meigs	512,599	68,899	12,834	594,332	3.33	305	106	73	484	190	91,828	6.47
Morgan	159,798	41,861	----------	201,659	3.25	76	51	22	149	167	24,849	8.12
Muskingum	1,141,215	583,081	296	1,724,592	3.05	331	161	136	628	191	120,168	14.35
Noble	1,994,865	7,507	113	2,002,485	2.70	4	252	119	375	235	88,292	22.68
Perry	2,827,661	431,217	643	3,259,521	4.31	1,178	449	469	2,096	179	374,643	8.70
Portage	----------	153,701	----------	153,701	4.40	--------	35	14	49	282	13,834	11.11
Scioto	----------	7,380	----------	7,380	4.07	--------	4	--------	4	201	804	9.18
Stark	16,587	977,594	5,547	999,728	2.94	30	260	56	346	235	81,294	12.30
Tuscarawas	135,817	2,093,838	45,799	2,275,454	3.76	665	299	168	1,132	223	252,898	9.00
Vinton	161,714	85,045	25	246,784	4.23	131	98	32	261	202	52,740	4.68
Washington	121,000	112,469	----------	233,469	3.38	--------	49	18	67	181	12,120	19.26
Wayne	----------	118,913	70	118,983	4.25	--------	19	10	29	303	8,787	13.54
Total Ohio	27,941,621	9,608,392	211,078	37,761,091	3.81	10,684	4,447	4,348	19,479	190	3,696,876	10.21

For footnotes, see end of table.

TABLE 40.—Production, value, men working daily, days active, man-days, and output per man per day at bituminous-coal and lignite mines in the United States, 1950, by State and by county—Continued

County	Production (net tons)				Average value per ton [3]	Average number of men working daily				Average number of days worked	Number of man-days worked	Average tons per man per day [4]
	Shipped by rail or water [1]	Shipped by truck	Used at mine [2]	Total		Underground	Surface		Total			
							In strip pits	All others				
OKLAHOMA												
Coal	68,937	12,332		81,269	$5.37	10	33	19	62	200	12,371	6.57
Craig	59,439	23,934	1,841	85,214	4.12		54	8	62	179	11,115	7.67
Haskell	373,723	12,221	2,113	388,057	6.17	198	85	43	326	215	70,109	5.54
Latimer	960	1,460		2,420	5.26	5		1	6	129	774	3.13
Le Flore	371,034	53,603		424,637	6.29	260	123	75	458	130	59,662	7.12
Muskogee	151,010			151,010	3.35		42	15	57	241	13,726	11.00
Okmulgee	658,481	32,243		690,724	4.95	442	46	106	594	150	89,167	7.75
Pittsburg	279,570	1,703	947	282,220	7.90	355	10	48	413	208	85,893	3.29
Rogers	380,345	72,012	3,739	456,096	4.16		171	89	260	222	57,760	7.90
Sequoyah	106,628			106,628	5.61		23	6	29	298	8,652	12.32
Tulsa	4,186	3,200		7,386	6.07	14		2	16	188	3,008	2.46
Wagoner	2,910			2,910	3.07		9		9	61	549	5.30
Total Oklahoma	2,457,223	212,708	8,640	2,678,571	5.44	1,284	596	412	2,292	180	412,786	6.49
OREGON												
Total Oregon		1,376	8	1,384	$6.08	3		1	4	240	959	1.44
PENNSYLVANIA (BITUMINOUS COAL)												
Allegheny	8,706,371	2,774,289	1,250,715	12,731,375	$4.91	7,577	775	1,424	9,776	200	1,957,475	6.50
Armstrong	3,789,588	488,590	6,912	4,285,090	4.36	2,332	629	543	3,504	161	563,284	7.61
Beaver	84,031	294,542		378,573	4.59	133	70	45	248	225	55,909	6.77
Bedford	251,516	53,150		304,666	5.39	375	58	52	485	150	72,719	4.19
Blair	125,897	246,638	177	372,712	3.95	111	63	31	205	176	36,035	10.34
Bradford	2,509	12,292		14,801	4.51	7	9		16	166	2,660	5.56
Butler	1,919,528	878,656	15,724	2,813,908	4.11	620	570	256	1,446	216	312,206	9.01
Cambria	11,206,575	748,612	789,808	12,744,995	5.67	11,793	488	2,197	14,478	191	2,759,076	4.62
Cameron	68,619	29,882		98,501	3.68		33	5	38	274	10,420	9.45

Centre	878,050	301,902	32	1,179,984	4.09	424	371	145	940	178	167,100	7.06
Clarion	2,359,105	869,121	15,444	3,243,670	3.90	711	809	409	1,929	188	362,726	8.94
Clearfield	6,199,625	274,404	31,168	6,505,197	4.43	2,820	1,587	786	5,193	182	947,286	6.87
Clinton	338,349	329,916	739	669,004	3.64	71	239	62	372	181	67,306	9.94
Elk	645,679	230,073	146	875,898	4.87	396	197	129	722	175	126,644	6.92
Fayette	6,224,338	1,340,493	2,659,383	10,224,214	5.23	8,514	317	1,216	10,047	200	2,013,973	5.08
Forest		3,690		3,690	4.74	3		1	4	283	1,132	3.26
Greene	10,077,934	157,842	57,696	10,293,472	5.35	7,412	72	1,471	8,955	202	1,809,240	5.69
Indiana	6,699,705	589,475	545,810	7,834,990	4.83	4,677	592	1,040	6,309	197	1,240,874	6.31
Jefferson	1,842,582	95,147	3,144	1,940,873	4.21	1,046	460	248	1,754	176	308,153	6.30
Lawrence	160	469,697	2,292	472,149	3.74	38	97	21	156	244	38,081	12.40
Lycoming		41,240	100	41,340	3.81	18	8	5	31	252	7,817	5.29
McKean		61,257		61,257	3.88		25	5	30	202	6,046	10.13
Mercer	147,772	401,737	3,464	552,973	4.15	167	125	76	368	191	70,341	7.86
Somerset	5,322,865	641,069	24,404	5,988,338	4.99	4,545	694	962	6,201	172	1,065,009	5.62
Tioga	92,070	75,015	881	167,966	5.20	116	22	38	176	168	29,554	5.68
Venango	101,230	353,924	1,249	456,403	3.96	5	79	23	107	269	28,771	15.86
Washington	12,797,634	1,324,406	567,692	14,689,732	5.38	10,974	663	1,991	13,628	192	2,616,405	5.61
Westmoreland	3,091,559	2,439,024	869,870	6,400,453	5.08	4,236	540	785	5,561	185	1,029,883	6.21
Other counties:												
Fulton and Huntingdon	408,063	115,647	187	523,897	5.64	307	138	57	502	171	85,836	6.10
Total Pennsylvania	83,381,354	15,641,730	6,847,037	105,870,121	5.00	69,428	9,730	14,023	93,181	191	17,791,961	5.95
TENNESSEE												
Anderson	821,587	32,933	7,248	861,768	$5.30	848	8	138	994	162	161,129	5.35
Bledsoe		4,380		4,380	3.00	11		1	12	260	3,120	1.40
Campbell	1,378,123	74,866	11,636	1,464,625	6.11	1,605	60	283	1,948	171	334,052	4.38
Claiborne	979,553	52,481	10,444	1,042,478	5.48	1,168	75	176	1,419	160	227,070	4.59
Cumberland		2,854		2,854	3.77	6			6	211	1,266	2.25
Fentress	108,016			108,016	4.97	107		25	132	172	22,759	4.75
Grundy	214,539	1,500		216,039	4.66	208	21	39	268	144	38,610	5.60
Hamilton	30,080	10,697	2,000	42,777	4.29	65		11	76	188	14,291	2.99
Marion	294,180	152,697	6,317	453,194	5.37	417	40	72	529	156	82,505	5.49
Morgan	265,856	14,161	6,060	286,077	5.64	385	13	64	462	222	102,682	2.79
Overton	28,909	8,599	12	37,520	3.80	53	7	12	72	135	9,746	3.85
Putnam	207,030	25,667	380	233,077	3.98	143		38	181	195	35,290	6.60
Scott	238,690	240	702	239,632	4.33	219	20	45	284	137	38,909	6.16
Sequatchie	5,685	23,311		28,996	3.27	46		5	51	154	7,847	3.70
Van Buren		3,000		3,000	3.00	5			5	160	800	3.75
White	9,398	35,969		45,367	2.96	7	15	3	25	188	4,691	9.67
Total Tennessee	4,581,646	443,355	44,799	5,069,800	5.40	5,293	259	912	6,464	168	1,084,767	4.67

For footnotes, see end of table.

TABLE 40.—Production, value, men working daily, days active, man-days, and output per man per day at bituminous-coal and lignite mines in the United States, 1950, by State and by county—Continued

County	Production (net tons)				Average value per ton [3]	Average number of men working daily				Average number of days worked	Number of man-days worked	Average tons per man per day [4]
	Shipped by rail or water [1]	Shipped by truck	Used at mine [2]	Total		Underground	Surface		Total			
							In strip pits	All others				
TEXAS (LIGNITE)												
Milam	17,959		210	18,169	$1.69		8	6	14	281	3,934	4.62
UTAH												
Carbon	4,376,028	206,042	56,330	4,638,400	$4.96	2,503		931	3,434	180	618,999	7.49
Emery	1,675,259	196,685	6,803	1,878,747	4.46	1,054		265	1,319	204	269,315	6.98
Grand	8,328	375		8,703	5.02	6		3	9	217	1,950	4.46
Iron		24,689		24,689	4.66	15		3	18	270	4,858	5.08
Kane		2,202		2,202	5.06	3			3	147	441	4.99
Sevier	39,845	42,354		82,199	4.57	39		12	51	213	10,855	7.57
Summit		32,256	200	32,456	3.52	16		5	21	261	5,489	5.91
Uintah		2,500		2,500	4.69	4		1	5	240	1,200	2.08
Total Utah	6,099,460	507,103	63,333	6,669,896	4.81	3,640		1,220	4,860	188	913,107	7.30
VIRGINIA												
Buchanan	4,653,976	55,907	11,643	4,721,526	$5.58	3,217	191	639	4,047	177	717,467	6.58
Dickenson	3,022,736	70,402	1,322	3,094,460	5.21	2,099	125	348	2,572	167	430,203	7.19
Lee	693,242	84,785	7,197	785,224	6.56	980		165	1,145	180	206,147	3.81
Montgomery	106,351	6,812		113,163	4.65	105		29	134	206	27,604	4.10
Russell	953,981	145,161	8	1,099,150	5.58	921	21	147	1,089	170	185,100	5.94
Scott		18,000		18,000	5.45	22		3	25	185	4,625	3.89
Tazewell	2,841,432	65,462	28,044	2,934,938	6.12	3,036	9	589	3,634	195	708,214	4.14
Wise	4,428,982	213,617	257,587	4,900,186	5.02	4,167	97	717	4,981	183	909,991	5.38
Total Virginia	16,700,700	660,146	305,801	17,666,647	5.49	14,547	443	2,637	17,627	181	3,189,351	5.54

WASHINGTON

King	82,803	93,305	485	176,593	$6.94	189	8	71	268	175	46,870	3.77
Kittitas	491,121	14,641	14,747	520,509	6.65	403	19	149	571	229	130,824	3.98
Lewis		47,684		47,684	5.36	36		5	41	215	8,796	5.42
Pierce	3,858	2,533	98	6,489	6.91	10		2	12	142	1,707	3.80
Thurston	24,540	1,321	111	25,972	4.78	23	20	8	51	61	3,136	8.28
Whatcom	77,998	13,230	5,514	96,742	7.39	121		35	156	187	29,107	3.32
Total Washington	680,320	172,714	20,955	873,989	6.67	782	47	270	1,099	201	220,440	3.96

WEST VIRGINIA

Barbour	3,488,461	18,756	896	3,508,113	$4.11	1,338	302	507	2,147	154	329,581	10.64
Boone	5,865,833	144,554	14,548	6,024,935	5.21	3,856	117	1,056	5,029	186	935,099	6.44
Braxton	136,014	18,415		154,429	3.88	80	21	18	119	199	23,640	6.53
Brooke	895,083	233,062	835,510	1,963,655	4.33	837	213	163	1,213	196	238,281	8.24
Clay	1,057,120	70,399	24,303	1,151,822	5.73	597	25	210	832	241	200,656	5.74
Fayette	10,503,562	157,856	369,503	11,030,921	5.69	9,258	355	1,784	11,397	192	2,186,766	5.04
Gilmer	115,430	46,578		162,008	3.41	123		18	141	189	26,670	6.07
Grant	4,131	44,417		48,548	4.70	73	12	7	92	166	15,265	3.18
Greenbrier	2,073,872	19,333	18,389	2,111,594	5.21	1,654	119	270	2,043	172	351,196	6.01
Hancock	35,003	150,546		185,549	3.58	11	28	7	46	243	11,188	16.58
Harrison	9,777,883	99,950	1,573	9,879,406	4.09	3,496	1,004	1,125	5,625	160	902,374	10.95
Kanawha	8,474,063	179,431	47,726	8,701,220	5.15	5,930	156	1,072	7,158	184	1,318,919	6.60
Lewis	312,538	14,526		327,064	3.37	7	83	32	122	153	18,678	17.51
Lincoln	30,275	7,606		37,881	4.19	63		10	73	135	9,822	3.86
Logan	19,874,903	3,349	133,755	20,012,007	5.26	11,892	71	2,591	14,554	187	2,726,591	7.34
Marion	8,013,435	139,795	441,290	8,594,520	4.83	4,183	25	1,071	5,279	186	981,262	8.76
Marshall	484,152	41,769	1,000	526,921	4.56	480		59	539	183	98,690	5.34
Mason	290,586	210,874	333	501,793	3.72	376		80	456	185	84,321	5.95
McDowell	19,098,477	123,974	503,088	19,725,539	6.00	15,269	352	3,588	19,209	197	3,781,486	5.22
Mercer	2,430,896	17,296	15,886	2,464,078	6.28	1,934	222	534	2,690	186	500,066	4.93
Mineral	96,309	12,118		108,427	5.42	80	34	11	125	163	20,408	5.31
Mingo	5,841,158	3,446	35,013	5,879,617	5.29	4,194	94	914	5,202	176	915,572	6.42
Monongalia	9,174,715	398,956	5,121	9,578,792	4.29	4,856	150	992	5,998	174	1,045,668	9.16
Nicholas	3,185,165	52,385	41,584	3,279,134	5.42	2,730	120	478	3,328	181	603,802	5.43
Ohio	1,369,678	103,528	4,810	1,478,016	4.48	1,094		112	1,206	204	246,046	6.01
Pleasants		28,218		28,218	3.23		21	7	28	105	2,942	9.59
Pocahontas	192,991			192,991	5.22	47	23	11	81	255	20,631	9.35
Preston	2,298,330	101,701	186,477	2,586,508	4.51	2,194	237	403	2,834	183	517,898	4.99
Putnam		112,727		112,727	4.71	44	20	5	69	204	14,084	8.00
Raleigh	11,306,695	25,341	110,858	11,442,894	5.99	10,024	119	1,909	12,052	194	2,337,611	4.90
Randolph	1,503,397	57,608	5,061	1,566,066	5.34	1,139	167	264	1,570	165	258,897	6.05
Taylor	468,680	28,817	14	497,511	3.80	223	161	84	468	110	51,684	9.63
Tucker	261,556	1,477	194	263,227	5.17	192	47	41	280	158	44,102	5.97
Upshur	1,162,132	55,781	862	1,218,775	3.76	521	134	126	781	175	136,462	8.93
Wayne	385,544	53,690	550	439,784	4.56	405		81	486	140	68,035	6.46
Webster	1,506,346		7,722	1,514,068	5.77	1,273	16	300	1,589	163	259,329	5.84
Wyoming	6,767,581	11,854	37,490	6,816,925	5.95	4,966	105	956	6,027	197	1,188,431	5.74
Total West Virginia	138,481,994	2,790,133	2,843,556	144,115,683	5.23	95,439	4,553	20,896	120,888	186	22,472,153	6.41

For footnotes, see end of table.

TABLE 40.—Production, value, men working daily, days active, man-days, and output per man per day at bituminous-coal and lignite mines in the United States, 1950, by State and by county—Continued

County	Production (net tons)				Average value per ton [3]	Average number of men working daily				Average number of days worked	Number of man-days worked	Average tons per man per day [4]
	Shipped by rail or water [1]	Shipped by truck	Used at mine [2]	Total		Underground	Surface		Total			
							In strip pits	All others				
WYOMING												
Campbell	303,154	29,579	16,826	349,559	$1.40	--------	8	38	46	277	12,719	27.48
Carbon	1,103,213	15,233	32,085	1,150,531	3.90	275	75	143	493	190	93,901	12.25
Converse	----------	10,028	120	10,148	2.85	--------	7	--------	7	242	1,691	6.00
Fremont	----------	4,724	----------	4,724	5.36	7	--------	4	11	187	2,059	2.29
Hot Springs	21,515	15,799	15	37,329	6.74	75	--------	26	101	92	9,332	4.00
Johnson	----------	2,968	200	3,168	4.00	3	--------	1	4	247	988	3.21
Lincoln	438,265	9,843	2,836	450,944	3.20	169	100	127	396	107	42,564	10.59
Sheridan	829,163	49,701	----------	878,864	3.02	176	63	126	365	207	75,554	11.63
Sublette	----------	1,797	----------	1,797	4.06	5	--------	--------	5	105	525	3.42
Sweetwater	3,375,191	8,666	76,276	3,460,133	4.23	2,049	--------	451	2,500	196	490,902	7.05
Uinta	----------	1,052	----------	1,052	2.96	2	--------	--------	2	156	312	3.37
Total Wyoming	6,070,501	149,390	128,358	6,348,249	3.79	2,761	253	916	3,930	186	730,547	8.69
OTHER STATES												
Bituminous coal:												
Total Georgia (Walker County) and North Carolina (Chatham County)	3,550	38,135	250	41,935	$6.74	77	--------	12	89	269	23,939	1.75
Lignite:												
Total California (Amador County) and South Dakota (Corson, Dewey, and Perkins Counties)	300	35,839	2,555	38,694	3.82	2	16	1	19	210	3,991	9.70
UNITED STATES												
Total United States	444,808,038	58,286,295	13,216,720	516,311,053	$4.84	311,669	29,955	73,958	415,582	183	76,240,864	6.77

[1] Includes coal loaded at mine directly into railroad cars or river barges, hauled by truck to railroad siding, and hauled by truck to waterway.

[2] Includes coal used by mine employees, taken by locomotive tenders at tipple, used at mine for power and heat, transported to point of use by conveyor or tram, made into beehive coke at mine, and all other uses.

[3] Value received or charged for coal f. o. b. mine, including selling cost. (Includes a value for coal not sold but used by producer, such as mine fuel and coal coked as estimated by producer at average prices that might have been received if such coal had been sold commercially.)

[4] In certain counties the average tons per man per day is large due to strip mining or mechanical loading underground.

TABLE 41.—Production, value, men working daily, days active, man-days, and output per man per day at bituminous-coal and lignite mines in the United States, 1951, by State and by county

[Exclusive of mines producing less than 1,000 tons]

County	Production (net tons)				Average value per ton [3]	Average number of men working daily				Average number of days worked	Number of man-days worked	Average tons per man per day [4]
	Shipped by rail or water [1]	Shipped by truck	Used at mine [2]	Total		Underground	Surface		Total			
							In strip pits	All others				
ALABAMA												
Bibb	211,873	47,819	5,766	265,458	$7.12	396	----	98	494	157	77,407	3.43
Blount	152,704	63,975	20	216,699	6.27	82	78	38	198	202	39,988	5.42
Cherokee	----	6,242	----	6,242	5.34	----	6	----	6	192	1,152	5.42
Cullman	11,057	59,129	2,280	72,466	6.56	67	27	19	113	181	20,500	3.53
Jackson	----	3,722	----	3,722	5.39	9	----	----	9	160	1,440	2.58
Jefferson	8,376,404	177,526	51,335	8,605,265	6.28	7,500	96	1,566	9,162	209	1,910,656	4.50
Marion	130,981	168,985	2,028	301,994	8.14	462	----	110	572	181	103,598	2.92
St. Clair	----	10,611	----	10,611	5.80	14	2	2	18	192	3,456	3.07
Shelby	14,750	88,610	----	103,360	6.19	155	11	23	189	178	33,696	3.07
Tuscaloosa	630,445	68,382	1,273	700,100	4.61	130	186	82	398	204	81,352	8.61
Walker	2,225,981	305,180	778,364	3,309,525	5.51	1,922	304	434	2,660	168	447,601	7.39
Winston	1,000	540	----	1,540	5.76	3	----	----	3	150	450	3.42
Total Alabama	11,755,195	1,000,721	841,066	13,596,982	6.06	10,740	710	2,372	13,822	197	2,721,296	5.00
ALASKA												
Total Alaska	486,678	3,900	3,755	494,333	$7.62	120	58	75	253	243	61,371	8.05
ARIZONA												
Navajo	----	4,969	----	4,969	$6.00	8	----	1	9	242	2,177	2.28

For footnotes, see end of tables.

302512—54—25

TABLE 41.—Production, value, men working daily, days active, man-days, and output per man per day at bituminous-coal and lignite mines in the United States, 1951, by State and by county—Continued

County	Production (net tons)				Average value per ton [3]	Average number of men working daily				Average number of days worked	Number of man-days worked	Average tons per man per day [4]
	Shipped by rail or water [1]	Shipped by truck	Used at mine [2]	Total		Underground	Surface		Total			
							In strip pits	All others				
ARKANSAS												
Franklin	73,695	6,655	----------	80,350	$7.25	167	14	27	208	118	24,511	3.28
Johnson	416,268	5,677	408	422,353	7.33	181	86	58	325	142	46,196	9.14
Logan	163,660	1,789	116	165,565	9.40	425	--------	77	502	111	55,901	2.96
Pope	20,935	2,324	200	23,459	8.66	60	4	18	82	97	7,988	2.65
Sebastian	401,152	13,596	230	414,978	7.82	517	91	95	703	166	116,624	2.78
Total Arkansas	1,075,710	30,041	954	1,106,705	7.85	1,350	195	275	1,820	138	251,220	4.41
CALIFORNIA (LIGNITE)												
Amador	----------	----------	3,657	3,657	$10.25	--------	3	--------	3	125	375	9.75
COLORADO												
Boulder	23,078	88,343	2,502	113,923	$5.35	109	--------	24	133	169	22,427	5.08
Delta	40,651	32,853	1,431	74,935	4.57	58	--------	13	71	189	13,429	5.58
El Paso	12,666	54,387	22,567	89,620	4.58	62	5	12	79	223	17,612	5.09
Fremont	72,584	205,984	898	279,466	4.71	164	8	58	230	193	44,446	6.29
Garfield	5,013	33,111	----------	38,124	5.26	27	--------	4	31	237	7,361	5.18
Gunnison	273,807	56,690	10,818	341,315	5.50	351	--------	125	476	128	60,934	5.60
Huerfano	267,236	39,962	2,562	309,760	5.73	333	--------	82	415	168	69,644	4.45
Jackson	----------	3,354	----------	3,354	5.34	--------	8	--------	8	155	1,236	2.71
Jefferson	14,745	6,374	----------	21,119	4.88	18	--------	2	20	212	4,240	4.98
La Plata	11,879	26,294	603	38,776	4.03	38	--------	5	43	207	8,917	4.35
Las Animas	927,446	43,057	20,916	991,419	6.44	1,083	--------	199	1,282	222	285,009	3.48
Mesa	59,158	29,939	581	89,678	4.72	59	--------	22	81	216	17,475	5.13
Moffat	86,764	23,332	----------	110,096	4.92	44	--------	20	64	155	9,951	11.06
Montrose	----------	2,419	----------	2,419	5.14	3	--------	--------	3	251	753	3.21
Pitkin	4,140	3,590	----------	7,730	4.60	8	--------	1	9	159	1,428	5.41
Rio Blanco	20,032	15,590	39	35,661	4.82	17	--------	5	22	215	4,732	7.54

Routt	624,470	38,540	13,011	676,021	4.73	433	35	206	674	118	79,223	8.53
Weld	581,367	282,142	15,714	879,223	4.08	442	12	95	549	179	98,503	8.93
Total Colorado	3,025,036	985,961	91,642	4,102,639	5.16	3,249	68	873	4,190	178	747,320	5.49
ILLINOIS												
Bureau	763,385	34,441	7,106	804,932	$4.24		44	92	136	285	38,760	20.77
Christian	7,971,033	101,724	54,298	8,127,055	3.15	2,978		823	3,801	173	658,892	12.33
Clinton	57,184	134,663	8,886	200,733	4.25	190		47	237	207	49,158	4.08
Douglas	139,307	15,901	1,087	156,295	4.45	42		12	54	230	12,422	12.58
Edgar		10,852	398	11,250	5.69	24		3	27	117	3,159	3.56
Franklin	7,024,669	178,213	231,782	7,434,664	4.73	4,767		1,244	6,011	155	932,501	7.97
Fulton	5,056,872	480,751	10,936	5,548,559	3.84	171	447	525	1,143	229	261,850	21.19
Gallatin	101,539	54,302	2,815	158,656	3.68	64	20	33	117	175	20,493	7.74
Greene		1,020		1,020	4.14	2			2	100	200	5.10
Grundy	337,536	83,009	197	420,742	4.92	11	88	39	138	253	34,895	12.06
Hancock	1,500	39,406	124	41,030	5.93		12	3	15	163	2,446	16.77
Henry	100,587	41,179	864	142,630	4.53	70		21	91	201	18,280	7.80
Jackson	1,390,994	90,954	9,823	1,491,771	4.16	283	113	183	579	215	124,545	11.98
Jefferson	802,269	9,840	7,334	819,443	4.61	403		211	614	172	105,613	7.76
Kankakee	671,654	85,861		757,515	4.86		159	56	215	262	56,338	13.45
Knox	2,016,328	96,024	1,496	2,113,848	3.96	71	155	296	522	235	122,906	17.20
La Salle		18,879	2,983	21,862	5.82	10	13	4	27	166	4,473	4.89
Livingston		2,695		2,695	7.22		5		5	125	625	4.31
Logan		48,256		48,256	5.58	34		10	44	180	7,916	6.10
Macoupin	2,143,249	101,190	116,573	2,361,012	3.99	1,930		471	2,401	133	320,067	7.38
Madison	561,614	805,711	45,105	1,412,430	4.08	856		224	1,080	190	205,138	6.89
Marion	139,160	30,552	6,386	176,098	3.79	102		40	142	198	28,116	6.26
Menard		21,087	265	21,352	6.12	44		11	55	195	10,709	1.99
Montgomery	574,102	20,355	47,342	641,799	3.94	364		132	496	164	81,304	7.89
Peoria	112,670	293,744	2,930	409,344	4.25	337	52	63	452	124	55,907	7.32
Perry	4,393,306	129,483	39,694	4,562,483	3.77	845	306	573	1,724	188	323,772	14.09
Randolph	1,546,146	118,706	6,511	1,671,363	3.68	267	55	192	514	175	90,004	18.57
St. Clair	2,034,891	1,593,406	41,107	3,669,404	3.84	841	142	306	1,289	215	277,034	13.25
Saline	3,442,883	57,104	40,495	3,540,482	4.78	1,967	95	701	2,763	138	380,810	9.30
Sangamon	168,622	460,956	20,024	649,602	4.83	711		129	840	115	96,460	6.73
Schuyler		28,353	10	28,363	4.95	26	13	10	49	183	8,964	3.16
Tazewell		46,887	818	47,705	6.08	65		11	76	152	11,520	4.14
Vermilion	760,825	287,879	4,154	1,052,858	4.23	106	89	63	258	222	57,181	18.41
Warren		2,296	20	2,316	7.03	4		1	5	310	1,550	1.49
Washington	8,898	19,511	746	29,155	4.23	65		14	79	118	9,314	3.13
Will	61,230	104,774		166,004	5.50		24	19	43	254	10,923	15.20
Williamson	5,028,699	399,115	25,123	5,452,937	4.36	1,857	134	726	2,717	178	483,736	11.27
Woodford		1,979	233	2,212	3.99	48		7	55	28	1,540	1.44
Total Illinois	47,411,152	6,051,058	737,665	54,199,875	4.07	19,555	1,966	7,295	28,816	170	4,909,521	11.04

For footnotes, see end of table.

TABLE 41.—Production, value, men working daily, days active, man-days, and output per man per day at bituminous-coal and lignite mines in the United States, 1951, by State and by county—Continued

County	Production (net tons)				Average value per ton [3]	Average number of men working daily				Average number of days worked	Number of man-days worked	Average tons per man per day [4]
	Shipped by rail or water [1]	Shipped by truck	Used at mine [2]	Total		Underground	Surface		Total			
							In strip pits	All others				
INDIANA												
Clay	1,052,859	246,910	5,224	1,304,993	$4.11	-------	371	99	470	246	115,389	11.31
Daviess	416,913	30,119	-------	447,032	4.35	8	59	48	115	298	34,223	13.06
Dubois	1,650	50,858	-------	52,508	3.69	80	-------	12	92	110	10,160	5.17
Fountain	-------	66,821	-------	66,821	5.76	-------	25	5	30	252	7,560	8.84
Gibson	576,380	112,533	21,774	710,687	4.43	495	32	107	634	143	90,904	7.82
Greene	379,433	33,121	1,854	414,408	4.44	31	50	30	111	238	26,376	15.71
Knox	2,281,252	528,002	12,681	2,821,935	3.83	1,056	67	310	1,433	182	260,629	10.83
Martin	-------	1,600	-------	1,600	4.55	2	-------	-------	2	200	400	4.00
Owen	153,036	6,126	463	159,625	4.71	-------	35	5	40	230	9,180	17.39
Parke	-------	14,464	-------	14,464	5.18	21	-------	3	24	91	2,184	6.62
Pike	3,139,941	49,301	20,710	3,209,952	3.81	10	466	231	707	269	190,030	16.89
Spencer	49,650	4,098	-------	53,748	4.76	20	14	10	44	127	5,588	9.62
Sullivan	2,495,153	114,576	15,487	2,625,216	4.12	980	178	331	1,489	174	258,375	10.16
Vermillion	197,032	59,757	1,205	257,994	4.22	48	24	26	98	218	21,315	12.10
Vigo	3,323,664	289,172	410,413	4,023,249	4.24	2,044	118	442	2,604	179	465,549	8.64
Warrick	3,114,176	167,678	4,359	3,286,213	3.85	393	307	408	1,108	205	226,822	14.49
Total Indiana	17,181,139	1,775,136	494,170	19,450,445	4.04	5,188	1,746	2,067	9,001	192	1,724,684	11.28
IOWA												
Appanoose	45,475	88,871	8,608	142,954	$5.09	357	-------	44	401	162	64,875	2.20
Boone	-------	20,247	-------	20,247	5.59	26	-------	8	34	145	4,925	4.11
Davis	28,625	58,469	99	87,193	3.48	15	14	9	38	240	9,117	9.56
Greene	-------	1,142	-------	1,142	4.36	6	-------	-------	6	36	216	5.29
Guthrie	-------	1,240	15	1,255	8.40	6	-------	1	7	64	448	2.80
Jasper	-------	7,251	-------	7,251	4.18	34	4	7	45	48	2,138	3.39
Lucas	8,371	16,358	-------	24,729	5.35	43	-------	8	51	123	6,257	3.95
Mahaska	46,439	55,159	5,137	106,735	3.56	6	51	7	64	224	14,336	7.45
Marion	606,028	312,935	312	919,275	3.37	118	189	77	384	209	80,381	11.44
Monroe	56,575	72,776	172	129,523	4.22	142	-------	21	163	173	28,131	4.60
Page	-------	5,745	-------	5,745	8.00	12	-------	3	15	162	2,430	2.36

Van Buren	8,754	44,076	112	52,942	4.33	14	23	13	50	175	8,732	6.06
Wapello	45,443	75,126	15	120,584	3.69	14	35	18	67	221	14,822	8.14
Warren		10,723		10,723	4.41	15		3	18	188	3,386	3.17
Total Iowa	845,710	770,118	14,470	1,630,298	3.75	808	316	219	1,343	179	240,194	6.79
KANSAS												
Bourbon	57,084	22,951	96	80,131	$3.83		45	16	61	141	8,604	9.31
Cherokee	575,978	37,776	1,378	615,132	3.88	11	168	108	287	160	45,951	13.39
Coffey		3,406		3,406	5.87		9		9	120	1,080	3.15
Crawford	682,486	81,389	3,672	767,547	4.03	143	180	107	430	181	77,822	9.86
Franklin		1,300		1,300	6.50	6		1	7	57	399	3.26
Labette		2,993		2,993	5.40		6		6	199	1,191	2.51
Linn	449,687	7,637		457,324	3.73		37	47	84	233	19,555	23.39
Osage	17,589	15,627	52	33,268	6.08	52	23	7	82	153	12,573	2.65
Total Kansas	1,782,824	173,079	5,198	1,961,101	3.94	212	468	286	966	173	167,175	11.73
KENTUCKY												
Eastern Kentucky:												
Bell	1,679,250	517,467	14,933	2,211,650	$5.63	2,583	87	347	3,017	156	471,843	4.69
Boyd	186,218	224,715		410,933	4.49	221	61	42	324	218	70,538	5.83
Breathitt	988,745	165,037	1,850	1,155,632	5.46	549	47	138	734	193	141,572	8.16
Carter	44,565	259,743	111	304,419	5.09	371		54	425	141	59,758	5.09
Clay	301,483	308,704	648	610,835	5.13	774	18	121	913	176	160,892	3.80
Clinton		53,500		53,500	4.22	63		10	73	129	9,448	5.66
Elliott		380,581		380,581	4.68	149	72	36	257	218	56,032	6.79
Floyd	5,834,456	669,628	9,143	6,513,227	5.73	4,934		921	5,855	197	1,153,350	5.65
Greenup		236,208		236,208	4.69	131	20	25	176	216	37,970	6.22
Harlan	10,552,474	447,608	160,885	11,160,967	5.86	10,214	34	1,516	11,764	199	2,339,676	4.77
Jackson		498,557		498,557	5.09	557	45	67	669	151	101,266	4.92
Johnson	479,316	424,473	251	904,040	5.54	1,345		191	1,536	143	219,073	4.13
Knott	698,633	414,852	576	1,114,061	4.69	922		110	1,032	136	140,251	7.94
Knox	210,224	295,101	1,041	506,366	5.54	598	36	53	687	134	92,015	5.50
Laurel	24,177	88,043		112,220	5.02	130	3	22	155	180	27,952	4.01
Lawrence		85,512		85,512	4.17	117		12	129	194	25,016	3.42
Lee	72,300	214,796		287,096	5.34	286	8	37	331	171	56,768	5.06
Leslie	1,867,371	505,587	3,258	2,376,216	4.85	1,484		237	1,721	159	273,705	8.68
Letcher	3,674,478	1,087,908	46,803	4,809,189	5.85	3,488	46	582	4,116	174	715,226	6.72
Madison		1,400		1,400	4.79		4		4	58	232	6.03
Magoffin	131,268	2,866	1,784	135,918	3.82	13	44	8	65	168	10,930	12.44
Martin	161,873	28,997	227	191,097	4.86	210		45	255	118	29,985	6.37
McCreary	422,636	409,797	4,171	836,604	5.95	890	51	124	1,065	159	169,608	4.93

For footnotes, see end of table.

TABLE 41.—Production, value, men working daily, days active, man-days, and output per man per day at bituminous-coal and lignite mines in the United States, 1951, by State and by county—Continued

County	Production (net tons)				Average value per ton [3]	Average number of men working daily				Average number of days worked	Number of man-days worked	Average tons per man per day [4]
	Shipped by rail or water [1]	Shipped by truck	Used at mine [2]	Total		Underground	Surface		Total			
							In strip pits	All others				
KENTUCKY—Continued												
Eastern Kentucky—Continued												
Menifee	----------	9,100	----------	9,100	$5.60	16	--------	1	17	163	2,779	3.27
Morgan	----------	218,076	----------	218,076	5.01	173	30	31	234	161	37,563	5.81
Owsley	----------	10,905	----------	10,905	5.73	29	--------	1	30	103	3,103	3.51
Perry	5,707,205	437,815	25,220	6,170,240	5.24	4,830	--------	989	5,819	170	988,235	6.24
Pike	8,701,621	1,669,662	213,590	10,584,873	4.98	7,881	--------	1,293	9,174	201	1,842,082	5.75
Pulaski	----------	481,491	----------	481,491	4.72	311	58	31	400	179	71,700	6.72
Rockcastle	----------	213,631	----------	213,631	4.66	179	37	14	230	148	34,051	6.27
Wayne	----------	46,904	----------	46,904	3.83	65	--------	1	66	158	10,457	4.49
Whitley	193,719	218,242	974	412,935	5.50	401	105	80	586	161	94,215	4.38
Wolfe	----------	37,340	----------	37,340	5.18	38	10	1	49	161	7,873	4.74
Total Eastern Kentucky	41,932,012	10,664,246	485,465	53,081,723	5.41	43,952	816	7,140	51,908	182	9,455,164	5.61
Western Kentucky:												
Butler	----------	107,280	----------	107,280	3.93	87	5	11	103	147	15,091	7.11
Christian	48,200	3,435	----------	51,635	4.16	41	2	6	49	184	9,030	5.72
Daviess	172,012	310,515	----------	482,527	3.68	187	39	42	268	148	39,774	12.13
Grayson	----------	4,000	----------	4,000	4.09	--------	5	--------	5	65	325	12.31
Hancock	6,600	41,708	----------	48,308	3.53	--------	15	10	25	136	3,406	14.18
Henderson	15,050	356,934	----------	371,984	3.16	277	--------	39	316	203	63,993	5.81
Hopkins	11,989,659	687,735	6,171	12,683,565	3.74	2,481	590	1,038	4,109	205	844,138	15.03
McLean	----------	34,145	----------	34,145	4.09	37	--------	3	40	137	5,491	6.22
Muhlenberg	4,785,466	272,904	20,104	5,078,474	3.30	1,466	270	519	2,255	161	362,743	14.00
Ohio	2,088,276	148,254	1,620	2,238,150	3.69	258	137	241	636	192	122,264	18.31
Union	458,029	61,939	2,706	522,674	3.65	216	--------	48	264	210	55,518	9.41
Webster	256,511	11,359	----------	267,870	3.78	53	27	20	100	158	15,761	17.00
Total Western Kentucky	19,819,803	2,040,208	30,601	21,890,612	3.62	5,103	1,090	1,977	8,170	188	1,537,534	14.24
Total Kentucky	61,751,815	12,704,454	516,066	74,972,335	4.89	49,055	1,906	9,117	60,078	183	10,992,698	6.82

MARYLAND												
Allegany	97,052	217,968	1,469	316,489	$4.78	288	65	29	382	192	73,297	4.32
Garrett	107,072	164,958	120	272,150	4.66	215	75	40	330	172	56,731	4.80
Total Maryland	204,124	382,926	1,589	588,639	4.73	503	140	69	712	180	130,028	4.53
MICHIGAN												
Saginaw		6,267	1,080	7,347	$10.19	28		2	30	151	4,530	1.62
MISSOURI												
Adair		88,673	1,485	90,158	$5.05	118		26	144	177	25,517	3.53
Barton	252,900	35,049	85	288,034	4.25		58	33	91	216	19,633	14.67
Bates	365,714	5,576		371,290	3.73		36	38	74	228	16,853	22.03
Boone		33,002	26	33,028	4.03		13	4	17	227	3,867	8.54
Callaway		141,957		141,957	4.70		36	13	49	277	13,571	10.46
Clay		22,100	2,182	24,282	8.10	92		7	99	114	11,283	2.15
Dade		7,150		7,150	3.85		7		7	200	1,400	5.11
Daviess		5,022		5,022	8.16	16		2	18	155	2,790	1.80
Harrison		3,596		3,596	6.80	13		2	15	160	2,400	1.50
Henry	612,868	65,188		678,056	3.91		136	69	205	191	39,215	17.29
Johnson		2,012		2,012	5.50		3		3	194	582	3.46
Lafayette		26,394	243	26,637	6.34	67		11	78	193	15,066	1.77
Linn		5,706		5,706	5.88	23		4	27	171	4,628	1.23
Macon	698,245	45,521	73	743,839	3.88	26	70	65	161	240	38,583	19.28
Putnam		8,438		8,438	4.95	19		3	22	109	2,400	3.52
Ralls		5,212		5,212	5.62	9	7	3	19	118	2,250	2.32
Randolph	464,123	62,665		526,788	4.27	135	49	57	241	201	48,363	10.89
Ray		3,318		3,318	7.66	26		4	30	114	3,420	.97
St. Clair	219,280	6,205		225,485	3.77		57	21	78	195	15,181	14.85
Vernon	66,840	12,435		79,275	3.90		34	9	43	171	7,365	10.76
Total Missouri	2,679,970	585,219	4,094	3,269,283	4.10	544	506	371	1,421	193	274,367	11.92

For footnotes, see end of table.

TABLE 41.—Production, value, men working daily, days active, man-days, and output per man per day at bituminous-coal and lignite mines in the United States, 1951, by State and by county—Continued

County	Production (net tons)				Average value per ton [3]	Average number of men working daily				Average number of days worked	Number of man-days worked	Average tons per man per day [4]
	Shipped by rail or water [1]	Shipped by truck	Used at mine [2]	Total		Underground	Surface		Total			
							In strip pits	All others				
MONTANA												
Bituminous coal:												
Blaine		9,678	150	9,828	$6.36	9		2	11	300	3,300	2.98
Carbon	135,588	12,514	1,811	149,913	4.79	77		27	104	210	21,879	6.85
Cascade	761	17,344		18,105	5.14	8		2	10	209	2,085	8.68
Musselshell	612,855	26,675	4,672	644,202	4.21	328		158	486	192	93,410	6.90
Rosebud	1,485,852		2,448	1,488,300	1.65		55	15	70	225	15,780	94.32
Total bituminous coal	2,235,056	66,211	9,081	2,310,348	2.61	422	55	204	681	200	136,454	16.93
Lignite:												
Custer		11,190	19	11,209	3.74	9			9	143	1,284	8.73
Dawson		2,028		2,028	3.50	2			2	156	312	6.50
Richland		8,150		8,150	3.96	3		1	4	304	1,215	6.71
Sheridan		13,533	150	13,683	3.06	3	4	3	10	195	1,951	7.01
Total lignite		34,901	169	35,070	3.51	17	4	4	25	190	4,762	7.36
Total Montana	2,235,056	101,112	9,250	2,345,418	2.63	439	59	208	706	200	141,216	16.61
NEW MEXICO												
Bernalillo		1,290	20	1,310	$5.09	3		1	4	131	524	2.50
Colfax	616,799	19,865	741	637,405	5.69	436		72	508	212	107,790	5.91
McKinley	50,574	16,513	11,149	78,236	6.69	169		35	204	98	19,956	3.92
Rio Arriba	20,115	2,615	24	22,754	4.34	29		4	33	192	6,329	3.60
Sandoval	2,410			2,410	5.69	4			4	134	535	4.50
San Juan	2,789	1,009		3,798	5.74	10		1	11	112	1,227	3.10
Santa Fe	17,448	17,447		34,895	5.71	47		8	55	192	10,560	3.30
Socorro		1,890		1,890	5.70	5		1	6	140	840	2.25
Total New Mexico	710,135	60,629	11,934	782,698	5.75	703		122	825	179	147,761	5.30

NORTH DAKOTA (LIGNITE)												
Adams	21,558	10,621	----	32,179	$3.28	2	12	----	14	161	2,252	14.29
Bowman	119,072	5,439	----	124,511	1.68	----	6	5	11	276	3,032	41.07
Burke	347,426	33,416	50,220	431,062	2.49	----	27	41	68	265	18,016	23.93
Burleigh	----	22,582	----	22,582	3.18	----	6	----	6	240	1,440	15.68
Divide	290,890	27,854	----	318,744	2.29	----	18	22	40	271	10,848	29.38
Dunn	----	15,615	185	15,800	2.83	----	6	----	6	181	1,084	14.58
Golden Valley	----	2,093	45	2,138	2.79	2	----	----	2	138	276	7.75
Grant	----	29,180	----	29,180	3.09	3	12	----	15	126	1,890	15.44
Hettinger	40	17,268	25	17,333	2.90	----	10	1	11	161	1,771	9.79
McKenzie	----	3,273	----	3,273	3.75	2	2	----	4	212	848	3.86
McLean	271,212	56,677	280	328,169	2.45	----	36	33	69	239	16,506	19.88
Mercer	1,040,681	21,083	112,449	1,174,213	2.29	73	67	98	238	246	58,657	20.02
Morton	----	33,894	----	33,894	2.54	4	16	----	20	161	3,214	10.55
Mountrail	----	7,063	25	7,088	3.58	3	2	----	5	108	540	13.13
Oliver	----	6,920	----	6,920	2.50	----	3	----	3	108	324	21.36
Stark	----	19,083	100,868	119,951	2.53	----	24	6	30	256	7,671	15.64
Ward	422,777	117,379	120	540,276	2.61	11	48	58	117	256	29,971	18.03
William	----	16,664	50	16,714	3.38	10	6	1	17	141	2,402	6.96
Total North Dakota	2,513,656	446,104	264,267	3,224,027	2.41	110	301	265	676	238	160,742	20.06
OHIO												
Athens	736,391	231,942	2,008	970,341	$4.79	684	47	200	931	166	154,478	6.28
Belmont	8,174,898	386,433	16,465	8,577,796	4.04	3,476	197	891	4,564	225	1,026,147	8.36
Carroll	167,039	164,141	2,005	333,185	4.05	163	74	27	264	194	51,110	6.52
Columbiana	194,823	1,190,395	323	1,385,541	3.57	120	375	89	584	220	128,323	10.80
Coshocton	538,361	488,520	6,276	1,033,157	3.85	180	182	102	464	222	102,968	10.03
Gallia	446,917	144,049	----	590,966	3.35	332	94	80	506	183	92,554	6.39
Guernsey	488,141	73,601	309	562,051	3.91	106	121	54	281	212	59,509	9.44
Harrison	6,736,405	188,082	13,448	6,937,935	3.99	532	560	705	1,797	217	390,225	17.78
Hocking	40,046	94,680	----	134,726	4.11	80	47	18	145	138	20,015	6.73
Holmes	----	7,937	----	7,937	2.91	----	6	----	6	160	960	8.27
Jackson	147,713	156,524	4,421	308,658	3.67	68	112	40	220	188	41,456	7.45
Jefferson	3,943,480	1,629,702	18,870	5,592,052	3.93	1,434	447	573	2,454	223	547,715	10.21
Lawrence	----	224,911	----	224,911	4.18	99	51	26	176	190	33,491	6.72
Mahoning	9,813	745,624	6,130	761,567	3.82	----	196	36	232	239	55,501	13.72
Meigs	457,221	55,831	----	513,052	3.42	264	60	46	370	213	78,769	6.51
Morgan	95,205	74,548	----	169,753	3.41	34	42	9	85	178	15,112	11.23
Muskingum	811,341	790,924	351	1,602,616	2.68	282	180	140	602	193	116,245	13.79
Noble	1,382,038	82,631	19	1,464,688	2.88	3	177	93	273	214	58,479	25.05
Perry	2,369,402	359,157	579	2,729,138	4.28	1,017	358	369	1,744	163	285,060	9.57
Portage	----	158,290	24,620	182,910	4.15	----	29	15	44	320	14,080	12.99
Scioto	----	1,618	----	1,618	5.44	----	4	----	4	74	296	5.47
Stark	998	949,925	----	950,923	3.22	29	261	61	351	214	74,978	12.68
Tuscarawas	120,950	2,268,385	74,251	2,463,586	3.86	657	300	173	1,130	237	267,526	9.21
Vinton	73,936	164,089	48	238,073	4.24	73	112	19	204	182	37,133	6.41
Washington	31,647	74,916	----	106,563	3.46	----	21	8	29	191	5,536	19.25
Wayne	----	104,854	95	104,949	4.25	----	23	10	33	306	10,098	10.39
Total Ohio	26,966,765	10,811,709	170,218	37,948,692	3.87	9,633	4,076	3,784	17,493	210	3,667,764	10.35

For footnotes, see end of table.

TABLE 41.—Production, value, men working daily, days active, man-days, and output per man per day at bituminous-coal and lignite mines in the United States, 1951, by State and by county—Continued

County	Production (net tons)				Average value per ton [3]	Average number of men working daily				Average number of days worked	Number of man-days worked	Average tons per man per day [4]
	Shipped by rail or water [1]	Shipped by truck	Used at mine [2]	Total		Underground	Surface		Total			
							In strip pits	All others				
OKLAHOMA												
Coal	53,875	18,392		72,267	$5.17	10	34	17	61	162	9,899	7.30
Craig	50,329	6,995	1,380	58,704	4.13		33	5	38	217	8,252	7.11
Haskell	349,850	40,349	1,900	392,099	6.88	220	98	54	372	201	74,746	5.25
Le Flore	348,003	13,319	5	361,327	7.66	217	91	58	366	183	67,935	5.32
McIntosh	100,199	1,638		101,837	3.09		29	10	39	172	6,707	15.18
Muskogee		2,268		2,268	5.74	3	4	1	8	129	1,032	2.20
Okmulgee	445,370	12,226		457,596	5.42	348	36	90	474	145	68,664	6.66
Pittsburg	297,067	2,115	120	299,302	8.72	346		47	393	231	90,921	3.29
Rogers	317,565	14,339	2,750	334,654	4.73		96	37	133	257	34,192	9.79
Sequoyah	136,404	689		137,093	5.58		28	7	35	265	9,275	14.78
Tulsa		4,203		4,203	4.02	15		3	18	188	3,384	1.24
Wagoner		1,879		1,879	3.87		8		8	76	608	3.09
Total Oklahoma	2,098,662	118,412	6,155	2,223,229	6.24	1,159	457	329	1,945	193	375,615	5.92
PENNSYLVANIA (BITUMINOUS COAL)												
Allegheny	8,593,806	2,239,284	1,227,227	12,060,317	$5.19	7,024	480	1,381	8,885	223	1,985,530	6.07
Armstrong	3,596,604	502,740	8,777	4,108,121	4.25	1,664	576	417	2,657	188	498,304	8.24
Beaver	64,448	358,285		422,733	4.61	60	122	48	230	218	50,040	8.45
Bedford	222,626	67,279		289,905	5.76	297	52	48	397	158	62,880	4.61
Blair	113,091	142,581	2,554	258,226	4.71	106	43	22	171	236	40,375	6.40
Bradford		10,039		10,039	5.05	5	5	2	12	158	1,900	5.28
Butler	1,377,243	890,060	6,617	2,273,920	4.01	512	516	234	1,262	199	250,687	9.07
Cambria	12,129,301	701,425	958,907	13,789,633	5.98	11,030	345	2,167	13,542	214	2,902,273	4.75
Cameron	41,331	31,234		72,565	4.01		25	3	28	241	6,745	10.76
Centre	685,043	407,708	205	1,092,956	4.19	301	327	92	720	195	140,191	7.80
Clarion	1,882,942	931,175	19,475	2,833,592	3.59	307	663	283	1,253	223	278,921	10.16
Clearfield	5,675,965	547,532	14,890	6,238,387	4.61	2,407	1,356	717	4,480	197	881,688	7.08
Clinton	324,629	387,339		711,968	3.20	43	165	44	252	245	61,787	11.52
Elk	616,653	195,845	571	813,069	4.83	310	186	111	607	163	99,105	8.20
Fayette	5,654,899	1,977,747	3,004,874	10,637,520	5.93	7,452	329	1,127	8,908	229	2,042,649	5.21

Forest		1,065		1,065	5.26	1		1	2	243	486	2.19
Greene	11,649,413	204,722	41,093	11,895,228	5.64	7,214	39	1,385	8,638	233	2,015,012	5.90
Indiana	6,712,070	528,117	561,316	7,801,503	5.18	4,551	450	946	5,947	203	1,206,776	6.46
Jefferson	1,776,977	147,137	1,279	1,925,393	4.38	951	383	234	1,568	190	298,515	6.45
Lawrence	32,953	486,984	84	520,021	3.20	14	140	21	175	211	36,972	14.07
Lycoming		34,909	100	35,009	4.12	16	9	5	30	250	7,494	4.67
McKean		80,657		80,657	3.79		24	2	26	247	6,428	12.55
Mercer	185,567	301,058	746	487,371	4.39	143	84	44	271	210	56,843	8.57
Somerset	6,130,022	483,312	40,787	6,654,121	5.22	4,176	605	849	5,630	204	1,150,370	5.78
Tioga	84,215	71,754	997	156,966	5.54	93	22	28	143	173	24,802	6.33
Venango	74,343	374,087	386	448,816	3.82	4	97	22	123	255	31,380	14.30
Washington	14,055,354	1,386,332	734,658	16,176,344	5.64	10,608	568	2,035	13,211	216	2,850,150	5.67
Westmoreland	2,734,180	2,353,862	747,270	5,835,312	5.27	3,602	403	673	4,678	198	927,173	6.29
Other counties:												
Fulton and Huntingdon	448,757	80,677	3,652	533,086	5.93	282	135	46	463	171	79,206	6.73
Total Pennsylvania	84,862,432	15,924,946	7,376,465	108,163,843	5.29	63,173	8,149	12,987	84,309	213	17,994,682	6.01
SOUTH DAKOTA (LIGNITE)												
Corson and Dewey		28,325	25	28,350	$3.49		13	1	14	222	3,109	9.12
TENNESSEE												
Anderson	505,529	101,349	7,844	614,722	$5.10	797	9	132	938	116	109,123	5.63
Bledsoe		12,200		12,200	2.73	20		4	24	186	4,464	2.73
Campbell	1,205,943	89,568	10,152	1,305,663	6.00	1,557	48	224	1,829	170	311,619	4.19
Claiborne	839,052	48,868	7,738	895,658	5.23	914	65	134	1,113	158	175,863	5.09
Cumberland		72,032		72,032	3.52	103		15	118	191	22,500	3.20
Fentress	16,040	65,872		81,912	4.72	130		10	140	137	19,203	4.27
Grundy	30,553	64,900		95,453	4.21	31	26	15	72	148	10,649	8.96
Hamilton	9,500	92,746		102,246	3.56	116	15	18	149	150	22,291	4.59
Marion	560,644	252,267	2,750	815,661	5.27	665	21	79	765	188	143,566	5.68
Morgan	248,101	45,950	6,989	301,040	4.63	477	13	67	557	232	129,390	2.33
Overton	32,619	21,373		53,992	3.49	51	8	10	69	159	10,995	4.91
Putnam	338,127	35,672	143	373,942	3.66	156		37	193	222	42,904	8.72
Roane		2,906		2,906	5.27	5			5	168	840	3.46
Scott	383,451	200,744	824	585,019	3.99	313	25	78	416	191	79,315	7.38
Sequatchie	3,457	59,508		62,965	3.08	83		5	88	156	13,736	4.58
Van Buren		16,400		16,400	2.75	18		3	21	168	3,520	4.66
White		9,135		9,135	2.92	13	4		17	133	2,254	4.05
Total Tennessee	4,173,016	1,191,490	36,440	5,400,946	4.99	5,449	234	831	6,514	169	1,102,232	4.90

For footnotes, see end of table.

TABLE 41.—Production, value, men working daily, days active, man-days, and output per man per day at bituminous-coal and lignite mines in the United States, 1951, by State and by county—Continued

County	Production (net tons)				Average value per ton [3]	Average number of men working daily				Average number of days worked	Number of man-days worked	Average tons per man per day [4]
	Shipped by rail or water [1]	Shipped by truck	Used at mine [2]	Total		Underground	Surface		Total			
							In strip pits	All others				
UTAH												
Carbon	3,852,293	205,130	208,048	4,265,471	$5.25	2,202	-------	645	2,847	200	569,450	7.49
Emery	1,598,581	125,786	8,850	1,733,217	5.61	856	-------	254	1,110	213	236,095	7.34
Grand	5,291	241	51	5,583	5.15	4	-------	2	6	194	1,164	4.80
Iron	----------	24,113	----------	24,113	5.10	17	-------	3	20	260	5,209	4.63
Kane	----------	2,041	----------	2,041	5.71	3	-------	-------	3	175	525	5.98
Sevier	40,757	39,619	28	80,404	3.59	42	-------	14	56	199	11,139	7.22
Summit	----------	22,728	----------	22,728	3.48	10	-------	4	14	256	3,579	6.35
Uintah	----------	2,400	----------	2,400	6.00	4	-------	1	5	240	1,200	2.00
Total Utah	5,496,922	422,058	216,977	6,135,957	5.32	3,138	-------	923	4,061	204	828,361	7.41
VIRGINIA												
Buchanan	6,159,697	233,616	26,023	6,419,336	$5.40	3,803	148	739	4,690	211	991,191	6.48
Dickenson	3,865,858	375,000	2,029	4,242,887	5.00	2,468	71	371	2,910	213	619,632	6.85
Lee	831,886	93,987	7,216	933,089	6.35	1,193	-------	175	1,368	176	241,159	3.87
Montgomery	104,942	50,260	1,019	156,221	5.04	149	-------	34	183	201	36,730	4.25
Russell	807,417	73,466	722	881,605	5.39	747	16	93	856	185	158,269	5.57
Scott	18,119	20,141	----------	38,260	5.45	45	-------	7	52	185	9,620	3.98
Tazewell	3,541,299	58,060	21,048	3,620,407	6.14	2,664	6	530	3,200	229	731,283	4.95
Wise	4,578,450	198,213	331,401	5,108,064	5.13	3,680	138	606	4,424	206	911,832	5.60
Total Virginia	19,907,668	1,102,743	389,458	21,399,869	5.42	14,749	379	2,555	17,683	209	3,699,716	5.78
WASHINGTON												
King	106,205	85,802	279	192,286	$7.40	138	24	48	210	* 211	44,399	4.33
Kittitas	512,606	12,561	12,931	538,098	7.08	452	17	89	558	241	134,629	4.00
Lewis	1,404	43,332	110	44,846	5.45	30	-------	6	36	213	7,673	5.84
Pierce	4,507	2,164	54	6,725	7.09	7	-------	2	9	176	1,584	4.25

Thurston	9,956	112		10,068	4.44		12	2	14	65	924	10.90
Whatcom	55,344	7,093	2,566	65,003	7.08	97		32	129	97	12,562	5.17
Total Washington	690,022	151,064	15,940	857,026	7.04	724	53	179	956	211	201,771	4.25

WEST VIRGINIA

Barbour	3,971,776	52,974	899	4,025,649	$4.25	1,365	371	532	2,268	175	398,025	10.11
Boone	6,952,707	130,506	12,946	7,096,159	4.98	3,612	94	1,007	4,713	214	1,007,019	7.05
Braxton	118,821	22,013		140,834	4.11	79	17	17	113	197	22,216	6.34
Brooke	828,733	356,680	972,976	2,158,389	4.24	698	203	166	1,067	231	245,954	8.78
Clay	965,049	17,752	13,750	996,551	5.65	525		166	691	243	167,666	5.94
Fayette	11,765,002	176,484	627,786	12,569,272	5.68	8,588	328	1,496	10,412	231	2,409,302	5.22
Gilmer	136,725	62,914		199,639	3.35	119		19	138	195	26,943	7.41
Grant		75,726		75,726	4.61	79	5	13	97	244	23,695	3.20
Greenbrier	2,519,641	74,583	7,319	2,601,543	5.39	1,333	198	265	1,796	226	405,434	6.42
Hancock	56,126	100,040		156,166	3.82	11	28	6	45	251	11,285	13.84
Harrison	9,810,870	157,426	1,824	9,970,120	4.14	3,056	783	1,000	4,839	186	900,594	11.07
Kanawha	9,563,287	235,483	106,528	9,905,298	5.02	5,251	152	977	6,380	249	1,588,226	6.24
Lewis	446,092	9,426		455,518	3.46	8	77	23	108	233	25,126	18.13
Lincoln	4,700			4,700	4.16	26		4	30	59	1,770	2.66
Logan	22,659,835	81,120	151,287	22,892,242	5.07	11,224		2,335	13,559	223	3,020,750	7.58
Marion	9,436,024	156,940	532,865	10,125,829	4.93	4,272	20	1,123	5,415	216	1,171,141	8.65
Marshall	508,293	45,317	3,104	556,714	4.57	389		71	460	215	98,984	5.62
Mason	165,244	25,835	437,224	628,303	4.69	396		71	467	232	108,492	5.79
McDowell	20,687,756	183,087	493,428	21,364,271	6.12	13,728	294	2,727	16,749	229	3,827,552	5.58
Mercer	2,777,353	45,014	21,575	2,843,942	6.07	1,800	268	502	2,570	211	541,791	5.25
Mineral	58,809	32,998	17	91,824	5.27	54	35	15	104	118	12,272	7.48
Mingo	7,575,071	31,443	36,786	7,643,300	5.16	4,120	92	920	5,132	213	1,094,043	6.99
Monongalia	10,774,364	431,999	6,296	11,212,659	4.43	4,775	101	1,001	5,877	207	1,215,653	9.22
Nicholas	4,198,698	108,590	41,590	4,348,878	5.27	2,910	101	461	3,472	208	722,099	6.02
Ohio	1,408,019	102,573	5,363	1,515,955	4.56	1,077	8	157	1,242	200	248,530	6.10
Pocahontas	241,714			241,714	6.66	78	36	19	133	288	38,302	6.31
Preston	1,751,024	60,219	157,961	1,969,204	4.37	1,527	174	345	2,046	189	387,414	5.08
Putnam		95,119		95,119	4.80	26	16	3	45	221	9,926	9.58
Raleigh	12,807,467	48,254	113,478	12,969,199	5.87	9,083	134	1,657	10,874	226	2,461,037	5.27
Randolph	1,700,840	33,422	8,855	1,743,117	5.27	1,025	164	251	1,440	190	273,047	6.38
Summers	9,679			9,679	5.98	12		2	14	99	1,386	6.98
Taylor	487,281	16,818		504,099	3.77	203	119	63	385	152	58,544	8.61
Tucker	221,396	237	491	222,124	5.58	185	26	34	245	161	39,411	5.64
Upshur	1,108,611	53,867	457	1,162,935	3.47	540	98	128	766	162	123,807	9.39
Wayne	428,959	8,035		436,994	4.47	325		52	377	205	77,220	5.66
Webster	1,638,976	4,703	8,494	1,652,173	5.83	1,119	11	287	1,417	207	293,355	5.63
Wyoming	8,559,906	104,284	59,794	8,723,984	6.06	5,244	101	1,055	6,400	230	1,472,240	5.93
Total West Virginia	156,344,848	3,141,881	3,823,093	163,309,822	5.23	88,862	4,054	18,970	111,886	219	24,530,251	6.66

For footnotes, see end of table.

TABLE 41.—Production, value, men working daily, days active, man-days, and output per man per day at bituminous-coal and lignite mines in the United States, 1951, by State and by county—Continued

County	Production (net tons)				Average value per ton [3]	Average number of men working daily				Average number of days worked	Number of man-days worked	Average tons per man per day [4]
	Shipped by rail or water [1]	Shipped by truck	Used at mine [2]	Total		Underground	Surface		Total			
							In strip pits	All others				
WYOMING												
Campbell	261,232	27,241	18,601	307,074	$1.44	--------	16	20	36	291	10,464	29.35
Carbon	1,208,990	2,979	22,979	1,234,948	4.57	270	81	135	486	201	97,783	12.63
Converse	----------	4,668	----------	4,668	3.69	2	2	--------	4	231	924	5.05
Fremont	----------	5,271	----------	5,271	5.63	11	--------	6	17	143	2,432	2.17
Hot Springs	10,316	14,086	63	24,465	6.26	24	--------	9	33	126	4,159	5.88
Johnson	----------	2,597	200	2,797	4.00	2	--------	1	3	246	738	3.79
Lincoln	646,611	19,717	2,185	668,513	3.01	98	85	62	245	179	43,905	15.23
Sheridan	631,432	47,124	1,857	680,413	3.18	89	37	68	194	190	36,780	18.50
Sublette	----------	1,128	----------	1,128	4.48	4	--------	--------	4	100	400	2.82
Sweetwater	3,414,198	6,153	80,005	3,500,356	4.70	1,830	24	441	2,295	202	463,792	7.55
Total Wyoming	6,172,779	130,964	125.890	6,429,633	4.19	2,330	245	742	3,317	199	661,377	9.72
OTHER STATES												
Georgia (Walker County) and North Carolina (Chatham County)	----------	26,614	----------	26,614	$6.71	39	--------	9	48	277	13,305	2.00
UNITED STATES												
Total United States	460,371,314	58,131,900	15,161,518	533,664,732	$4.92	281,868	26,102	64,927	372,897	203	75,754,858	7.04

[1] Includes coal loaded at mine directly into railroad cars or river barges, hauled by truck to railroad siding, and hauled by truck to waterway.

[2] Includes coal used by mine employees, taken by locomotive tenders at tipple, used at mine for power and heat, transported to point of use by conveyor or tram, made into beehive coke at mine, and all other uses.

[3] Value received or charged for coal f. o. b. mine, including selling cost. (Includes a value for coal not sold but used by producer, such as mine fuel and coal coked as estimated by producer at average prices that might have been received if such coal had been sold commercially.)

[4] In certain counties the average tons per man per day is large due to strip mining or mechanical loading undergfound.

TRANSPORTATION

TABLE 42.—Bituminous coal and lignite loaded for shipment by railroads and waterways in the United States, 1950–51, as reported by mine operators [1]

Route	State	1950 (net tons)		1951 (net tons)	
		By State	Total for route	By State	Total for route
RAILROAD					
Alabama Central	Alabama	67,208	67,208	17,460	17,460
Alaska	Alaska	403,697	403,697	486,678	486,678
Algers, Winslow & Western	Indiana	2,193,955	2,193,955	2,241,555	2,241,555
Artemus-Jellico	Kentucky	163,608	163,608	164,974	164,974
Atchison, Topeka & Santa Fe	Colorado	203,324	1,183,056	226,500	1,223,137
	Illinois	366,538		286,114	
	Kansas	23,646		20,503	
	New Mexico	589,548		690,020	
Baltimore & Ohio	Illinois	162,997	39,809,561	198,326	41,729,124
	Indiana	520,794		545,908	
	Maryland	17,816		10,066	
	Ohio	4,252,407		3,847,629	
	Pennsylvania	8,765,300		9,201,014	
	West Virginia	26,090,247		27,926,181	
Bessemer & Lake Erie	Pennsylvania	3,784,688	3,784,688	3,321,786	3,321,786
Brimstone	Tennessee	100,408	100,408	143,819	143,819
Buffalo Creek & Gauley	West Virginia	903,507	903,507	861,696	861,696
Cambria & Indiana	Pennsylvania	2,651,125	2,651,125	2,955,655	2,955,655
Campbell's Creek	West Virginia	553,339	553,339	651,504	651,504
Carbon County	Utah	1,578,113	1,578,113	1,723,904	1,723,904
Central of Georgia	Alabama	500,774	504,324	3,297	3,297
	Georgia	3,550			
Chesapeake & Ohio	Kentucky	11,116,317	58,829,166	11,921,191	66,451,128
	Ohio	790,467		535,887	
	Virginia	378,662		905,314	
	West Virginia	46,543,720		53,088,736	
Cheswick & Harmar	Pennsylvania	748,093	748,093	728,157	728,157
Chicago, Burlington & Quincy	Colorado	17,953	9,895,228	37,823	9,908,563
	Illinois	7,932,743		8,026,295	
	Iowa	243,424		243,220	
	Missouri	547,276		698,245	
	Wyoming	1,153,832		902,980	
Chicago & Eastern Illinois	Illinois	557,055	1,547,296	693,435	2,024,663
	Indiana	990,241		1,331,228	
Chicago & Illinois Midland	Illinois	7,789,155	7,789,155	6,083,359	6,083,359
Chicago, Indianapolis & Louisville.	Indiana	430,907	430,907	499,128	499,128
Chicago, Milwaukee, St. Paul & Pacific.	Indiana	4,456,647	4,996,108	4,029,674	4,922,122
	Montana (bit.)	478,894		605,282	
	North Dakota (lig.)	60,267		287,166	
	South Dakota (lig.)	300			
Chicago & North Western	Illinois	2,105,872	2,105,872	2,189,379	2,189,379
Chicago, Rock Island & Pacific	Arkansas	20,528	1,037,237	62,592	1,273,012
	Illinois	642,981		854,316	
	Iowa	164,471		136,761	
	Missouri	161,962		179,843	
	Oklahoma	47,295		39,500	
Clinchfield	Kentucky	259,835	4,610,637	86,761	5,375,175
	Virginia	4,350,802		5,288,414	
Colorado & Southeastern	Colorado	85,506	85,506	108,885	108,885
Colorado & Southern	Colorado	242,582	242,582	198,542	198,542
Colorado & Wyoming	Colorado	487,807	487,807	506,432	506,432
Conemaugh & Black Lick	Pennsylvania	675,545	675,545	537,140	537,140
Cumberland & Pennsylvania	Maryland	53,686	53,686	47,674	47,674
Dardanelle & Russellville Ry. Co.	Arkansas	41,666	41,666	20,935	20,935

For footnotes, see end of table.

TABLE 42.—Bituminous coal and lignite loaded for shipment by railroads and waterways in the United States, 1950–51, as reported by mine operators [1]—Con.

Route	State	1950 (net tons)		1951 (net tons)	
		By State	Total for route	By State	Total for route
RAILROAD—continued					
Denver & Rio Grande Western	Colorado	1,555,952	4,704,615	1,365,487	3,904,935
	New Mexico	24,055		20,115	
	Utah	3,124,608		2,519,333	
Detroit, Toledo & Ironton	Ohio	3,738	3,738	1,704	1,704
East Broad Top R. R. & Coal Co.	Pennsylvania	456,316	456,316	432,126	432,126
Erie	Ohio	112,591	978,741	193,023	875,220
	Pennsylvania	866,150		682,197	
Fort Smith & Van Buren	Oklahoma	424,975	424,975	359,621	359,621
Galesburg & Great Eastern	Illinois	473,208	473,208	505,936	505,936
Great Northern	Montana (bit.)	4,834	724,009	761	870,086
	North Dakota (lig.)	641,177		813,981	
	Washington	77,998		55,344	
Gulf, Mobile & Ohio	Alabama	145,815	1,648,413	145,492	1,728,384
	Illinois	1,502,598		1,582,892	
Huntingdon & Broad Top Mountain R. R. & Coal Co.	Pennsylvania	205,772	205,772	239,257	239,257
Illinois Central	Alabama	133,532	26,236,059	131,561	27,024,684
	Illinois	11,441,636		12,871,907	
	Indiana	148,395		169,171	
	Kentucky	14,512,496		13,852,045	
Illinois Terminal	Illinois	226,137	226,137	263,233	263,233
Interstate	Kentucky	240,632	2,508,897	226,182	2,433,234
	Virginia	2,268,265		2,207,052	
Johnstown & Stony Creek	Pennsylvania	292,640	292,640	270,104	270,104
Joplin-Pittsburg	Kansas	99,965	99,965	114,405	114,405
Kanawha Central	West Virginia	67,759	67,759	100,467	100,467
Kansas City Southern	Arkansas	70,000	1,141,377		988,225
	Kansas	673,936		450,094	
	Missouri	214,888		365,714	
	Oklahoma	182,553		172,417	
Kelley's Creek & Northwestern	West Virginia	928,314	928,314	1,264,725	1,264,725
Kentucky & Tennessee	Kentucky	379,652	379,652	400,107	400,107
Lake Erie, Franklin & Clarion	Pennsylvania	638,763	638,763	637,559	637,559
Laramie, North Park & Western	Colorado	5,953	5,953		
Ligonier Valley	Pennsylvania	54,599	54,599	2,400	2,400
Litchfield & Madison	Illinois	542,944	542,944	394,884	394,884
Louisville & Nashville	Alabama	3,103,065	35,022,687	2,702,238	31,761,567
	Illinois	18,652		32,110	
	Kentucky	30,439,227		27,848,183	
	Tennessee	1,155,928		883,373	
	Virginia	305,815		295,663	
Mary Lee	Alabama	653,981	653,981	614,912	614,912
Midland Valley	Arkansas	148,102	457,675	168,587	310,989
	Oklahoma	309,573		142,402	
Minneapolis & St. Louis	Illinois	1,772,556	1,785,911	1,299,270	1,301,277
	Iowa	13,355		2,007	
Minneapolis, St. Paul & Sault Ste. Marie	North Dakota (lig.)	765,619	765,619	683,398	683,398
Missouri-Kansas-Texas	Kansas	219,881	657,533	356,439	976,618
	Missouri	162,161		247,462	
	Oklahoma	275,491		372,717	
Missouri Pacific	Arkansas	690,326	6,732,532	677,376	5,920,418
	Illinois	5,233,279		4,606,361	
	Kansas	652,708		569,841	
	Missouri	81,974		66,840	
	Oklahoma	74,245			
Monongahela	Pennsylvania	1,909,421	11,019,893	2,327,260	14,017,805
	West Virginia	9,110,472		11,690,545	
Montana, Wyoming & Southern	Montana (bit.)	183,368	183,368	135,588	135,588
Montour	Pennsylvania	3,759,143	3,759,143	3,674,600	3,674,600
Nashville, Chattanooga & St. Louis	Tennessee	515,154	515,154	591,197	591,197
New York Central [2]	Illinois	5,070,179	21,357,374	5,364,475	20,962,114
	Indiana	3,195,177		3,339,721	
	Ohio	5,664,514		5,556,272	
	Pennsylvania	6,081,990		4,736,958	
	West Virginia	1,345,514		1,964,688	

For footnotes, see end of table.

TABLE 42.—Bituminous coal and lignite loaded for shipment by railroads and waterways in the United States, 1950–51, as reported by mine operators [1]—Con.

Route	State	1950 (net tons)		1951 (net tons)	
		By State	Total for route	By State	Total for route
RAILROAD—continued					
New York, Chicago & St. Louis	Ohio	8,001,850	8,001,850	8,085,716	8,085,716
Nicholas, Fayette & Greenbrier	West Virginia	809,187	809,187	1,950,626	1,950,626
Norfolk & Western	Kentucky	5,117,594	40,642,911	6,357,626	46,907,915
	Virginia	8,291,425		10,053,680	
	West Virginia	27,233,892		30,496,609	
Northeast Oklahoma	Kansas	1,104	1,104	5,000	5,000
Northern Pacific	Montana (bit.)	1,706,853	3,311,518	1,493,425	2,771,480
	North Dakota (lig.)	1,058,864		729,111	
	Washington	545,801		548,944	
Oklahoma City-Ada-Atoka	Oklahoma	68,937	68,937	53,875	53,875
Pacific Coast	Washington	31,981	31,981	81,597	81,597
Pennsylvania (includes Pittsburgh, Cincinnati, Chicago & St. Louis).	Illinois	33,495	40,394,575	55,764	39,441,920
	Indiana	4,855,371		4,120,254	
	Ohio	7,145,309		6,696,432	
	Pennsylvania	27,782,711		28,024,421	
	West Virginia	577,689		545,049	
Peoria Terminal	Illinois	338,491	338,491	21,739	21,739
Pittsburgh & Lake Erie	Pennsylvania	725,953	725,953	1,206,423	1,206,423
Pittsburg & Shawmut	Pennsylvania	2,344,550	2,344,550	2,080,879	2,080,879
Pittsburgh, Chartiers & Youghiogheny.	Pennsylvania	29,874	29,874	53,386	53,386
Pittsburgh & West Virginia	Ohio	643,771	1,436,422	485,533	986,389
	Pennsylvania	308,829		111,873	
	West Virginia	483,822		388,983	
Preston	West Virginia	93,880	93,880	46,935	46,935
Rockdale, Sandow & Southern	Texas (lig.)	17,959	17,959		
St. Louis & O'Fallon	Illinois	316,218	316,218	331,756	331,756
St. Louis-San Francisco	Alabama	1,452,369	3,574,975	1,319,271	3,362,314
	Arkansas	140,304		146,220	
	Kansas	306,402		266,542	
	Missouri	601,746		672,151	
	Oklahoma	1,074,154		958,130	
Southern	Alabama	1,590,795	5,942,160	1,206,712	5,163,089
	Indiana	962,448		904,500	
	Kentucky	827,130		586,165	
	Tennessee	1,562,407		1,413,109	
	Virginia	999,380		1,052,603	
Southern Iowa	Iowa	29,750	29,750	39,645	39,645
Southern Pacific	New Mexico	66,263	66,263		
Springfield Terminal	Illinois	615,878	615,878	158,880	158,880
Tennessee	Tennessee	760,651	760,651	607,073	607,073
Tennessee Central	Tennessee	352,603	352,603	377,874	377,874
Tennessee Coal, Iron & Railroad Co.	Alabama	3,903,862	3,903,862	4,044,705	4,044,705
Thomas & Sayreton	Alabama	290,229	290,229	297,866	297,866
Toledo, Peoria & Western	Illinois	13,216	13,216	98,862	98,862
Union	Pennsylvania	142,602	142,602	27,367	27,367
Union Pacific	Colorado	500,617	5,441,826	581,367	5,855,303
	Washington	24,540		4,137	
	Wyoming	4,916,669		5,269,799	
Unity	Pennsylvania	434,861	434,861	455,585	455,585
Utah	Utah	1,396,739	1,396,739	1,253,685	1,253,685
Virginian	Virginia	106,351	13,246,314	104,942	15,404,520
	West Virginia	13,139,963		15,299,578	
Wabash	Illinois	688,954	1,633,397	429,423	1,303,215
	Iowa	468,439		424,077	
	Missouri	476,004		449,715	
West Virginia Northern	West Virginia	1,094,028	1,094,028	709,538	709,538
Western Allegheny	Pennsylvania	147,939	147,939	201,708	201,708
Western Maryland	Maryland	232,016	5,314,290	146,384	5,440,065
	Pennsylvania	634,427		886,446	
	West Virginia	4,447,847		4,407,235	
Winifrede	West Virginia	206,915	206,915	263,810	263,810
Woodward Iron Co	Alabama	880,590	880,590	1,122,791	1,122,791
Youngstown & Southern	Ohio	43,200	43,200	12,813	12,813
Total railroad shipments		417,224,494	417,224,494	430,387,006	430,387,006

For footnotes, see end of table.

TABLE 42.—Bituminous coal and lignite loaded for shipment by railroads and waterways in the United States, 1950–51, as reported by mine operators [1]—Con.

Route	State	1950 (net tons)		1951 (net tons)	
		By State	Total for route	By State	Total for route
WATERWAY					
Allegheny River	Pennsylvania	1,543,652	1,543,652	1,510,791	1,510,791
Black Warrior River	Alabama	135,583	135,583	148,890	148,890
Emory River	Tennessee	134,495	134,495	153,114	153,114
Illinois River	Illinois	998,628	998,628	962,732	962,732
Kanawha River	West Virginia	2,748,579	2,748,579	3,039,164	3,039,164
Monongahela River	Pennsylvania	18,251,532	19,571,995	20,539,091	21,599,754
	West Virginia	1,320,463		1,060,663	
Ohio River	Illinois		2,397,882	99,704	2,550,912
	Kentucky	239,102		308,581	
	Ohio	1,283,774		1,551,756	
	Pennsylvania	92,149		2,755	
	West Virginia	782,857		588,116	
Tennessee River	Tennessee			3,457	3,457
Youghiogheny River	Pennsylvania	52,730	52,730	15,494	15,494
Total waterway shipments		27,583,544	27,583,544	29,984,308	29,984,308
Total loaded at mines for shipment by railroads and waterways.		444,808,038	444,808,038	460,371,314	460,371,314
Shipped by truck from mine to final destination.		58,286,295	58,286,295	58,131,900	58,131,900
Used at mine [3]		13,216,720	13,216,720	15,161,518	15,161,518
Total production		516,311,053	516,311,053	533,664,732	533,664,732

[1] Includes coal loaded at mine directly into railroad cars or river barges, hauled by truck to railroad siding and hauled by truck to waterway. In general, figures show the quantity of bituminous coal and lignite originated for each railroad and waterway as reported by mine operators. It must be noted that in 1 year an operator may report coal loaded on the subsidiary railroad and in another year the same operator may report coal loaded on the parent railroad system.

[2] Includes coal shipped over Kanawha & Michigan, Kelley's Creek, Toledo & Ohio Central, and Zanesville & Western.

[3] Includes coal used by mine employees, taken by locomotive tenders at tipple, used at mine for power and heat, coal transported from mine to point of use by conveyor or tram, coal made into beehive coke at mine, and all other uses at mine.

TABLE 43.—Truck shipments from mines of bituminous coal and lignite, in the United States, 1940–51 [1]

Year	Trucked to final destination		Trucked to railroad siding or waterway		
	Thousands of net tons	Percent of total production	Thousands of net tons	Percent of total production	Average distance trucked (miles)
1940	35,540	7.7	6,127	1.3	3.6
1941	40,056	7.8	12,486	2.4	3.7
1942	45,154	7.7	18,843	3.2	3.9
1943	42,433	7.2	32,092	5.4	3.8
1944	40,123	6.5	51,871	8.4	3.8
1945	41,477	7.2	48,536	8.4	3.8
1946	42,731	8.0	44,070	8.2	4.0
1947	55,859	8.9	48,778	7.7	4.6
1948	58,260	9.7	60,933	10.2	5.3
1949	47,787	10.9	41,489	9.5	5.4
1950	58,286	11.3	42,931	8.3	5.9
1951	58,132	10.9	35,044	6.6	5.7

[1] Detailed data, classified by distance shipped, published in Bureau of Mines Mineral Market Rept. 2102, Oct. 27, 1952.

CONSUMPTION [5]

TABLE 44.—Consumption of bituminous coal and lignite, by consumer class, with retail deliveries in the United States, 1938–51, in thousands of net tons

Year	Electric power utilities [1]	Bunker foreign trade [2]	Railroads [3] (class I)	Coke plants		Steel and rolling mills	Cement mills [4]	Other industrial [5]	Retail deliveries [6]	Total of classes shown [7]
				Beehive	Oven					
1938	36,440	1,352	73,921	1,360	45,266	8,412	4,483	96,527	68.520	336,281
1939	42,304	1,477	79,072	2,298	61,216	9,808	5,274	103,079	71,570	376.098
1940	49,126	1,426	85,130	4,803	76,583	10,040	5,633	110,469	87,700	430,910
1941	59,888	1,643	97,384	10,529	82,609	10,902	6,832	124,868	97,460	492,115
1942	63,472	1,585	115,410	12,876	87,974	10,434	7,570	135,979	104,750	540,050
1943	74,036	1,647	130,283	12,441	90,019	11,238	5,851	145,518	122,764	593,797
1944	76,656	1,559	132,049	10,858	94,438	10,734	3,789	134,610	124,906	589,599
1945	71,603	1,785	125,120	8,135	87,214	10,084	4,215	129,606	121,805	559,567
1946	68,743	1,381	110,166	7,167	76,121	8,603	7,009	120,610	100,586	500,386
1947	86,009	1,689	109,296	10,475	94,325	10,048	7,938	126,948	99,163	545,891
1948	95,620	1,057	94,838	10,322	96,984	10,046	8,554	112,741	89,747	519,909
1949	80,610	874	68,123	5,354	85,882	7,451	7,988	98,957	90,299	445,538
1950	88,262	717	60,969	9,088	94,757	7,698	7,943	98,164	86,604	454,202
1951	101,898	890	54,005	11,418	102,030	7,973	8,525	105,634	76,531	468,904

[1] Federal Power Commission. Represents latest available revised figures for bituminous coal and lignite consumed by public-utility power plants in power generation, including a small quantity of coke amounting to approximately 100,000 tons annually.
[2] U. S. Department of Commerce.
[3] Association of American Railroads. Represents consumption of bituminous coal and lignite by class I railways for all uses, including locomotive, powerhouse, shop, and station fuel. The Interstate Commerce Commission reports that in 1951 consumption for all uses by class I line-haul railways, plus purchases of class II and class III railways, plus purchases by all switching terminal companies combined was 56,196,152 tons of bituminous coal and lignite.
[4] Includes a small amount of anthracite.
[5] Estimates based upon reports collected from a selected list of representative manufacturing plants.
[6] Estimates based upon reports collected from a selected list of representative retailers. Includes some coal shipped by truck from mine to final destination.
[7] The total of classes shown approximates total consumption. It is not possible to calculate consumption closely from production, imports, exports and changes in stocks because certain significant items of stocks are not included in year-end stocks. These items are: Stocks on Lake and Tidewater docks, stocks at other intermediate storage piles between mine and consumer, and coal in transit.

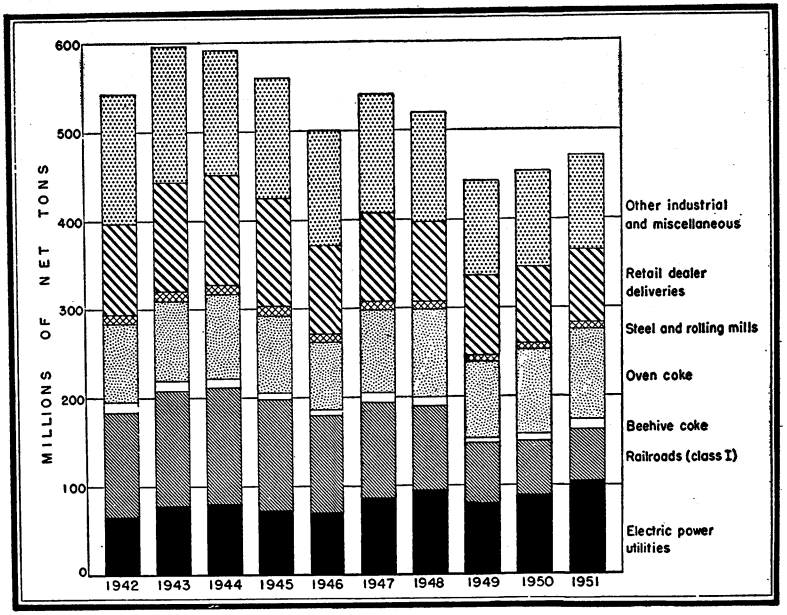

FIGURE 6.—Consumption of bituminous coal and lignite, by consumer class, with retail dealer deliveries in the United States, 1942–51.

[5] Figures on relative rate of growth of fuels and energy are given in the Fuels and Energy chapter of this volume.

TABLE 45.—Fuel economy in consumption of coal at electric-utility power plants in the United States, 1919–51

[Federal Power Commission]

Year	Pounds of coal per kilowatt-hour	Economy gain over 1919 (percent)	Year	Pounds of coal per kilowatt-hour	Economy gain over 1919 (percent)	Year	Pounds of coal per kilowatt-hour	Economy gain over 1919 (percent)
1919	3.20		1930	1.60	50.0	1941	1.34	58.1
1920	3.00	6.2	1931	1.52	52.5	1942	1.30	59.4
1921	2.70	15.6	1932	1.49	53.4	1943	1.30	59.4
1922	2.50	21.9	1933	1.46	54.4	1944	1.29	59.7
1923	2.40	25.0	1934	1.45	54.7	1945	1.30	59.4
1924	2.20	31.3	1935	1.44	55.0	1946	1.29	59.7
1925	2.00	37.5	1936	1.44	55.0	1947	1.31	59.1
1926	1.90	40.6	1937	1.44	55.0	1948	1.30	59.4
1927	1.82	43.1	1938	1.40	56.2	1949	1.24	61.2
1928	1.73	45.9	1939	1.38	56.9	1950	1.19	62.8
1929	1.66	48.1	1940	1.34	58.1	1951	1.14	64.4

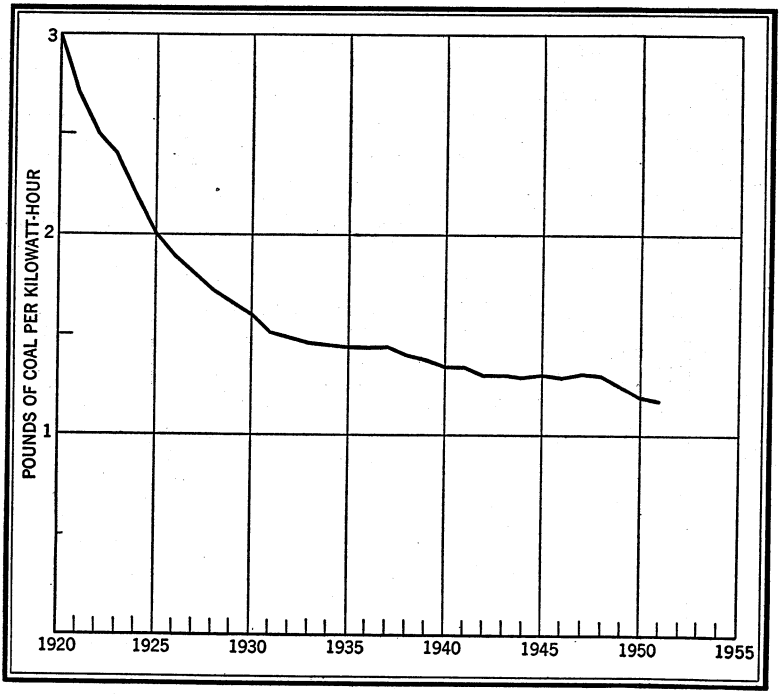

FIGURE 7.—Trend in fuel economy at electric-utility power plants in the United States, 1920–51.

STOCKS

Stocks of bituminous coal and lignite in the hands of industrial consumers and at retail yards in 1942–51 are shown graphically in figure 1. Stocks at upper Lake docks in 1950–51 are listed in table 1.

TABLE 46.—Stocks of bituminous coal and lignite in hands of commercial consumers and in retail dealers' yards in the United States, 1950–51

Date	Total stocks (thousands of net tons)	Days' supply at current rate of consumption on date of stock taking							
		Coke ovens	Steel plants	Other industrials	Electric utilities	Retail yards	Railroads	Cement mills	Total
1950									
Jan. 1	45,111	39	39	35	77	4	21	45	32
Feb. 1	37,119	29	33	32	64	3	18	41	27
Mar. 1	24,583	17	20	23	48	1	14	26	20
Apr. 1	28,054	21	21	25	50	4	15	30	22
May 1	37,590	28	31	39	63	7	16	32	31
June 1	44,795	35	42	47	78	14	20	37	41
July 1	51,376	42	51	54	86	15	24	43	46
Aug. 1	51,979	39	51	63	94	13	21	47	48
Sept. 1	58,964	47	49	63	91	10	23	50	48
Oct. 1	64,293	52	53	68	100	11	22	54	52
Nov. 1	70,478	57	50	69	101	14	24	56	56
Dec. 1	72,131	61	45	61	98	12	25	55	54
Dec. 31	72,516	61	39	58	93	8	28	53	50
1951									
Jan. 1	72,516	61	39	58	93	8	28	53	50
Feb. 1	74,006	61	39	59	90	6	29	59	48
Mar. 1	70,662	60	38	56	87	6	29	58	47
Apr. 1	71,425	60	44	60	94	7	28	55	52
May 1	72,081	59	51	66	109	9	30	54	59
June 1	74,807	58	63	75	121	16	32	56	67
July 1	76,992	58	63	79	121	14	38	58	68
Aug. 1	74,100	50	68	84	127	16	36	58	69
Sept. 1	75,414	51	62	79	116	12	33	59	64
Oct. 1	76,245	51	63	81	120	10	33	59	64
Nov. 1	78,019	53	57	72	115	9	30	60	60
Dec. 1	77,858	54	49	63	109	8	29	58	56
Dec. 31	76,636	55	48	62	112	7	29	58	56

PRICES

The average values per ton of bituminous coal and lignite sold in 1900–1951 are listed in table 3, and those sold in 1905–51 are plotted in figure 2. The average values, classified according to method of mining, in 1925–51 are shown in table 20. The unit prices of railroad fuel and coking coal and the average retail price in 1950–51 are quoted in table 1. Figure 1 includes a graph of prices of railroad fuel in 1942–51. Lignite values are shown separately in tables 48 and 49.

TABLE 47.—Average value per ton, f. o. b. mines, bituminous coal and lignite produced in the United States, 1950–51, by States [1]

State	1950			1951		
	Strip mines	Underground mines	Total all mines	Strip mines	Underground mines	Total all mines
Alabama	$5.60	$6.21	$6.13	$5.37	$6.18	$6.06
Alaska	6.99	7.53	7.35	6.61	8.51	7.62
Arizona		6.00	6.00		6.00	6.00
Arkansas	6.34	8.55	7.60	6.84	8.44	7.85
Colorado	4.52	5.15	5.09	4.36	5.24	5.16
Illinois	3.87	4.14	4.05	3.92	4.15	4.07
Indiana	3.88	4.08	3.97	3.93	4.19	4.04
Iowa	3.32	4.32	3.69	3.43	4.51	3.75
Kansas	3.83	4.82	3.87	3.90	4.94	3.94
Kentucky	3.96	5.24	5.01	3.89	5.08	4.89
Maryland	4.34	5.00	4.84	4.19	4.93	4.73
Michigan		10.12	10.12		10.19	10.19
Missouri	4.03	5.34	4.17	4.00	5.33	4.10
Montana:						
Bituminous	1.30	4.56	2.30	1.65	4.36	2.61
Lignite	3.00	3.44	3.37	3.00	3.63	3.51
Total Montana	1.31	4.50	2.33	1.65	4.34	2.63
New Mexico		5.39	5.39		5.75	5.75
North Dakota (lignite)	2.40	2.24	2.38	2.42	2.39	2.41
Ohio	3.42	4.41	3.81	3.51	4.33	3.87
Oklahoma	4.65	6.87	5.44	5.15	7.57	6.24
Oregon		6.08	6.08			
Pennsylvania	4.06	5.32	5.00	4.02	5.64	5.29
Tennessee	4.87	5.47	5.40	4.55	5.03	4.99
Texas (lignite)	1.69		1.69			
Utah		4.81	4.81		5.32	5.32
Virginia	4.97	5.54	5.49	4.73	5.47	5.42
Washington	6.12	6.72	6.67	7.19	7.02	7.04
West Virginia	4.30	5.33	5.23	4.23	5.32	5.23
Wyoming	2.82	4.08	3.79	3.15	4.61	4.19
Other States:						
California and South Dakota (lignite)	3.88	1.68	3.82	4.26		4.26
Georgia and North Carolina		6.74	6.74		6.71	6.71
Total	3.87	5.15	4.84	3.88	5.21	4.92

[1] Average gross realization, selling cost not deducted.

LIGNITE [6]

The consumption of lignite in generating electric energy amounted to 1,520,616 net tons or 46 percent of total production in 1951, according to the Federal Power Commission. The principal consumption was in North Dakota, Minnesota, and South Dakota, with a very small amount in Colorado.

[6] Detailed data, by counties, shown in tables 40 and 41, and by size of mine in tables 11 and 12.

TABLE 48.—Summary of number of mines, production, value, men working daily, days operated, man-days of labor, output per man per day, and detailed operations at underground and strip lignite mines in the United States, 1950, by States [1]

	California and South Dakota	Montana [2]	North Dakota	Texas	Total
Operations at underground and strip mines:					
Number of mines	4	7	44	1	56
Production (net tons):					
Shipped by rail [3]	300		2,525,927	17,959	2,544,186
Shipped by truck or wagon	35,839	51,930	576,359		664,128
Used at mines [4]	2,555	200	158,687	210	161,652
Total	38,694	52,130	3,260,973	18,169	3,369,966
Average value per ton	$3.82	$3.37	$2.38	$1.69	$2.41
Average number of men working daily:					
Underground	2	31	119		152
Surface: In strip pits	16	3	276	8	303
All others	1	9	229	6	245
Total	19	43	624	14	700
Average number of days worked	210	165	234	281	230
Number of man-days worked	3,991	7,093	146,096	3,934	161,114
Average tons per man per day	9.70	7.35	22.32	4.62	20.92
Operations at underground mines:					
Number of mines	1	6	7		14
Shot off the solid—net tons	1,211	43,100	25,025		69,336
Cut by machines—do			407,892		407,892
Total—do	1,211	43,100	432,917		477,228
Number of cutting machines			5		5
Average output per machine—net tons			81,578		81,578
Percent of total underground production cut by machines			94.2		94.2
Average value per ton	$1.68	$3.44	$2.24		$2.35
Average number of men working daily:					
Underground	2	31	119		152
All others		6	44		50
Total	2	37	163		202
Average number of days worked	120	166	264		245
Man-days of labor	240	6,133	43,073		49,446
Average tons per man per day	5.05	7.03	10.05		9.65
Operations at strip mines:					
Number of strip pits	3	1	37	1	42
Production at strip pits—net tons	37,483	9,030	2,828,056	18,169	2,892,738
Average value per ton	$3.88	$3.00	$2.40	$1.69	$2.42
Number of shovels and dragline excavators	3	1	47	2	53
Average number of men working daily:					
In strip pits	16	3	276	8	303
All others	1	3	185	6	195
Total	17	6	461	14	498
Average number of days worked	221	160	223	281	224
Number of man-days worked	3,751	960	103,023	3,934	111,668
Average tons per man per day	9.99	9.41	27.45	4.62	25.90

[1] Exclusive of small mines producing less than 1,000 tons.
[2] Includes output from Custer, Dawson, Richland, Roosevelt, and Sheridan Counties.
[3] Includes coal loaded at mine directly into railroad cars and hauled by truck to railroad siding.
[4] Includes coal used by mine employes, taken by locomotive tenders at tipple, used at mine for power and heat coal made into briquets, and other uses.

TABLE 49.—Summary of number of mines, production, value, men working daily, days operated, man-days of labor, output per man per day, and detailed operations at underground and strip lignite mines in the United States, 1951, by States [1]

	California and South Dakota	Montana [2]	North Dakota	Total
Operations at underground and strip mines:				
Number of mines	3	6	54	63
Production (net tons):				
Shipped by rail [3]			2,513,656	2,513,656
Shipped by truck or wagon	28,325	34,901	446,104	509,330
Used at mines [4]	3,682	169	264,267	268,118
Total	32,007	35,070	3,224,027	3,291,104
Average value per ton	$4.26	$3.51	$2.41	$2.44
Average number of men working daily:				
Underground		17	110	127
Surface: In strip pits	16	4	301	321
All others	1	4	265	270
Total	17	25	676	718
Average number of days worked	205	190	238	235
Number of man-days worked	3,484	4,762	160,742	168,988
Average tons per man per day	9.19	7.36	20.06	19.48
Operations at underground mines:				
Number of mines		5	13	18
Shot off the solid net tons		28,757	24,910	53,667
Cut by machines do			225,991	225,991
Total do		28,757	250,901	279,658
Number of cutting machines			4	4
Average output per machine net tons			56,498	56,498
Percent of total underground production cut by machines			90.1	80.8
Average value per ton		$3.63	$2.39	$2.51
Average number of men working daily:				
Underground		17	110	127
All others		2	31	33
Total		19	141	160
Average number of days worked		206	235	232
Man-days of labor		3,922	33,142	37,064
Average tons per man per day		7.33	7.57	7.55
Operations at strip mines:				
Number of strip pits	3	1	41	45
Production at strip pits net tons	32,007	6,313	2,973,126	3,011,446
Average value per ton	$4.26	$3.00	$2.42	$2.44
Number of shovels and dragline excavators	4	1	49	54
Average number of men working daily:				
In strip pits	16	4	301	321
All others	1	2	234	237
Total	17	6	535	558
Average number of days worked	205	140	239	236
Number of man-days worked	3,484	840	127,600	131,924
Average tons per man per day	9.19	7.52	23.30	22.83

[1] Exclusive of small mines producing less than 1,000 tons.
[2] Includes output from Custer, Dawson, Richland, Roosevelt, and Sheridan Counties.
[3] Includes coal loaded at mine directly into railroad cars and hauled by truck to railroad siding.
[4] Includes coal used by mine employes, taken by locomotive tenders at tipple, used at mine for power and heat, coal made into briquets, and other uses.

FOREIGN TRADE [7]

TABLE 50.—Bituminous coal imported for consumption in the United States, 1949–51, by country and by customs district, in net tons [1]

[U. S. Department of Commerce]

Country	1949	1950	1951
North America:			
Canada	311,801	344,838	290,932
Mexico	165	165	
South America: Brazil		53	441
Europe:			
France		1,650	
Germany			18
Greece	13		145
Italy	6		
United Kingdom	2,995		
Total	314,980	346,706	291,536

Customs district	1949	1950	1951
Alaska	7,535	4,634	2,506
Chicago	6	1,687	52
Dakota	1,438	1,655	1,185
Duluth and Superior	186	39	221
Hawaii	8,831		310
Laredo	165	165	
Los Angeles		53	441
Maine and New Hampshire	137,033	140,482	126,974
Maryland			18
Michigan	538	3,354	74
Mobile	2,995		
Montana and Idaho	143,926	164,973	157,500
New York	144		612
Philadelphia		3,145	
Vermont	115	4,255	49
Washington	12,068	15,264	1,594
Wisconsin		7,000	
Total	314,980	346,706	291,536

[1] Includes slack, culm, and lignite.

TABLE 51.—Exports of bituminous coal, 1947–51, by country group, in thousands of net tons

[U. S. Department of Commerce]

Year	Canada (including New foundland) and Mexico	West Indies and Central America [1]	"Overseas" (all other countries)						Grand total
			Miquelon, Bermuda, and Greenland	South America	Europe	Asia	Africa	Oceania	Total "Overseas"	
1947	26,171	369	24	2,866	[2] 36,761	311	2,057	108	42,127	[2] 68,667
1948	26,000	214	4	1,867	16,093	765	961	26	19,716	45,930
1949	16,100	140	6	819	8,682	1,395	612	88	11,602	27,842
1950	23,010	108	1	1,303	794	147	105		2,350	25,468
1951	22,823	125	13	3,016	27,926	1,894	918	11	33,778	56,726

[1] Includes Bahamas and Panama.
[2] Excludes 102,179 tons ($1,010,820) exported to Austria as a part of the Army Civilian Supply Program.

[7] Figures on imports and exports compiled by M. B. Price and E. D. Page, of the Bureau of Mines, from records of the U. S. Department of Commerce.

TABLE 52.—Bituminous coal exported from the United States, 1947–51, by countries, in net tons [1]

[U. S. Department of Commerce]

Country	1947	1948	1949	1950	1951
North America:					
Bermuda	14,567	3,508	731		612
Canada	25,848,117	25,842,797	15,982,038	23,009,089	22,823,044
Newfoundland and Labrador	321,553	154,932	115,797		
Central America:					
British Honduras	30	4	45	50	20
Canal Zone	34,342	22,207	9,051	10,632	
Costa Rica	50	3,177	42	41	100
El Salvador	128	86	176	110	75
Guatemala	257	230	140	337	190
Honduras	302	293	276	372	248
Nicaragua	8			6	16
Panama	35	45	20	50	30
Greenland	4,493				11,461
Mexico	694	1,593	1,617	767	907
Miquelon and St. Pierre	4,864	500	4,697	508	444
West Indies:					
British:					
Barbados	2,574	1,225			
Jamaica	89,339	48,890	32,465	3,360	30,274
Leeward and Windward	14,800				11,060
Trinidad and Tobago	100,797	57,675	33,502	11,184	11,974
Other British	491	5		20	
Cuba	98,277	76,471	55,907	73,021	64,808
Dominican Republic	7,309	625	106	99	177
French	20,448	1,910	9,330	8,940	5,467
Haiti	2	15	15	15	15
Netherlands Antilles	374	2,004	137	80	176
Total North America	26,563,851	26,218,192	16,246,092	23,118,681	22,961,098
South America:					
Argentina	1,113,734	826,750	30,625	97,343	1,632,480
Bolivia	329	511	15,288	11,101	2,810
Brazil	1,468,312	959,323	681,838	1,055,305	1,026,952
Chile	163,693	27,634	29,472	97,101	219,496
Surinam	2,570	3,875	2,510	3,008	2,590
Uruguay	117,135	48,705	58,628	39,168	128,370
Other South America	500	276	321	47	3,505
Total South America	2,866,273	1,867,074	818,682	1,303,073	3,016,203
Europe:					
Austria	[3] 122,391	58,447			929,356
Belgium-Luxembourg	3,363,800	630,604		50,352	1,495,110
Denmark	2,377,583	52,098			1,075,809
Finland	637,271	6,273		48,107	191,218
France	12,466,388	8,459,268	3,639,516	10,944	4,305,301
Germany	42,630	70,777		31,333	6,047,167
Gibraltar	156,872			21,743	170,587
Greece	34,056	62,830			
Iceland	57,627				4,865
Ireland	1,005,584	8		10,827	681,679
Italy	8,780,259	4,696,415	3,912,139	114,578	5,085,519
Netherlands	2,691,248	770,761	310,961	33,629	3,368,526
Norway	738,735			5,643	991,523
Portugal	846,901	257,230	184,275	26,378	139,286
Sweden	2,074,092	587,322	437,012	140,882	942,039
Switzerland	683,400	420,621	186,655	195,975	1,062,053
United Kingdom	675,043			103,579	1,302,260
Other Europe	6,966	20,117	11,226		133,195
Total Europe	36,760,846	16,092,771	8,681,784	793,970	27,925,493
Asia:					
China	4,234	40,078	40,002		
Hong Kong	92,203				
Indochina	2,520				
Indonesia	95,417				13,803
Israel-Jordan	3,436				
Japan		688,776	1,355,102	147,218	1,569,080
Malaya	99,519				
Pakistan	10	32,376			310,945
Syria	13,667				
Other Asia	23	3,934	10	25	20
Total Asia	311,029	765,164	1,395,114	147,243	1,893,848

For footnotes, see end of table.

TABLE 52.—Bituminous coal exported from the United States, 1947–51, by countries, in net tons [1]—Continued

Country	1947	1948	1949	1950	1951
Africa:					
Algeria	1,052,370	556,686	265,576	68,211	401,592
Belgian Congo	14,151				32,242
British West Africa	36,425				
Canary Islands	51,822	2,082		6,193	66,452
Cape Verde Islands	89,354	(3)	(3)	(3)	(3)
Egypt	298,135	27,596		3,557	106,212
French Cameroon	140	17,206	22,740		
French Equatorial Africa		10,827	46,517		
French Morocco	92,020	169,551	127,753		76,574
French West Africa	244,643	132,668	84,595		80,217
Libya	27,083				
Madagascar		10,918	55,273		
Madeira Islands	21,491				8,886
Spanish Africa, n. e. s.	114,311	22,481			
Tunisia	14,531		9,291	27,470	107,823
Other Africa	935	10,725	6	5	38,318
Total Africa	2,057,411	960,740	611,751	105,436	918,316
Oceania	107,553	26,192	88,633		11,197
Grand total	[2]68,666,963	45,930,133	27,842,056	25,468,403	56,726,155

[1] Amounts stated do not include fuel or bunker coal loaded on vessels engaged in foreign trade, which aggregated 1,689,328 tons in 1947, 1,057,118 tons in 1948, 874,029 tons in 1949, 717,488 tons in 1950, and 908,269 tons in 1951.
[2] Exclusive of 103,179 tons exported to Austria as a part of the Army Civilian Supply Program.
[3] Beginning Jan. 1, 1948, not separately classified.

TABLE 53.—Bituminous coal exported from the United States, 1947–51, by customs district, in net tons

[U. S. Department of Commerce]

Customs district	1947	1948	1949	1950	1951
North Atlantic:					
Maine and New Hampshire	57,408	5,586	6,276	4,208	3,629
Massachusetts	61		68	30	
New York	1,382,037	23,788	7,196	1,294	4,169
Philadelphia	2,740,855	453,540	32,150	22,217	356,978
Rhode Island					
South Atlantic:					
Georgia	10,708		560	49	
Maryland	10,871,709	3,471,674	1,336,249	337,153	3,861,883
South Carolina	1,825,197	768,520	54,450		646,454
Virginia	20,146,083	13,827,771	10,061,387	2,104,393	28,742,863
Gulf coast:					
Florida	2,015,102	330,455	3,501	4,618	562
Galveston	463,494				
Mobile	1,427,881	617,042	26,388	66,874	193,143
New Orleans	315,944	7,968	1,569	1,545	1,462
Sabine	731,418				10
Mexican border:					
Arizona	272	273	265	399	308
El Paso	45	1,138	1,317	211	488
Laredo	27				
Pacific coast:					
Los Angeles	142,522	100			10,065
Oregon	379,239	10,982		325	20,160
San Diego	83	125	10	157	77
San Francisco	20	69	115	62	830
Washington	301,035	134,461	37,929	6,112	118,800

TABLE 53.—Bituminous coal exported from the United States, 1947–51, by customs district, in net tons—Continued

Customs district	1947	1948	1949	1950	1951
Northern border:					
Buffalo	1,548,629	1,103,124	744,288	979,624	1,036,728
Chicago	1,505,335	1,633,134	711,818	442,569	925,479
Dakota	23,392	36,373	50,210	36,728	36,559
Duluth and Superior	385,036	340,995	204,062	207,212	350,332
Michigan	3,046,644	3,127,640	2,245,509	3,662,662	3,572,549
Montana and Idaho	4,431	723	1,284	614	1,637
Ohio	11,619,905	13,314,027	8,763,909	12,456,669	11,551,859
Rochester	3,829,918	3,465,712	1,798,570	3,068,678	3,160,056
St. Lawrence	3,677,266	2,815,519	1,473,762	2,062,946	2,126,249
Vermont	4,106	5,041	1,575	1,044	1,388
Wisconsin	193				200
Miscellaneous:					
Alaska	204	283	10		5
Colorado	3,037				
Hawaii	3,282				40
Indiana	5				
Minnesota			74		
Pittsburgh	11,210				1,193
Puerto Rico	325			10	
Total	[1]68,666,963	[1]45,930,133	[1]27,842,056	25,468,403	56,726,155

[1] Includes 192,905 tons in 1947, 434,070 tons in 1948, and 277,555 tons in 1949, representing shipments on vessels operated by the United States Army or Navy. Excludes 102,179 tons exported to Austria in 1947 as a part of the Army Civilian Supply Program.

TABLE 54.—Shipments of bituminous coal to possessions and other areas administered by the United States, 1949–51

[U. S. Department of Commerce]

	1949		1950		1951 [1]	
	Net tons	Value	Net tons	Value	Net tons	Value
Puerto Rico	4,999	$48,366	6,007	$58,142	5,192	$47,346
Virgin Islands	20,601	196,211	19,473	174,883		

[1] Data cover period January through July; data not available for balance of year.

WORLD PRODUCTION

World production of anthracite and bituminous coal amounted to 1,591 million metric tons in 1951 and of lignite, 324 million tons—a total of 1,915 million tons. Total coal output in 1951, including lignite, exceeded that in 1950 by 110 million metric tons. Of the total world coal output, 72 percent was produced in four countries—the United States, Russia, Germany, and the United Kingdom. The United States supplied 523 million metric tons (bituminous, anthracite, and lignite) or 27 percent of the world output in 1951.

Most coal-producing countries in Europe increased production during 1951; however, consumption requirements of the principal coal-producing countries on the European Continent exceeded available supplies.

Although world production of anthracite, bituminous coal, and lignite increased in 1951, the European output was inadequate to meet requirements, and production from the United States made up a large part of the deficit.

TABLE 55.—World production of bituminous coal, anthracite, and lignite, 1947–51, by countries, in thousands of metric tons [1]

[Compiled by Pauline Roberts and Berenice R. Mitchell]

Country [1]	1947	1948	1949	1950	1951
North America:					
Canada:					
Bituminous	12,971	15,296	15,648	15,364	14,845
Lignite	1,425	1,442	1,697	1,999	2,017
Greenland: Bituminous	6	7	9	7	8
Mexico: Bituminous	1,055	1,057	1,075	912	1,119
United States:					
Anthracite (Pennsylvania)	51,882	51,836	38,738	39,986	38,709
Bituminous	569,482	541,072	394,420	465,330	481,144
Lignite	2,607	2,799	2,805	3,057	2,986
South America:					
Argentina: Bituminous [2]	14	17	18	26	[3] 45
Brazil:					
Bituminous	1,999	2,025	2,129	1,959	1,950
Lignite					
Chile: Bituminous (marketable)	1,850	2,015	1,882	1,964	1,989
Colombia: Bituminous [2]	800	900	1,015	1,200	1,350
Peru: Bituminous and anthracite	215	189	170	196	[3] 235
Venezuela: Bituminous	[3] 15	21	24	25	28
Europe:					
Albania: Lignite [2]	20	16	16	16	(4)
Austria:					
Bituminous	178	181	183	183	196
Lignite	2,839	3,338	3,816	4,308	4,989
Belgium: Bituminous and anthracite	24,436	26,691	27,854	27,304	29,675
Bulgaria:					
Anthracite [2]	27	27	27	30	35
Bituminous	[3] 203	[3] 300	4,695	5,682	6,134
Lignite	4,043	3,544			
Czechoslovakia:					
Bituminous	16,216	17,746	17,003	18,456	17,900
Lignite	22,362	23,589	26,526	27,506	31,000
Denmark: Lignite	2,800	2,347	1,600	770	1,582
France:					
Bituminous and anthracite	45,216	43,291	51,199	50,843	52,968
Lignite	2,093	1,838	1,845	1,686	2,004
Saar	10,541	12,567	14,262	15,091	16,128
Germany: [5]					
Bituminous and anthracite:					
East Germany	2,754	2,840	[6] 3,000	[6] 3,000	[3] 3,100
West Germany	72,528	88,416	104,808	110,756	118,920
Lignite:					
East Germany [2]	102,000	110,000	117,000	123,000	147,000
West Germany	58,728	64,860	72,064	75,840	83,124
Greece: Lignite	133	125	180	152	191
Hungary:					
Bituminous	1,059	1,238	1,380	1,400	1,600
Lignite	7,750	9,377	10,438	11,850	14,000
Ireland: Bituminous and anthracite	221	182	115	181	184
Italy:					
Bituminous and anthracite	1,362	972	1,104	1,030	1,167
Lignite	1,856	907	850	780	854
Netherlands:					
Bituminous	10,104	11,032	11,705	12,247	12,424
Lignite	474	279	205	194	249
Poland:					
Bituminous	59,130	70,262	74,081	78,001	81,900
Lignite	4,766	5,040	4,621	4,837	5,000
Portugal:					
Bituminous and anthracite	370	387	443	426	418
Lignite	108	103	111	95	83
Rumania:					
Bituminous and anthracite	163	2,631	187	[3] 300	[3] 300
Lignite	2,105		2,576	[3] 2,900	[3] 3,500
Spain:					
Bituminous and anthracite	10,606	10,627	10,832	11,118	11,553
Lignite	1,263	1,400	1,332	1,318	1,497
Svalbard (Spitsbergen): Bituminous	336	516	580	[7] 379	[7] 470
Sweden: Bituminous	416	374	317	309	272
Switzerland:					
Bituminous and anthracite	15	[3] 15	[3] 10	[3] 10	[3] 10
Lignite	12				
U. S. S. R.:					
Bituminous and anthracite [2]	154,000	170,000	236,000	264,000	281,000
Lignite [2]	30,000	35,000			

For footnotes, see end of table.

TABLE 55.—World production of bituminous coal, anthracite, and lignite, 1947–51, by countries, in thousands of metric tons [1]—Continued

Country [1]	1947	1948	1949	1950	1951
Europe—Continued					
United Kingdom:					
Great Britain: Bituminous and anthracite [8]	200,617	212,755	218,570	219,792	225,815
Northern Ireland:					
Bituminous	1	1	1	1	1
Lignite	(9)	(9)			
Yugoslavia:					
Bituminous	1,062	972	1,275	1,154	992
Lignite	8,229	9,751	10,833	11,712	10,827
Asia:					
Afghanistan: Bituminous	5	[6] 15	5	9	13
China: Bituminous, anthracite, and lignite	18,700	18,000	16,000	37,000	43,250
India: Bituminous	30,628	30,608	32,208	32,815	34,983
Indochina: Bituminous and anthracite	248	359	379	502	645
Indonesia: Bituminous	223	[10] 537	662	804	865
Iran: Bituminous [11]	188	[3] 150	170	[3] 200	[3] 200
Japan:					
Bituminous and anthracite	27,235	33,720	37,968	38,461	43,320
Lignite	2,820	2,552	2,088	1,284	1,403
Korea:					
North Korea:					
Anthracite [3]	1,340	1,500	1,500	1,500	1,000
Lignite	[3] 1,616	(4)	(4)	(4)	(4)
South Korea:					
Anthracite	475	799	1,039	586	[3] 600
Lignite	37	68	60	27	(4)
Malaya: Bituminous	230	381	393	422	389
Pakistan: Bituminous	358	245	337	444	513
Philippines: Bituminous	74	88	123	159	151
Taiwan (Formosa): Bituminous	1,307	1,629	1,649	1,402	1,450
Turkey (marketable):					
Bituminous	2,623	2,669	2,705	2,824	2,988
Lignite	628	829	939	[3] 907	[3] 1,000
U. S. S. R.: Sakhalin, southern: Bituminous [12]	(13)	(13)	(13)	(13)	(13)
Africa:					
Algeria: Bituminous and anthracite	206	226	265	258	257
Belgian Congo: Bituminous and anthracite	102	117	152	160	219
French Morocco: Anthracite	269	290	341	368	394
Madagascar: Bituminous		(4)	16	2	5
Mozambique: Bituminous	16	9	13	56	78
Nigeria: Bituminous	589	618	559	593	559
Southern Rhodesia: Bituminous	1,508	1,695	1,918	2,128	2,300
Tunisia: Lignite	76	71	47	41	8
Union of South Africa: Bituminous (marketable)	23,818	24,017	25,496	26,473	26,632
Oceania:					
Australia:					
Bituminous	15,069	15,018	14,332	16,795	17,891
Lignite	6,239	6,800	7,494	7,445	7,962
New Zealand:					
Bituminous and anthracite	951	968	952	936	689
Lignite	1,845	1,853	1,907	1,777	1,786
Total all grades	1,654,000	1,719,000	1,654,000	1,805,000	1,915,000
Lignite (total of items shown above)	269,000	290,000	273,000	284,000	324,000
Bituminous coal and anthracite (by subtraction)	1,385,000	1,429,000	1,381,000	1,521,000	1,591,000

[1] This table includes a number of revisions of figures published in the 1950 Coal-Bituminous and Lignite chapter. Coal is also mined in British Borneo, Faroe Islands, and Italian East Africa (formerly), but production figures are not available and no estimate is included in the total.

[2] In addition, the following quantities (metric tons) of asphaltite were produced and used as solid fuels: 1947, 80,900; 1948, 82,289; 1949, 79,477; 1950, and 1951, data not available.

[3] Estimate.

[4] Data not available; estimate included in total.

[5] Does not include production of the Saar.

[6] Planned production.

[7] Norwegian mines only.

[8] Includes open-cast coal as follows, in thousands of tons: 1947, 10,410; 1948, 11,937; 1949, 12,639; 1950, 12,380; 1951, 11,148.

[9] Production less than 500 tons.

[10] Excludes production of Ombilin mines in Sumatra.

[11] Fiscal year ended Mar. 20 of year following that stated.

[12] Formerly Karafuto.

[13] Output from U. S. S. R. in Asia included with U. S. S. R. in Europe.

Coal—Pennsylvania Anthracite

By J. A. Corgan, Marian I. Cooke, and J. A. Vaughan

GENERAL SUMMARY

PENNSYLVANIA anthracite production in 1951 totaled approximately 42.7 million net tons.[1] The 1951 production figures include for the first time the output of independent operators who were formerly classified as "bootleggers." With inclusion of this tonnage (approximately 1.5 million tons), the 1951 output represents a 3-percent decline from 1950. This decline in production was due almost entirely to a decreased demand in the United States, which more than counterbalanced a substantial increase in exports. Exports to countries other than Canada increased from 93,000 tons in 1950 to 2,474,000 tons in 1951, while shipments to Canada were down about 300,000 tons. As anthracite is primarily a space-heating fuel, weather conditions are an important factor in consumption. Average 1951 temperatures in the principal anthracite markets were about the same as in 1950; therefore, a large part of the decline in the demand for anthracite in the United States was due undoubtedly to the inroads made into the anthracite markets by natural gas and heating oils.

According to data of the Pennsylvania Department of Mines, the New England and Middle Atlantic States received 80 percent of the total anthracite shipments during 1951, other States 6 percent; 9 percent was shipped to Canada and 5 percent to all other countries.

The percentages of anthracite produced by the various types of mining showed some changes from the 1950 pattern, as the proportion produced by culm-bank recovery increased while underground and strip-pit output declined. Underground operations supplied 62 percent of the 1951 total; strip pits, 26 percent; culm banks, 11 percent; and dredges, 1 percent. The average number of men working in the industry decreased 5 percent from the 1950 figure; but productivity increased slightly, principally as a result of the relative increase in culm-bank output. The decline in production resulted in short working time at many operations, hence the average number of days worked in the industry was also lower than in 1950.

Statistical Trends.—Summary data on the Pennsylvania anthracite industry are given in tables 1, 2, and 3.

Anthracite Committee.—The Anthracite Standards Law of the Commonwealth of Pennsylvania, as amended May 18, 1949, was amended further by the General Assembly of the Commonwealth of Pennsylvania by an act approved September 26, 1951, to implement the enforcement provisions of the law. Under this act of the assem-

[1] All tonnage figures in this chapter are expressed in net tons of 2,000 pounds unless otherwise stated.

bly, the quality of each shipment of anthracite leaving a breaker or preparation plant by rail or truck for points within or outside the State of Pennsylvania must be attested as "standard" or "substandard" by a responsible officer of the shipping company. Inspectors of the Anthracite Committee were engaged throughout the year in sampling and testing shipments of coal to ascertain whether the product being shipped met fully the quality requirements of the law. Specifications for "standard" anthracite, approved by the Anthracite Committee and incorporated into the original act of the Pennsylvania General Assembly dated May 31, 1947, are shown in table 4.

The committee also continued to administer the Production Control Plan to regulate production so as to reduce uneconomic mining and waste of valuable natural resources. During 1951 the committee extended its efforts toward eliminating the "bootlegging" of anthracite.

Anthracite Institute.—The Anthracite Institute continued its extensive advertising campaigns in newspapers and trade journals in 1951. These programs were designed not only to retain present consumers of anthracite but to expand the market by stressing its advantages to architects, combustion engineers, and property-management interests. A weekly ½-hour television show of the home-hobby type was presented during the latter half of the year; over 11 stations covered the primary anthracite market areas. A special exhibit, featuring all types of modern anthracite-burning equipment, was featured at 30 local farm and home shows in 7 States and Canada.

The 16 field representatives of the institute continued to act as instructors in schools for retail dealers and their employees and as consultants to owners and property-management executives on fuel problems. The field representatives also spoke on the use of anthracite before many private and public audiences and, in many instances, advised local authorities on the promulgation of effective antismoke ordinances. Institute representatives appeared as witnesses before congressional, Federal, and State bodies on matters of concern to the industry.

The institute laboratory continued work on basic research problems and in testing and developing anthracite equipment. Projects on mining and utilization were carried out in cooperation with Pennsylvania State College and the U. S. Bureau of Mines. (*See* Technology section of this chapter.)

Labor Relations.—There were no general work stoppages in the anthracite industry during 1951, as relations between management and labor continued to be amicable throughout the year. A new contract between the United Mine Workers of America and the anthracite operators became effective on February 1, 1951, without interruption of work. The new agreement continued the provisions of the contract of March 16, 1950, and granted a further wage increase of $1.60 per day to the miners. The new contract provided for termination by either party on 60 days written notice, but in no event before March 31, 1952.

Sources and Acknowledgments.—Basic statistics of the Pennsylvania anthracite-mining industry in this chapter are prepared from a mail canvass of all known anthracite operations; about 99 percent of the tonnage is reported in this manner, and the remaining 1 percent is estimated from collateral evidence. The data on individual operations furnished by the producers are voluntary and confidential, as is customary in the statistical services of the Bureau of Mines. In assembling available detailed information, free use has been made of the pertinent statistics prepared by the Pennsylvania Department of Mines, the Anthracite Institute, the Anthracite Committee, and the Association of American Railroads; thanks are extended to all of them for their cordial and continued cooperation.

TABLE 1.—Salient statistics of the Pennsylvania anthracite industry, 1947–51

	1947	1948	1949	1950	1951 [1]
Production:					
Loaded at mines for shipment outside producing region:					
Breakers—net tons	[2] 48,073,153	47,816,627	35,653,628	37,658,864	36,204,268
Washeries—do	[2] 2,009,233	1,725,124	1,380,115	882,541	923,610
Dredges—do	970,027	941,441	655,753	488,739	379,460
Sold to local trade and used by employees—net tons	4,232,871	4,795,721	3,848,420	3,930,889	4,125,495
Used at collieries for power and heat—net tons	1,904,725	1,861,035	1,163,808	1,115,670	1,037,164
Total production—do	57,190,009	57,139,948	42,701,724	44,076,703	42,669,997
Value at breaker, washery, or dredge	$413,019,486	$467,051,800	$358,008,451	$392,398,006	$405,817,963
Average sales realization per net ton on breaker shipments:					
Domestic	$9.82	$11.05	$11.39	$11.94	$13.19
Steam	$4.32	$4.90	$5.05	$5.25	$5.48
Total all sizes	$7.65	$8.67	$8.90	$9.34	$9.94
Percent of total breaker shipments:					
Total domestic	60.4	61.3	60.6	61.1	57.8
Total steam	39.6	38.7	39.4	38.9	42.2
Producers' stocks at end of year [3]—net tons	702,109	963,839	975,457	1,268,300	982,396
Exports [4]—do	8,509,995	6,675,914	4,942,670	3,891,569	5,959,175
Imports [4]—do	10,350	945		18,289	26,812
Consumption (apparent)—do	48,200,000	50,200,000	37,700,000	39,900,000	37,000,000
Average number of days worked	259	265	195	211	208
Average number of men working	78,600	76,215	75,377	72,624	68,995
Output per man per day—net tons	2.78	2.81	2.87	2.83	2.97
Output per man per year—do	720	745	560	597	618
Quantity cut by machines—do	1,209,983	1,016,757	557,599	611,734	496,085
Quantity mined by stripping—do	12,603,545	13,352,874	10,376,808	11,833,934	11,135,990
Quantity loaded by machines underground—net tons	16,054,011	15,742,368	11,858,088	12,335,650	10,847,787
Distribution:					
Total receipts in New England [5]—net tons	4,737,946	4,862,834	3,445,543	3,677,738	3,174,473
Exports to Canada [4]—do	4,470,034	4,931,918	3,580,568	3,798,285	3,484,800
Loaded into vessels at Lake Erie [6]—net tons	936,040	1,125,050	611,888	[8] 611,409	460,776
Receipts at Duluth-Superior [7]—do	446,605	538,992	271,854	[8] 297,814	149,776

[1] Figures for 1951 are not strictly comparable with those for previous years. *See* the Production section for explanation.
[2] Small quantity of washery coal included with "Breakers."
[3] Anthracite Committee.
[4] U. S. Department of Commerce.
[5] Commonwealth of Massachusetts, Division of the Necessaries of Life; and Association of American Railroads.
[6] Ore and Coal Exchange, Cleveland, Ohio.
[7] U. S. Engineer, Duluth, Minn.
[8] Revised.

TABLE 2.—Statistical summary of monthly developments in the Pennsylvania anthracite industry in 1951

[All tonnage figures are net tons]

	January	February	March	April	May	June	July	August	September	October	November	December	Year 1951	Change from 1950 (percent)	Year 1950
Production (including mine fuel, local sales, and dredge coal)	4,316,000	3,621,000	2,244,000	2,675,000	3,723,000	3,848,000	2,847,000	3,612,000	3,267,000	4,675,000	4,129,000	3,713,000	[1]42,670,000	−3.2	44,077,000
Shipments (breakers and washeries only, all sizes):															
By rail [2]	3,296,112	2,591,249	1,694,164	2,181,675	2,993,141	3,200,769	2,459,078	3,076,630	2,798,655	3,597,464	3,193,912	2,771,121	33,853,970	−4.9	35,583,128
By truck [3]	748,886	678,371	534,370	414,363	456,736	413,452	259,890	398,198	403,066	616,714	683,881	703,899	6,311,826	−8.3	6,880,685
Carloadings [4]	65,872	53,136	33,645	41,182	58,180	61,974	48,292	60,789	52,893	68,576	61,265	53,764	659,568	−5.6	698,631
Distribution:															
Lake Erie loadings [5]				59,741	59,022	68,464	70,907	51,389	47,621	51,366	52,266		460,776	−24.6	[6]611,409
Lake Ontario loadings [7]				9,871	15,222		6,834	9,404	5,255	10,486	1,156		58,228	−65.1	166,811
Receipts at Duluth-Superior [8]				16,015	28,849	21,987	15,074	14,647	7,229	6,291	39,684		149,776	−49.7	[6]297,814
Upper Lake dock trade: [9]															
Receipts from lower-Lake docks:															
Lake Superior				16,015	28,859	22,174	15,073	14,647	22,687	6,291	38,196	1,525	165,467	−47.4	314,692
Lake Michigan	1,952	2,972	4,135	44,407	38,120	41,316	56,403	57,360	17,476	27,104	42,608	4,135	337,988	−10.8	379,008
Reloadings for final delivery:															
Lake Superior	25,280	19,929	11,111	2,329	6,168	7,801	11,668	16,922	33,519	34,864	27,774	20,632	217,997	−26.6	296,905
Lake Michigan	36,241	37,683	27,744	13,328	17,072	27,541	22,379	26,112	24,453	37,305	31,738	26,838	328,434	−15.8	389,857
New England Recipts:															
Tidewater [4]	3,275	1,682	892	11,573	3,429	5,844	2,750	839	1,037	4,632	268	2,902	39,123	−37.6	62,700
Rail [10]	338,388	268,070	166,772	150,846	270,269	268,093	241,849	310,124	213,828	300,310	313,492	293,309	3,135,350	−13.3	3,615,038
Exports [11]	374,389	323,230	197,117	226,805	413,838	475,131	526,289	605,128	705,921	891,695	636,612	583,020	5,959,175	+53.1	3,891,569
Imports [11]	5,363				4,991			2,877	4,956	5,855	2,770		26,812	+46.6	18,289
Industrial consumption and stocks:															
Railroads (class 1 only): [4]															
Consumption	83,979	74,704	76,105	55,050	45,415	41,070	38,533	41,540	40,770	48,081	62,550	70,432	678,229	−12.1	771,888
Stocks at end of month	65,939	59,592	53,430	51,994	46,746	53,333	45,412	47,689	52,067	54,656	48,986	49,097	49,097	−19.6	61,081
Electric utilities: [12]															
Consumption	330,779	291,212	317,697	299,357	329,450	331,825	307,696	330,264	314,064	347,370	333,966	335,832	3,869,512	+7.2	3,608,863
Stocks at end of month	4,693,955	4,682,189	4,663,495	4,705,503	4,826,797	4,924,946	4,976,659	5,046,997	5,092,108	5,156,564	5,277,605	5,125,369	5,125,369	+8.6	4,720,147
Stocks on Upper Lake docks at end of month: [9]															
Lake Superior	93,823	73,994	62,436	76,151	98,771	113,114	116,519	114,503	103,718	74,851	85,263	65,501	65,501	−45.0	119,078
Lake Michigan	88,844	54,133	30,522	61,299	82,347	96,087	130,111	161,359	154,382	144,181	155,051	132,289	132,289	+7.4	123,159
Stocks in retail dealer yards [13]	3,271,000	2,781,000	2,180,000	2,265,000	2,700,000	2,714,000	2,741,000	2,824,000	2,792,000	2,947,000	2,960,000	2,694,000	2,694,000	−22.0	3,452,000
Producers' stocks [14]	1,068,323	815,416	739,895	732,343	746,786	791,541	876,824	1,005,328	1,144,626	1,161,223	1,055,138	982,396	982,396	−22.5	1,268,300

Sales of mechanical stokers: [11]															
Class 1 (capacity under 61 lb. of coal per hour)	357	267	212	210	276	364	257	532	510	603	458	222	4,268	+1.8	4,191
Class 2 (capacity 61 to 100 lb. of coal per hour)	55	53	20	9	16	26	29	39	43	54	29	41	414	−15.0	487
Wholesale price indexes (1926=100): [15]															
On tracks, destination:															
Chestnut	143.3	155.1	154.7	151.0	149.0	150.6	151.6	153.2	155.4	155.4	155.7	156.0	152.6	+10.0	138.7
Pea	159.3	168.6	167.8	164.8	163.4	164.9	165.9	166.9	169.3	169.3	169.7	169.7	166.7	+6.6	156.4
Employee wages and hours: [15]															
Average weekly earnings	$71.33	$66.65	$50.68	$47.20	$66.67	$68.94	$79.50	$58.52	$60.36	$78.24	$81.84	$69.98	$66.60	+5.3	$63.24
Average hourly earnings	$1.987	$2.207	$2.194	$2.185	$2.215	$2.224	$2.252	$2.225	$2.219	$2.229	$2.224	$2.250	$2.198	+11.6	$1.970
Average number hours worked per week	35.9	30.2	23.1	21.6	30.1	31.0	35.3	26.3	27.2	35.1	36.8	31.1	30.3	−5.6	32.1

[1] *See* footnote 1, table 1.
[2] Furnished by Anthracite Institute.
[3] Pennsylvania Department of Mines.
[4] Association of American Railroads.
[5] Ore and Coal Exchange, Cleveland, Ohio.
[6] Revised.
[7] Buffalo Branch, Ore and Coal Exchange, Cleveland, Ohio.
[8] U. S. Engineer Office, Duluth, Minn.
[9] Includes all commercial docks on Lake Superior and west shore of Lake Michigan as far south as Kenosha. Based on data courteously supplied by Maher Coal Bureau and direct reports to the Bureau of Mines.
[10] Furnished by Commonwealth of Massachusetts, Division on the Necessaries of Life.
[11] U. S. Department of Commerce.
[12] Federal Power Commission.
[13] Estimated from monthly reports submitted by a select list of retail dealers.
[14] Anthracite Committee. Represents coal in storage nearest available date to the end of the month.
[15] Bureau of Labor Statistics.

TABLE 3.—Statistical trends in the Pennsylvania anthracite industry, 1926–51 [1]

Year	Production (net tons)	Value of production	Average value per net ton	Exports [2] (net tons)	Imports [2] (net tons)	Apparent consumption (net tons)	Average number of men working	Average number of days worked	Average tons per man per day	Average tons per man per year	Quantity cut by machines (net tons)	Quantity produced by stripping (net tons)	Quantity loaded mechanically underground [3] (net tons)
1926	84, 437, 452	$474, 164, 252	$5. 62	4, 029, 683	813, 956	77, 221, 000	165, 386	244	2. 09	511	931, 650	2, 401, 356	
1927	80, 095, 564	420, 941, 726	5. 26	3, 325, 507	119, 030	74, 672, 000	165, 259	225	2. 15	485	1, 171, 888	2, 153, 156	[4] 2, 223, 281
1928	75, 348, 069	393, 637, 690	5. 22	3, 336, 272	384, 707	73, 650, 000	160, 681	217	2. 17	469	1, 289, 809	2, 422, 924	[4] 2, 351, 074
1929	73, 828, 195	385, 642, 751	5. 22	3, 406, 369	487, 172	71, 457, 000	151, 501	225	2. 16	487	1, 159, 910	1, 911, 766	3, 470, 158
1930	69, 384, 837	354, 574, 191	5. 11	2, 551, 659	674, 812	67, 628, 000	150, 804	208	2. 21	460	1, 410, 123	2, 536, 288	4, 467, 750
1931	59, 645, 652	296, 354, 586	4. 97	1, 778, 308	637, 951	58, 408, 000	139, 431	181	2. 37	428	1, 587, 265	3, 813, 237	4, 384, 780
1932	49, 855, 221	222, 375, 129	4. 46	1, 303, 355	607, 097	50, 500, 000	121, 243	162	2. 54	411	1, 674, 223	3, 980, 973	5, 433, 340
1933	49, 541, 344	206, 718, 405	4. 17	1, 034, 562	456, 252	49, 600, 000	104, 633	182	2. 60	473	1, 648, 249	4, 932, 069	6, 557, 267
1934	57, 168, 291	244, 152, 245	4. 27	1, 297, 610	478, 118	55, 500, 000	109, 050	207	2. 53	524	1, 981, 088	5, 798, 138	9, 284, 486
1935	52, 158, 783	210, 130, 565	4. 03	1, 608, 549	571, 439	51, 100, 000	103, 269	189	2. 68	505	1, 848, 095	5, 187, 072	9, 279, 057
1936	54, 579, 535	227, 003, 538	4. 16	1, 678, 024	614, 639	53, 200, 000	102, 081	192	2. 79	535	2, 162, 744	6, 203, 267	10, 827, 946
1937	51, 856, 433	197, 598, 849	3. 81	1, 914, 173	395, 737	50, 400, 000	99, 085	189	2. 77	523	1, 984, 512	5, 696, 018	10, 683, 837
1938	46, 099, 027	180, 600, 167	3. 92	1, 908, 911	362, 895	45, 200, 000	96, 417	171	2. 79	478	1, 588, 407	5, 095, 341	10, 151, 669
1939	51, 487, 377	187, 175, 324	3. 64	2, 590, 000	298, 153	49, 700, 000	93, 138	183	3. 02	553	1, 881, 884	5, 486, 479	11, 773, 833
1940	51, 484, 640	205, 489, 814	3. 99	2, 667, 632	135, 436	49, 000, 000	91, 313	186	3. 02	562	1, 816, 483	6, 352, 700	12, 326, 000
1941	[5] 56, 368, 267	240, 275, 126	4. 26	3, 380, 189	74, 669	52, 700, 000	88, 054	203	[6] 3. 04	[6] 617	1, 855, 422	7, 316, 574	13, 441, 987
1942	[5] 60, 327, 729	271, 673, 380	4. 50	4, 438, 588	140, 115	56, 500, 000	82, 121	239	[6] 2. 95	[6] 705	2, 285, 640	9, 070, 933	14, 741, 459
1943	[5] 60, 643, 620	306, 816, 018	5. 06	4, 138, 680	166, 020	57, 100, 000	79, 153	270	[6] 2. 78	[6] 751	1, 624, 883	8, 989, 387	14, 745, 793
1944	[5] 63, 701, 363	354, 582, 884	5. 57	4, 185, 933	11, 847	59, 400, 000	77, 591	292	[6] 2. 79	[6] 815	1, 336, 082	10, 953, 030	14, 975, 146
1945	[5] 54, 933, 909	323, 944, 435	5. 90	3, 691, 247	149	51, 600, 000	72, 842	269	[6] 2. 79	[6] 751	1, 210, 171	10, 056, 325	13, 927, 955
1946	[5] 60, 506, 873	413, 417, 070	6. 83	6, 497, 245	9, 556	53, 900, 000	78, 145	271	[6] 2. 84	[6] 770	1, 232, 828	12, 858, 930	15, 619, 162
1947	[5] 57, 190, 009	413, 019, 456	7. 22	8, 509, 995	10, 350	48, 200, 000	78, 600	259	[6] 2. 78	[6] 720	1, 209, 983	12, 603, 545	16, 054, 011
1948	[5] 57, 139, 948	467, 051, 800	8. 17	6, 675, 914	945	50, 200, 000	76, 215	265	[6] 2. 81	[6] 745	1, 016, 757	13, 352, 874	15, 742, 368
1949	[5] 42, 701, 724	358, 008, 451	8. 38	4, 942, 670		37, 700, 000	75, 377	195	[6] 2. 87	[6] 560	557, 599	10, 376, 808	11, 858, 088
1950	[5] 44, 076, 703	392, 398, 006	8. 90	3, 891, 569	18, 289	39, 900, 000	72, 624	211	[6] 2. 83	[6] 597	611, 734	11, 833, 934	12, 335, 650
1951 [7]	42, 669, 997	405, 817, 963	9. 51	5, 959, 175	26, 812	37, 000, 000	68, 995	208	2. 97	618	496, 085	11, 135, 990	10, 847, 787

[1] "Bootleg" operations excluded, except as indicated in footnotes 5 and 6.
[2] U. S. Department of Commerce.
[3] Data first collected in 1929.
[4] As reported by the Commonwealth of Pennsylvania, Department of Mines.
[5] Includes some "bootleg" coal purchased by legitimate operators and prepared at their breakers.
[6] Calculated on legitimate tonnages only; "bootleg" purchases excluded.
[7] *See* footnote 1, table 1.

TABLE 4.—Standard anthracite specifications approved and adopted by the Anthracite Committee effective July 28, 1947 [1]

	Round test mesh, inches	Percent					
		Oversize, maximum	Undersize [2]		Maximum impurities [3]		
			Maximum	Minimum	Slate [4]	Bone or ash [5]	
Broken	Through 4⅜				1½	2	11
	Over 3¼ to 3		15	7½			
Egg	Through 3¼ to 3	5			1½	2	11
	Over 2 7/16		15	7½			
Stove	Through 2 7/16	7½			2	3	11
	Over 1⅝		15	7½			
Chestnut	Through 1⅝	7½			3	4	11
	Over 13/16		15	7½			
Pea	Through 13/16	10			4	5	12
	Over 9/16		15	7½			
Buckwheat No. 1	Through 9/16	10					13
	Over 5/16		15	7½			
Buckwheat No. 2 (Rice)	Through 5/16	10					13
	Over 3/16		17	7½			
Buckwheat No. 3 (Barley)	Through 3/16	10					15
	Over 3/32		20	10			
Buckwheat No. 4	Through 3/32	20					15
	Over 3/64		30	10			
Buckwheat No. 5	Through 3/64	30	No limit				16

[1] A tolerance of 1 percent is allowed on the maximum percentage of undersize and the maximum percentage of ash content.
[2] The maximum percentage of undersize is applicable only to anthracite as it is produced at the preparation plant.
[3] When slate content in the sizes from Broken to Chestnut, inclusive, is less than these standards, bone content may be increased by 1½ times the decrease in the slate content under the allowable limits, but specified slate content shall not be exceeded in any event.
[4] "Slate" is defined as any material that has less than 40 percent fixed carbon.
[5] "Bone" is defined as any material that has 40 percent or more, but less than 75 percent fixed carbon. Ash determinations are on a dry basis.

PRODUCTION

The production of Pennsylvania anthracite totaled 42,669,997 tons in 1951. Included for the first time in 1951 are 1,544,076 tons prepared by independent operators. It was not considered advisable until 1951 (by which time illegal mining had been eliminated, largely by legal agreements made with the owners of the coal lands) to include the production of the independents owing to inadequate coverage. Information available on the activities of the independents, formerly called "bootleggers," who began operating during the depression years of the 1930's on lands neither owned nor leased by them, has been presented in previous chapters of the Minerals Yearbook. Inasmuch as the independent mining is centered in the Schuylkill region, inclusion of the independent tonnage will have no effect upon data for the Wyoming and Lehigh regions; however, such inclusion does preclude any direct comparison between total industry and Schuylkill region data for 1951 with that published for prior years. For example, if the independent tonnage were not included, the decrease between production in 1950 and 1951 would have been 7 percent rather than the 3 percent indicated by the totals shown for the two years. A small tonnage (28,762 tons) of Sullivan County semianthracite is also included in the 1951 output.

TABLE 5.—Pennsylvania anthracite produced, 1947–51, by field and type of plant, in net tons

[The figures of breaker product include a certain quantity of culm-bank coal, which amounted to 3,597,368 tons in 1951]

Field and type of plant	1947	1948	1949	1950	1951 [1]
Eastern Middle:					
Breakers	4,270,240	4,467,628	3,379,672	3,094,587	3,063,131
Washeries	315,014	298,601	238,532	195,387	243,744
Total Eastern Middle	4,585,254	4,766,229	3,618,204	3,289,974	3,306,875
Western Middle:					
Breakers	12,147,528	12,405,178	9,636,954	10,755,416	12,371,387
Washeries	591,652	240,157	135,670	----------	11,709
Dredges	411,804	311,183	246,905	197,812	122,732
Total Western Middle	13,150,984	12,956,518	10,019,529	10,953,228	12,505,828
Southern:					
Breakers	11,643,971	11,622,538	8,776,671	8,660,440	8,245,800
Washeries	237,131	496,194	484,595	439,934	556,142
Dredges	796,174	664,350	603,217	406,002	431,836
Total Southern	12,677,276	12,783,082	9,864,483	9,506,376	9,233,778
Northern:					
Breakers	25,831,439	25,839,648	18,579,955	19,930,556	17,366,517
Washeries	890,368	719,676	584,463	354,129	221,237
Dredges	11,728	12,471	15,000	15,750	7,000
Total Northern	26,733,535	26,571,795	19,179,418	20,300,435	17,594,754
Total, excluding Sullivan County:					
Breakers	53,893,178	54,334,992	40,373,252	42,440,999	41,046,835
Washeries	2,034,165	1,754,628	1,443,260	989,450	1,032,832
Dredges	1,219,706	988,004	865,122	619,564	561,568
Total, excluding Sullivan County	57,147,049	57,077,624	42,681,634	44,050,013	42,641,235
Sullivan County: [2]					
Breakers	[3] 42,960	62,324	20,090	26,690	28,762
Washeries	([3])	----------	----------	----------	----------
Total Sullivan County	42,960	62,324	20,090	26,690	28,762
Grand total	57,190,009	57,139,948	42,701,724	44,076,703	42,669,997

[1] *See* footnote 1, table 1.
[2] For purposes of historical comparison and statistical convenience, the mines of Sullivan County are grouped with the Pennsylvania anthracite region, although the product is classified as semianthracite according to the American Society for Testing Materials Tentative Standard.
[3] Small quantity of washery coal included with "Breakers."

Breakers and Washeries.—Run-of-mine anthracite ranges in size from large lumps to the finest dust and contains such impurities as slate and rock. The exacting requirements of the market necessitate thorough cleaning of this material. The modern breaker is equipped with complete crushing and screening equipment for breaking down the larger masses of coal and for separating the crushed coal into the several sizes. By various means, such as washing, the use of jigs and tables, froth flotation, and heavy-medium separators, all foreign bodies are removed from the coal and the ash, slate, and bone content brought within the specification limits for "standard" anthracite.

The smaller sizes of anthracite have been used as fuel only since the turn of the century, as the equipment to burn them efficiently was not available. In the early years many millions of tons of the smaller particles of coal had been dumped with the mine and breaker refuse into large culm or refuse banks. With development of the necessary burning equipment, the use of the smaller sizes increased so rapidly that current production was insufficient to supply the demand. Washeries, or small preparation plants equipped with washing and screening facilities, were erected near the culm banks to recover the coal contained in them, thus depleting many of the banks of marketable coal. As little coal of the fine sizes currently produced is lost in the refuse, the culm banks will cease to be an important source of anthracite in the near future.

TABLE 6.—Pennsylvania anthracite shipped outside producing region, sold locally, and used as colliery fuel in 1951, by regions

Region and type of plant	Shipments outside region		Local sales		Colliery fuel		Total	
	Net tons	Value [1]	Net tons	Value	Net tons	Value	Net tons	Value [1]
Lehigh:								
Breakers	5,867,294	$57,782,420	406,366	$4,326,206	155,339	$1,058,406	6,428,999	$63,167,032
Washeries	274,404	837,410					274,404	837,410
Dredges	25,344	67,573					25,344	67,573
Total Lehigh	6,167,042	58,687,403	406,366	4,326,206	155,339	1,058,406	6,728,747	64,072,015
Schuylkill:								
Breakers	15,905,112	140,296,101	1,158,593	9,867,928	187,614	542,162	17,251,319	150,706,191
Washeries	533,434	1,729,290	2,820	15,025	937	1,575	537,191	1,745,890
Dredges	354,116	1,061,484	175,108	431,769			529,224	1,493,253
Total Schuylkill	16,792,662	143,086,875	1,336,521	10,314,722	188,551	543,737	18,317,734	153,945,334
Wyoming:								
Breakers	14,412,847	161,471,354	2,260,396	22,483,502	693,274	2,924,405	17,366,517	186,879,261
Washeries	115,772	358,738	105,465	300,166			221,237	658,904
Dredges			7,000	15,750			7,000	15,750
Total Wyoming	14,528,619	161,830,092	2,372,861	22,799,418	693,274	2,924,405	17,594,754	187,553,915
Total, excluding Sullivan County:								
Breakers	36,185,253	359,549,875	3,825,355	36,677,636	1,036,227	4,524,973	41,046,835	400,752,484
Washeries	923,610	2,925,438	108,285	315,191	937	1,575	1,032,832	3,242,204
Dredges	379,460	1,129,057	182,108	447,519			561,568	1,576,576
Total	37,488,323	363,604,370	4,115,748	37,440,346	1,037,164	4,526,548	42,641,235	405,571,264
Sullivan County: Breakers	19,015	151,974	9,747	94,725			28,762	246,699
Grand total:								
1951	37,507,338	363,756,344	4,125,495	37,535,071	1,037,164	4,526,548	42,669,997	405,817,963
1950	39,030,144	355,763,579	3,930,889	32,548,520	1,115,670	4,085,907	44,076,703	392,398,006
Change, percent	−3.9	+2.2	+5.0	+15.3	−7.0	+10.8	−3.2	+3.4

[1] Value given for shipments is value at which coal left possession of producing company and does not include margins of separately incorporated sales companies.

TABLE 7.—Pennsylvania anthracite produced in 1951, classified as fresh-mined, culm-bank, and river coal, and as breaker, washery, and dredge product, by regions, in net tons

Region and type of plant	From mines			From culm banks	From river dredging	Total
	Underground		Strip pits			
	Mechanically loaded	Hand loaded				
Lehigh:						
Breakers	347,686	3,740,257	2,048,847	292,209	----------	6,428,999
Washeries	----------	----------	----------	274,404	----------	274,404
Dredges	----------	----------	----------	----------	25,344	25,344
Total Lehigh	347,686	3,740,257	2,048,847	566,613	25,344	6,728,747
Schuylkill:						
Breakers	1,129,370	6,651,190	6,429,155	3,041,604	----------	17,251,319
Washeries	----------	----------	----------	537,191	----------	537,191
Dredges	----------	----------	----------	----------	529,224	529,224
Total Schuylkill	1,129,370	6,651,190	6,429,155	3,578,795	529,224	18,317,734
Wyoming:						
Breakers	9,370,731	5,074,243	2,657,988	263,555	----------	17,366,517
Washeries	----------	----------	----------	221,237	----------	221,237
Dredges	----------	----------	----------	----------	7,000	7,000
Total Wyoming	9,370,731	5,074,243	2,657,988	484,792	7,000	17,594,754
Total, excluding Sullivan County:						
Breakers	10,847,787	15,465,690	11,135,990	3,597,368	----------	41,046,835
Washeries	----------	----------	----------	1,032,832	----------	1,032,832
Dredges	----------	----------	----------	----------	561,568	561,568
Total	10,847,787	15,465,690	11,135,990	4,630,200	561,568	42,641,235
Sullivan County:						
Breakers	----------	28,762	----------	----------	----------	28,762
Grand total	10,847,787	15,494,452	11,135,990	4,630,200	561,568	42,669,997

TABLE 8.—Pennsylvania anthracite produced in 1951, classified as fresh-mined, culm-bank, and river coal, and as breaker, washery, and dredge product, by fields, in net tons

Field and type of plant	From mines			From culm banks	From river dredging	Total
	Underground		Strip pits			
	Mechanically loaded	Hand loaded				
Eastern Middle:						
Breakers	347,686	1,338,293	1,270,088	107,064	----------	3,063,131
Washeries	----------	----------	----------	243,744	----------	243,744
Total Eastern Middle	347,686	1,338,293	1,270,088	350,808	----------	3,306,875
Western Middle:						
Breakers	727,573	4,608,729	4,508,941	2,526,144	----------	12,371,387
Washeries	----------	----------	----------	11,709	----------	11,709
Dredges	----------	----------	----------	----------	122,732	122,732
Total Western Middle	727,573	4,608,729	4,508,941	2,537,853	122,732	12,505,828
Southern:						
Breakers	401,797	4,444,425	2,698,973	700,605	----------	8,245,800
Washeries	----------	----------	----------	556,142	----------	556,142
Dredges	----------	----------	----------	----------	431,836	431,836
Total Southern	401,797	4,444,425	2,698,973	1,256,747	431,836	9,233,778
Northern:						
Breakers	9,370,731	5,074,243	2,657,988	263,555	----------	17,366,517
Washeries	----------	----------	----------	221,237	----------	221,237
Dredges	----------	----------	----------	----------	7,000	7,000
Total Northern	9,370,731	5,074,243	2,657,988	484,792	7,000	17,594,754
Total, excluding Sullivan County:						
Breakers	10,847,787	15,465,690	11,135,990	3,597,368	----------	41,046,835
Washeries	----------	----------	----------	1,032,832	----------	1,032,832
Dredges	----------	----------	----------	----------	561,568	561,568
Total	10,847,787	15,465,690	11,135,990	4,630,200	561,568	42,641,235
Sullivan County: Breakers	----------	28,762	----------	----------	----------	28,762
Grand total	10,847,787	15,494,452	11,135,990	4,630,200	561,568	42,669,997

TABLE 9.—Pennsylvania anthracite produced in 1951, by counties

County	Shipments outside producing region		Sold to local trade		Colliery fuel		Total production	
	Net tons	Value [1]	Net tons	Value	Net tons	Value	Net tons	Value [1]
Carbon	1,596,726	$15,215,874	32,657	$343,841	41,384	$362,793	1,670,767	$15,922,508
Columbia	747,833	8,007,648	39,237	307,883	16,525	48,289	803,595	8,363,820
Dauphin, Susquehanna, and Wayne	166,007	710,617	138,707	370,149	----------	----------	304,714	1,080,766
Lackawanna	4,449,718	48,578,221	959,905	9,786,763	324,159	1,274,195	5,733,782	59,639,179
Lancaster, Lebanon, Northampton, and Snyder [2]	250,870	697,177	15,476	50,361	----------	----------	266,346	747,538
Luzerne	12,354,973	135,832,285	1,658,101	15,632,151	447,454	2,051,318	14,460,528	153,515,754
Northumberland	5,241,481	42,745,403	461,789	3,556,467	39,013	96,367	5,742,283	46,398,237
Schuylkill	12,680,715	111,817,145	809,876	7,392,731	168,629	693,586	13,659,220	119,903,462
Sullivan	19,015	151,974	9,747	94,725	----------	----------	28,762	246,699
Total	37,507,338	363,756,344	4,125,495	37,535,071	1,037,164	4,526,548	42,669,997	405,817,963

[1] Value given for shipments is value at which coal left possession of producing company and does not include margins of separately incorporated sales companies.
[2] Counties producing dredge coal only.

TABLE 10.—Pennsylvania anthracite shipped in 1951, by region and size

Size	Breaker shipments [1]								
	Lehigh region			Schuylkill region			Wyoming region		
	Outside region	Local sales	Total	Outside region	Local sales	Total	Outside region	Local sales	Total
NET TONS									
Lump [2] and Broken	58,451	121	58,572	66,415	2,052	68,467	133,954	25,946	159,900
Egg	216,262	385	216,647	575,005	1,991	576,996	561,206	3,394	564,600
Stove	1,180,495	14,116	1,194,611	2,570,145	93,654	2,663,799	4,010,622	85,456	4,096,078
Chestnut	1,314,497	99,050	1,413,547	3,123,385	232,842	3,356,227	4,411,323	406,609	4,817,932
Pea	452,098	135,557	587,655	1,270,559	247,469	1,518,028	956,497	758,763	1,715,260
Total domestic	3,221,803	249,229	3,471,032	7,605,509	578,008	8,183,517	10,073,602	1,280,168	11,353,770
Buckwheat No. 1	771,995	65,600	837,595	2,241,908	145,738	2,387,646	1,880,411	429,982	2,310,393
Buckwheat No. 2 (Rice)	470,811	73,073	543,884	1,422,230	105,286	1,527,516	946,335	275,346	1,221,681
Buckwheat No. 3 (Barley)	544,461	18,464	562,925	2,093,482	94,595	2,188,077	1,104,942	210,253	1,315,195
Buckwheat No. 4	430,009		430,009	1,195,084	230,456	1,425,540	231,660	7,037	238,697
Other (including silt)	428,215		428,215	1,346,899	4,510	1,351,409	175,897	57,610	233,507
Total steam	2,645,491	157,137	2,802,628	8,299,603	580,585	8,880,188	4,339,245	980,228	5,319,473
Grand total	5,867,294	406,366	6,273,660	15,905,112	1,158,593	17,063,705	14,412,847	2,260,396	16,673,243
VALUE									
Lump [2] and Broken	$775,098	$1,620	$776,718	$884,081	$27,882	$911,963	$1,736,528	$331,948	$2,068,476
Egg	2,921,622	5,630	2,927,252	7,707,443	27,353	7,734,796	7,445,497	47,600	7,493,097
Stove	16,509,055	193,704	16,702,759	34,658,035	1,242,606	35,900,641	55,300,437	1,217,866	56,518,303
Chestnut	18,346,734	1,432,646	19,779,380	41,585,503	3,133,139	44,718,642	60,069,825	5,787,397	65,857,222
Pea	4,931,255	1,563,915	6,495,170	12,708,928	2,560,133	15,269,061	10,159,748	8,584,700	18,744,448
Total domestic	43,483,764	3,197,515	46,681,279	97,543,990	6,991,113	104,535,103	134,712,035	15,969,511	150,681,546

Buckwheat No. 1	5,931,028	538,245	6,469,273	16,542,529	1,088,838	17,631,367	14,202,185	3,492,153	17,694,338
Buckwheat No. 2 (Rice)	2,850,264	493,192	3,343,456	8,203,383	587,522	8,790,905	5,713,173	1,775,228	7,488,401
Buckwheat No. 3 (Barley)	2,584,156	97,254	2,681,410	9,580,888	419,399	10,000,287	5,403,901	1,080,996	6,484,897
Buckwheat No. 4	1,603,869		1,603,869	4,098,054	770,611	4,868,665	912,518	28,083	940,601
Other (including silt)	1,329,339		1,329,339	4,327,257	10,445	4,337,702	527,542	137,531	665,073
Total steam	14,298,656	1,128,691	15,427,347	42,752,111	2,876,815	45,628,926	26,759,319	6,513,991	33,273,310
Grand total	57,782,420	4,326,206	62,108,626	140,296,101	9,867,928	150,164,029	161,471,354	22,483,502	183,954,856
AVERAGE VALUE PER TON									
Lump[2] and Broken	$13.26	$13.39	$13.26	$13.31	$13.59	$13.32	$12.96	$12.79	$12.94
Egg	13.51	14.62	13.51	13.40	13.74	13.41	13.27	14.02	13.27
Stove	13.98	13.72	13.98	13.48	13.27	13.48	13.79	14.25	13.80
Chestnut	13.96	14.46	13.99	13.31	13.46	13.32	13.62	14.23	13.67
Pea	10.91	11.54	11.05	10.00	10.35	10.06	10.62	11.31	10.93
Total domestic	13.50	12.83	13.45	12.83	12.10	12.77	13.37	12.47	13.27
Buckwheat No. 1	7.68	8.20	7.72	7.38	7.47	7.38	7.55	8.12	7.66
Buckwheat No. 2 (Rice)	6.05	6.75	6.15	5.77	5.58	5.76	6.04	6.45	6.13
Buckwheat No. 3 (Barley)	4.75	5.27	4.76	4.58	4.43	4.57	4.89	5.14	4.93
Buckwheat No. 4	3.73		3.73	3.43	3.34	3.42	3.94	3.99	3.94
Other (including silt)	3.10		3.10	3.21	2.32	3.21	3.00	2.39	2.85
Total steam	5.40	7.18	5.50	5.15	4.96	5.14	6.17	6.65	6.26
Grand total	9.85	10.65	9.90	8.82	8.52	8.80	11.20	9.95	11.03

For footnotes, see end of table.

TABLE 10.—Pennsylvania anthracite shipped in 1951, by region and size—Continued

Size	Breaker shipments [1]—Continued								
	Sullivan County			Total					
				Excluding Sullivan County			Including Sullivan County		
	Outside region	Local sales	Total	Outside region	Local sales	Total	Outside region	Local sales	Total
NET TONS									
Lump [2] and Broken				258,820	28,119	286,939	258,820	28,119	286,939
Egg				1,352,473	5,770	1,358,243	1,352,473	5,770	1,358,243
Stove	1,876	1,250	3,126	7,761,262	193,226	7,954,488	7,763,138	194,476	7,957,614
Chestnut	3,806	2,538	6,344	8,849,205	738,501	9,587,706	8,853,011	741,039	9,594,050
Pea	2,936	2,936	5,872	2,679,154	1,141,789	3,820,943	2,682,090	1,144,725	3,826,815
Total domestic	8,618	6,724	15,342	20,900,914	2,107,405	23,008,319	20,909,532	2,114,129	23,023,661
Buckwheat No. 1	2,376	1,018	3,394	4,894,314	641,320	5,535,634	4,896,690	642,338	5,539,028
Buckwheat No. 2 (Rice)	8,021		8,021	2,839,376	453,705	3,293,081	2,847,397	453,705	3,301,102
Buckwheat No. 3 (Barley)				3,742,885	323,312	4,066,197	3,742,885	323,312	4,066,197
Buckwheat No. 4				1,856,753	237,493	2,094,246	1,856,753	237,493	2,094,246
Other (including silt)		2,005	2,005	1,951,011	62,120	2,013,131	1,951,011	64,125	2,015,136
Total steam	10,397	3,023	13,420	15,284,339	1,717,950	17,002,289	15,294,736	1,720,973	17,015,709
Grand total	19,015	9,747	28,762	36,185,253	3,825,355	40,010,608	36,204,268	3,835,102	40,039,370
VALUE									
Lump [2] and Broken				$3,395,707	$361,450	$3,757,157	$3,395,707	$361,450	$3,757,157
Egg				18,074,562	80,583	18,155,145	18,074,562	80,583	18,155,145
Stove	$23,563	$15,708	$39,271	106,467,527	2,654,176	109,121,703	106,491,090	2,669,884	109,160,974
Chestnut	50,018	33,345	83,363	120,002,062	10,353,182	130,355,244	120,052,080	10,386,527	130,438,607
Pea	30,341	30,331	60,672	27,799,931	12,708,748	40,508,679	27,830,272	12,739,079	40,569,351
Total domestic	103,922	79,384	183,306	275,739,789	26,158,139	301,897,928	275,843,711	26,237,523	302,081,234

Buckwheat No. 1	17,548	7,521	25,069	36,675,742	5,119,236	41,794,978	36,693,290	5,126,757	41,820,047
Buckwheat No. 2 (Rice)	30,504		30,504	16,766,820	2,855,942	19,622,762	16,797,324	2,855,942	19,653,266
Buckwheat No. 3 (Barley)				17,568,945	1,597,649	19,166,594	17,568,945	1,597,649	19,166,594
Buckwheat No. 4				6,614,441	798,694	7,413,135	6,614,441	798,694	7,413,135
Other (including silt)		7,820	7,820	6,184,138	147,976	6,332,114	6,184,138	155,796	6,339,934
Total steam	48,052	15,341	63,393	83,810,086	10,519,497	94,329,583	83,858,138	10,534,838	94,392,976
Grand total	151,974	94,725	246,699	359,549,875	36,677,636	396,227,511	359,701,849	36,772,361	396,474,210
AVERAGE VALUE PER TON									
Lump [2] and Broken				$13.12	$12.85	$13.09	$13.12	$12.85	$13.09
Egg				13.36	13.97	13.37	13.36	13.97	13.37
Stove	$12.56	$12.57	$12.56	13.72	13.74	13.72	13.72	13.73	13.72
Chestnut	13.14	13.14	13.14	13.56	14.02	13.60	13.56	14.02	13.60
Pea	10.33	10.33	10.33	10.38	11.13	10.60	10.38	11.13	10.60
Total domestic	12.06	11.81	11.95	13.19	12.41	13.12	13.19	12.41	13.12
Buckwheat No. 1	7.39	7.39	7.39	7.49	7.98	7.55	7.49	7.98	7.55
Buckwheat No. 2 (Rice)	3.80		3.80	5.91	6.29	5.96	5.90	6.29	5.95
Buckwheat No. 3 (Barley)				4.69	4.94	4.71	4.69	4.94	4.71
Buckwheat No. 4				3.56	3.36	3.54	3.56	3.36	3.54
Other (including silt)		3.90	3.90	3.17	2.38	3.15	3.17	2.43	3.15
Total steam	4.62	5.07	4.72	5.48	6.12	5.55	5.48	6.12	5.55
Grand total	7.99	9.72	8.58	9.94	9.59	9.90	9.94	9.59	9.90

For footnotes, see end of table

TABLE 10.—Pennsylvania anthracite shipped in 1951, by region and size—Continued

Size	Washery shipments			Dredge shipments			Grand total		
	Outside region	Local sales	Total	Outside region	Local sales	Total	Outside region	Local sales	Total
NET TONS									
Lump [2] and Broken							258,820	28,119	286,939
Egg							1,352,473	5,770	1,358,243
Stove							7,763,138	194,476	7,957,614
Chestnut	445	590	1,035				8,853,456	741,629	9,595,085
Pea	255	173	428		250	250	2,682,345	1,145,148	3,827,493
Total domestic	700	763	1,463		250	250	20,910,232	2,115,142	23,025,374
Buckwheat No. 1	8,898	80	8,978	135	518	653	4,905,723	642,936	5,548,659
Buckwheat No. 2 (Rice)	10,149	160	10,309	158	2,098	2,256	2,857,704	455,963	3,313,667
Buckwheat No. 3 (Barley)	78,560	50	78,610	71,023	15,023	86,046	3,892,468	338,385	4,230,853
Buckwheat No. 4	462,060	40,000	502,060	74,012	19,788	93,800	2,392,825	297,281	2,690,106
Other (including silt)	363,243	67,232	430,475	234,132	144,431	378,563	2,548,386	275,788	2,824,174
Total steam	922,910	107,522	1,030,432	379,460	181,858	561,318	16,597,106	2,010,353	18,607,459
Grand total	923,610	108,285	1,031,895	379,460	182,108	561,568	37,507,338	4,125,495	41,632,833
VALUE									
Lump [2] and Broken							$3,395,707	$361,450	$3,757,157
Egg							18,074,562	80,583	18,155,145
Stove							106,491,090	2,669,884	109,160,974
Chestnut	$4,895	$6,490	$11,385				120,056,975	10,393,017	130,449,992
Pea	2,295	1,557	3,852		$1,750	$1,750	27,832,567	12,742,386	40,574,953
Total domestic	7,190	8,047	15,237		1,750	1,750	275,850,901	26,247,320	302,098,221

Buckwheat No. 1	51,421	520	51,941	$1,006	2,674	3,680	36,745,717	5,129,951	41,875,668
Buckwheat No. 2 (Rice)	53,851	928	54,779	832	5,964	6,796	16,852,007	2,862,834	19,714,841
Buckwheat No. 3 (Barley)	361,676	230	361,906	242,295	41,875	284,170	18,172,916	1,639,754	19,812,670
Buckwheat No. 4	1,355,640	90,000	1,445,640	211,931	60,732	272,663	8,182,012	949,426	9,131,438
Other (including silt)	1,095,660	215,466	1,311,126	672,993	334,524	1,007,517	7,952,791	705,786	8,658,577
Total steam	2,918,248	307,144	3,225,392	1,129,057	445,769	1,574,826	87,905,443	11,287,751	99,193,194
Grand total	2,925,438	315,191	3,240,629	1,129,057	447,519	1,576,576	363,756,344	37,535,071	401,291,415
AVERAGE VALUE PER TON									
Lump [2] and Broken							$13.12	$12.85	$13.09
Egg							13.36	13.97	13.37
Stove							13.72	13.73	13.72
Chestnut	$11.00	$11.00	$11.00				13.56	14.01	13.60
Pea	9.00	9.00	9.00		$7.00	$7.00	10.38	11.13	10.60
Total domestic	10.27	10.55	10.41		7.00	7.00	13.19	12.41	13.12
Buckwheat No. 1	5.78	6.50	5.79	$7.45	5.16	5.64	7.49	7.98	7.55
Buckwheat No. 2 (Rice)	5.31	5.80	5.31	5.27	2.84	3.01	5.90	6.28	5.95
Buckwheat No. 3 (Barley)	4.60	4.60	4.60	3.41	2.79	3.30	4.67	4.85	4.68
Buckwheat No. 4	2.93	2.25	2.88	2.86	3 07	2.91	3.42	3.19	3.39
Other (including silt)	3.02	3.20	3.05	2.87	2.32	2.66	3.12	2.56	3.07
Total steam	3.16	2.86	3.13	2.98	2.45	2.81	5.30	5.61	5.33
Grand total	3.17	2.91	3.14	2.98	2.46	2.81	9.70	9.10	9.64

[1] Figures of shipments from breakers include some culm-bank coal handled in breakers.
[2] Quantity of Lump included is insignificant.

TABLE 11.—Sizes of Pennsylvania anthracite shipped from breakers to points outside and inside producing area in 1951, by regions, in percent of total

[Note that shipments of dredge and washery coal are not included]

Size	Percent of total shipments								
	Lehigh region			Schuylkill region			Wyoming region		
	Shipped outside region	Local sales	Total	Shipped outside region	Local sales	Total	Shipped outside region	Local sales	Total
Lump [1] and Broken	1.0	[2]	0.9	0.4	0.2	0.4	0.9	1.1	0.9
Egg	3.7	.1	3.5	3.6	.2	3.4	3.9	.2	3.4
Stove	20.1	3.4	19.0	16.2	8.1	15.6	27.8	3.8	24.6
Chestnut	22.4	24.4	22.5	19.6	20.1	19.7	30.7	18.0	28.9
Pea	7.7	33.4	9.4	8.0	21.3	8.9	6.6	33.5	10.3
Total domestic	54.9	61.3	55.3	47.8	49.9	48.0	69.9	56.6	68.1
Buckwheat No. 1	13.2	16.1	13.4	14.1	12.6	14.0	13.0	19.0	13.9
Buckwheat No. 2 (Rice)	8.0	18.0	8.7	8.9	9.1	8.9	6.6	12.2	7.3
Buckwheat No. 3 (Barley)	9.3	4.6	9.0	13.2	8.1	12.8	7.7	9.3	7.9
Buckwheat No. 4	7.3	-------	6.8	7.5	19.9	8.4	1.6	.3	1.4
Other (including silt)	7.3	-------	6.8	8.5	.4	7.9	1.2	2.6	1.4
Total steam	45.1	38.7	44.7	52.2	50.1	52.0	30.1	43.4	31.9
All sizes	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Size	Sullivan County			Total					
				Excluding Sullivan County			Including Sullivan County		
Lump [1] and Broken	-------	-------	-------	0.7	0.7	0.7	0.7	0.7	0.7
Egg	-------	-------	-------	3.7	.2	3.4	3.7	.2	3.4
Stove	9.9	12.8	10.9	21.5	5.1	19.9	21.5	5.1	19.9
Chestnut	20.0	26.1	22.0	24.5	19.3	24.0	24.5	19.3	24.0
Pea	15.4	30.1	20.4	7.4	29.8	9.5	7.4	29.8	9.5
Total domestic	45.3	69.0	53.3	57.8	55.1	57.5	57.8	55.1	57.5
Buckwheat No. 1	12.5	10.4	11.8	13.5	16.8	13.9	13.5	16.8	13.8
Buckwheat No. 2 (Rice)	42.2	-------	27.9	7.9	11.9	8.2	7.9	11.8	8.3
Buckwheat No. 3 (Barley)	-------	-------	-------	10.3	8.4	10.2	10.3	8.4	10.2
Buckwheat No. 4	-------	-------	-------	5.1	6.2	5.2	5.1	6.2	5.2
Other (including silt)	-------	20.6	7.0	5.4	1.6	5.0	5.4	1.7	5.0
Total steam	54.7	31.0	46.7	42.2	44.9	42.5	42.2	44.9	42.5
All sizes	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

[1] Quantity of Lump included is insignificant.

[2] Less than 0.05 percent.

TABLE 12.—Sizes of Pennsylvania anthracite shipped from breakers to points outside producing region, 1947–51, by regions, in percent of total

[Note that shipments of dredge and washery coal are not included]

Size	Percent of total shipments									
	Lehigh region					Schuylkill region				
	1947	1948	1949	1950	1951	1947	1948	1949	1950	1951 [1]
Lump [2] and Broken	0.7	0.8	0.4	0.4	1.0	0.7	0.7	0.3	0.2	0.4
Egg	5.0	5.7	2.9	3.6	3.7	5.3	5.8	3.1	3.5	3.6
Stove	20.0	20.5	20.6	22.0	20.1	15.9	16.5	17.5	18.1	16.2
Chestnut	21.7	21.6	22.8	22.7	22.4	21.2	21.0	22.3	22.4	19.6
Pea	8.2	8.2	7.7	7.9	7.7	7.6	8.0	8.3	7.9	8.0
Total domestic	55.6	56.8	54.4	56.6	54.9	50.7	52.0	51.5	52.1	47.8
Buckwheat No. 1	13.5	13.0	13.1	13.5	13.2	14.1	14.0	14.2	14.6	14.1
Buckwheat No. 2 (Rice)	8.7	8.6	8.1	7.9	8.0	8.6	8.7	8.9	8.6	8.9
Buckwheat No. 3 (Barley)	10.1	9.3	9.7	9.8	9.3	14.6	14.4	12.6	11.9	13.2
Buckwheat No. 4	5.6	6.4	7.9	6.1	7.3	9.0	6.8	6.3	6.2	7.5
Other (including silt)	6.5	5.9	6.8	6.1	7.3	3.0	4.1	6.5	6.6	8.5
Total steam	44.4	43.2	45.6	43.4	45.1	49.3	48.0	48.5	47.9	52.2
All sizes	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Size	Wyoming region					Sullivan County				
Lump [2] and Broken	0.3	0.2	0.2	0.3	0.9	------	------	------	------	------
Egg	6.5	6.3	3.4	3.3	3.9	------	------	------	------	------
Stove	27.0	28.3	29.4	29.3	27.8	8.5	20.5	32.0	15.1	9.9
Chestnut	29.5	29.4	31.7	31.2	30.7	29.7	30.9	38.0	25.5	20.0
Pea	6.8	6.5	6.7	6.6	6.6	15.4	10.9	10.0	20.5	15.4
Total domestic	70.1	70.7	71.4	70.7	69.9	53.6	62.3	80.0	61.1	45.3
Buckwheat No. 1	13.1	12.7	13.4	13.3	13.0	10.2	8.0	2.1	16.4	12.5
Buckwheat No. 2 (Rice)	6.5	6.8	7.0	7.0	6.6	.6	------	------	------	42.2
Buckwheat No. 3 (Barley)	6.8	6.5	6.0	6.7	7.7	------	------	------	------	------
Buckwheat No. 4	1.7	1.4	1.1	1.2	1.6	------	------	------	------	------
Other (including silt)	1.8	1.9	1.1	1.1	1.2	35.6	29.7	17.9	22.5	------
Total steam	29.9	29.3	28.6	29.3	30.1	46.4	37.7	20.0	38.9	54.7
All sizes	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Size	Total									
	Excluding Sullivan County					Including Sullivan County				
Lump [2] and Broken	0.5	0.5	0.2	0.3	0.7	0.5	0.5	0.2	0.3	0.7
Egg	5.8	6.0	3.2	3.4	3.7	5.8	6.0	3.2	3.4	3.7
Stove	21.7	22.5	23.2	23.7	21.5	21.7	22.5	23.2	23.7	21.5
Chestnut	25.1	24.9	26.5	26.4	24.5	25.1	24.9	26.5	26.4	24.5
Pea	7.3	7.4	7.5	7.3	7.4	7.3	7.4	7.5	7.3	7.4
Total domestic	60.4	61.3	60.6	61.1	57.8	60.4	61.3	60.6	61.1	57.8
Buckwheat No. 1	13.5	13.3	13.7	13.8	13.5	13.5	13.3	13.7	13.8	13.5
Buckwheat No. 2 (Rice)	7.7	7.8	7.9	7.8	7.9	7.7	7.8	7.9	7.8	7.9
Buckwheat No. 3 (Barley)	10.3	9.9	9.2	9.3	10.3	10.2	9.9	9.2	9.3	10.3
Buckwheat No. 4	5.1	4.3	4.4	3.9	5.1	5.1	4.3	4.4	3.9	5.1
Other (including silt)	3.0	3.4	4.2	4.1	5.4	3.1	3.4	4.2	4.1	5.4
Total steam	39.6	38.7	39.4	38.9	42.2	39.6	38.7	39.4	38.9	42.2
All sizes	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

[1] *See* footnote 1, table 1.
[2] Quantity of Lump included is insignificant.

By Weeks and Months.—The weekly and monthly production figures for anthracite published in the Bureau of Mines Weekly Anthracite and Beehive Coke reports are estimated from records of railroad carloadings and from reports obtained from trade sources. The data so obtained have been adjusted in tables 13 and 14 to the total annual anthracite production as obtained by a direct mail canvass of the operators.

TABLE 13.—Estimated weekly production of Pennsylvania anthracite in 1951 [1]

Week ended—	Thousand net tons	Week ended—	Thousand net tons	Week ended—	Thousand net tons	Week ended—	Thousand net tons
Jan. 6	807	Apr. 14	544	July 21	835	Oct. 27	1,116
13	979	21	750	28	885	Nov. 3	692
20	983	28	745	Aug. 4	758	10	945
27	1,001	May 5	770	11	723	17	1,021
Feb. 3	883	12	869	18	732	24	865
10	890	19	804	25	850	Dec. 1	1,076
17	915	26	881	Sept. 1	896	8	953
24	959	June 2	755	8	608	15	961
Mar. 3	712	9	811	15	806	22	950
10	544	16	900	22	856	29	633
17	424	23	925	29	963	31 [2]	174
24	530	30	1,014	Oct. 6	1,008		
31	554	July 7	102	13	1,049	Total	42,670
Apr. 7	478	14	712	20	1,074		

[1] Estimated from weekly carloadings as reported by the Association of American Railroads. Adjusted to annual production total from Bureau of Mines canvass.
[2] Figures represent output of working days in that part of week included in the calendar year 1951.

TABLE 14.—Estimated monthly production of Pennsylvania anthracite, 1944–51, in thousands of net tons [1]

Month	1944	1945	1946	1947	1948	1949	1950	1951 [2]
January	4,970	4,219	4,968	5,172	4,929	3,725	2,893	4,316
February	5,811	4,471	4,774	4,254	4,682	2,930	2,563	3,621
March	5,512	5,269	5,476	4,984	4,935	2,375	4,847	2,244
April	5,141	5,124	5,069	4,293	4,445	3,725	3,331	2,675
May	5,781	2,083	5,453	4,564	4,874	4,407	4,228	3,723
June	5,558	5,667	3,625	4,624	4,597	3,406	4,166	3,848
July	4,905	4,944	5,248	4,098	4,372	3,925	2,855	2,847
August	5,558	4,656	5,428	5,011	5,129	3,710	4,386	3,612
September	5,380	4,640	5,033	5,158	5,015	2,114	3,835	3,267
October	5,538	5,304	5,393	5,524	4,969	4,979	4,282	4,675
November	5,029	4,559	4,975	4,629	4,687	4,657	3,355	4,129
December	4,518	3,998	5,065	4,879	4,506	2,749	3,336	3,713
Total	63,701	54,934	60,507	57,190	57,140	42,702	44,077	42,670

[1] Estimated from weekly carloadings as reported by the Association of American Railroads. *See* table 13.
[2] *See* footnote 1, table 1.

Culm-Bank Coal.—The recovery of anthracite from culm banks in 1951 was 34 percent greater than in 1950 and was 11 percent of total production from all sources. It is believed that the increase was due to a renewed demand in Europe for the smaller sizes, as considerable quantities of Buckwheat No. 2 and smaller were shipped abroad during the year. Tables 15 and 16 give details on production, by regions and fields.

TABLE 15.—Production of Pennsylvania anthracite from culm banks, 1935–51, by regions, in net tons

Year	Lehigh	Schuylkill	Wyoming	Sullivan County	Total
1935	192,790	1,748,960	760,718	----------	2,702,468
1936	136,058	2,532,116	525.798	----------	3,193,972
1937	101,239	2,178,482	442,878	----------	2,722,599
1938	53,037	1,941,896	345,511	----------	2,340,444
1939	64,180	2,159,548	360,086	----------	2,583,814
1940	192,878	2,109,557	480,603	----------	2,783,038
1941	326,755	2,881,049	449,062	----------	3,656,866
1942	745,934	3,529,757	459,373	----------	4,735,064
1943	1,944,047	4,577,917	1,041,841	19,893	7,583,698
1944	2,125,317	5,787,036	1,673,994	13,833	9,600,180
1945	2,086,864	4,936,907	1.728.440	34,448	8,786.659
1946	1,875,590	4,752,141	1,780,874	22,487	8,431,092
1947	1,044,501	3,947,016	1,409,217	2,912	6,403.646
1948	796,114	3,729,542	1,098,123	----------	5,623,779
1949	694,763	2,778,131	956,250	----------	4,429,144
1950	366,069	2,533,535	565,829	1,877	3,467,310
1951	566,613	3,578,795	484,792	----------	4,630,200

TABLE 16.—Culm-bank coal put through breakers, 1947–51, by fields, in net tons

Year	Northern	Eastern Middle	Western Middle	Southern	Total
1947	[1] 525,732	249,151	1,607,166	2,099,299	4,481,348
1948	393,787	152,827	1,871,847	1,571,119	3,989,580
1949	371,787	193,565	1,366,775	1,081,585	3,013,712
1950	[2] 213,577	35,270	1,388,760	840,253	2,477,860
1951	263,555	107,064	2,526,144	700,605	3,597,368

[1] Includes some washery coal.
[2] A small quantity of culm-bank coal was put through breakers in Sullivan County.

MINING METHODS AND EQUIPMENT

Mechanical Loading.—Of the total underground production of Pennsylvania anthracite in 1951, 41 percent was loaded mechanically compared with 44 percent in 1950. The tonnage loaded mechanically in 1951 was 12 percent less than in 1950. The coal seams of the Northern field are relatively flat when compared with the more sharply pitching beds of the other fields and are thus more adaptable to machine loading—hence, 86 percent of the total loaded mechanically in 1951 was produced in the Northern field compared with 14 percent for the 3 others combined. Data on mechanical loading underground are presented in tables 17 to 19. Trends in the mechanical loading, hand loading, and stripping of Pennsylvania anthracite, 1928–51, are shown in figure 1.

TABLE 17.—Pennsylvania anthracite loaded mechanically underground, 1947–51

Year	Scrapers		Mobile loaders		Conveyors and pit-car loaders [1]		Total loaded mechanically	
	Number of units	Net tons loaded	Number of units	Net tons loaded	Number of units	Net tons loaded	Number of units	Net tons loaded
1947	594	2,371,370	25	132,237	3,457	13,550,404	4,076	16,054,011
1948	643	2,721,180	19	60,657	3,562	12,960,531	4,224	15,742,368
1949	589	1,950,503	27	80,104	3,618	9,827,481	4,234	11,858,088
1950	556	1,900,185	30	89,191	3,460	10,346,274	4,046	12,335,650
1951	528	1,693,656	43	79,032	3,282	9,075,099	3,853	10,847,787

[1] Includes duck bills and other self-loading conveyors.

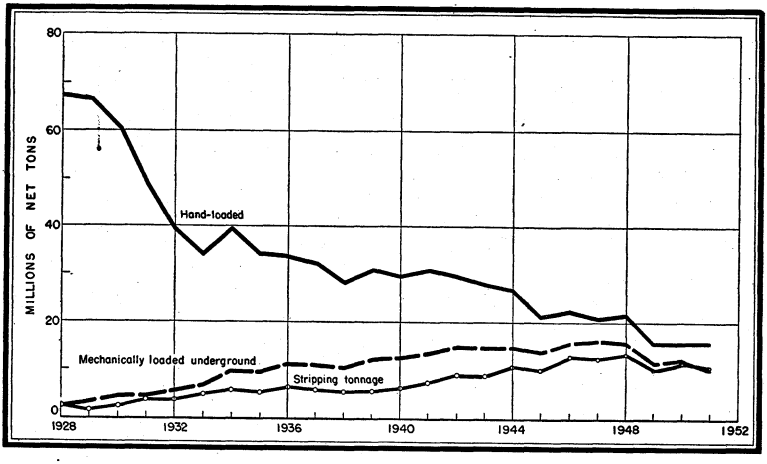

FIGURE 1.—Trends in mechanical loading, hand loading, and stripping of Pennsylvania anthracite, 1928–51.

TABLE 18.—Pennsylvania anthracite loaded mechanically underground, 1950–51, by fields, in net tons

Field	Scraper loaders [1]		Pit-car loaders		Hand-loaded face conveyors, all types [2]		Total mechanically loaded underground	
	1950	1951	1950	1951	1950	1951	1950	1951
Northern	1,759,602	1,552,784	58,285	33,735	8,927,716	7,784,212	10,745,603	9,370,731
Eastern Middle	52,662	13,574	55,950	53,442	303,246	280,670	411,858	347,686
Western Middle	158,026	163,272	19,909	4,423	661,625	559,878	839,560	727,573
Southern	19,086	43,058	2,500	-------	317,043	358,739	338,629	401,797
Total	1,989,376	1,772,688	136,644	91,600	10,209,630	8,983,499	12,335,650	10,847,787

[1] Includes mobile loaders.
[2] Shaker chutes, etc., including those equipped with duckbills.

TABLE 19.—Relative growth of mechanical loading, hand loading, and stripping in Pennsylvania anthracite mines, 1927–51

[Mechanical loading includes coal handled on pit-car loaders and hand-loaded face conveyors]

Year	Net tons			Index numbers: 1937=100		
	Mechanical loading underground	Stripping	Hand [1] loading	Mechanical loading underground	Stripping	Hand loading
1927	[2] 2,223,281	2,153,156	71,434,537	20	38	224
1928	[2] 2,351,074	2,422,924	67,373,788	22	43	211
1929	3,470,158	1,911 766	66,493,690	32	34	209
1930	4,467,750	2,536,288	60,458,344	42	45	190
1931	4,384,780	3,813,237	49,074,722	41	67	154
1932	5,433,340	3,980,973	38,400,820	51	70	120
1933	6,557,267	4,932,069	34,474,844	61	87	108
1934	9,284,486	5,798,138	39,290,255	87	102	123
1935	9,279,057	5,187,072	34,503,819	87	91	108
1936	10,827,946	6,203,267	33,898,560	101	109	106
1937	10,683,837	5,696,018	31,882,514	100	100	100
1938	10,151,669	5,095,341	27,990,628	95	89	88
1939	11,773,833	5,486,479	30,797,715	110	96	97
1940	12,326,000	6,352,700	29,190,837	115	112	92
1941	13,441,987	7,316,574	30,435,277	126	128	95
1942	14,741,459	9,070,933	30,495,240	138	159	96
1943	14,745,793	8,989,387	27,990,005	138	158	88
1944	14.975,146	10,953,030	26,800,270	140	192	84
1945	13,927,955	10,056,325	20,957,744	130	177	66
1946	15,619,162	12,858,930	22,465,295	146	226	70
1947	16,054,011	12,603,545	20,909,101	150	221	66
1948	15.742,368	13,352,874	21,432,923	147	234	67
1949	11,858,088	10,376,808	10,172,562	111	182	48
1950	12,335,650	11,833,934	15,820,245	115	208	50
1951	10,847,787	11,135,990	15,494,452	102	196	49

[1] *See* footnote 1, table 1.
[2] As reported by Pennsylvania Department of Mines.

Cutting Machines.—The tonnage of anthracite cut by machines declined 19 percent from 1950. All 152 machines used in 1951 were of the "permissible" type.

Strip-Pit Operations.—Anthracite produced by strip-pit operations was 30 percent of the total fresh-mined output in 1951, the same as for the preceding year. Of the total strip-pit production, 58 percent was obtained in the Schuylkill region, 24 percent in the Wyoming region, and 18 percent in the Lehigh. The relatively high rate of production in the Schuylkill region is due to the outcropping of many thick, highly pitched seams. (Data on strip-pit operations are shown in tables 20 and 21.) Figure 2 shows graphically the growth of strip-pit production during the period 1928–51.

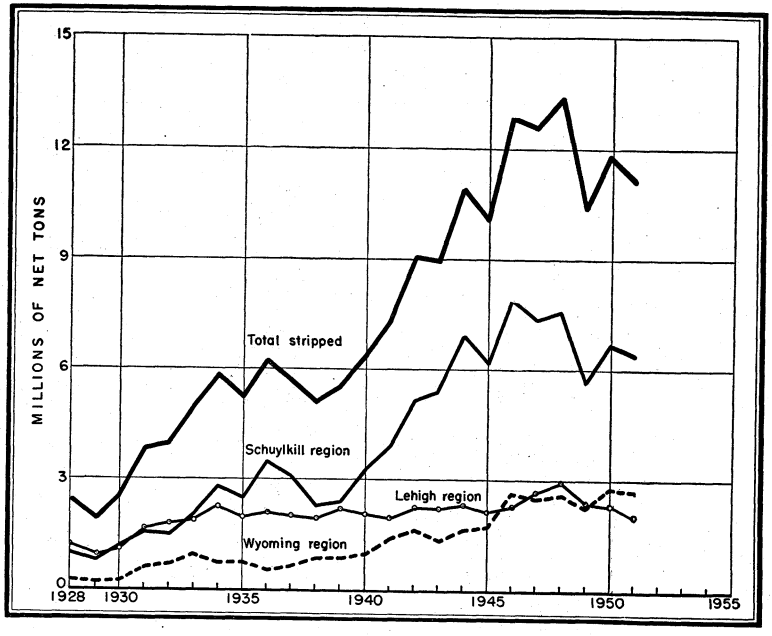

FIGURE 2.—Pennsylvania anthracite mined from strip pits, by regions, 1928–51.

TABLE 20.—Relative growth of Pennsylvania anthracite mined from strip pits, 1915, 1920, 1925, 1930, and 1946–51

	Net tons mined by stripping	Percent of fresh-mined total that was stripped	Average number of men working	Average number of days worked
1915	1,121,603	(1)	(1)	(1)
1920	2,054,441	2.5	(1)	(1)
1925	1,578,478	2.7	(1)	(1)
1930	2,536,288	3.7	(1)	(1)
1946	12,858,930	25.2	6,152	252
1947	12,603,545	25.4	7,264	242
1948	13,352,874	26.5	7,005	260
1949	10,376,808	27.7	7,386	198
1950	11,833,934	29.6	7,949	212
1951:				
Lehigh region	2,048,847	33.3	1,445	215
Schuylkill region	6,429,155	45.2	4,663	217
Wyoming region	2,657,988	15.5	1,539	237
Total [2]	11,135,990	29.7	7,647	220

[1] Data not available.
[2] No production by stripping in Sullivan County in 1951.

TABLE 21.—Power shovels and draglines used in stripping Pennsylvania anthracite, 1949–51, by type of power

Type of power	1949			1950			1951		
	Number of power shovels	Number of draglines	Total	Number of power shovels	Number of draglines	Total	Number of power shovels	Number of draglines	Total
Gasoline	66	20	86	53	11	64	47	7	54
Electric	53	45	98	48	47	95	55	50	105
Diesel	189	253	442	195	259	454	195	241	436
All other	1		1						
Total	309	318	627	296	317	613	297	298	595

Dredge Coal.—Production of Pennsylvania anthracite by dredges operating in the Lehigh, Schuylkill, and Susquehanna Rivers and their tributaries in 1951 declined 9 percent from 1950. The total represented the lowest annual output since 1936. It is expected that production of river coal will continue to decline as reserves of this fuel become less. Pennsylvania laws prohibit the drainage of untreated mine or breaker water into the surface streams, thus preventing any large deposition of coal on the river and creek beds. Electric power and other industrial plants located in or near the anthracite fields, formerly dependent upon dredge operators for a substantial part of their fuel requirements, undoubtedly will obtain more of their future needs from the preparation plants recovering the finer particles of coal by froth flotation, settling ponds, etc.

TABLE 22.—Pennsylvania anthracite produced by dredges, 1923–51, by rivers (including tributaries)

Year	Net tons				Value	
	Lehigh River	Schuylkill River	Susquehanna River	Total	Total	Average per ton
1923	106,092	97,254	753,022	956,368	$811,065	$0.85
1924	80,301	74,359	670,734	825,394	681,181	.83
1925	99,614	173,639	742,455	1,015,708	929,292	.91
1926	58,544	131,654	724,566	914,764	828,398	.91
1927	85,177	127,705	758,935	971,817	794,807	.82
1928	89,304	157,449	696,648	943,401	821,530	.87
1929	87,241	133,720	495,983	716,944	626,187	.87
1930	60,219	138,236	444,836	643,291	538,268	.84
1931	33,014	90,855	334,881	458,750	379,682	.83
1932	42,091	105,990	331,969	480,050	445,799	.93
1933	51,083	106,004	381,837	538,924	452,153	.84
1934	91,346	100,873	459,961	652,180	636,038	.98
1935	78,578	73,326	438,563	590,467	517,304	.88
1936	63,327	31,669	451,688	546,684	581,679	1.06
1937	[1] 95,065	(1)	665,409	760,474	842,052	1.11
1938	[1] 123,452	(1)	447,572	571,024	570,579	1.00
1939	62,134	67,539	574,187	703,860	746,000	1.06
1940	[1] 78,947	(1)	863,997	942,944	1,097,000	1.16
1941	47,838	396,522	1,073,203	1,517,563	1,839,784	1.21
1942	9,385	268,919	1,006,729	1,285,033	1,478,719	1.15
1943	37,452	342,815	954,470	1,334,737	1,972,777	1.48
1944	40,894	494,371	837,472	1,372,737	2,084,431	1.52
1945	41,409	366,161	797,656	1,205,226	1,924,148	1.60
1946	37,441	247,757	847,196	1,132,394	2,091,324	1.85
1947	46,478	158,102	1,015,126	1,219,706	2,480,068	2.03
1948	54,284	67,871	865,849	988,004	2,291,752	2.32
1949	22,131	52,012	790,979	865,122	2,131,096	2.46
1950	21,877	34,222	563,465	619,564	1,677,508	2.71
1951	25,344	27,454	508,770	561,568	1,576,576	2.81

[1] Schuylkill included with Lehigh.

TABLE 23.—Pennsylvania anthracite produced by dredges in 1951, by rivers (including tributaries)

River	Net tons	Value	
		Total	Average
Lehigh	25,344	$67,573	$2.67
Schuylkill	27,454	90,877	3.31
Susquehanna	508,770	1,418,126	2.79
Total	561,568	1,576,576	2.81

EMPLOYMENT

The average number of men working in the Pennsylvania anthracite industry during 1951 totaled 68,995. Of the total labor force, 66 percent were engaged underground, 11 percent in strip pits, and the remaining 23 percent in preparation plants and other surface occupations. By regions, the total number of men working was divided as follows: 51 percent in the Wyoming region, 33 percent in the

TABLE 24.—Average number of men working and days operations producing Pennsylvania anthracite were active in 1951, by region and type of plant

[Includes operations of strip contractors]

Region and type of plant	Average number of men working							Average number of days operations were active	Man-days of labor	Average tons per man per day
	Underground			Surface			Grand total			
	Miners and their laborers	Other	Total underground	In strip pits	In preparation plants	Other	Total surface			
Lehigh:										
Breaker	4,573	2,814	7,387	1,445	855	1,615	3,915	11,302	199	2,254,728	2.85
Washery [1]					18	31	49	49	227	11,126	24.66
Dredge					2	4	6	6	204	1,224	20.71
Total Lehigh	4,573	2,814	7,387	1,445	875	1,650	3,970	11,357	200	2,267,078	2.97
Schuylkill:											
Breaker	7,798	3,798	11,596	4,663	2,249	3,747	10,659	22,255	209	4,656,212	3.71
Washery [1]					76	158	234	234	175	40,953	13.12
Dredge					85	132	217	217	209	45,247	11.70
Total Schuylkill	7,798	3,798	11,596	4,663	2,410	4,037	11,110	22,706	209	4,742,412	3.86
Wyoming:											
Breaker	17,037	9,408	26,445	1,539	1,600	5,181	8,320	34,765	211	7,320,394	2.37
Washery [1]					29	60	89	89	206	18,327	12.07
Dredge					3	3	6	6	145	870	8.05
Total Wyoming	17,037	9,408	26,445	1,539	1,632	5,244	8,415	34,860	211	7,339,591	2.40
Total, excluding Sullivan County:											
Breaker	29,408	16,020	45,428	7,647	4,704	10,543	22,894	68,322	208	14,231,334	2.88
Washery [1]					123	249	372	372	189	70,406	14.67
Dredge					90	139	229	229	207	47,341	11.86
Total	29,408	16,020	45,428	7,647	4,917	10,931	23,495	68,923	208	14,349,081	2.97
Sullivan County	40	15	55		14	3	17	72	178	12,816	2.24
Grand total	29,448	16,035	45,483	7,647	4,931	10,934	23,512	68,995	208	14,361,897	2.97

[1] Represents washeries for which both production and employment were separately reported.

Schuylkill, and 16 percent in the Lehigh. The 1951 data include workers employed by the independent operators, formerly categorized as "bootleggers." These operations are now being conducted largely under leasing arrangements with the landowners. As pointed out in the discussion of production, the addition of these workers has the most drastic effect upon the comparability of 1951 data for the Schuylkill region with that for earlier years, as the illegal mining was confined to that area. The addition of these workers also, of course, affects the employment totals of the industry.

Detailed labor statistics are shown in tables 24 and 25.

TABLE 25.—Average number of men working at operations producing Pennsylvania anthracite, 1950–51, by counties

[Includes operations of strip contractors]

County	1950	1951 [1]	County	1950	1951 [1]
Carbon	3,880	3,019	Luzerne	32,361	28,846
Columbia	1,685	1,286	Northumberland	5,569	6,140
Dauphin, Susquehanna, and Wayne [2]	92	167	Schuylkill	18,011	19,457
Lackawanna	10,771	9,886	Sullivan	93	72
Lancaster, Lebanon, Northampton, and Snyder [3]	162	122	Total	72,624	68,995

[1] *See* footnote 1, table 1.
[2] None in Wayne in 1950.
[3] Counties producing dredge coal only.

CONSUMPTION

Although production of Pennsylvania anthracite declined only 3 percent in 1951 including the tonnage produced by independents, apparent consumption (calculated on the basis of production, imports, exports, and changes in producers' stocks) in the United States declined 7 percent owing to a sharp decrease in the space-heating market.

The tonnage of anthracite fines mixed with bituminous coal in the manufacture of coke increased from 169,275 tons in 1950 to 237,136 tons in 1951. Reported consumption at electric-power plants increased 7 percent—from 3,608,863 tons in 1950 to 3,869,512 in 1951. The consumption of anthracite in the manufacture of briquets declined 20 percent from the 638,356 tons used in 1950, as production in that industry decreased. The quantity used by railroads also dropped—from 771,888 tons in 1950 to 678,229 tons in 1951.

According to the Pennsylvania Department of Mines, anthracite shipments to the primary anthracite market area (New England and Middle Atlantic States, Maryland, Delaware, and District of Columbia) comprised 96 percent of the total shipments to destinations in the United States, the same percentage as in 1950. Data on the consumption of all fuels in this area are not available; however, the apparent consumption of anthracite, domestic coke, briquets, and heating and range oils, in terms of anthracite, are shown in table 26.

Mechanical Stokers.—According to data of the Bureau of the Census, United States Department of Commerce, factory sales of class 1 stokers (burning capacity, under 61 pounds of coal per hour) increased from 4,191 in 1950 to 4,268 in 1951. Sales of class 2 stokers, with a

TABLE. 26.—Apparent consumption of anthracite and selected competitive fuels in the principal anthracite markets, 1948–51, based on shipments

[Thousands of net tons]

Fuel	New England	New York	New Jersey	Pennsylvania	Delaware	Maryland	District of Columbia	Total	Percent of total fuels
Anthracite (all users):									
Pennsylvania: [1]									
1948	4,600	[2] 15,004	[2] 6,806	16,116	313	709	215	43,763	45.6
1949	3,277	[2] 11,191	[2] 4,896	12,194	255	429	153	32,395	40.0
1950	3,552	[2] 11,054	[2] 5,007	12,690	266	464	179	33,212	37.4
1951	2,956	[2] 9,482	[2] 4,519	11,512	240	422	136	29,267	33.0
Imported: [3]									
1948						1		1	(4)
1949									
1950	18							18	(4)
1951	27							27	(4)
Briquets (for domestic use):									
Domestic origin:									
1948	59	44	26	88	1	24	3	245	.3
1949	25	21	21	39	(5)	15	1	122	.2
1950	36	23	13	39	(5)	22	3	136	.2
1951	42	17	25	27	(5)	17	2	130	.1
Imported: [3]									
1948								(5)	(4)
1949								(5)	(4)
1950								(5)	(4)
1951								(5)	(4)
Coke (for domestic use):									
Domestic origin:									
1948	778	689	386	242	1	(5)		2,096	2.2
1949	592	510	281	168	(5)	1		1,552	1.9
1950	617	545	348	186	(5)	1		1,697	1.9
1951	542	343	321	168	(5)	1		1,375	1.6
Imported: [3]									
1948	1	38						39	(4)
1949	1	83						84	.1
1950	56	30						86	.1
1951	(5)	9		4				13	(4)
Oil: Heating and range: [6]									
1948	18,652	14,390	8,224	5,207	278	2,256	776	49,783	51.9
1949	17,353	14,086	7,735	4,418	433	2,048	713	46,786	57.8
1950	19,807	15,877	8,558	5,686	476	2,454	783	53,641	60.4
1951	21,302	16,846	8,701	6,637	558	2,979	990	58,013	65.3
Total:									
1948	24,090	30,165	15,442	21,653	593	2,990	994	95,927	100.0
1949	21,248	25,891	12,933	16,819	688	2,493	867	80,939	100.0
1950	24,086	27,529	13,926	18,601	742	2,941	965	88,790	100.0
1951	24,869	26,697	13,566	18,348	798	3,419	1,128	88,825	100.0

[1] Pennsylvania Department of Mines; illicit coal not included.
[2] An important but undetermined part of anthracite shown as shipped to New Jersey is reshipped to New York City.
[3] U. S. Department of Commerce.
[4] Less than 0.05 percent.
[5] Less than 500 tons.
[6] Converted to coal equivalent upon basis of 4 barrels of fuel oil equaling 1 ton of coal.

burning range between 61 and 100 pounds of coal per hour, declined 15 percent to 414 units (487 units in 1950).

DISTRIBUTION

Data on the distribution of Pennsylvania anthracite in table 27 are based on reports submitted voluntarily to the Bureau of Mines by producers, American and Canadian wholesalers, and dock operators. As these data cover the coal year ended March 31, 1951 they are not comparable with other 1951 data in this chapter which cover the calendar year.

Shipments reported to the Bureau of Mines for the 1950–51 coal year totaled 41.9 million net tons or slightly less than 1 percent over the 1949–50 total.

Various reasons, such as competition from natural gas and heating oils, have been given for the decline in anthracite production since the 1947–48 coal year, but another significant factor was that the winter of 1950–51 marked the third successive heating season in which average temperatures in the primary anthracite markets ranged substantially higher than normal. In spite of weather conditions unfavorable from the standpoint of anthracite consumption, shipments to points in the United States were approximately 2 percent higher than in the 1949–50 coal year and about 5 percent greater in Canada. Exports to Ontario were approximately 9 percent higher, but shipments to Quebec and the Maritime Provinces declined 8 and 17 percent, respectively. The most significant change in distribution occurred in shipments to countries other than Canada, as only 263,901 net tons were exported during the 1950–51 coal year compared with 1,040,315 tons during the 1949–50 coal year. However, monthly export data of the Bureau of the Census, United States Department of Commerce, indicate that the volume exported to non-Canadian destinations will exceed 2.8 million tons for the 1951–52 coal year.

According to monthly reports of the Pennsylvania Department of Mines, 35.3 million net tons of anthracite was shipped from mines in the calendar year 1951. Of this total, 6.3 million tons, or 18 percent, was shipped by truck and the remainder by rail; an undetermined part of the rail tonnage, however, subsequently reached final destinations by tidewater or lake carriers. In 1951 about 55 percent of the truck movement, as compared to 54 percent in 1950, was destined within the producing region and 45 percent (46 percent in 1950), to points outside the region. Data compiled by the Interstate Commerce Commission indicate that Pennsylvania anthracite ranked second in 1951 in carload originations and tonnage on the 49 class I railroads comprising the Eastern district. Nine of these railroads originated all of the anthracite produced. Anthracite rail shipments, by State of destination, are shown in table 28, and truck shipments, by month and State of destination, in table 29.

Data compiled from records of the Massachusetts Division on the Necessaries of Life and the Association of American Railroads show that New England rail receipts of Pennsylvania anthracite in 1951 decreased 13 percent from 1950 while tidewater receipts declined 38 percent. Details on anthracite movement to New England are shown in table 30.

TABLE. 27.—Distribution of Pennsylvania anthracite, April 1, 1950, to March 31, 1951, by States, Canadian Provinces, and other countries, in net tons

Destination	Domestic sizes						Steam sizes						Total all sizes	Percent of total
	Broken	Egg	Stove	Chestnut	Pea	Total domestic	Buckwheat No. 1	Buckwheat No. 2 (Rice)	Buckwheat No. 3 (Barley)	Buckwheat No. 4	All other sizes	Total steam		
United States:														
New England States:														
Connecticut	258	13,742	305,991	326,717	28,511	675,219	53,772	36,057	7,552	50	7,650	105,081	780,300	1.86
Maine	-------	13,581	105,921	87,534	2,985	210,021	14,275	10,199	47	-------	1,419	25,940	235,961	.56
Massachusetts	3,293	147,257	980,278	523,491	51,597	1,705,916	140,733	70,740	64,263	1,961	11,366	289,063	1,994,979	4.77
New Hampshire	-------	10,624	87,013	59,055	3,038	159,730	18,328	46,621	42,101	49	1,330	108,429	268,159	.64
Rhode Island	-------	10,907	116,196	80,661	6,759	214,523	15,467	10,675	-------	-------	109	26,251	240,774	.58
Vermont	849	7,395	86,897	63,094	7,501	165,736	36,561	18,781	23,695	-------	-------	79,037	244,773	.59
Total	4,400	203,506	1,682,296	1,140,552	100,391	3,131,145	279,136	193,073	137,658	2,060	21,874	633,801	3,764,946	9.00
Middle Atlantic States:														
New Jersey	16,170	66,298	741,372	1,630,275	419,950	2,874,065	637,543	534,662	1,033,135	478,770	77,094	2,761,204	5,635,269	13.46
New York	20,308	399,699	2,950,752	2,557,748	811,183	6,739,690	3,080,880	895,203	1,083,164	479,638	220,044	5,758,929	12,498,619	29.86
Pennsylvania [1]	54,616	122,245	1,028,850	2,706,137	2,075,177	5,987,025	1,329,829	1,231,639	1,939,352	964,118	1,751,188	7,216,126	13,203,151	31.54
Total	91,094	588,242	4,720,974	6,894,160	3,306,310	15,600,780	5,048,252	2,661,504	4,055,651	1,922,526	2,048,326	15,736,259	31,337,039	74.86
South Atlantic States: [2]														
Delaware	-------	10,681	59,679	158,061	11,976	240,397	6,178	5,479	24,523	71	8,196	44,447	284,844	.68
District of Columbia	-------	8,240	64,301	81,290	9,224	163,055	22,547	1,033	-------	-------	-------	23,580	186,635	.45
Maryland	2,625	22,822	200,830	205,738	21,934	453,949	74,297	8,612	20,311	7,865	298	111,383	565,332	1.35
Virginia	-------	7,288	27,288	38,283	5,818	78,677	18,009	446	-------	-------	967	19,422	98,099	.23
Total	2,625	49,031	352,098	483,372	48,952	936,078	121,031	15,570	44,834	7,936	9,461	198,832	1,134,910	2.71
Lake States: [3]														
Illinois	15,987	15,489	40,625	75,927	1,581	149,609	21,056	20,192	11,163	5,280	11,358	69,049	218,658	.52
Michigan	257	17,687	100,379	75,311	1,357	194,991	3,471	13,906	-------	1,716	2,580	21,673	216,664	.52
Minnesota	-------	126	11,753	17,004	1,018	29,901	1,385	337	-------	23,026	16,375	41,123	71,024	.17
Ohio	844	5,142	5,199	40,946	1,027	53,158	20,148	8,517	4,342	2,035	10,746	45,788	98,946	.24
Wisconsin	72	447	159,611	240,828	18,913	419,871	11,409	2,798	-------	76,120	253,241	343,568	763,439	1.82
Total	17,160	38,891	317,567	450,016	23,896	847,530	57,469	45,750	15,505	108,177	294,300	521,201	1,368,731	3.27
All other States:	76	16,660	10,378	86,500	3,106	116,720	15,586	3,199	5,295	9,587	51,730	85,397	202,117	.48
Total United States	115,355	896,330	7,083,313	9,054,600	3,482,655	20,632,253	5,521,474	2,919,096	4,258,943	2,050,286	2,425,691	17,175,490	37,807,743	90.32

Canada:														
Ontario	309	104,398	1,479,561	1,063,609	55,663	2,703,540	110,611	86,055	2,877	5	4,109	203,657	2,907,197	6.94
Quebec	301	24,887	285,024	158,482	8,966	477,660	184,721	127,010	39,280	254	156	351,421	829,081	1.98
Other Provinces	337	5,053	17,454	19,162	418	42,424	4,090	6,934	49	340	67	11,480	53,904	.13
Total Canada	947	134,338	1,782,039	1,241,253	65,047	3,223,624	299,422	219,999	42,206	599	4,332	566,558	3,790,182	9.05
Other countries	28,189	71,114	509	27,349	----------	127,161	8,109	63,064	----------	35,799	29,768	136,740	[4] 263,901	.63
Grand total	144,491	1,101,782	8,865,861	10,323,202	3,547,702	23,983,038	5,829,005	3,202,159	4,301,149	2,086,684	2,459,791	17,878,788	41,861,826	100.00

[1] Includes local sales.
[2] Shipments to other States generally referred to as being in the South Atlantic area are included in "All other States."
[3] Shipments to Indiana are included in "All other States."
[4] France received approximately 62 percent, The Netherlands 23 percent, Belgium about 10 percent, and other countries 5 percent.

TABLE 28.—Rail shipments of Pennsylvania anthracite, 1948–51, by destination, in net tons [1]

[Pennsylvania Department of Mines]

Destination	1948	1949	1950	1951
New England States	4,600,429	3,277,034	3,551,489	2,955,785
New York	14,526,250	10,804,020	10,589,197	9,095,169
New Jersey	6,213,667	4,522,749	4,613,659	4,140,095
Pennsylvania	9,706,429	6,935,710	6,740,610	6,026,258
Delaware	283,106	237,479	245,097	222,750
Maryland	626,948	396,561	431,546	397,129
District of Columbia	214,291	152,940	177,754	135,742
Virginia	118,611	84,275	73,809	75,982
Ohio	118,735	50,673	94,022	85,303
Indiana	94,492	66,773	80,209	58,155
Illinois	286,888	152,791	211,366	207,291
Wisconsin	627,366	463,625	489,784	355,852
Minnesota	48,683	47,944	61,353	28,340
Michigan	351,304	235,703	249,088	171,315
Other States	57,070	57,148	86,213	144,861
Total United States	37,874,269	27,485,425	27,695,196	24,100,027
Canada	3,977,698	3,154,387	3,620,573	3,199,775
Other foreign countries	913,920	671,350	35,139	1,724,439
Grand total	42,765,887	31,311,162	31,350,908	29,024,241

[1] Does not include dredge coal.

TABLE 29.—Truck shipments of Pennsylvania anthracite in 1951, by month and State of destination, in net tons [1]

Destination	January	February	March	April	May	June	July
Pennsylvania:							
Within region	450,529	401,144	310,642	259,577	237,591	189,725	118,441
Outside region	225,283	195,917	156,725	108,918	157,811	150,504	94,639
New York	23,182	34,129	30,501	23,381	26,364	33,708	21,288
New Jersey	39,860	37,967	31,281	19,613	32,553	35,982	22,968
Delaware	3,386	2,986	1,363	795	568	365	439
Maryland	4,308	3,794	2,069	1,031	668	1,759	1,005
District of Columbia	6	418					
Other States	2,332	2,016	1,789	1,048	1,181	1,409	1,110
Total: 1951	748,886	678,371	534,370	414,363	456,736	413,452	259,890
1950	607,265	624,231	900,883	494,835	461,819	437,820	341,274

Destination	August	September	October	November	December	Total	Percent of total trucked
Pennsylvania:							
Within region	192,586	206,578	287,262	416,797	430,601	3,501,473	55.5
Outside region	143,978	131,243	241,061	184,382	193,390	1,983,851	31.4
New York	32,306	33,497	43,468	42,558	41,936	386,318	6.1
New Jersey	26,366	28,478	37,354	35,659	30,439	378,520	6.0
Delaware	1,227	526	1,831	1,232	2,801	17,519	.3
Maryland	555	1,291	3,394	2,138	3,177	25,189	.4
District of Columbia			278			702	[2]
Other States	1,180	1,453	2,066	1,115	1,555	18,254	.3
Total: 1951	398,198	403,066	616,714	683,881	703,899	6,311,826	100.0
1950	607,973	525,753	575,161	565,991	737,680	6,880,685	100.0

[1] Compiled from reports of Pennsylvania Department of Mines. Does not include dredge coal.
[2] Less than 0.05 percent.

TABLE 30.—Receipts of anthracite in New Engand, 1917, 1920, 1923, 1927, and 1940–51, in thousands of net tons

Year	Receipts by tidewater [1]	Receipts by rail [2]	Imports [3]	Total receipts of Pennsylvania anthracite [4]	Year	Receipts by tidewater [1]	Receipts by rail [2]	Imports [3]	Total receipts of Pennsylvania anthracite [4]
1917	4,421	7,259	1	11,679	1944	398	5,836	12	6,222
1920	3,521	7,804	1	11,324	1945	331	4,750	(5)	5,081
1923	4,082	8,102	145	12,039	1946	399	5,244	----------	5,643
1927	2,421	6,725	106	9,040	1947	240	4,498	----------	4,738
1940	648	4,174	135	4,687	1948	217	4,646	----------	4,863
1941	682	4,870	75	5,477	1949	110	3,336	----------	3,446
1942	581	5,393	139	5,835	1950	81	3,615	18	3,678
1943	575	5,310	164	5,721	1951	66	3,135	27	3,174

[1] 1941 and earlier years from Commonwealth of Massachusetts, Division on the Necessaries of Life; data for 1942 and succeeding years, as reported by Association of American Railroads.
[2] Commonwealth of Massachusetts, Division on the Necessaries of Life.
[3] U. S. Department of Commerce.
[4] Total receipts by rail and by tidewater less imports.
[5] Less than 500 tons.

There was a substantial reduction in the Lake movement of anthracite in 1951, as loadings at Lake Erie ports dropped almost 25 percent from the 1950 volume of 611,409 tons. Loadings at Lake Ontario ports totaled 58,228 tons, down 65 percent from 1950, while receipts at upper Lake docks totaled 503,455 tons in 1951, a decline of 27 percent.

Shipments of anthracite from the Lehigh, Schuylkill, and Wyoming regions, 1890–1951, are shown graphically in figure 3.

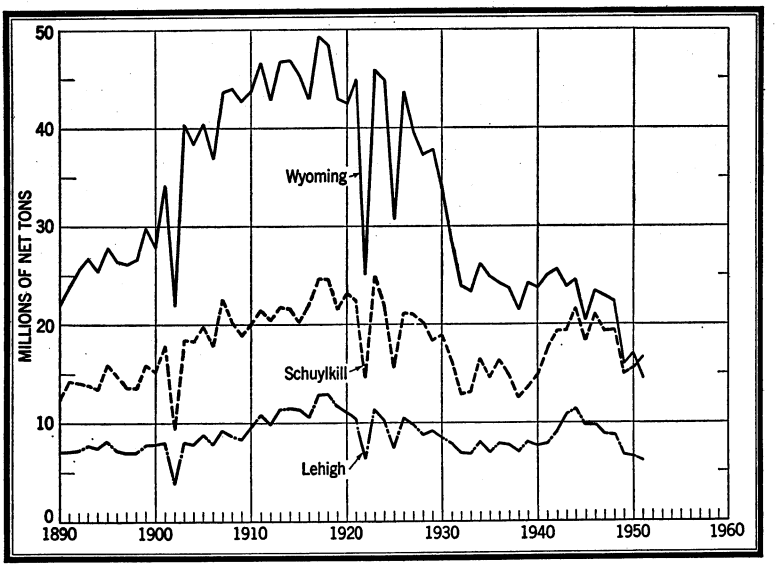

FIGURE 3.—Anthracite shipped from Lehigh, Schuylkill, and Wyoming regions, 1890–1951.

STOCKS

Producer's stocks of Pennsylvania anthracite at the end of December 1951 totaled 982,396 tons compared with 1,268,300 tons in December 1950, a decrease of approximately 23 percent. Stocks on the upper Lake docks were also down, falling from 242,237 tons at the end of December 1950 to 197,790 tons in December 1951; the low point for the year was reached in March, when only 92,958 tons was in stock on the upper Lake docks. Anthracite stocks at electric utility plants at the close of 1951 were approximately 9 percent higher than in December 1950 and during the latter months of the year exceeded 5 million tons. Stocks of class I railroads again declined, totaling 49,097 tons at the end of December 1951 compared to 61,081 tons in 1950.

Stocks of anthracite in retail dealers' yards on December 31, 1950 were estimated by the Bureau of Mines at 3,452,000 tons, comprised of 2,041,000 tons of Egg, Stove, and Chestnut sizes, 342,000 tons of Pea, and 1,069,000 tons of Buckwheat No. 1 and Buckwheat No. 2. Stocks on December 31, 1951, were estimated as follows: Egg, Stove, and Chestnut sizes, 1,552,000 tons; Pea, 283,000 tons; and Buckwheat No. 1 and No. 2 sizes, 859,000 tons.

PRICES

Pursuant to the Defense Production Act of 1950, the Office of Price Stabilization placed ceiling prices on Pennsylvania anthracite at the mine or preparation plant by the issuance of Ceiling Price Regulation 4, effective February 1, 1951. As the producers had incurred higher costs after the outbreak of the conflict in Korea in 1950 owing to increases in miners' wages and taxes the ceiling prices set generally reflected these higher costs. Under CPR–4, the practice of making service charges for split cars, oil and calcium chloride treatment, pocket loading of trucks, etc., was continued. In addition, those companies that had in the past sold coal from certain seams or preparation plants at a premium (usually $0.25 per ton) were permitted to add the extra charge to the established ceilings.

The entire ceiling price structure was based upon the specifications for "standard" anthracite, as approved by the Anthracite Committee (see table 4), and specified the amounts by which the ceiling prices had to be lowered for substandard coal. Ceiling prices for standard anthracite were as follows: Broken, $14.20 per net ton; Egg, $14.45; Stove, $14.70; Chestnut, $14.60; Pea, $11.40; Buckwheat No. 1, $8.00; Buckwheat No. 2 (Rice), $6.40; Buckwheat No. 3 (Barley), $5.10; and Buckwheat No. 4 and smaller, $4.10. Prices on coal not meeting the specifications for standard anthracite were $1.15 less per ton for Broken through Chestnut sizes; $1.00 for Pea; $0.70 for Buckwheat No. 1; $0.60 for Buckwheat No. 2 (Rice); $0.50 for Buckwheat No. 3 (Barley); and $0.40 for Buckwheat No. 4 and smaller. According to Saward's Journal, prices being quoted in December 1951 were either the ceiling prices shown above, or $0.25 per ton higher for the premium coals. Data compiled from reports of the Bureau of Labor Statistics, United States Department of Labor, on retail prices of certain fuels in selected cities for 1951, by months, are shown in table 31.

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TABLE 31.—Retail prices of selected fuels in 1951, by months, for various cities [1]

[Coal and coke, per net ton; heating oil, per 100 gallons]

City and fuel	January	February	March	April	May	June	July	August	September	October	November	December
Baltimore, Md.: [2]												
Anthracite:												
Stove	$21.21	$22.34	$22.62	$22.62	$21.41	$21.51	$21.74	$21.74	$21.84	$22.38	$22.56	$22.60
Buckwheat No. 1	15.04	15.43	15.58	15.58	15.36	15.43	15.47	15.47	15.53	15.75	15.75	15.80
Heating oil: Fuel oil No. 2	12.44	12.44	12.44	12.44	12.44	12.44	12.44	12.44	12.44	12.44	12.44	12.44
Boston, Mass.:												
Anthracite:												
Stove	24.20	24.55	25.58	25.58	24.69	24.69	25.19	25.19	25.58	25.78	25.78	25.78
Buckwheat No. 1	17.35	17.48	17.88	17.88	17.54	17.54	17.79	17.79	17.92	18.08	18.08	18.08
Coke: Egg	23.20	23.20	23.20	23.20	22.22	22.22	22.80	22.80	23.08	23.20	23.20	23.20
Heating oil: Fuel oil No. 2	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.60
Buffalo, N. Y.: [3]												
Anthracite: Stove	22.89	24.25	24.25	23.98	23.73	23.93	23.93	24.12	24.20	24.34	24.41	24.41
Coke: Nut	21.29	21.29	21.29	21.29	21.29	21.29	21.29	21.29	21.29	21.31	21.29	21.29
Heating oil:												
Fuel oil No. 2	13.74	13.74	13.74	13.74	13.74	13.74	13.74	13.74	13.74	13.74	13.74	13.74
Fuel oil No. 3	13.74	13.74	13.74	13.74	13.74	13.74	13.74	13.74	13.74	13.74	13.74	13.74
Milwaukee, Wis.:												
Anthracite: Stove	24.22	24.22	25.59	25.59	25.08	25.08	25.39	25.39	25.66	25.66	25.71	25.86
Bituminous coal: Low-volatile Stove	20.32	20.32	20.32	20.32	19.58	19.58	19.86	19.89	19.89	20.39	20.39	20.59
Coke: Nut	22.16	22.16	22.16	22.16	22.16	22.06	22.16	22.16	22.16	22.16	22.16	22.16
Heating oil:												
Fuel oil No. 2	13.84	13.84	13.84	13.84	13.84	13.84	13.84	13.84	13.84	13.84	14.10	14.10
Fuel oil No. 3	13.72	13.72	13.72	13.72	13.72	13.72	13.72	13.72	13.72	13.72	14.00	14.00
New York, N. Y.: [3]												
Anthracite:												
Stove	23.51	24.88	24.88	24.88	24.22	24.52	24.63	24.92	24.99	25.31	25.29	25.29
Buckwheat No. 1 [4]	14.95	15.49	15.49	15.49	15.15	15.33	15.39	15.58	15.61	15.81	15.79	15.79
Coke: Nut	23.05	23.05	23.05	23.05	22.58	23.41	23.42	23.42	23.42	23.42	23.42	23.42
Heating oil: Fuel oil No. 2	12.63	12.63	12.63	12.63	12.75	12.75	12.75	12.75	12.75	12.75	12.71	12.71
Philadelphia, Pa.:												
Anthracite:												
Stove	21.06	22.12	22.49	22.26	21.19	21.56	21.72	22.10	22.10	22.22	22.60	22.60
Buckwheat No. 1	14.43	14.83	15.03	15.03	14.83	14.88	14.88	14.93	14.93	14.93	15.13	15.13
Coke: Nut	20.95	20.95	20.95	19.95	19.95	20.95	20.95	20.95	20.95	20.95	20.95	20.95
Heating oil: Fuel oil No. 2	12.20	12.20	12.20	12.20	12.20	12.20	12.20	12.20	12.20	12.20	12.20	12.20

For footnotes, see end of table.

TABLE 31.—Retail prices of selected fuels in 1951, by months, for various cities [1]—Continued

[Coal and coke, per net ton; heating oil, per 100 gallons]

City and fuel	January	February	March	April	May	June	July	August	September	October	November	December
Portland, Maine:												
Anthracite:												
Stove	$22.25	$22.78	$23.57	$23.32	$22.35	$22.65	$22.95	$23.25	$23.52	$23.64	$23.75	$23.75
Buckwheat No. 1	16.45	16.70	16.96	16.84	16.45	16.55	16.65	16.75	16.95	17.10	17.15	17.15
Coke: Egg	21.75	21.75	21.75	21.51	20.55	20.85	21.35	21.35	21.35	21.77	21.83	21.82
Heating oil: Fuel oil No. 2	12.40	12.40	12.40	12.40	12.40	12.40	12.40	12.40	12.40	12.40	12.40	12.40
Washington, D. C.: [2]												
Anthracite:												
Stove	21.85	23.28	23.28	23.28	22.55	22.74	22.94	23.10	23.36	23.50	23.50	23.50
Buckwheat No. 1	15.58	16.00	16.00	16.00	15.80	15.87	15.97	16.02	16.02	16.13	16.13	16.17
Bituminous coal: Low-volatile Stove	18.10	18.10	18.10	18.10	18.17	18.17	18.17	18.17	18.17	18.31	18.31	18.31
Heating oil: Fuel oil No. 2	12.85	12.85	12.85	12.85	12.85	12.85	12.85	12.85	12.85	12.85	12.85	12.85

[1] Compiled from reports of Bureau of Labor Statistics. Prices are as of the 15th of each month. Data are preliminary.
[2] Includes 2-percent sales tax.
[3] Includes 1-percent sales tax.
[4] Commercial.

VALUE OF SALES

Owing to increased labor, materials, and equipment costs in 1951, the price of Pennsylvania anthracite increased over 1950. Average realization per ton on shipments to points outside the producing region was 6 percent higher in 1951 than in 1950; including "local sales," colliery fuel, dredge and washery sales, however, the 1951 average was 7 percent higher. As the average sales-realization data in this chapter are calculated on the basis of reported f. o. b. breaker, washery, or dredge prices and exclude the mark-up of separately organized wholesale companies, the averages shown will be less than the circular prices quoted by trade sources.

Detailed data on sales realization are presented in tables 32 to 34.

TABLE 32.—Average sales realization per net ton on Pennsylvania anthracite shipped from breakers to points outside and inside producing region in 1951, by region and size

[Value does not include margins of separately incorporated sales companies]

Size	Lehigh region			Schuylkill region			Wyoming region		
	Shipped outside region	Local sales	Total	Shipped outside region	Local sales	Total	Shipped outside region	Local sales	Total
Lump [1] and Broken	$13.26	$13.39	$13.26	$13.31	$13.59	$13.32	$12.96	$12.79	$12.94
Egg	13.51	14.62	13.51	13.40	13.74	13.41	13.27	14.02	13.27
Stove	13.98	13.72	13.98	13.48	13.27	13.48	13.79	14.25	13.80
Chestnut	13.96	14.46	13.99	13.31	13.46	13.32	13.62	14.23	13.67
Pea	10.91	11.54	11.05	10.00	10.35	10.06	10.62	11.31	10.93
Total domestic	13.50	12.83	13.45	12.83	12.10	12.77	13.37	12.47	13.27
Buckwheat No. 1	7.68	8.20	7.72	7.38	7.47	7.38	7.55	8.12	7.66
Buckwheat No. 2 (Rice)	6.05	6.75	6.15	5.77	5.58	5.76	6.04	6.45	6.13
Buckwheat No. 3 (Barley)	4.75	5.27	4.76	4.58	4.43	4.57	4.89	5.14	4.93
Buckwheat No. 4	3.73	-------	3.73	3.43	3.34	3.42	3.94	3.99	3.94
Other (including silt)	3.10	-------	3.10	3.21	2.32	3.21	3.00	2.39	2.85
Total steam	5.40	7.18	5.50	5.15	4.96	5.14	6.17	6.65	6.26
Total all sizes	9.85	10.65	9.90	8.82	8.52	8.80	11.20	9.95	11.03

Size	Sullivan County			Total					
				Excluding Sullivan County			Including Sullivan County		
Lump [1] and Broken	-------	-------	-------	$13.12	$12.85	$13.09	$13.12	$12.85	$13.09
Egg	-------	-------	-------	13.36	13.97	13.37	13.36	13.97	13.37
Stove	$12.56	$12.57	$12.56	13.72	13.74	13.72	13.72	13.73	13.72
Chestnut	13.14	13.14	13.14	13.56	14.02	13.60	13.56	14.02	13.60
Pea	10.33	10.33	10.33	10.38	11.13	10.60	10.38	11.13	10.60
Total domestic	12.06	11.81	11.95	13.19	12.41	13.12	13.19	12.41	13.12
Buckwheat No. 1	7.39	7.39	7.39	7.49	7.98	7.55	7.49	7.98	7.55
Buckwheat No. 2 (Rice)	3.80	-------	3.80	5.91	6.29	5.96	5.90	6.29	5.95
Buckwheat No. 3 (Barley)	-------	-------	-------	4.69	4.94	4.71	4.69	4.94	4.71
Buckwheat No. 4	-------	-------	-------	3.56	3.36	3.54	3.56	3.36	3.54
Other (including silt)	-------	3.90	3.90	3.17	2.38	3.15	3.17	2.43	3.15
Total steam	4.62	5.07	4.72	5.48	6.12	5.55	5.48	6.12	5.55
Total all sizes	7.99	9.72	8.58	9.94	9.59	9.90	9.94	9.59	9.90

[1] Quantity of Lump included is insignificant.

TABLE 33.—Average sales realization per net ton on Pennsylvania anthracite shipped from breakers to points outside producing region, 1947–51, by region and size

[Value does not include margins of separately incorporated sales companies]

Size	Lehigh region					Schuylkill region				
	1947	1948	1949	1950	1951	1947	1948	1949	1950	1951 [1]
Lump [2] and Broken	$10.21	$11.47	$11.98	$12.27	$13.26	$10.10	$11.09	$11.56	$12.14	$13.31
Egg	10.23	11.42	11.81	12.20	13.51	10.11	11.22	11.57	12.06	13.40
Stove	10.23	11.44	11.80	12.46	13.98	10.02	11.34	11.56	12.20	13.48
Chestnut	10.24	11.45	11.81	12.44	13.96	10.07	11.38	11.62	12.14	13.31
Pea	8.44	9.50	9.86	10.24	10.91	8.17	9.33	9.56	9.77	10.00
Total domestic	9.97	11.16	11.53	12.12	13.50	9.77	11.03	11.27	11.79	12.83
Buckwheat No. 1	5.97	6.52	6.64	6.90	7.68	5.76	6.39	6.43	6.64	7.38
Buckwheat No. 2 (Rice)	4.93	5.53	5.56	5.70	6.05	4.78	5.37	5.46	5.53	5.77
Buckwheat No. 3 (Barley)	3.57	4.14	4.36	4.50	4.75	3.52	4.03	4.26	4.37	4.58
Buckwheat No. 4	2.65	2.96	3.23	3.43	3.73	2.39	2.84	3.11	3.24	3.43
Other (including silt)	2.21	2.50	2.79	2.83	3.10	2.16	2.68	2.91	3.06	3.21
Total steam	4.25	4.73	4.80	5.08	5.40	4.09	4.68	4.79	4.94	5.15
Total all sizes	7.43	8.38	8.47	9.07	9.85	6.97	7.98	8.12	8.51	8.82

Size	Wyoming region					Sullivan County				
Lump [2] and Broken	$9.87	$11.06	$11.66	$12.10	$12.96	-------	-------	-------	-------	-------
Egg	10.01	11.15	11.54	12.03	13.27	-------	-------	-------	-------	-------
Stove	9.98	11.24	11.61	12.21	13.79	$11.36	$9.67	$10.96	$11.74	$12.56
Chestnut	9.98	11.20	11.60	12.20	13.62	10.20	9.59	10.98	11.50	13.14
Pea	8.19	9.31	9.70	9.98	10.62	9.28	7.86	8.88	9.50	10.33
Total domestic	9.81	11.04	11.42	11.99	13.37	10.12	9.31	10.71	10.89	12.06
Buckwheat No. 1	5.81	6.50	6.63	6.83	7.55	3.98	5.99	5.00	6.25	7.39
Buckwheat No. 2 (Rice)	4.84	5.48	5.63	5.76	6.04	3.14	-------	-------	-------	3.80
Buckwheat No. 3 (Barley)	3.63	4.15	4.37	4.58	4.89	-------	-------	-------	-------	-------
Buckwheat No. 4	2.49	3.01	3.32	3.54	3.94	-------	-------	-------	-------	-------
Other (including silt)	1.74	2.13	2.81	2.72	3.00	1.93	4.10	3.26	4.00	-------
Total steam	4.67	5.30	5.63	5.77	6.17	2.39	4.50	3.44	4.95	4.62
Total all sizes	8.27	9.35	9.77	10.17	11.20	6.54	7.50	9.26	8.58	7.99

Size	Total									
	Excluding Sullivan County					Including Sullivan County				
Lump [2] and Broken	$10.07	$11.19	$11.71	$12.15	$13.12	$10.07	$11.19	$11.71	$12.15	$13.12
Egg	10.08	11.22	11.60	12.07	13.36	10.08	11.22	11.60	12.07	13.36
Stove	10.03	11.30	11.63	12.25	13.72	10.03	11.29	11.63	12.25	13.72
Chestnut	10.05	11.30	11.64	12.21	13.56	10.05	11.29	11.64	12.21	13.56
Pea	8.23	9.36	9.67	9.94	10.38	8.23	9.35	9.67	9.94	10.38
Total domestic	9.82	11.05	11.39	11.94	13.19	9.82	11.05	11.39	11.94	13.19
Buckwheat No. 1	5.82	6.46	6.55	6.76	7.49	5.82	6.46	6.55	6.76	7.49
Buckwheat No. 2 (Rice)	4.83	5.45	5.54	5.65	5.91	4.83	5.45	5.54	5.65	5.90
Buckwheat No. 3 (Barley)	3.56	4.09	4.31	4.46	4.69	3.56	4.09	4.31	4.46	4.69
Buckwheat No. 4	2.46	2.89	3.18	3.33	3.56	2.46	2.89	3.18	3.33	3.56
Other (including silt)	2.06	2.49	2.87	2.96	3.17	2.06	2.50	2.87	2.97	3.17
Total steam	4.32	4.90	5.05	5.25	5.48	4.32	4.90	5.05	5.25	5.48
Total all sizes	7.65	8.67	8.90	9.34	9.94	7.65	8.67	8.90	9.34	9.94

[1] *See* footnote 1, table 1.
[2] Quantity of Lump included is insignificant.

TABLE 34.—Average value per ton of Pennsylvania anthracite, 1950–51, by regions [1]

[Data include washery and dredge coal]

Region	1950				1951 [2]			
	Shipped outside region	Local sales	Colliery fuel	Total production	Shipped outside region	Local sales	Colliery fuel	Total production
Lehigh	$8.82	$9.98	$6.52	$8.83	$9.52	$10.65	$6.81	$9.52
Schuylkill	8.20	6.77	2.47	8.05	8.52	7.72	2.88	8.40
Wyoming	10.06	8.63	3.38	9.63	11.14	9.61	4.22	10.66
Total, excluding Sullivan County	9.12	8.28	3.66	8.90	9.70	9.10	4.36	9.51
Sullivan County	8.58	8.65	----	8.60	7.99	9.72	----	8.58
Grand total	9.12	8.28	3.66	8.90	9.70	9.10	4.36	9.51

[1] Value given for shipments is value at which coal left possession of producing company and does not include margins of separately incorporated sales companies.
[2] *See* footnote 1, table 1.

FOREIGN TRADE [2]

Exports of Pennsylvania anthracite to all countries totaled 6 million net tons in 1951, a 53-percent increase over 1950. Although shipments to Canada declined 8 percent from the 1950 total, exports to the rest of the Western Hemisphere and to Europe increased substantially. The tonnage exported in 1951 represented the fifth largest annual total recorded in the history of the industry.

In the latter half of 1950, it became apparent that, even though western European coal production had shown progressive improvement since the close of World War II and had almost reached the 1938 level, requirements could not be met adequately without the importation of large quantities of American coal. As a result, shipments of anthracite to Europe in 1951 totaled 2.4 million tons. Monthly data of the Bureau of the Census, United States Department of Commerce, show that the revival of the trade with Europe began in December 1950, as 50,059 tons of the 1950 total of 81,930 tons was shipped in that month alone; exports to Europe for the first quarter of 1951 totaled 147,008 tons; the second quarter, 352,960; the third quarter, 894,221; and the fourth quarter of the year, 1,032,458. It is estimated that approximately 46 percent of the total exported to Europe in 1951 consisted of Pea and larger sizes and the remainder Buckwheat No. 2 and smaller. Export data are shown in detail in table 35.

[2] Figures on imports and exports compiled by M. B. Price and E. D. Page, of the Bureau of Mines, from records of the U. S. Department of Commerce.

TABLE 35.—Anthracite exported from the United States, 1950–51, by country and customs district, in net tons

[U. S. Department of Commerce]

Country	1950	1951
North America:		
Bermuda	442	476
British West Indies	203	62
Canada	3,798,285	3,484,800
Cuba		22,788
Mexico	9,553	16,023
South America:		
Bolivia		1,568
Brazil		679
Chile		1,276
Colombia	10	77
Peru		1,209
Uruguay		1,285
Venezuela	5	13
Europe:		
Austria		32,516
Belgium-Luxembourg	20,744	226,780
Denmark		1,946
France	50,614	1,337,438
Germany		14
Ireland		6,666
Italy		45,302
Netherlands		490,545
Norway		190,269
Switzerland		84,553
Yugoslavia	10,572	10,618
Asia:		
Japan		20
Saudi Arabia		14
Other Asia	23	
Africa:		
Belgian Congo	1,113	2,238
Other Africa	5	
Total	3,891,569	5,959,175

Customs district	1950	1951
North Atlantic:		
Maine and New Hampshire	12,620	9,686
New York	1,939	3,501
Philadelphia	108,602	2,470,088
Massachusetts		25
South Atlantic:		
Maryland		576
Virginia	203	3,248
Gulf Coast:		
Mobile		697
New Orleans	10	14
Mexican border: Laredo	119	47
Northern border:		
Buffalo	2,507,193	2,354,024
Dakota	2,665	36
Duluth and Superior	6,827	1,854
Michigan	121	225
Montana and Idaho		14
Ohio	20,237	8,153
Rochester	89,962	17,396
St. Lawrence	1,138,685	1,086,779
Vermont	2,386	2,812
Total	3,891,569	5,959,175

The decline in shipments to Canada from 3.8 million tons in 1950 to 3.5 million in 1951 may be attributed to the continuation of mild weather conditions, with temperatures averaging well above normal in the eastern part of that country, as over 95 percent of the anthracite shipped to Canada in recent years has been space-heating sizes (Buckwheat No. 2 and larger). Competition from Welsh anthracite declined during the year, as shipments to Canada from Great Britain fell from 395,865 tons in 1950 to 291,655 in 1951.

Imports of anthracite for consumption in the United States totaled 26,812 net tons in 1951; all came from Great Britain. Details on imports are presented in table 36.

TABLE 36.—Anthracite imported for consumption in the United States, 1950–51 by country and customs district, in net tons

[U. S. Department of Commerce]

Country	1950	1951
Canada	113	
United Kingdom	18,176	26,812
Total	18,289	26,812

Customs district	1950	1951
Massachusetts	17,970	26,812
Michigan	113	
New Orleans	206	
Total	18,289	26,812

TECHNOLOGY

The Bureau of Mines anthracite research laboratory at Schuylkill Haven, Pa., was virtually completed in 1951. It was expected that research on problems relating to the mining, preparation, and utilization of anthracite would be accelerated as rapidly as available funds permitted, with completion of the laboratory and formation of the various advisory committees. For several years before erection of the laboratory, Bureau personnel stationed in the anthracite region cooperated closely with the industry and the Anthracite Institute in practical research work. Research begun in 1944 was continued on scraper-shaker loading machines for driving gangways, and tests were run with the Eickhoff shearing machine, model DEK, to obtain data on power requirements for cutting anthracite. The Korfmann universal shearing machine, model SK–20, was tested to determine its power characteristics, maneuverability, and general qualities in cutting anthracite. Experiments were also made on pneumatic packing with a Brieden machine. Much of this research has been discussed previously in Minerals Yearbook chapters on Pennsylvania anthracite, and various publications related to this work are cited in those chapters. Formal establishment of the industry groups advisory to the laboratory was expected to be of valuable assistance in selecting and completing projects. Mining projects underway in 1951 or planned for early 1952 related to: Loads borne by roadway supports (the objective of this study was to obtain data on loads borne by mine timber as a basis for designing a steel protection shield to eliminate the installation of timber by face miners); a mechanical method for mining coal left below rock holes in thick, steeply pitching anthracite beds; compressed-air transmission, distribution, and storage underground in anthracite mines; the use of yielding steel supports (Becorit props) in mining thick, flat seams; continuation of practical research in back filling with Brieden pneumatic packing machines; continuation of experimental work with the Bureau of Mines scraper-shaker loading machine; mining of steeply pitching anthracite beds by induced block caving; and the use of lightweight concrete roof supports.

In anthracite utilization, the Bureau worked principally on the operation and performance of small commercial and industrial anthracite-burning equipment. This was a continuing project conducted in the anthracite research laboratory heating plant and boiler room. Research also was continued cooperatively with private industry on investigations in atmospheric fixed-bed-type anthracite gas producers. Information obtained from the gas-producer tests would supplement information already obtained on this subject from cooperative work conducted for a number of years by the Anthracite Institute, the Commonwealth of Pennsylvania, and Pennsylvania State College. Cooperation was given to the Anthracite Institute and private industry on projects and tests related to the feasibility of making from bone coal a producer gas for underfiring colliery boilers.

In coal preparation the Technical Advisory Preparation Subcommittee recommended that launder-screen investigations be continued, that studies on dewatering and drying fine coal be inaugurated, and that work begin on grinding anthracite to obtain the necessary data for determining the merits of hammer-mill and roll crushing in preparing anthracite. The subcommittee also suggested that a study

be made of the removal of cinders from anthracite, as this problem is important in preparing anthracite recovered by strip-mining and spoil-bank operations.

The Bureau of Mines has done considerable investigation of the anthracite mine-water problem, most of which has been discussed briefly in previous anthracite chapters of Minerals Yearbooks. Mine water from anthracite workings is generally pumped, drained away by gravity, or stored underground in huge quantities. The drainage systems in the anthracite region handle over 200 billion gallons of water annually; of this, more than 150 billion gallons is pumped to the surface. Much of this water is used in the breakers in preparing coal, for allaying mine dust, in hydraulic back-filling, and for combating fires, etc.

To obtain a sound foundation upon which engineering studies of the mine-water problem could be based, it was first necessary to gather reliable data on all factors involved, such as the quantity of water impounded in abandoned and active mines, the volume of water being pumped from each mine, the condition of barrier pillars in abandoned mines or serving as protection for active workings, the extent and depth of the glacial deposits overlying the coal measures in the Northern field, the characteristics of water, and the effect of mine water upon surface streams. Many of the data required have been obtained by the Safety Branch of the Health and Safety Division of the Bureau of Mines, and the Bureau is continuing its engineering survey.

It has been suggested that the long-range solution of the anthracite mine-water problem might best be accomplished by a gravity tunnel system and several pumping plants. The proposal envisages a tunnel 80 miles in length and 16 feet in diameter, lined with concrete. Construction would be on a grade of 1 foot per mile, starting at a point on the Susquehanna River near Conowingo, Md., and extending to Mahanoy City, Pa., with laterals draining water from the Southern and Western Middle fields. From Mahanoy City to Glen Lyon—a distance of 23 miles—the tunnel would have a diameter of 14 feet. From Glen Lyon the tunnel would extend along the Northern field 38 miles to Scranton; this segment of the tunnel would start with a diameter of 13 feet and progressively decrease in size to 9 feet at its end. A survey was run along the proposed Conowingo-Glen Lyon tunnel system to locate possible shaft sites, and diamond-drill holes were put down at 15 places to determine the character of the underlying rock.[3] Information obtained from this drilling and other data pertaining to the proposed tunnel are published in Bureau of Mines Bulletin 513.

Work at the Anthracite Institute's laboratory at Wilkes-Barre, Pa., during 1951 was divided into basic research, development of equipment, and testing of equipment. In addition to its own research, the institute cooperated on technical projects with Pennsylvania State College, the Bureau of Mines laboratory at Schuylkill Haven, and various research groups of the bituminous-coal and coke industries.

[3] Ash, S. H., Doherty, R. Emmet, Miller, P. S., Romischer, W. M., and Smith, J. D., Core Drilling at Shaft Sites of Proposed Mine-Water Drainage Tunnel; Anthracite Region of Pennsylvania: Bureau of Mines Bull. 513, 1952, 43 pp.

Basic studies were begun during the year on the use of anthracite as a filtering aid by the chemical industry. Plant-scale tests using Chestnut-size bone coal in the Wellman-Galusha gas producer were conducted in cooperation with the Wellman Engineering Co. and the Bureau of Mines. The institute continued to investigate the possibility of promoting the use of anthracite in the drying of farm products. A low-cost tobacco-curing furnace was developed in the laboratories and received its first trial during the past curing season in Ontario, Canada, and in North Carolina. In its investigations of the development of equipment, the institute's laboratory conducted considerable research on commercial crossfeed stokers, and a new-type furnace for heating small, prefabricated homes was designed and built.

WORLD PRODUCTION

World production of anthracite in 1951 increased 4 percent over the 1950 output. Slight increases occurred in virtually all producing countries except the United States, North Korea, and Portugal. World production data for 1946–51 are presented in table 37.

TABLE 37.—World production of anthracite, 1946–51, in thousands of metric tons
[Compiled by Pauline Roberts]

Country	1946	1947	1948	1949	1950	1951
Belgium [1 2]	4,783	5,121	5,853	5,839	5,712	6,500
Bulgaria [1]	27	27	27	27	30	35
China	757	878	[1] 600	[1] 1,000	[1] 2,000	[1] 4,000
France [2]	8,313	8,042	[3] 9,299	[1] 9,000	[1] 8,800	[1] 9,800
French Morocco	222	269	290	341	368	394
Germany: [2]						
East Germany [1]	167	198	204	217	238	238
West Germany [1]	3,877	5,216	6,183	7,433	[3] 7,800	8,300
Indochina	262	248	355	379	[3] 502	645
Ireland	123	122	89	[3] 48	[3] 98	[1] 100
Italy	105	115	87	75	68	82
Japan	444	648	852	776	686	1,089
Korea:						
Korea, Republic of	242	475	799	1,039	[1 3] 586	[1] 600
North Korea [1]	830	1,340	1,500	1,500	1,500	1,000
New Zealand	2	2	2	2	2	1
Peru	82	82	42	28	[3] 27	[1] 29
Portugal [2]	380	370	387	443	426	418
Rumania	16	24	[1] 25	35	[1] 30	[1] 35
Spain [2]	1,458	1,411	1,463	1,439	1,504	1,601
Switzerland	75	15	[1] 15	[1] 10	[1] 10	[1] 10
U. S. S. R. [1]	41,050	45,975	52,425	58,975	66,000	67,760
United Kingdom	3,548	3,657	3,860	3,783	[3] 3,621	[1] 4,300
United States (Pennsylvania)	54,891	51,882	51,836	38,738	39,986	38,709
Total (estimate)	121,650	126,120	[3] 136,200	131,100	[3] 140,000	145,700

[1] Estimated.
[2] Including semianthracite.
[3] Revised figure.

Cobalt

By Hubert W. Davis and Charlotte R. Buck

GENERAL SUMMARY

COBALT consumption in the United States in 1951 reached the record total of 9,933,000 pounds, a 20-percent gain over 1950, itself a record year. Consumption of cobalt for high-temperature alloys, alloy hard-facing rods, and cemented carbides more than doubled in 1951, and substantially more cobalt was used in high-speed steel. These gains, however, were partly offset by substantial losses in consumption of cobalt in magnets, ground-coat frit, pigments, and low-cobalt alloy steels. Consumption of cobalt metal in 1951 was 24 percent greater than in 1950, but seven times more purchased cobalt scrap was used. These gains were balanced to some extent by reduced consumption of cobalt oxide, salts, and driers. So great was the demand for cobalt that, effective February 1, 1951, it was put under complete allocation by the National Production Authority, which also prohibited its use in manufacturing less essential products or in products in which substitute materials might be used effectively.

Cobalt-metal production in the United States in 1951 was 8 percent over 1950; but imports, which established a new record, were 21 percent larger. Sales of cobalt metal in the United States, however, were virtually the same in 1951 as in 1950; those to industry gained 22 percent, but deliveries to the National Stockpile were 38 percent smaller.

The demand for cobalt oxide declined substantially in 1951, chiefly because of the limitations on use in ground-coat frit for porcelain enamel and in pigments. The output of oxide in the United States exceeded that in 1950 by 23 percent, but imports were 52 percent less; sales declined 27 percent. Production and shipments of hydrate, salts, and driers were substantially smaller than in 1950.

A large part of the cobalt metal, oxide, hydrate, and other cobalt products sold in the United States is made from crude cobalt (white alloy) produced in Belgian Congo. Imports of white alloy from Belgian Congo exceeded those in 1950 by 6 percent. Belgian Congo also supplied a substantial quantity of cobalt granules, which are produced from precipitates recovered from the solutions used in electrolytic copper plants. Some cobalt products sold are made from domestic, Moroccan, and Canadian ores. The output of domestic ore was 12 percent greater than in 1950, and imports of Canadian ore were up 94 percent. Consumption of cobalt white alloy and ore increased 13 percent.

The prices of cobalt metal and oxide were advanced 60 and 38 cents a pound, respectively, during 1951.

Allocation of cobalt to the free-world countries for the fourth quarter of 1951 was announced on October 11 by the International Materials Conference. The United States was allocated 1,212 metric tons or 59 percent of the total.

A report on the utilization of cobalt and other metals was issued by the Joint Subcommittee of the International Materials Conference.[1]

Government Regulations.—An amendment of December 30, 1950, to National Production Authority Order M–10 in effect constituted a completely new order, inasmuch as the former Order M–10 contained only inventory-control provisions. In addition to carrying these on in similar form, amended Order M–10, effective January 31, 1951, prohibited the use of cobalt in manufacturing specified products that are relatively less essential or in which substitute materials might be effectively used; established limits on additions to inventory; and placed cobalt under allocation by prohibiting, subject to limited exceptions, deliveries not covered by allocation authorizations to be issued monthly by the National Production Authority.

The Office of Price Administration, under General Overriding Regulation 9, Amendment 4, exempted from price control cobalt ore and cobalt metal, effective August 10, and under General Overriding Regulation, Amendment 9, exempted cobalt oxide, effective October 12.

DOMESTIC PRODUCTION

Mine Production.—Despite the fact that the United States is the largest consumer of cobalt in the world, only a small part of its requirements have been furnished by domestic ore. (Table 1 shows domestic production and shipments through 1951.) However, there was a prospect of decreased dependence on foreign sources by 1954, when full production will have been attained by Calera Mining Co. in Idaho and Cobalt-Nickel Reduction Co. in Missouri.

Production and shipments of cobalt ore in the United States in 1951 were 12 and 14 percent, respectively, greater than in 1950.

The Bethlehem Steel Co. was the chief producer of commercial cobalt ore in the United States in 1951. The cobalt-bearing material (averaging 1.42 percent cobalt in 1951) is obtained as a flotation sulfide concentrate from the magnetite mined at Cornwall, Pa. The cobalt-bearing material is shipped to the Pyrites Co., Wilmington, Del., where it is processed into metal and other cobalt products.

The Sullivan Mining Co., Kellogg, Idaho, continued to recover cobalt at its electrolytic zinc plant in 1951 but, as in previous years, made no shipments. In 1951 it recovered 107 short tons of residues containing 7,885 pounds of cobalt.

The St. Louis Smelting & Refining Division of National Lead Co. continued to produce an iron concentrate carrying cobalt, nickel, and copper at its property near Fredericktown, Madison County, Mo. The cobalt content of reject concentrate produced in 1951 was 3.75 percent. Construction of a 50–ton plant (head feed) to process this is planned to begin early in 1952. The plant will be operated by Cobalt-Nickel Reduction Co. and is expected to produce cobalt,

[1] International Materials Conference, Utilization of Manganese, Nickel, Cobalt, Tungsten, Molybdenum. Washington, December 1951, 94 pp.

nickel, and copper at an annual rate of 1,386,000, 1,852,000, and 1,418,000 pounds, respectively.

TABLE 1.—Cobalt ore produced and shipped in the United States through 1951

Year	Produced		Shipped from mines	
	Gross weight (short tons)	Cobalt content (pounds)	Gross weight (short tons)	Cobalt content (pounds)
Previous to 1921 (partly estimated)	(1)	730,000	(1)	730,000
1921–32 (partly estimated)	93	9,300	41	5,000
1933	20	1,160	----------	----------
1934	31	2,009	----------	----------
1935	23	1,995	----------	----------
1936	6	526	----------	----------
1937	24	3,023	----------	----------
1938	16	1,075	----------	----------
1939	27	1,705	----------	----------
1940	5,048	133,800	4,500	127,000
1941	19,127	505,377	20,031	521,627
1942	26,241	735,335	23,741	661,657
1943	27,103	732,098	28,541	763,772
1944	18,407	828,515	17,539	556,687
1945	19,770	1,099,654	17,528	1,281,681
1946	15,620	518,378	15,542	506,884
1947	22,348	645,295	23,442	676,612
1948	25,721	687,464	22,173	580,703
1949	19,599	521,656	25,175	673,773
1950	28,660	809,328	23,662	660,025
1951	28,485	902,629	26,564	755,631
Total	(1)	8,870,322	(1)	8,501,052

[1] Data not available.

The Calera Mining Co., a wholly owned subsidiary of the Howe Sound Co., began production of cobalt concentrates in June 1951 at its Blackbird mine at Cobalt, Idaho. The ore carries about 0.6 to 0.8 percent cobalt, about twice as much copper, and a little gold. The concentrates produced averaged 11.26 percent cobalt in 1951. According to the Howe Sound Co.: [2]

The concentrator at the mine, as originally designed for treating 600 tons of ore daily, was complete and ready for operation on July 1. The enlarged plant with a capacity of 1,000 tons per day is nearing completion at this writing (Feb. 29, 1952).

Completion of the refinery near Garfield, Utah, has not been possible because of frustrating delays in obtaining delivery of equipment and special supplies. * * * Construction of the plant has continued with a small crew and as equipment has been received it has been installed, or preparations have been made for quick installation when a larger crew is available. Barring the unforeseen breaking down of delivery schedules it is now expected that the plant will be ready for operation by the end of June.

No attempt was made during this time to block out additional ore and the small underground crew was utilized in preparing stopes for production so that, upon completion of the refinery, capacity operation could be developed as rapidly as the labor force could be expanded. The ore extracted from this preparatory work was milled with the concentrator operating one shift per day at partial capacity. Resulting copper concentrate was sold as produced and the cobalt concentrate was stored. This arrangement allowed for a thorough preliminary testing of the new flotation process which has been developed in the research laboratories of the Company. Difficulties encountered were rectified and necessary changes in the flow sheet were made and it is now expected that results which will be obtained under full operating conditions will be at least as good as those indicated by small scale tests made in the laboratory and pilot plant.

[2] Howe Sound Co., Annual Report: 1951, pp. 5–6.

The construction of additional apartments and dormitories was continued and is approaching completion. During the year the road between the mine and the main highway near Challis, Idaho, a distance of over 40 miles was improved by the Government and after surfacing is completed, early in 1952, it will be a reasonably good all weather highway.

This concentrator was described more fully in a trade journal article.[3]

Refinery Production.—Consumption by refiners or processors of cobalt contained in alloy and ore was 2,857,328 pounds in 1951—a 13-percent increase over 1950. However, consumption of cobalt intermediates by refiners or processors was 25 percent less. Of the alloy and ore consumed in 1951, much the greater part was utilized in making cobalt metal.

TABLE 2.—Cobalt products produced and shipped in the United States, 1950–51, in pounds

Product	Production		Shipments	
	Gross weight	Cobalt content	Gross weight	Cobalt content
1950				
Metal	1,850,145	1,817,550	2,280,321	2,240,834
Oxide	522,666	371,215	570,394	404,618
Hydrate	262,479	107,771	271,076	110,917
Salts:				
Acetate	199,385	46,673	199,969	46,806
Carbonate	205,986	94,760	212,100	97,591
Sulfate	839,500	178,231	777,549	165,314
Other	47,620	11,366	48,629	12,589
Driers	12,471,700	766,712	12,450,974	764,839
1951				
Metal	1,989,952	1,955,145	2,022,560	1,987,023
Oxide	637,456	457,618	638,896	458,455
Hydrate	242,264	98,444	244,216	97,477
Salts:				
Acetate	87,324	20,611	105,875	24,762
Carbonate	153,308	68,922	160,170	71,924
Sulfate	675,025	144,084	713,541	151,684
Other	122,869	28,174	124,976	28,891
Driers	8,739,612	541,541	8,801,734	532,141

TABLE 3.—Cobalt consumed by refiners or processors in the United States, 1946–51, in pounds of contained cobalt

Cobalt material[1]	1946	1947	1948	1949	1950	1951
Alloy and ore	2,009,018	2,672,991	2,715,605	2,607,281	2,526,755	2,857,328
Fines and granules	499,737	528,544	393,725	422,493	856,042	647,016
Rondelles	148,197	128,937	107,520	95,759	137,822	70,620
Hydrate	128,740	152,102	150.826	129,444	80,497	81,710
Carbonate	19,243	6,904	4,608	2,664	13,944	6,841
Other				17,565	48,261	48,549

[1] Total consumption is not shown, since the fines, granules, rondelles, hydrate, and carbonate originated from alloy and ore; combining alloy and ore with these materials would result in duplication.

CONSUMPTION

Industrial consumers established a new record in 1951, using 9,932,993 pounds, a 20-percent gain over 1950, the previous record

[3] Mining World, Sweat, Ingenuity, Dollars; A New Mine for Howe Sound: Vol. 13, No. 12, November 1951, pp. 40–43.

year. The largest single use for cobalt in 1951 was for cobalt-chromium-tungsten-molybdenum alloys, which represented 49 percent of the total quantity consumed and utilized 120 percent more than in 1950.

Magnet alloys, the largest utilizer of cobalt since 1946, dropped to second place in 1951 and used only 21 percent of the total consumed; moreover, consumption for this purpose was 26 percent less than in 1950. A cobalt-platinum magnet, which, in small sizes, is described as the world's most powerful permanent magnet, has been developed by scientists of the General Electric Research Laboratory.[4]

Less cobalt was also used in low-cobalt alloy steels, ground-coat frit for porcelain enamel, and pigments. These losses, however, were largely offset by greater use of cobalt in high-speed steel, alloy hard-facing rods, and cemented carbides. Cobalt salts and driers were utilized at a rate about 26 percent less than in 1950.

TABLE 4.—Cobalt consumed in the United States, 1947–51, by use, in pounds of contained cobalt

Use	1947	1948	1949	1950	1951
Metallic:					
High-speed steel	223,148	289,391	283,496	235,227	316,064
Other steel	87,719	132,803	162,638	252,885	79,885
Permanent-magnet alloys	1,016,147	1,352,371	1,194,920	2,834,040	2,052,042
Soft-magnetic alloys			42,965	37,552	58,652
Cobalt-chromium-tungsten-molybdenum alloys	941,087	1,196,608	1,238,083	2,226,199	4,899,591
Alloy hard-facing rods and materials	71,545	116,313	82,965	260,371	575,268
Cemented carbides	51,917	85,314	118,522	136,935	297,751
Other metallic	99,476	115,255	116,344	208,574	276,222
Total metallic	2,491,039	3,288,055	3,239,933	6,191,783	8,555,475
Nonmetallic (exclusive of salts and driers):					
Ground-coat frit	607,316	613,745	424,051	683,358	448,983
Pigments	207,928	232,725	188,606	262,441	50,073
Other nonmetallic	51,439	66,699	84,336	43,826	60,462
Total nonmetallic	866,683	913,169	696,993	989,625	559,518
Salts and driers: Lacquers, varnishes, paints, inks, pigments, enamels, glazes, feed, electroplating, etc. (estimate)	797,000	818,000	765,000	1,102,000	818,000
Grand total	4,154,722	5,019,224	4,701,926	8,283,408	9,932,993

An analysis of the function of cobalt oxide in promoting adherence to sheet-iron ground-coat enamels [5] and a study of the possibility of using other materials to accomplish the same result [6] have been made. A patent has been issued for "cobalt-base, cast alloys containing carbon, chromium and metal of the group tungsten and molybdenum as essential constituents, and such as are primarily adapted for cutting tools, particularly of the high-speed variety, and which are also adapted for other wear- and abrasion-resisting applications, for example, dies." [7]

The use of cobalt isotope for steel inspection was reported.[8] Success-

[4] Materials and Methods, vol. 34, No. 2, August 1951, pp. 145–146.
[5] Healy, J. H., and Andrews, A. I., The Cobalt-Reduction Theory for the Adherence of Sheet-Iron Ground Coats: Jour. Am. Ceram. Soc., vol. 34, No. 7, July 1951, pp. 207–214.
[6] Healy, J. H., and Andrews, A. I., The Elements of the Third, Fourth, and Fifth Series as Possible Adherence-Promoting Materials for Sheet-Iron Enamels: Jour. Am. Ceram. Soc., vol. 34, No. 7, July 1951, pp. 214–221.
[7] Schmucker, R. A., Jr., and others (assigned to Crucible Steel Co. of America), Cobalt Base Alloy and Articles Thereof: United States Patent 2,551,170, May 1, 1951.
[8] Materials and Methods, vol. 35, No. 3, March 1952, pp. 170, 172.

ful application of cobalt-60 as a source of gamma rays for industrial radiography was also announced.[9]

TABLE 5.—Cobalt consumed in the United States, 1947–51, by form in which used, in pounds of contained cobalt

Form	1947	1948	1949	1950	1951
Metal	2,542,174	3,321,516	3,311,229	6,087,048	7,534,864
Oxide	794,372	850,255	606,510	964,055	680,452
Cobalt-nickel compound	13,810	9,413	4,315	3,434	1,786
Ore and alloy	2,229			436	3,438
Purchased scrap	5,137	20,040	14,872	126,435	894,453
Salts and driers	797,000	818,000	765,000	1,102,000	818,000
Total	4,154,722	5,019,224	4,701,926	8,283,408	9,932,993

PRICES

The price of cobalt metal (97–99 percent, in 500–600-pound kegs) was increased to $2.10 a pound f. o. b. Niagara Falls or New York, N. Y., on January 1, 1951, and to $2.40 a pound on October 1. The former price of $1.80 a pound had been in effect since April 1, 1949. On January 1 the price of ceramic-grade oxide was advanced to $1.60 a pound (gross weight) east of the Mississippi River, and on November 8 it was raised to $1.76 a pound. The former price of $1.38 a pound had also been in effect since April 1, 1949. Sales of cobalt metal and ores were exempted from price control on August 10 and sales of oxide on October 12.

FOREIGN TRADE[10]

Imports.—Imports of cobalt into the United States established a new high of 10,338,000 pounds (cobalt content) in 1951 and were 14 percent larger than in 1950, the previous record year. Belgian Congo continued to be the chief source, in 1951 supplying 4,929,512 pounds of metal and 4,083,541 pounds of white alloy containing 1,904,429 pounds of cobalt. Belgium provided 3,000,500 pounds of metal and 431,767 pounds of oxide containing 306,400 pounds of cobalt; both metal and oxide were produced from Belgian Congo alloy. Canada furnished 182,700 pounds of metal, 4,750 pounds (gross weight) of oxide, 2,237 pounds (gross weight) of salts and compounds, and 344,872 pounds of ore containing 36,478 pounds of cobalt. Mexico contributed 146 pounds (gross weight) of zaffer and 192,291 pounds of ore containing 3,825 pounds of cobalt. France supplied 6,613 pounds of metal, the United Kingdom 1 pound of metal and 360 pounds (gross weight) of salts and compounds, and Germany and Switzerland 13 and 547 pounds (gross weight), respectively, of salts and compounds.

[9] Tobey, R. G., Cobalt-60 Cuts Costs by Industrial Radiography: Steel, vol. 128, No. 1, Jan. 1, 1951, pp. 267–268.

[10] Figures on imports and exports (unless otherwise indicated) compiled by M. B. Price and E. D. Page of the Bureau of Mines, from records of the U. S. Department of Commerce.

TABLE 6.—Cobalt imported for consumption in the United States, 1947–51, by class

[U. S. Department of Commerce]

Year	Alloy [1] (pounds)		Ore		
	Gross weight	Cobalt content	Pounds		Value
			Gross weight	Cobalt content	
1947	3,751,452	1,640,952	751,438	77,721	$58,920
1948	4,879,413	2,179,473	8,167,545	870,519	647,000
1949	3,691,051	1,657,788	109,009	11,965	9,344
1950	3,979,088	1,792,348	164,188	18,838	16,003
1951	4,083,541	1,904,429	[2] 537,309	40,303	[2] 54,015

Year	Metal		Oxide		Salts and other compounds	
	Pounds	Value	Pounds (gross weight)	Value	Pounds (gross weight)	Value
1947	[3] 6,035,153	[3] $7,994,347	752,150	$753,916	530	$1,856
1948	[3] 5,266,521	7,743,679	790,300	828,667	1,374	4,514
1949	5,588,327	9,025,595	360,318	384,879	359	1,167
1950	[3] 6,706,875	[3] 11,210,872	[3] 904,650	[3] 1,009,431	4,649	5,927
1951	[3] 8,119,326	16,302,356	436,517	603,855	3,157	4,048

[1] Reported by importer to Bureau of Mines; not separately classified by U. S. Department of Commerce. Value not available.
[2] Includes 146 pounds of zaffer, valued at $215.
[3] Adjusted by Bureau of Mines.

During the 29 years 1923–51 receipts of metal comprised about 50 percent of the cobalt imports, most of which were supplied by Belgium and Belgian Congo. Smaller quantities of metal have been received from Austria, Canada, Finland, France, Germany, Japan, Sweden, and United Kingdom. Imports of alloy represented the second-largest quantity (36 percent); virtually all were from Belgian Congo. About 10 percent of the imports of cobalt have been in the form of oxide, chiefly from Belgium. Substantial quantities of oxide have also been received from Australia, Finland, and France. Cobalt ore has comprised about 4 percent of total imports; Canada has been the largest source, with most of the remainder coming from Australia and French Morocco.

Exports.—Exports of cobalt from the United States are small; 10,275 pounds of metal, alloys, and cobalt-bearing scrap valued at $63,968 was exported in 1951. Some oxide, salts, and driers are also exported, but the figures are not separately recorded by the United States Department of Commerce.

Tariff.—The duty on cobalt oxide continued to be 10 cents a pound, sulfate 5 cents a pound, and linoleate 10 cents until June 7, 1951, when it was reduced 50 percent under the Torquay Agreement. The duty on salts and compounds continued at 30 percent ad valorem. Cobalt metal and ore entered the United States duty-free.

WORLD REVIEW

Virtually all cobalt occurs in combination with other metals, such as copper, nickel, iron, arsenic, lead, zinc, manganese, silver, and gold. Belgian Congo and Northern Rhodesia, where cobalt is associated with copper, have been the chief producing countries in recent years, followed by the United States, Canada, and French Morocco. These five countries have been supplying about 95 percent of the world output of cobalt. Iron pyrites from Finland, Germany, Greece, Italy, Norway, Spain, and Sweden contains cobalt, of which some is recovered. Although the quantities of cobalt in iron pyrites are generally very small—often only 0.05 percent—and its recovery only 50 to 60 percent, the very large tonnage treated before and during the war contributed greatly to the cobalt production in Germany. It is reported [11] that about 10 tons of cobalt concentrates is obtained from 100,000 tons of cinder. A complete record of cobalt output from iron pyrites is lacking.

TABLE 7.—World mine production of cobalt, 1942–51, by countries, in metric tons of contained cobalt [1]

[Compiled by Berenice B. Mitchell]

Country [1]	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951
Australia	14	15	9	9	10	8	10	9	10	(2)
Belgian Congo	1,656	2,061	1,877	2,800	2,150	3,563	4,322	4,350	5,148	5,875
Bolivia (exports)	1	(3)							(2)	(2)
Canada [4]	38	80	16	49	34	260	701	281	[5] 265	430
Chile	(3)	3	5	1						(2)
Finland	98	79	86	84	101	[5] 102	(2)	(3)	(2)	(2)
Italy	69	27	7	6			1	(3)		(2)
Japan	1	3	15	11	7	6	(3)			
Morocco, French	3	216	243	98	188	212	221	209	[5] 420	680
Northern Rhodesia [6]	914	943	978	874	552	420	367	402	670	678
Sweden				9						(2)
United States (shipments)	300	346	253	581	230	307	263	306	299	343
Total (estimate)	3,500	4,200	3,900	4,700	3,500	5,000	6,100	5,900	7,100	8,500

[1] In addition to countries listed, Brazil, China, Germany, and Spain produce cobalt, but production data are not available. Estimate by author of chapter included in total.
[2] Data not available; estimate by author of chapter included in total.
[3] Less than 0.5 ton.
[4] Figures comprise Canadian ore processed in Canada and exported (irrespective of year when mined), plus cobalt content of concentrates made at Port Colborne from copper-nickel ore. However, figures exclude the cobalt recovered at Clydach, Wales, from Canadian nickel-copper ores, for which estimate by author of chapter has been included in world total.
[5] Revised figure.
[6] Year ended June 30 of year stated.

Belgian Congo.—The leading source of cobalt continues to be Belgian Congo; the Union Minière du Haut-Katanga, the only producer, reported an output of 5,875 metric tons in 1951, a new record. Production of cobalt in Belgian Congo was begun in 1924 and since that year has increased, almost without interruption; the total through 1951 is about 48,000 metric tons.

Union Minière has six 720-kw. electric furnaces at Jadotville and one of 2,000 kw. for smelting cobalt ores and concentrates from the Kolwezi, Musonoi, and Luiswishi open-pit mines. The cobalt content of low-grade ore from the Kolwezi mine is raised by washing, and the washed ore is sent either directly to the electric furnaces at

[11] Dennis, W. H., Recovery of Nonferrous Metals from Pyrite: Mine and Quarry Eng. (London), vol. 13, No. 12, December 1947, pp. 358–362.

Jadotville or to the concentrator at Kolwezi, depending upon the content. The Kolwezi concentrator, now being enlarged, will have two stages of crushing, two grinding sections, and two flotation sections. The vast Musonoi copper-cobalt deposit contains large veins especially rich in cobalt, which, in spite of the mixture of ores, are worked separately by selective mining. The Musonoi mine contains ore that attains and sometimes surpasses 6 to 7 percent cobalt, also ores carrying 1.5 to 2 percent cobalt but susceptible of being enriched by concentration up to 7 or 8 percent. These rich products are smelted and reduced in electric-arc furnaces at the Jadotville-Panda plants. The mixed copper-cobalt ore from the Luiswishi mine is sent directly to Jadotville. The cobalt and copper obtained from smelting the cobalt-rich ores and concentrates blend with other metals contained in the charge to form two alloys—a red alloy rich in copper and poor in cobalt and a white alloy rich in cobalt and iron but containing about 15 percent copper. The red alloy is treated in rotary furnaces at the Lubumbashi plant to yield a cobaltiferous slag, which is returned to the electric furnaces at Jadotville to produce white alloy. The white alloy, containing about 45 percent cobalt, is cast into ingots, which are sent to Belgium and the United States for refining.

The greater part of the company reserves of cobalt consists of oxidized copper ores containing less than 0.5 percent cobalt. The cobalt is recovered from these ores by two distinct methods: By an electrolytic process and by smelting in electric furnaces. The ores or concentrates that are poorest in cobalt are sent to the electrolytic copper plant at Jadotville-Shituru, where they are submitted to special treatment to recover the copper and the cobalt. The cobalt, which is recovered as a precipitate, is supplied to the Electrolysis Section. Because cobalt is an electronegative product, electrolytic deposition is possible only in a neutral solution. This is achieved by the electrolysis of a pulp containing cobalt hydrate in suspension. The hydrate acts as a neutralizing agent for the acid that has been liberated by the cathodic deposit. The harmful effect of the solids in suspension (about 100 grams per liter), occlusion of which in the cathodic deposit would lower its grade, is neutralized by mixture of the electrolyte through introducing an air flow through especially designed anodes. Another advantage of this air flow is that it activates reaction of the hydrates of cobalt with the acid. The electrolysis results in consumption of 4.5 kw.-hr. of energy per kilogram of cobalt.

The deposited cathodic cobalt is of the following composition:

	Percent
Co	91–95
Ni	.45–.7
Fe	.08–.2
Mn	.1–.3
Zn	3–5
S	.1–.3
Cu	.01–.03

The cathodic cobalt is refined in a 1,600 kv.-a. triphasic arc furnace. This refining, similar to the operation applied in the production of extra-mild basic steels, permits a slightly oxidizing fusion, which scorifies the manganese, and desulfuration by a reducing slag at a

high lime content. The zinc, volatilized in large part at the beginning of the operation, is eliminated by a poling operation. The liquid cobalt is then granulated in water and polished for export. The granules average about 99 percent cobalt. The company production of electrolytic cobalt is about 2,500 tons a year. The capacity of the plant will soon be increased to about 3,300 tons annually.

On the basis of a rate of production of 4,000 metric tons annually, the company reported reserves of cobalt adequate for 40 to 50 years and anticipates that these reserves will increase after further development of its copper deposits.

The operations of Union Minière in Belgian Congo have been described in much detail by its chairman, and much of the above information has been taken from his articles.[12]

Canada.—Production of cobalt in Canada is measured by the quantities of Canadian ores processed and exported, irrespective of the year when mined, plus the cobalt content of concentrates produced by the International Nickel Co. of Canada, Ltd., at Port Colborne, Ontario. Canadian production figures, however, do not include the cobalt recovered by Mond Nickel Co. at its Clydach (Wales) nickel refinery from the nickel-copper ores of the Sudbury district.

According to the Dominion Bureau of Statistics, production of cobalt (content) in Canada was 947,216 pounds in 1951 compared with 583,806 pounds in 1950.

To maintain incentive for the producers, particularly in the Cobalt district of Ontario, to continue to mine cobalt ores in the face of increasing operating costs, three advances in prices were made in the early part of 1951. Effective April 1, it was reported that the following schedule for the purchase of cobalt in ores or concentrates, f. o. b. Cobalt, Ontario, would be in effect:[13]

Cobalt, percent:	*Per pound cobalt*
7 to 7.99	$1.00
8 to 8.99	1.15
9 to 9.99	1.30
10 to 10.99	1.40
11 to 11.99	1.50
12 and over	1.60

Concurrently, it was announced that payment would be made for 100 percent of the cobalt content in silver ores and concentrates. The new price schedule applies to the cobalt in such ores and concentrates delivered by rail to Marmora or by truck at Deloro and is as follows:

Cobalt, percent:	*Per pound cobalt*
Up to 2.99	$0.15
3 to 3.99	.25
4 to 4.99	.35
5 to 5.99	.50
6 to 6.99	.65
7 to 7.99	.80
8 to 8.99	.95
9 to 9.99	1.10

[12] Sengier, E. B., Katanga's Mineral Empire Based on Many Metals: Eng. and Min. Jour., vol. 152, No. 11, November 1951, pp. 86–89; No. 12, December 1951, pp. 92–96.
[13] Northern Miner, vol. 37, No. 2, Apr. 5, 1951, pp. 1, 5.

The International Nickel Co. of Canada, Ltd., continued to recover impure cobalt concentrates at its Port Colborne refinery; they are shipped to Clydach, Wales, for refining.

Production of cobalt by Falconbridge Nickel Mines, Ltd., was to begin in 1952. The company has completed a plant at Kristiansand, Norway, to recover cobalt from the matte contained in Sudbury nickel-copper ores.

The Eldorado Mining & Refining (1944), Ltd., continued to produce cobalt-nickel speiss at its Port Hope refinery from pitchblende mined at Port Radium, Northwest Territory. The speiss averages about 14 percent cobalt.

French Morocco.—Production of cobalt concentrate in French Morocco was 6,255 metric tons containing 680 tons of cobalt in 1951 compared with 3,509 tons containing 420 tons of cobalt in 1950. La Société Minière de Bou-Azzer et du Graara, Casablanca, is the sole producer. The cobalt concentrate contains 10 to 12 percent cobalt, as well as some nickel, gold, and silver. During 1951 Deloro Smelting & Refining Co. at Deloro, Ontario, Canada, refined some French Morocco concentrate to metal for the Economic Cooperation Administration; as a result, about 182,700 pounds of metal was delivered to the United States in 1951.

Northern Rhodesia.—Northern Rhodesia was displaced by French Morocco as the second-largest producer of cobalt in the world in 1951. The Rhokana Corp., which has been producing cobalt since 1933, is the sole producer. The output of alloy was 1,978 short tons containing 747 tons of cobalt in the year ended June 30, 1951, compared with 1,954 tons containing 739 tons in 1950. The grade of ore treated was 0.155 percent cobalt in 1951 compared with 0.137 percent in 1950. Concentrates produced contained 1.56 percent cobalt in 1951 compared with 1.39 percent in 1950. Work continued throughout the year on erection of the electrolytic cobalt refinery, which is expected to begin operation early in 1952. The refinery is designed for a production of 1,500 short tons of electrolytic cobalt metal annually.

It was reported that the Economic Cooperation Administration loaned $8,400,000 to Chibuluma Mines, Ltd., to develop new sources of copper and cobalt in Northern Rhodesia. The deposit is near the southern border of Belgian Congo. Reserves of the ore deposit are estimated at 7,300,000 short tons averaging 5.23 percent copper and 0.25 percent cobalt. Production is scheduled to start in 1956. The mine, when in full operation, is expected to yield 16,000 long tons of copper and 500,000 pounds of cobalt annually.[14]

[14] Daily Metal Reporter, vol. 51, No. 158, Aug. 17, 1951, p. 6.

Coke and Coal Chemicals

By J. A. DeCarlo, J. A. Corgan, and Maxine M. Otero

GENERAL SUMMARY

NEW RECORDS were established in 1951 for the production of coke and coal chemicals in the United States. The output of oven and beehive coke combined totaled 79.3 million net tons, a 9-percent gain over 1950 production and a 6-percent increase over the previous record, set in 1948. The new record was made possible by the absence of major work stoppages, an unusually strong demand for coke-oven products, and the availability of adequate coking-coal supplies. The monthly average rate of oven-coke production was unusually uniform throughout the year, ranging from a low of 95.3 percent of capacity in November to a level of 97.9 percent in June; it averaged 96.5 percent for the year, the second highest annual rate on record. This accelerated rate of operation was achieved in spite of the poor condition of a large number of old ovens, which had to be operated carefully. Because of the obsolescence of many ovens and the critical importance of the coke industry to defense mobilization as well as the civilian economy, it became apparent that a coke-expansion program was necessary. Accordingly, on December 5, 1951, the Defense Production Administration established a goal of 84 million net tons of slot-type coke-oven capacity by the end of 1953. The goal set represented a total nearly 10 million tons greater than the capacity actually in place on December 31, 1951. The annual coke capacity of ovens under construction at the end of 1951 totaled 8.1 million net tons; but the new construction did not entirely represent additional capacity, as about 1.4 million tons was for replacement of old batteries.

Beehive-coke ovens, generally marginal producers of coke in periods of heavy demand, produced their largest tonnage since 1943. The monthly rate of beehive-coke production was highest in January; it averaged 23,700 net tons per day but declined thereafter and averaged about 20,000 tons daily during the remaining months of the year. The larger part of the beehive production was shipped to iron blast furnaces and was an important factor in establishing a new record in iron production. Of the total quantity of coke used in blast furnaces in 1951, 10 percent was supplied by beehive ovens, an amount adequate to produce approximately 7 million tons of pig iron.

The consumption pattern of coke in 1951 in general followed that of the preceding year. Increases were attained in consumption by blast furnaces and foundries but the quantity used in manufacturing

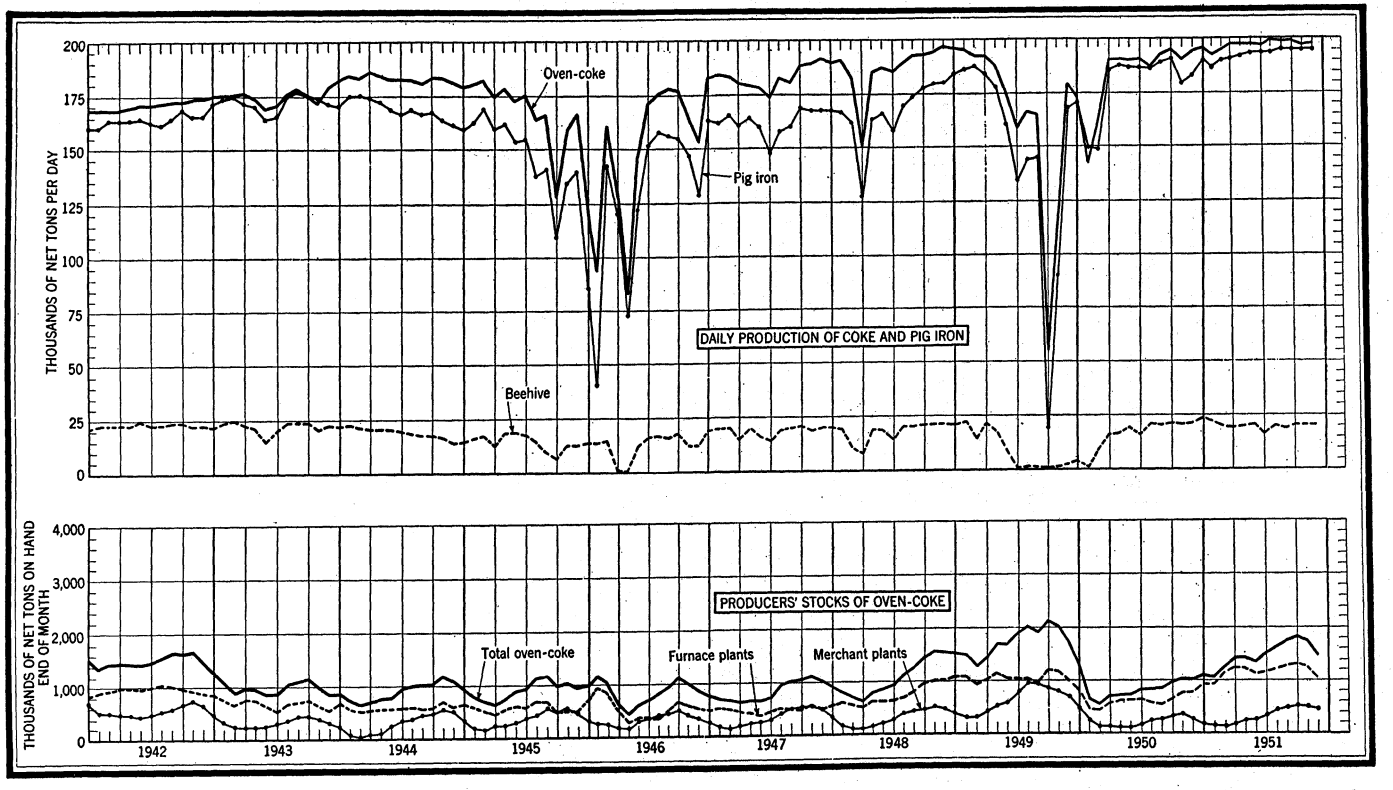

FIGURE 1.—Average daily production of oven and beehive coke and pig iron and producers' stocks of oven coke, 1942–51, by months.

producer gas and water gas, and in residential heating declined. The total used for metallurgical purposes (blast furnace and foundry) was the highest on record. Blast furnaces utilized 85 percent of total production in 1951 compared with 83 percent in 1950; foundries, 5 percent; the manufacture of producer gas and water gas, 4 percent; other industrial uses (nonferrous smelting, chemical processing, etc.), 3 percent; household heating, 2 percent; and exports, 1 percent.

The Defense Solid Fuels Administration was established in the United States Department of the Interior in December 1950 to direct mobilization of the solid-fuels industries (including coke and coal chemicals) to meet defense requirements. Functions with respect to distribution of coal chemicals produced at oven-coke plants were delegated to the Secretary of Commerce, effective May 16, 1951. As the claimant agency for the coke industry, DSFA ascertained the requirements of the coke producers for materials to be used in maintenance, repair and operation, or new construction. Starting with the fourth quarter of 1951, construction permits were issued by this agency, and building materials under priority control were allocated to approved projects. Applications for necessity certificates for rapid tax amortization of the capital costs of new construction were processed by DSFA for the Defense Production Administration. Statistical and technical assistance was provided the DSFA by the Bureau of Mines in carrying out the defense program for expanding coke-making capacity.

A number of defense regulations were issued relating to coke and coal chemicals. The National Production Authority issued Priority Regulation 1—Inventory Control—effective September 18, 1951, to prevent accumulation of excessive inventories of critical materials by limiting the quantity that could be ordered, received, or delivered. Benzol was the only coal chemical originally controlled, but the regulation was amended October 22, 1951, to include naphthalene, phenol, and pyridine.

The Office of Price Stabilization placed price ceilings on coke and coal chemicals on March 16, 1951, under Supplementary Regulation (S. R.) 13 to the General Ceiling Price Regulation. Under this regulation, coke producers were permitted to adjust prices to reflect increases in costs of raw materials, principally bituminous coal, provided that the increases put in effect would not cause the producers' operating margin to exceed that of the base period, January 1—December 31, 1950. S. R. 13 was amended subsequently as follows: On May 16, 1951, it was altered to include distributors as well as producers; and on June 30, the expiration date was extended to Sept. 30, later to Dec. 31, 1951, and then to Feb. 29, 1952.

According to the Bureau of Mines survey of man-hours and active days in the coke industry in 1951, there was an average of 22,058 men working per active day representing a total of 64,102,990 man-hours in the oven-coke industry. These figures represent an increase of 1,116 men working per active day and 3,509,903 man-hours over 1950. In the beehive segment of the industry, the average number of men working per active day increased from 3,405 in 1950 to 3,657 in 1951, and the man-hours worked advanced from 5,267,918 to 6,087,503. Productivity at both oven and beehive plants increased slightly as output per man-hour at the coke-oven plants rose from

1.19 tons in 1950 to 1.20 in 1951; at beehive plants the increase was from 1.12 tons per man-hour in 1950 to 1.22 in 1951. Productivity in the oven-coke industry is not accurately indicated by the statistics, as the number of man-hours devoted to coke production, as such, cannot be separated from those worked in the chemical-recovery plants. If such separation were possible, however, the figures would undoubtedly show a higher output per man-hour at oven-coke plants than at beehive installations.

The production of coal-chemical materials, which usually parallels that of oven coke, also reached a new peak. The output of ammonia and tar increased 8 percent each, of crude light oil 9 percent, and of gas 7 percent over 1950. An increased production of basic chemical raw materials resulted in substantial gains also in the production of ammonium sulfate, ammonia liquor, and virtually all of the other light-oil and tar derivatives. In spite of the gains indicated above, demand for some of the coal chemicals, particularly benzol and naphthalene, was greater than the supply available from domestic

TABLE 1.—Salient statistics of the coke industry in the United States, 1937 and 1950–51

	1937	1950	1951
Coke production:			
Oven—net tons	49,210,748	66,890,618	71,987,172
Beehive—do	3,164,721	5,827,420	7,343,530
Total—do	52,375,469	72,718,038	79,330,702
Percent oven	94.0	92.0	90.7
Producers' stocks of coke, end of year—net tons	2,595,287	1,110,714	1,482,972
Exports, all coke—do	526,683	397,801	1,026,730
Imports, all coke—do	286,364	437,585	161,639
Apparent consumption, all coke—do	51,271,929	73,416,519	78,093,353
Disposal, all coke sold or used:			
Blast furnace—do	36,751,969	60,918,549	67,440,987
Foundry—do	2,038,822	3,523,396	3,805,686
Other industrial (including producer and water gas)—do	4,597,894	6,366,497	5,603,262
Domestic—do	8,107,518	2,565,176	2,087,934
Receipts per ton of coke sold (merchant sales):			
Blast furnace	$4.22	$13.95	$14.99
Foundry	$7.91	$19.78	$21.81
Water gas	$6.25	$15.02	$15.73
Other industrial	$5.48	$13.55	$14.09
Domestic	$6.43	$13.59	$14.43
Coal-chemical materials produced:			
Tar—gallons	603,053,288	739,868,767	795,311,283
Ammonium sulfate or equivalent—pounds	1,506,431,251	1,849,127,582	1,995,546,999
Gas—M cubic feet	757,628,942	979,592,988	1,052,280,603
Burned in coking process—percent	37.04	36.81	36.19
Surplus sold or used—do	61.12	61.54	62.09
Wasted—do	1.84	1.65	1.72
Crude light oil—gallons	187,054,346	260,856,875	284,496,933
Yield of coal-chemical materials per ton of coal:			
Tar—gallons	8.67	7.79	7.78
Ammonium sulfate or equivalent—pounds	21.84	19.89	19.82
Gas—M cubic feet	10.89	10.32	10.29
Crude light oil—gallons	2.86	2.81	2.82
Value of coal-chemical materials sold:			
Tar	$18,456,483	$37,558,999	$43,546,155
Ammonia (sulfate and liquor)	$16,048,325	$31,322,588	$36,032,105
Gas (surplus)	$72,961,697	$132,247,656	$138,300,299
Crude light oil and derivatives	$20,215,404	$53,819,463	$78,024,932
Other coal-chemical materials [1]	$4,442,929	$19,421,444	$28,044,466
Total value of all products [2]	$411,706,484	$1,278,625,062	$1,474,406,800

[1] Naphthalene, tar derivatives, intermediate light oil, and miscellaneous materials.
[2] Includes value of coke and breeze produced and tar used as fuel by producers.

sources. Substantial quantities of benzol and naphthalene were imported. Although supplies of these two commodities were limited, nevertheless they were not placed under allocation control. However, action was taken by NPA from time to time on some of the scarcer chemicals, particularly toluol, to provide for its use in explosives and on benzol, to alleviate spot shortages. The price of coke-oven benzol under price ceilings averaged $0.34 per gallon. Petroleum benzol, however, was produced in increasing quantities in 1951 to make up the difference between demand and coke-oven output. It averaged $0.47 per gallon, according to data published by the United States Tariff Commission.

The total value of coal-chemical materials sold amounted to $323.9 million, a gain of 18 percent over the 1950 figure. The value of all coke-oven products, whether used by producers or sold, totaled $1.5 billion, a new record.

TABLE 2.—Statistical summary of the coke industry in the United States in 1951

	Slot-type ovens	Beehive ovens	Total
Coke produced—			
At merchant plants:			
Net tons	13,190,550	(2)	(2)
Value	$218,174,099		
At furnace plants: [1]			
Net tons	58,796,622		
Value	$798,891,452		
Total:			
Net tons	71,987,172	7,343,530	79,330,702
Value	$1,017,065,551	$102,408,135	$1,119,473,686
Breeze produced:			
Net tons	5,125,834	87,653	5,213,487
Value	$19,832,315	$212,956	$20,045,271
Coal charged into ovens:			
Bituminous:			
Net tons	102,030,281	11,418,465	113,448,746
Value	$912,183,681	$70,212,117	$982,395,798
Average per ton	$8.94	$6.15	$8.66
Anthracite:			
Net tons	237,136	----------	237,136
Value	$1,959,021	----------	$1,959,021
Average per ton	$8.26	----------	$8.26
Total:			
Net tons	102,267,417	11,418,465	113,685,882
Value	$914,142,702	$70,212,117	$984,354,819
Average per ton	$8.94	$6.15	$8.66
Average yield in percent of total coal charged:			
Coke	70.39	64.31	69.78
Breeze (at plants actually recovering)	5.01	2.47	4.93
Ovens:			
In existence January 1	14,982	17,708	32,690
In existence December 31	15,319	20,458	35,777
Dismantled during year	359	51	410
In course of construction December 31	1,446	398	1,844
Annual coke capacity December 31 net tons	74,228,400	13,858,900	88,087,300
Coke used by producers—			
In blast furnaces:			
Net tons	44,629,127	370,732	44,999,859
Value	$595,477,226	$5,675,482	$601,152,708
In foundries:			
Net tons	59,397	----------	59,397
Value	$967,508	----------	$967,508
To make producer gas:			
Net tons	578,284	----------	578,284
Value	$7,457,643	----------	$7,457,643
To make water gas:			
Net tons	1,028,521	----------	1,028,521
Value	$11,849,194	----------	$11,849,194
For other purposes:			
Net tons	339,018	1,579	340,597
Value	$4,383,451	$22,632	$4,406,083

For footnotes, see end of table.

TABLE 2.—Statistical summary of the coke industry in the United States in 1951—Continued

	Slot-type ovens	Beehive ovens	Total
Coke sold—			
To financially affiliated companies—			
For blast-furnace use:			
Net tons	11,256,984	1,771,379	13,028,363
Value	$159,093,772	$22,203,458	$181,297,230
For foundry use:			
Net tons	57,665	----------	57,665
Value	$1,093,956	----------	$1,093,956
For manufacture of water gas:			
Net tons	663,144	----------	663,144
Value	$10,056,072	----------	$10,056,072
For other purposes:			
Net tons	301,363	5	301,368
Value	$4,907,142	$77	$4,907,219
To other consumers—			
For blast-furnace use:			
Net tons	5,139,935	4,272,830	9,412,765
Value	$80,403,499	$60,689,574	$141,093,073
For foundry use:			
Net tons	3,460,528	228,096	3,688,624
Value	$76,778,633	$3,667,223	$80,445,856
For manufacture of water gas:			
Net tons	516,005	114,473	630,478
Value	$8,162,062	$1,756,735	$9,918,797
For other industrial use:			
Net tons	1,505,695	555,175	2,060,870
Value	$21,040,653	$7,998,344	$29,038,997
For domestic use:			
Net tons	2,060,697	27,237	2,087,934
Value	$29,770,954	$354,701	$30,125,655
Disposal of breeze:			
Used by producers—			
For steam raising:			
Net tons	3,228,179	3,453	3,231,632
Value	$11,446,224	$4,987	$11,451,211
To make producer or water gas:			
Net tons	118,878	----------	118,878
Value	$640,024	----------	$640,024
For other purposes:			
Net tons	855,351	11	855,362
Value	$2,926,768	[3]	$2,926,768
Sold:			
Net tons	1,237,788	75,652	1,313,440
Value	$5,800,200	$233,130	$6,033,330
Average receipts per ton sold (merchant sales):			
Blast-furnace coke	$15.64	$14.20	$14.99
Foundry coke	$22.19	$16.08	$21.81
Water-gas coke	$15.82	$15.35	$15.73
Other industrial coke	$13.97	$14.41	$14.09
Domestic coke	$14.45	$13.02	$14.43
Breeze	$4.69	$3.08	$4.59
Producers' stocks on January 1, 1952:			
Blast-furnace coke, net tons	1,011,989	14,129	1,026,118
Foundry coke, do	16,140	1,344	17,484
Domestic and other coke, do	439,270	100	439,370
Breeze, do	820,892	5,413	826,305

[1] Plants associated with iron blast furnaces (refer to definition in section on Production by Merchant and Furnace Plants.)
[2] Not separately recorded.
[3] Included with value of breeze sold to avoid disclosure of individual company operations.

TABLE 3.—Coke produced, value, number of ovens, coal charged, and average yield in the United States in 1951, by States

State	Oven coke						
	Plants in existence Dec. 31	Ovens in existence Dec. 31	Coal charged (net tons)	Yield of coke from coal (percent)	Coke produced (net tons)	Value of coke at ovens	
						Total	Per ton
Alabama	7	1,340	8,756,422	71.85	6,291,280	$75,124,573	$11.94
California	1	135	924,537	61.46	568,216	(1)	(1)
Colorado	1	266	1,452,062	68.55	995,332	(1)	(1)
Illinois	8	900	5,214,085	70.69	3,685,662	62,052,609	16.84
Indiana	5	1,955	12,320,739	71.78	8,843,452	156,205,401	17.66
Maryland	1	551	3,955,067	72.19	2,855,209	(1)	(1)
Massachusetts	1	204	1,561,541	71.01	1,108,826	(1)	(1)
Michigan	4	584	4,001,353	72.98	2,920,082	44,321,098	15.18
Minnesota	3	240	1,338,937	72.59	971,913	16,143,039	16.61
New Jersey	2	341	2,124,486	72.44	1,538,953	(1)	(1)
New York	7	1,115	8,095,523	69.31	5,610,975	80,327,062	14.32
Ohio	15	2,285	15,858,101	70.32	11,151,201	146,140,699	13.11
Pennsylvania	13	3,710	25,127,515	68.65	17,250,217	220,910,330	12.81
Tennessee	1	44	322,037	77.84	250,658	(1)	(1)
Texas	2	125	1,041,766	72.51	755,418	(1)	(1)
Utah	2	308	1,934,422	63.41	1,226,536	(1)	(1)
West Virginia	5	705	5,366,963	71.36	3,829,879	44,416,343	11.60
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	5	511	2,871,861	74.29	2,133,363	34,211,525	16.04
Undistributed						137,212,872	14.76
Total 1951	83	15,319	102,267,417	70.39	71,987,172	1,017,065,551	14.13
At merchant plants	27	2,958	18,322,799	71.99	13,190,550	218,174,099	16.54
At furnace plants	56	12,361	83,944,618	70.04	58,796,622	798,891,452	13.59
Total 1950	84	14,982	94,926,310	70.47	66,890,618	899,667,327	13.45

State	Beehive coke						Total	
	Ovens	Coal charged (net tons)	Yield of coke from coal (percent)	Coke produced (net tons)	Value of coke at ovens		Coke produced (net tons)	Value of coke at ovens
					Total	Per ton		
Alabama							6,291,280	$75,124,573
California							568,216	(1)
Colorado	20	1,300	55.08	716	(1)	(1)	996,048	(1)
Illinois							3,685,662	62,052,609
Indiana							8,843,452	156,205,401
Maryland							2,855,209	(1)
Massachusetts							1,108,826	(1)
Michigan							2,920,082	44,321,098
Minnesota							971,913	16,143,039
New Jersey							1,538,953	(1)
New York							5,610,975	80,327,062
Ohio							11,151,201	146,140,699
Pennsylvania	17,596	9,872,414	64.79	6,396,480	$87,877,904	$13.74	23,646,697	308,788,234
Tennessee	90	3,440	47.62	1,638	(1)	(1)	252,296	(1)
Texas							755,418	(1)
Utah	797	183,830	55.31	101,672	(1)	(1)	1,328,208	(1)
Virginia	748	492,062	58.35	287,116	4,453,445	15.51	287,116	4,453,445
West Virginia	1,012	686,230	62.98	432,155	6,407,259	14.83	4,262,034	50,823,602
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	195	179,189	69.06	123,753	(1)	(1)	2,257,116	(1)
Undistributed					3,669,527	16.11		175,093,924
Total 1951	20,458	11,418,465	64.31	7,343,530	102,408,135	13.95	79,330,702	1,119,473,686
Total 1950	17,708	9,088,385	64.12	5,827,420	77,235,875	13.25	72,718,038	976,903,202

[1] Included with "Undistributed" to avoid disclosure of individual company operations.

SCOPE OF REPORT

The statistics in this chapter, except where otherwise noted, are based on data voluntarily supplied to the Bureau of Mines by coke-plant operators within the continental limits of the United States. Except for minor variations, the characteristic form and manner of presentation of material developed in coke chapters for preceding years are followed in this report, carrying the Bureau's series on coke and coal-chemical materials through 1951. For convenience, most of the statistical tables herein include comparable data for three or four preceding years.

These statistics are confined to the operations of high-temperature beehive and slot-type coke-oven plants. To present data in this chapter on the carbonization of coal by other processes, salient statistics for gas retorts are shown in table 4. Statistics on medium- and low-temperature carbonization have also been shown in recent years; but, as less than three producing companies reported production in 1951, data are withhheld to prevent disclosure of individual company operations. When compared with the production of coke and related products from slot-type and beehive-coke ovens, production from retorts and low-temperature ovens was not an important factor in supply and requirements.

Some coke is made by processes not included in this report, namely, from the refining of petroleum and crude tar. Data for 1951 showed that the production of petroleum coke totaled 3,795,400 net tons and the output of pitch coke, as reported by the United States Tariff Commission, totaled 45,000 net tons.

The standard unit of measurement in the coke industry in the United States is the short or net ton of 2,000 pounds. Unless otherwise specified, it is the unit employed throughout this chapter.

The term "coke" as used throughout this report refers only to the larger sizes (usually one-half inch plus) from which the smaller sizes have been screened. The fine coke, which is separated by screening, is known in the industry as "breeze"; that term is used by the Bureau of Mines to designate this material.

RETORT COKE

TABLE 4.—Salient statistics of the coal-gas industry in the United States in 1951 [1]

	Horizontal retorts	Vertical retorts	Total
Coke produced:			
Net tons	51,822	74,816	126,638
Value	$692,426	$862,080	$1,554,506
Breeze produced, net tons	5,868	13,537	19,405
Coal charged into retorts:			
Net tons	78,472	128,296	206,768
Value	$872,121	$1,567,227	$2,439,348
Average per ton	$11.11	$12.22	$11.80
Average yield in percent of coal charged:			
Coke	66.04	58.32	61.25
Breeze (at plants actually recovering)	8.06	10.55	9.65
Retorts:			
In existence December 31	346	53	399
In operation December 31	212	37	249
Annual coal capacity, net tons	98,200	94,200	192,400
Coke used by producers:			
Net tons	35,012	51,423	86,435
Value	$467,816	$578,980	$1,046,796
Coke sold to other consumers:			
Net tons	11,879	30,084	41,963
Value	$165,637	$352,552	$518,189
Stocks on January 1, 1952:			
Coke, net tons	5,112	18,013	23,125
Breeze, do	890	320	1,210
Coal-chemical materials:			
Tar:			
Production, gallons	957,350	1,966,550	2,923,900
Sales, do	848,762	2,202,434	3,051,196
Value of sales	$64,910	$147,020	$211,930
Stocks on January 1, 1952, gallons	311,103	1,359,459	1,670,562
Per ton of coal charged, do	12.20	15.33	14.14
Crude light oil: [2]			
Production, do	41,909	57,073	98,982
Sales, do	39,059	43,126	82,185
Value of sales	$5,859	$3,858	$9,717
Stocks on January 1, 1952, gallons	8,600	26,000	34,600
Per ton of coal charged, do	1.45	1.80	1.63

[1] Additional data in Bureau of Mines, Production of Coke and Coal Chemicals from Coal-Gas Retorts in 1951: Mineral Market Rept. 2080, June 1952.
[2] Includes drip oil.

OVEN AND BEEHIVE COKE AND COKE BREEZE

TABLE 5.—Historical statistics of the coke industry in the United States, 1880, 1890, 1900, and 1910–51

Year	Production (million net tons)			Percent of total production from slot-type ovens	Ovens in existence		Slot-type ovens under construction at end of year	Coal charged (million net tons)	Yield of coke from coal (percent)	Average value of coke per ton at plant	Total value at plant (million dollars)			
	Oven coke	Beehive coke	Total		Slot type	Beehive					Beehive coke	Oven coke	All coal-chemical materials [1]	Total coke and coal-chemical materials
1880	-------	3.3	3.3	------	--------	12,372	-------	5.2	63.7	$1.99	7	-----	-----	7
1890	-------	11.5	11.5	------	--------	37,158	-------	18.0	63.9	2.02	23	-----	-----	23
1900	1.1	19.4	20.5	5.2	1,085	57,399	1,096	32.1	63.9	2.31	47		(2)	(2)
1910	7.1	34.6	41.7	17.1	4,078	100,362	1,200	63.1	66.1	2.39	75	25	8	108
1911	7.9	27.7	35.6	22.1	4,624	99,255	698	53.3	66.7	2.37	57	27	10	94
1912	11.1	32.9	44.0	25.3	5,211	97,019	793	65.6	67.1	2.54	69	43	14	126
1913	12.7	33.6	46.3	27.5	5,688	96,962	504	69.2	66.9	2.78	80	49	17	146
1914	11.2	23.4	34.6	32.5	5,809	93,946	644	51.6	66.9	2.56	50	38	18	106
1915	14.1	27.5	41.6	33.8	6,268	93,110	1,191	61.8	67.2	2.54	57	49	30	136
1916	19.1	35.4	54.5	35.0	7,283	91,581	2,084	81.6	66.8	3.13	96	75	62	233
1917	22.4	33.2	55.6	40.4	7,869	88,027	2,260	83.8	66.4	5.36	159	139	68	366
1918	26.0	30.5	56.5	46.0	9,279	84,635	1,815	85.0	66.4	6.77	189	193	77	459
1919	25.1	19.1	44.2	56.9	10,379	82,560	877	65.6	67.4	5.85	98	160	68	326
1920	30.8	20.5	51.3	60.0	10,881	75,298	396	76.2	67.4	9.27	163	313	105	581
1921	19.8	5.5	25.3	78.1	11,142	66,014	85	37.2	68.0	5.84	30	118	68	216
1922	28.5	8.6	37.1	76.9	11,212	63,958	403	54.3	68.3	6.42	50	188	95	333
1923	37.6	19.4	57.0	66.0	11,156	62,349	629	84.4	67.5	6.56	116	257	131	504
1924	34.0	10.3	44.3	76.8	11,413	60,432	247	65.0	68.1	5.51	48	196	120	364
1925	39.9	11.4	51.3	77.9	11,290	57,587	429	74.5	68.8	5.12	52	211	143	406
1926	44.4	12.5	56.9	78.0	11,716	52,558	978	82.9	68.6	5.41	57	251	157	465
1927	43.9	7.2	51.1	85.9	12,475	49,795	289	74.4	68.6	5.13	30	232	160	422
1928	48.3	4.5	52.8	91.5	12,544	41,288	145	77.2	68.4	4.79	16	237	177	430
1929	53.4	6.5	59.9	89.2	12,649	30,082	408	86.8	69.0	4.66	23	256	192	471
1930	45.2	2.8	48.0	94.2	12,831	23,907	276	69.8	68.7	4.36	10	200	168	378
1931	32.4	1.1	33.5	96.6	13,108	21,588	-------	48.6	68.9	4.83	4	158	125	287
1932	21.1	.7	21.8	97.0	13,053	19,440	-------	31.9	68.3	4.79	2	103	88	193
1933	26.7	.9	27.6	96.7	13,053	16,857	-------	40.1	68.7	4.46	3	120	95	218
1934	30.8	1.0	31.8	96.8	12,963	14,206	-------	46.0	69.2	5.01	4	155	104	263
1935	34.2	.9	35.1	97.4	12,860	13,674	122	50.5	69.6	5.03	4	173	113	290
1936	44.6	1.7	46.3	96.3	12,849	13,012	305	65.9	70.2	5.02	7	226	136	369
1937	49.2	3.2	52.4	94.0	12,718	12,194	259	74.5	70.3	4.98	14	247	151	412
1938	31.7	.8	32.5	97.4	12,724	10,816	146	46.6	69.7	5.14	4	163	116	283
1939	42.9	1.4	44.3	96.7	12,732	10,934	-------	63.5	69.8	4.80	6	207	142	355
1940	54.0	3.1	57.1	94.6	12,734	15,150	492	81.4	70.1	4.80	14	260	168	442
1941	58.5	6.7	65.2	89.7	13,016	18,669	181	93.1	70.0	5.41	37	316	183	536
1942	62.3	8.3	70.6	88.3	13,303	16,295	1,327	100.8	70.0	6.03	47	378	204	629
1943	63.8	7.9	71.7	88.9	14,253	17,666	528	102.5	70.0	6.64	52	424	210	686
1944	67.0	7.0	74.0	90.6	14,580	16,318	180	105.3	70.3	7.13	49	479	208	736
1945	62.1	5.2	67.3	92.3	14,510	12,179	335	95.7	70.4	7.56	38	470	191	699
1946	53.9	4.6	58.5	92.2	14,494	12,864	824	83.5	70.0	8.32	37	450	173	660
1947	66.8	6.7	73.5	90.9	14,728	13,443	572	105.0	69.9	10.57	65	711	248	1,024
1948	68.3	6.6	74.9	91.2	15,139	14,078	350	107.6	69.6	12.40	79	849	302	1,230
1949	60.2	3.4	63.6	94.6	15,104	13,662	562	91.4	69.6	13.24	44	799	268	1,111
1950	66.9	5.8	72.7	92.0	14,982	17,708	706	94.9	69.9	13.43	77	900	302	1,279
1951	72.0	7.3	79.3	90.7	15,319	20,458	1,446	113.7	69.8	14.11	102	1,017	355	1,474

[1] Value for tar up to and including 1917 represented that of tar "obtained and sold" which did not always include value of tar used by producer. Beginning with 1918, tar used by producer is specifically included. Value of breeze produced at oven-coke plants is included for those years for which it was reported, namely, 1916, 1917, and 1919–51. For other coal-chemical materials, only value of those sold is included. Value of breeze produced at beehive plants is not included, as it has usually been much less than a million dollars.

[2] No accurate data on value of the coal-chemical materials available.

MONTHLY AND WEEKLY PRODUCTION

Statistics on monthly production of coke in tables 6 to 8 are based upon reports received from producers. Weekly production of beehive coke in table 9 was estimated from reports of carloadings received from all coke-carrying railroads. The totals in these tables have been adjusted to the total ascertained by an annual canvass of the producers.[1]

TABLE 6.—Coke produced in the United States and average per day, 1937 and 1949–51, by months, in net tons [1]

Month	1937		1949		1950		1951	
	Total	Daily average	Total	Daily average	Total	Daily average	Total	Daily average
Oven coke:								
January	4,360,700	140,700	6,088,800	196,400	5,388,500	173,800	6,092,700	196,500
February	3,992,900	142,600	5,487,100	196,000	3,977,900	142,100	5,414,700	193,400
March	4,495,500	145,000	5,970,000	192,600	5,014,400	161,800	6,058,300	195,400
April	4,350,900	145,000	5,773,700	192,500	5,699,000	190,000	5,926,800	197,600
May	4,479,700	144,500	5,814,400	187,500	5,910,900	190,700	6,138,900	198,000
June	4,024,800	134,200	5,259,600	175,300	5,699,200	190,000	5,959,200	198,600
July	4,423,900	142,700	4,926,300	158,900	5,912,000	190,700	6,120,700	197,400
August	4,573,400	147,500	5,154,600	166,300	5,812,400	187,500	6,170,700	199,100
September	4,427,800	147,600	4,968,300	165,600	5,710,200	190,300	5,941,500	198,100
October	4,035,100	130,200	1,731,400	55,800	6,045,300	195,000	6,132,600	197,800
November	3,222,300	107,400	3,495,000	116,500	5,702,700	190,100	5,899,600	196,700
December	2,823,800	91,100	5,553,300	179,100	6,018,100	194,100	6,131,500	197,800
Total	49,210,800	134,800	60,222,500	165,000	66,890,600	183,200	71,987,200	197,200
Beehive coke:								
January	274,300	10,600	660,400	21,300	128,400	4,200	733,200	23,700
February	294,600	12,300	638,500	22,800	42,000	1,500	607,900	21,700
March	357,300	13,200	448,000	14,400	307,500	9,900	629,100	20,300
April	309,700	11,900	640,200	21,300	498,700	16,600	559,300	18,600
May	326,500	12,600	535,500	17,300	534,800	17,200	609,000	19,700
June	274,800	10,600	265,200	8,900	588,400	19,600	627,700	21,000
July	285,100	11,000	23,300	800	506,600	16,400	531,400	17,200
August	259,000	10,000	46,300	1,500	659,200	21,300	613,000	19,700
September	253,900	9,800	29,600	1,000	619,700	20,700	553,400	18,400
October	225,500	8,700	8,000	300	679,100	21,900	632,900	20,400
November	168,800	6,500	35,400	1,200	606,000	20,200	622,700	20,700
December	135,200	5,200	84,500	2,800	657,000	21,200	623,900	20,100
Total	3,164,700	10,200	3,414,900	9,300	5,827,400	16,000	7,343,500	20,100
Total:								
January	4,635,000	151,300	6,749,200	217,700	5,516,900	178,000	6,825,900	220,200
February	4,287,500	154,900	6,125,600	218,800	4,019,900	143,600	6,022,600	215,100
March	4,852,800	158,200	6,418,000	207,000	5,321,900	171,700	6,687,400	215,700
April	4,660,600	156,900	6,413,900	213,800	6,197,700	206,600	6,486,100	216,200
May	4,806,200	157,100	6,349,900	204,800	6,445,700	207,900	6,747,900	217,700
June	4,299,600	144,800	5,524,800	184,200	6,287,600	209,600	6,586,900	219,600
July	4,709,000	153,700	4,949,600	159,700	6,418,600	207,100	6,652,100	214,600
August	4,832,400	157,500	5,200,900	167,800	6,471,600	208,800	6,783,700	218,800
September	4,681,700	157,400	4,997,900	166,600	6,329,900	211,000	6,494,900	216,500
October	4,260,600	138,900	1,739,400	56,100	6,724,400	216,900	6,765,500	218,200
November	3,391,100	113,900	3,530,400	117,700	6,308,700	210,300	6,522,300	217,400
December	2,959,000	96,300	5,637,800	181,900	6,675,100	215,300	6,755,400	217,900
Grand total	52,375,500	145,000	63,637,400	174,300	72,718,000	199,200	79,330,700	217,300

[1] Before 1941 daily average production of beehive coke was calculated by subtracting Sundays and holidays in each month; 1942–51 daily average has been calculated by dividing total monthly production by total number of days in month.

[1] Data on weekly production of beehive coke are published by the Bureau of Mines in the Weekly Anthracite and Beehive-Coke Report and monthly data for both oven and beehive coke are summarized in the Monthly Coke Report, available upon request to the Publications Distribution Section, Bureau of Mines, Washington 25, D. C.

TABLE 7.—Oven coke produced in the United States in 1951, by State and month, in net tons

[Based on reports from producers]

State	January	February	March	April	May	June	July
Alabama	542,800	501,200	529,300	531,300	551,300	531,300	556,200
California	48,900	44,100	49,100	47,500	49,700	48,100	49,600
Colorado	82,500	57,700	81,400	79,900	95,500	89,100	90,500
Illinois	325,000	277,600	321,800	305,900	311,900	300,100	307,800
Indiana	736,900	647,700	757,300	730,000	740,600	726,900	760,700
Maryland	232,300	216,600	240,800	232,900	246,400	241,500	247,400
Massachusetts	95,800	87,000	96,500	90,700	91,500	88,700	90,300
Michigan	246,400	226,500	243,100	238,000	247,000	235,300	248,300
Minnesota	85,700	79,100	84,300	80,600	81,300	77,500	80,800
New Jersey	129,500	117,000	131,300	124,000	130,700	127,300	131,100
New York	490,100	437,400	482,100	467,900	483,200	470,100	478,800
Ohio	957,900	798,700	953,600	930,200	958,400	929,700	952,900
Pennsylvania	1,450,900	1,324,600	1,415,900	1,399,800	1,443,600	1,406,200	1,440,100
Tennessee	22,300	20,300	22,000	21,200	21,000	19,400	20,700
Texas	62,200	56,100	63,800	63,200	66,300	65,200	66,900
Utah	93,100	86,100	98,500	100,200	104,000	100,900	94,800
West Virginia	306,900	273,600	305,700	308,500	333,300	325,500	329,300
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	183,500	163,400	181,800	175,000	183,200	176,400	174,500
Total	6,092,700	5,414,700	6,058,300	5,926,800	6,138,900	5,959,200	6,120,700
At merchant plants	1,141,900	1,021,700	1,127,600	1,087,300	1,130,600	1,094,400	1,119,200
At furnace plants	4,950,800	4,393,000	4,930,700	4,839,500	5,008,300	4,864,800	5,001,500

State	August	September	October	November	December	Total
Alabama	545,800	525,300	501,200	421,500	554,100	6,291,300
California	49,300	47,700	48,700	41,000	44,500	568,200
Colorado	86,100	74,200	83,000	84,100	91,300	995,300
Illinois	311,500	297,900	314,200	300,600	311,400	3,685,700
Indiana	772,200	744,300	742,500	752,000	732,400	8,843,500
Maryland	245,400	236,800	241,200	232,600	241,300	2,855,200
Massachusetts	94,500	91,800	93,500	92,800	95,700	1,108,800
Michigan	250,000	239,500	252,700	246,500	246,800	2,920,100
Minnesota	80,200	76,700	80,900	80,800	84,000	971,900
New Jersey	130,900	126,800	129,400	128,400	132,600	1,539,000
New York	461,900	458,200	468,700	450,600	462,000	5,611,000
Ohio	960,600	923,900	953,100	922,200	910,000	11,151,200
Pennsylvania	1,472,400	1,423,000	1,509,900	1,456,000	1,507,800	17,250,200
Tennessee	20,700	19,900	19,700	20,200	23,300	250,700
Texas	67,000	59,200	63,800	60,600	61,100	755,400
Utah	107,700	103,500	111,400	111,800	114,500	1,226,500
West Virginia	337,400	316,600	336,400	322,100	334,600	3,829,900
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	177,100	176,200	182,300	175,800	184,100	2,133,300
Total	6,170,700	5,941,500	6,132,600	5,899,600	6,131,500	71,987,200
At merchant plants	1,124,100	1,075,800	1,106,300	1,069,200	1,092,500	13,190,600
At furnace plants	5,046,600	4,865,700	5,026,300	4,830,400	5,039,000	58,796,600

TABLE 8.—Beehive coke produced in the United States in 1951, by State and month, in net tons

[Based on reports from producers]

State	January	February	March	April	May	June	July
Colorado							100
Kentucky	12,900	11,500	11,500	8,300	11,100	11,000	7,500
Pennsylvania	644,000	529,200	543,800	480,400	524,700	544,300	468,600
Tennessee					800	800	
Utah	9,200	9,100	10,200	8,900	9,900	9,400	6,300
Virginia	25,400	21,800	24,000	24,600	25,100	25,600	19,200
West Virginia	41,700	36,300	39,600	37,100	37,400	36,600	29,700
Total	733,200	607,900	629,100	559,300	609,000	627,700	531,400

TABLE 8.—Beehive coke produced in the United States in 1951, by State and month, in net tons—Continued

[Based on reports from producers]

State	August	September	October	November	December	Total
Colorado	100	100	100	100	200	700
Kentucky	9,800	8,800	11,300	11,100	8,900	123,700
Pennsylvania	531,200	478,700	554,400	545,900	551,300	6,396,500
Tennessee						1,600
Utah	9,800	8,500	6,600	6,900	6,900	101,700
Virginia	26,300	24,200	24,400	23,400	23,100	287,100
West Virginia	35,800	33,100	36,100	35,300	33,500	432,200
Total	613,000	553,400	632,900	622,700	623,900	7,343,500

TABLE 9.—Beehive coke produced in the United States in 1951, by weeks

[Estimated from railroad shipments]

Week ended—	Net tons	Week ended—	Net tons	Week ended—	Net tons
Jan. 6	[1] 126,200	May 19	139,600	Sept. 29	132,600
Jan. 13	162,100	May 26	131,700	Oct. 6	140,400
Jan. 20	166,000	June 2	134,000	Oct. 13	138,100
Jan. 27	163,200	June 9	141,600	Oct. 20	131,700
Feb. 3	159,600	June 16	148,500	Oct. 27	137,100
Feb. 10	140,200	June 23	152,300	Nov. 3	144,000
Feb. 17	159,100	June 30	154,500	Nov. 10	144,000
Feb. 24	160,000	July 7	56,900	Nov. 17	140,700
Mar. 3	151,800	July 14	119,200	Nov. 24	136,500
Mar. 10	146,200	July 21	150,200	Dec. 1	148,100
Mar. 17	152,600	July 28	150,700	Dec. 8	165,800
Mar. 24	141,600	Aug. 4	145,200	Dec. 15	159,300
Mar. 31	141,600	Aug. 11	139,700	Dec. 22	152,900
Apr. 7	113,500	Aug. 18	140,700	Dec. 29	122,400
Apr. 14	133,100	Aug. 25	128,500	Jan. 5, 1952	[2] 39,000
Apr. 21	130,000	Sept. 1	127,600		
Apr. 28	140,000	Sept. 8	116,400	Total	7,343,500
May 5	137,700	Sept. 15	133,100		
May 12	139,500	Sept. 22	136,500		

[1] 6 days only. [2] 2 days only.

PRODUCTION BY FURNACE AND MERCHANT PLANTS

In 1922 the Bureau of Mines began classifying oven-coke plants into two groups, "furnace" and "merchant." This grouping is maintained in the interest of those who may wish to follow the carbonizing activity of the iron and steel industry proper and is used wherever applicable throughout this chapter. Under this classification, furnace plants may be defined as those under direct ownership of or having a financial affiliation with iron and steel companies whose main business is the production of blast-furnace coke for their own use. All other plants are classified as "merchant" and include those that manufacture metallurgical, industrial, and domestic grades of coke for sale on the open market; coke plants associated with chemical companies gas utilities; and plants affiliated with local iron furnaces where only a small percentage of the total annual output is used for blast-furnace fuel.

Production of oven coke by these two groups in 1951 and for several previous years is shown in table 10. These data show that, through 1951, production at furnace plants increased 63 percent since 1937, while output at merchant plants showed little change in actual tonnage, although the number of plants and the percentage of the total oven-coke output produced by this group dropped drastically. A number of economic factors caused this shift in oven-coke production. One of the principal reasons for the steady decline in number

of merchant plants in the past 2 decades has been the expansion and extension of natural-gas pipelines into areas formerly served by coke-oven gas. As a result, affected gas-utility companies either closed the coke plants or sold them to iron and steel companies, where the plants were located favorably in relation to blast-furnace installations. There has been a tendency on the part of the iron and steel producers to integrate their coking and steel-making facilities more closely. For example, in the 5-year period, 1932–36, furnace plants produced 65 percent of the total oven-coke output; in 1937–41, 74 percent; in 1942–46, 77 percent; and in 1947–51, 81 percent. This trend was expected to continue because virtually all of the expansion of coke-oven facilities underway at the end of 1951 was in the furnace group.

TABLE 10.—Number and production of oven-coke plants connected with iron furnaces and of other oven-coke plants in the United States, 1913, 1918, 1937, and 1949–51

Year	Number of active plants		Coke produced (net tons)		Percent of production	
	Furnace plants	Merchant plants	Furnace plants	Merchant plants	Furnace plants	Merchant plants
1913	20	16	9,277,832	3,436,868	73.0	27.0
1918	36	24	19,220,342	6,777,238	73.9	26.1
1937	43	42	36,134,209	13,076,539	73.4	26.6
1949	55	31	48,109,559	12,112,922	79.9	20.1
1950	55	30	54,543,796	12,346,822	81.5	18.5
1951	56	28	58,796,622	13,190,550	81.7	18.3

TABLE 11.—Monthly and average daily production of oven coke by plants connected with iron furnaces and of other oven-coke plants in the United States, 1937 and 1950–51, in net tons

Month	1937		1950		1951	
	Furnace plants	Merchant plants	Furnace plants	Merchant plants	Furnace plants	Merchant plants
Monthly production:						
January	3,241,600	1,119,100	4,317,800	1,070,700	4,950,800	1,141,900
February	2,996,500	996,400	3,168,700	809,200	4,393,000	1,021,700
March	3,355,000	1,140,500	4,061,000	953,400	4,930,700	1,127,600
April	3,310,300	1,040,600	4,664,900	1,034,100	4,839,500	1,087,300
May	3,375,600	1,104,100	4,842,300	1,068,600	5,008,300	1,130,600
June	2,917,500	1,107,300	4,668,000	1,031,200	4,864,800	1,094,400
July	3,316,100	1,107,800	4,847,500	1,064,500	5,001,500	1,119,200
August	3,469,300	1,104,100	4,792,700	1,019,700	5,046,600	1,124,100
September	3,334,700	1,093,100	4,721,700	988,500	4,865,700	1,075,800
October	2,910,500	1,124,600	4,956,100	1,089,200	5,026,300	1,106,300
November	2,142,700	1,079,600	4,620,600	1,082,100	4,830,400	1,069,200
December	1,764,400	1,059,400	4,882,500	1,135,600	5,039,000	1,092,500
Total	36,134,200	13,076,600	54,543,800	12,346,800	58,796,600	13,190,600
Average daily production:						
January	104,600	36,100	139,300	34,500	159,700	36,800
February	107,000	35,600	113,200	28,900	156,900	36,500
March	108,200	36,800	131,000	30,800	159,000	36,400
April	110,300	34,700	155,500	34,500	161,300	36,300
May	108,900	35,600	156,200	34,500	161,500	36,500
June	97,300	36,900	155,600	34,400	162,100	36,500
July	107,000	35,700	156,400	34,300	161,300	36,100
August	111,900	35,600	154,600	32,900	162,800	36,300
September	111,200	36,400	157,400	32,900	162,200	35,900
October	93,900	36,300	159,900	35,100	162,100	35,700
November	71,400	36,000	154,000	36,100	161,000	35,700
December	56,900	34,200	157,500	36,600	162,500	35,300
Average for year	99,000	35,800	149,400	33,800	161,100	36,100

PRODUCTION BY STATES AND DISTRICTS

Production of coke in 1951 increased over 1950 in all but 2 of the 23 States where coke ovens were active. The largest percentage increases were in Virginia, Massachusetts, Colorado, and Maryland, with gains of 45, 30, 24, and 21 percent, respectively. The largest tonnage increases were reported for Pennsylvania, Ohio, and Indiana. These 3 States combined made 54 percent of the gain over 1950.

Production of oven coke for 1951 and prior years, by geographic areas, is shown in table 13. The States west of the Mississippi River (California, Colorado, Texas, Utah, and Washington) increased production by a larger percentage than any other area since 1937, a gain of 444 percent. The area comprising Alabama, Kentucky, Tennessee, and West Virginia increased production substantially over this period, with advances of 68 percent, followed by Ohio, with a gain of 66 percent.

Coke-production facilities have been more or less located in recent years with regard to iron production, gas manufacture, or chemical processing. In the early days of the coke industry, when beehive ovens were the principal source of metallurgical coke, production was limited to States producing coking coal. However, with development of the slot-type oven and its adaptation to metallurgical coke production and gas manufacture, coke plants have been built great distances from sources of coal and near steel and gas consuming centers. As a consequence, 13 States where oven coke was produced did not mine any coking coal in 1951, and all coal carbonized was shipped in.

TABLE 12.—Coke produced in the United States, 1937 and 1948–51, by States, in net tons

State	1937	1948	1949	1950	1951
Oven coke:					
Alabama	4,259,771	6,015,460	5,161,397	5,833,142	6,291,280
California		296,749	346,552	512,790	568,216
Colorado	486,945	976,504	729,516	804,979	995,332
Illinois	2,998,663	3,675,284	3,195,645	3,590,502	3,685,662
Indiana	5,467,061	8,584,225	7,533,290	8,255,622	8,843,452
Maryland	1,513,651	2,147,787	2,039,957	2,367.233	2,855,209
Massachusetts	1,130,620	1,056,701	891,400	855,217	1,108,826
Michigan	2,283,518	2,849,601	2,484,409	2,730,847	2,920,082
Minnesota	704,631	846,246	781,943	833,861	971,913
New Jersey	1,015,073	1,410,941	1,345,094	1,481,030	1,538,953
New York	4,946,964	5,687,225	5,164,790	5,412,318	5,610,975
Ohio	6,737,881	10,562,486	8,911,140	10,313,767	11,151,201
Pennsylvania	13,701,262	16,649.689	14,768,809	16,332,998	17,250,217
Tennessee	89,451	251,428	213,378	243,950	250,658
Texas		644,225	497,019	686,407	755,418
Utah	149,659	1,058,501	901,829	1,140,737	1,226,536
Washington	14,656				
West Virginia	1,817,993	3,298,090	3,182,857	3,388,626	3,829,879
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	1,892,949	2,273,215	2,073,456	2,106,592	2,133,363
Total	49,210,748	68,284,357	60,222,481	66,890,618	71,987,172
Beehive coke:					
Colorado	64,222				716
Kentucky		101,745	48,583	49,233	123,753
Pennsylvania	2,559,048	5,733,835	2,898,683	5,193,191	6,396,480
Tennessee	14,982				1,638
Utah	6,657	188,586	132,762	84,808	101,672
Virginia	240,425	200,911	157,812	197,879	287,116
West Virginia	279,387	352,494	177,108	302,309	432,155
Total	3,164,721	6,577,571	3,414,948	5,827,420	7,343,530
Grand total	52,375,469	74,861,928	63,637,429	72,718,038	79,330,702

TABLE 13.—Production of oven coke, 1937, 1940, and 1948–51, by geographic area, in net tons

Geographic area	1937	1940	1948	1949	1950	1951
Connecticut, Massachusetts, and Rhode Island	1,717,558	1,779,306	1,746,550	1,543,356	1,541,161	1,791,090
Maryland, New Jersey, New York, and Pennsylvania	21,176,950	22,641,242	25,895,642	23,318,650	25,593,579	27,255,354
Ohio	6,737,881	7,897,929	10,562,486	8,911,140	10,313,767	11,151,201
Illinois, Indiana, and Missouri	8,730,680	9,660,017	12,539,204	10,948,153	12,074,629	12,745,599
Michigan, Minnesota, and Wisconsin	3,589,795	3,944,410	4,327,342	3,809,174	4,093,952	4,424,789
Alabama, Kentucky, Tennessee, and West Virginia	6,606,624	7,328,908	10,237,154	9,217,092	10,128,617	11,073,637
California, Colorado, Texas, Utah, and Washington	651,260	762,497	2,975,979	2,474,916	3,144,913	3,545,502
Total	49,210,748	54,014,309	68,284,357	60,222,481	66,890,618	71,987,172

TABLE 14.—Oven coke produced in the United States in 1951, by steel-producing district [1]

District	Plants in existence Dec. 31	Ovens in existence Dec. 31	Coal charged (net tons)	Yield of coke from coal (percent)	Coke produced (net tons)	Value of coke at ovens	
						Total	Per ton
Eastern	20	3,536	24,264,365	71.20	17,276,756	$246,796,387	$14.28
Pittsburgh-Youngstown	21	4,546	32,853,174	68.57	22,526,875	276,233,726	12.26
Cleveland-Detroit	10	1,668	10,895,442	72.01	7,845,795	111,690,516	14.24
Chicago	18	3,351	19,823,190	71.89	14,250,306	249,547,862	17.51
Southern	10	1,509	10,120,225	72.11	7,297,356	89,707,902	12.29
Western	4	709	4,311,021	64.72	2,790,084	43,089,158	15.44
Total	83	15,319	102,267,417	70.39	71,987,172	1,017,065,551	14.13

[1] As defined by American Iron & Steel Institute.

TABLE 15.—Coke produced in Pennsylvania in 1951, by district

District	Plants in existence Dec. 31	Ovens in existence Dec. 31	Coal charged (net tons)	Yield of coke from coal (percent)	Coke produced (net tons)	Value of coke at ovens	
						Total	Per ton
Oven coke:							
Eastern [1]	5	796	4,944,109	72.26	3,572,438	$53,218,028	$14.90
Western [2]	8	2,914	20,183,406	67.77	13,677,779	167,692,302	12.26
Total	13	3,710	25,127,515	68.65	17,250,217	220,910,330	12.81
Beehive coke:							
Fayette County	66	11,843	7,195,539	64.91	4,670,587	63,273,185	13.55
Westmoreland County	46	4,576	2,069,931	64.71	1,339,528	19,240,733	14.36
Other counties [3]	7	1,177	606,944	63.66	386,365	5,363,986	13.88
Total	119	17,596	9,872,414	64.79	6,396,480	87,877,904	13.74
Grand total	132	21,306	34,999,929	67.56	23,646,697	308,788,234	13.06

[1] Includes plants at Bethlehem, Chester, Philadelphia, Steelton, and Swedeland.
[2] Includes plants at Aliquippa, Clairton, Erie, Johnstown, Midland, Monessen, Neville Island, and Pittsburgh.
[3] Beaver, Bedford, Greene, and Indiana.

COKE BREEZE

TABLE 16.—Coke breeze recovered at coke plants in the United States in 1951, by States

State	Yield per ton of coal [1] (percent)	Produced		Used by producers— For steam raising		Used by producers— For other purposes (including water gas)		Sold		Wasted (net tons)	On hand Dec. 31 (net tons)
		Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value		
Oven coke:											
Alabama	4.08	357,615	$2,447,827	113,259	$661,809	40,479	$250,951	216,795	$1,663,762	----------	27,987
California	6.71	62,026	(2)	----------	----------	44,314	(2)	27,504	(2)	----------	5,034
Colorado	5.93	86,098	(2)	----------	----------	44,890	(2)	40,824	(2)	----------	4,950
Illinois	5.50	286,578	1,018,253	109,149	338,401	31,662	126,229	145,656	550,877	----------	30,489
Indiana	4.91	604,360	2,146,608	398,921	1,323,248	139,483	424,453	110,257	538,007	----------	94,046
Maryland	5.57	220,285	(2)	222,636	(2)	29,893	(2)	10,480	(2)	----------	120,030
Massachusetts	5.97	93,204	(2)	92,749	(2)	----------	----------	877	(2)	----------	2,244
Michigan	5.13	205,360	900,334	138,436	543,476	47,609	188,627	25,324	164,058	----------	6,030
Minnesota	4.89	65,512	254,542	28,172	90,457	7,454	(2)	32,968	(2)	----------	18,178
New Jersey	5.14	109,127	(2)	110,925	(2)	----------	----------	7	(2)	----------	9,227
New York	6.30	510,037	2,627,101	302,902	1,557,803	146,166	758,418	35,294	183,378	----------	139,322
Ohio	5.33	844,496	2,905,816	418,142	1,464,486	196,814	617,657	237,861	849,578	3,253	81,269
Pennsylvania	4.45	1,118,711	3,147,923	1,016,454	2,795,425	120,856	335,626	149,492	437,185	----------	196,759
Tennessee	.99	3,175	(2)	4,326	(2)	----------	----------	266	(2)	----------	1,085
Texas	4.04	42,131	(2)	----------	----------	16,095	(2)	34,627	(2)	----------	237
Utah	8.96	173,344	(2)	16,358	(2)	68,560	(2)	99,366	(2)	----------	1,807
West Virginia	3.82	205,015	479,496	132,439	307,994	39,954	89,698	48,797	116,248	----------	75,383
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	4.83	138,760	526,456	123,311	430,600	----------	----------	21,393	116,810	----------	6,815
Undistributed	----------	----------	3,377,959	----------	1,932,525	----------	775,133	----------	1,180,297	----------	----------
Total 1951	5.01	5,125,834	19,832,315	3,228,179	11,446,224	974,229	3,566,792	1,237,788	5,800,200	3,253	820,892
At merchant plants	5.10	933,836	4,559,886	679,807	3,023,376	88,716	510,068	144,042	891,407	1,755	111,802
At furnace plants	4.99	4,191,998	15,272,429	2,548,372	8,422,848	885,513	3,056,724	1,093,746	4,908,793	1,498	709,090
Total 1950	5.45	5,172,758	18,543,877	3,353,357	11,286,949	910,593	3,198,864	1,407,041	5,514,409	1,900	1,114,662
Beehive coke:											
Pennsylvania	2.30	60,130	91,946	835	(2)	----------	----------	40,066	60,680	19,049	5,413
Utah	6.39	11,742	(2)	----------	----------	----------	----------	26,739	(2)	----------	----------
Virginia	1.23	4,336	(2)	----------	----------	11	(3)	4,325	(2)	----------	----------
West Virginia	2.87	11,445	15,464	2,618	(2)	----------	----------	4,522	(2)	4,305	----------
Undistributed	----------	----------	105,546	----------	4,987	----------	----------	----------	172,450	----------	----------
Total 1951	2.47	87,653	212,956	3,453	4,987	11	(3)	75,652	233,130	[4] 23,354	5,413

[1] Computed by dividing production of breeze by coal charged at plants actually recovering breeze.
[2] Included with "Undistributed" to avoid disclosure of individual company operations.
[3] Included with value of breeze sold to avoid disclosure of individual company operations.
[4] As reported; quantity produced but not used was undoubtedly greater. *See* Mineral Resources of the United States, 1922, pt. II, pp. 726-727.

NUMBER AND TYPE OF OVENS

Slot-Type Coke Ovens.—One of the major problems confronting the coke industry in 1951 was to provide enough coal-carbonizing capacity to support the double burden of the National Defense Program and accelerated industrial activity. A total of 696 new slot-type coke ovens was placed in operation during the year; 359 ovens were taken out of production, a net gain of 337 ovens. Most of the 359 ovens were shut down for rebuilding, although 1 coke plant (Niagara Mohawk Power Corp., Utica, N. Y., plant) with 42 ovens closed permanently, and a few ovens at other plants were blocked off and will not produce coke again unless the batteries are rebuilt. The limited supply of refractories (coke-oven shapes) and other essential building materials limited the number of new ovens completed in 1951.

Although the coke industry had built a large number of new slot-type coke ovens (4,728) in the past decade, at the close of 1951 over half the total number of ovens in existence were at least 20 years old. This statement is not to be construed as placing the maximum life expectancy of coke ovens at 20 years, as a number of older batteries producing in 1951 were in good operating condition. However, coke-oven operators and builders agree that, with few exceptions, ovens over 20 years old become increasingly difficult to maintain. Moreover, the length of efficient service that may be rendered by a new coke-oven battery depends on operating conditions at each plant and on the decision of the owners as to when maintenance and repairs become excessive.

In an effort to maintain not only the existing capacity by rebuilding worn-out batteries but also to erect additional capacity commensurate with increased blast-furnace requirements, the coke industry had the largest number of ovens under construction at the close of the year since World War I. In all, 1,446 new ovens were under construction on December 31, 1951, and contracts for a number of new batteries were pending. Except for one battery of coke ovens of English design, all other ovens under construction were being built by the Koppers Co. and the Wilputte Coke Oven Division of Allied Chemical & Dye Corp. Of the 15,319 ovens in existence at the end of the year, 35 percent were Koppers; 41 percent, Koppers-Becker; 11 percent, Semet-Solvay; 12 percent, Wilputte; and 1 percent, all other kinds.

Beehive Ovens.—Data on the number and coking capacity of beehive ovens have been obtained for many years by the Bureau of Mines, but no attempt was made until recently to separate the operable ovens from the total in existence. This distinction is made in table 20, which shows capacity at the end of 1951. Old ovens, not capable of producing coke without extensive repairs or rebuilding, comprised 23 percent of the total beehive-coke capacity reported in existence. Therefore, for practical purposes, only the serviceable ovens should be considered available sources of coke. The heavy demand for coke in 1951 is reflected in the fact that 96 percent of the ovens considered to be in good operating condition actually produced coke in 1951.

TABLE 17.—Slot-type coke ovens completed and abandoned in the United States in 1951 and total number in existence at end of year, by States

State	Plants in existence Dec. 31	Ovens						
		In existence Dec. 31		New		Abandoned during year	Under construction Dec. 31	
		Number	Annual coke capacity (net tons)	Number	Annual coke capacity (net tons)		Number	Annual coke capacity (net tons)
Alabama	7	1,340	6,303,600	29	140,000		125	636,500
California	1	135	566,000					
Colorado	1	266	1,000,000					
Connecticut	1	70	(1)					
Illinois	8	900	3,866,100				42	233,300
Indiana	5	1,955	9,697,400	154	764,500		75	480,000
Kentucky	1	120	(1)				76	515,000
Maryland	1	551	2,928,000	63	281,000		65	410,000
Massachusetts	1	204	1,260,000					
Michigan	4	584	3,106,100				107	675,700
Minnesota	3	240	985,900			33	58	239,600
Missouri	1	56	(1)			8	40	153,300
New Jersey	2	341	1,500,000					
New York	7	1,115	5,867,400	36	178,000	57	76	463,000
Ohio	15	2,285	11,131,800			25	259	1,455,500
Pennsylvania	13	3,710	17,824,000	310	1,982,600	236	460	2,467,600
Rhode Island	1	65	(1)					
Tennessee	1	44	240,000					
Texas	2	125	688,500					
Utah	2	308	1,212,300	23	82,100			
West Virginia	5	705	3,851,000	61	390,000		63	405,000
Wisconsin	1	200	(1)	20	50,900			
Undistributed			2,200,300					
Total 1951	83	15,319	74,228,400	696	3,869,100	359	1,446	8,134,500
At merchant plants	27	2,958	13,535,500	49	190,900	50	116	668,300
At furnace plants	56	12,361	60,692,900	647	3,678,200	309	1,330	7,466,200
Total 1950	84	14,982	72,488,200	574	3,086,300	696	706	3,992,600

[1] Included with "Undistributed" to avoid disclosure of individual company operations.

TABLE 18.—Age of slot-type ovens in the United States on December 31, 1951 [1]

Age	Merchant plants		Furnace plants		Total			
	Number of ovens	Annual coke capacity (net tons)	Number of ovens	Annual coke capacity (net tons)	Number of ovens	Percent of total	Annual coke capacity (net tons)	Percent of total
Under 5 years	178	864,700	2,093	11,501,200	2,271	14.8	12,365,900	16.7
From 5 to 10 years	198	879,600	2,201	11,554,300	2,399	15.7	12,433,900	16.7
From 10 to 15 years	322	1,684,700	1,316	7,510,800	1,638	10.7	9,195,500	12.4
From 15 to 20 years	145	542,500	890	4,633,400	1,035	6.8	5,175,900	7.0
From 20 to 25 years	574	3,192,300	547	3,056,400	1,121	7.3	6,248,700	8.4
25 years and over	1,541	6,371,700	5,314	22,436,800	6,855	44.7	28,808,500	38.8
Total	2,958	13,535,500	12,361	60,692,900	15,319	100.0	74,228,400	100.0

[1] Age dates from first entry into operation or from last date of rebuilding.

TABLE 19.—Number of slot-type ovens in the United States on December 31, 1951, by kind and State

State	Koppers	Koppers-Becker	Semet-Solvay	Wilputte	All others [1]	Total
Alabama	517	578	180	65		1,340
California		135				135
Colorado	120	146				266
Connecticut		70				70
Illinois	371	246	120	163		900
Indiana	340	816	161	638		1,955
Kentucky			120			120
Maryland	240	311				551
Massachusetts		149		55		204
Michigan		222	362			584
Minnesota	122	98		20		240
Missouri	56					56
New Jersey	165	176				341
New York	186	566	180	152	31	1,115
Ohio	1,321	349	301	314		2,285
Pennsylvania	1,635	1,576	88	291	120	3,710
Rhode Island	40	25				65
Tennessee			24	20		44
Texas		125				125
Utah		308				308
West Virginia	154	406		145		705
Wisconsin	100		100			200
Total	5,367	6,302	1,636	1,863	151	15,319
At merchant plants	677	1,128	750	403		2,958
At furnace plants	4,690	5,174	886	1,460	151	12,361

[1] Comprises 31 American Foundation and 120 Cambria.

TABLE 20.—Beehive-coke ovens reconstructed and abandoned in the United States in 1951 and total number in existence at end of year, by States

State	Plants in existence Dec. 31	Ovens								
		Total available Dec. 31		In operating condition Dec. 31		Not in operating condition Dec. 31		Rebuilt or repaired	Abandoned or dismantled during year	In course of reconstruction Dec. 31
		Number	Annual coke capacity (net tons)	Number	Annual coke capacity (net tons)	Number	Annual coke capacity (net tons)			
Colorado	1	20	6,000	9	2,700	11	3,300	9		
Kentucky	1	195	117,000	192	115,200	3	1,800			3
Pennsylvania	119	17,596	12,374,600	13,060	9,285,200	4,536	3,089,400	636	48	295
Tennessee	1	90	54,000	26	15,600	64	38,400	26		
Utah	2	797	285,000	797	285,000					
Virginia	5	748	346,200	653	300,100	95	46,100		3	100
West Virginia	9	1,012	676,100	963	642,900	49	33,200			
Total	138	20,458	13,858,900	15,700	10,646,700	4,758	3,212,200	671	51	398

TABLE 21.—Average number of beehive ovens active in the United States in 1951, by months

Month	Number	Month	Number	Month	Number
January	13,844	May	12,736	September	12,704
February	13,783	June	13,014	October	12,799
March	13,200	July	13,016	November	13,065
April	12,727	August	12,927	December	13,151

CAPACITY OF OVEN-COKE PLANTS

The basis for calculating the potential annual maximum coke capacity of a plant is the minimum coking time necessary to produce a coke with qualities suitable for its intended use. For this reason, the potential capacity of a plant may change from year to year, depending on the age and condition of the ovens, the character and quality of the coal carbonized, the grade of coke required, and other economic factors. The capacity reported to the Bureau of Mines by the coke-producing companies may therefore differ from the designed or rated capacity estimated by the coke-oven builders at the time of construction. It is believed, however, that the potential capacity shown in table 22 is a reliable measure of the practical operating capacity for the years given.

The potential annual coke capacity on December 31, 1951, was 2 percent higher than for the preceding year. This increase was due entirely to expansion of carbonizing capacity at plants associated with iron and steel works (furnace plants) as capacity of merchant plants dropped 3 percent. The factors contributing to the steady decline in the capacity of merchant plants have been mentioned in a preceding section of this chapter and need not be repeated here. That the decline in merchant-plant capacity would continue was evidenced by the new ovens under construction. Of the 8,134,500 tons of potential capacity under construction at the end of 1951, 7,466,200 tons (92 percent) was at furnace plants.

The Bureau of Mines has collected monthly data on oven-coke production for many years. The rate of oven operations may be calculated from these data. Table 23 shows the percentage of coke capacity utilized each month for 1951, with certain preceding years for comparison. The average monthly rate of production for 1951 was the second highest on record and illustrates the high-level continuity of oven operations throughout that year. This outstanding record, when the poor condition of a large number of old ovens is considered, clearly indicates the skill and ingenuity of the coke-plant operators.

TABLE 22.—Potential maximum annual coke capacity of all oven-coke plants in existence in the United States, 1937 and 1947–51

Year	Merchant plants				Furnace plants				Total			
	Plants in existence Dec. 31	Ovens in existence Dec. 31	Potential maximum annual coke capacity (net tons)	Change from 1937 (percent)	Plants in existence Dec. 31	Ovens in existence Dec. 31	Potential maximum annual coke capacity (net tons)	Change from 1937 (percent)	Plants in existence Dec. 31	Ovens in existence Dec. 31	Potential maximum annual coke capacity (net tons)	Change from 1937 (percent)
1937	42	3,419	15,731,900	------	45	9,299	46,995,200	------	87	12,718	62,727,100	------
1947	32	3,047	14,599,200	−7.2	54	11,681	57,949,900	+23.3	86	14,728	72,549,100	+15.7
1948	31	2,983	14,199,900	−9.7	55	12,156	60,300,000	+28.3	86	15,139	74,499,900	+18.8
1949	30	3,057	14,209,200	−9.7	55	12,047	59,500,900	+26.6	85	15,104	73,710,100	+17.5
1950	29	3,036	13,959,300	−11.3	55	11,946	58,528,900	+24.5	84	14,982	72,488,200	+15.6
1951	27	2,958	13,535,500	−14.0	56	12,361	60,692,900	+29.1	83	15,319	74,228,400	+18.3

TABLE 23.—Relationship of production to potential maximum capacity[1] at oven-coke plants in the United States, 1937 and 1948–51, by months, in percent

Month	1937	1948	1949	1950	1951	Month	1937	1948	1949	1950	1951
January	83.0	94.8	95.2	85.6	97.8	August	86.0	93.1	80.3	91.8	96.5
February	83.5	94.7	95.0	70.0	95.5	September	86.1	94.9	79.8	94.0	96.2
March	84.9	90.9	93.3	79.3	96.2	October	76.0	93.9	26.9	96.2	95.4
April	84.9	74.6	93.3	92.9	96.7	November	62.8	94.0	55.8	93.8	95.3
May	84.6	92.0	90.8	92.7	97.6	December	53.1	95.0	86.2	95.8	95.8
June	78.6	93.3	84.9	92.4	97.9						
July	83.2	92.2	77.0	93.7	97.3	Year	78.8	92.0	79.7	90.0	96.5

[1] Capacity of all ovens in existence, whether active or idle, based upon maximum daily capacity times days in month.

QUANTITY AND COST OF COAL CHARGED

Coke ovens (slot-type and beehive) used a record quantity of bituminous coal in 1951—113.7 million tons. This figure represented a 9-percent gain over the 1950 total and was 6.4 million tons (6 percent) greater than the previous peak consumption of 1948. This new mark was attributed to the increased demand for coke (which, in turn, necessitated the maintenance of high operating rates at both oven- and beehive-coke plants) and to the absence of any major work stoppages in the steel and bituminous-coal industries. Because of the continuous nature of the coking process and the strong demand for the coke produced, monthly consumption of coal in coke ovens is generally uniform and does not vary because of seasonal conditions (table 24).

Pennsylvania continued to lead all coke-producing States in the carbonization of coal, processing 25 percent of the coal carbonized in slot-type ovens and 86 percent of the total used in beehives. Ohio ranked second, with 15 percent of the total used in slot-type ovens, followed by Indiana, Alabama, and New York, which, combined, consumed 29 percent. These 5 States, therefore, consumed 69 percent

of the total, compared with 31 percent for the other 17 States where oven coke was produced. The practice of mixing or blending a small percentage of anthracite fines, which was begun during World War II, was continued at 12 plants in 1951. A total of 237,100 tons was used for this purpose during the year.

As coal is the chief item of expense in the manufacture of oven coke (normally representing about 80 percent of total costs), its cost has a definite influence on coke-oven operations and is extremely important to coke-plant operators. The cost of coal delivered to the coke plants had been increasing steadily since the beginning of World War II and reached a new high in 1951. The average cost of coal at oven-coke plants in 1951 increased $0.27 per ton (3 percent) over 1950 and was 143 percent higher than the figure for 1940. A large part of the coal used at oven-coke plants must be transported great distances, increasing its cost at the ovens. Of the States for which figures on coal costs can be shown, Minnesota, Illinois, New York, and Indiana, in the order named, had the highest costs, while West Virginia, Alabama, and Pennsylvania had the lowest owing to their proximity to the coal fields.

The average cost of coal at beehive ovens in 1951 was the highest on record, yet it was lower than at oven-coke plants because the beehive plants generally were near the mines. In recent years, however, many beehive operators have had to truck part, or in some instances all of their coal requirements, substantially increasing their coal costs. In the Connellsville region, Pennsylvania, in 1951, coal was transported by truck as far as 40 miles to some beehive plants. Charges on such hauls approximated $2 per ton. This additional expense for many plants has influenced the average cost of coal for the entire beehive industry. The average cost of coal in 1951 ($6.15 per ton) was 8 percent above the 1950 average and 209 percent higher than the 1940 figure. Partly because of trucking charges, Pennsylvania had the highest costs and West Virginia the lowest.

TABLE 24.—Coal consumed in coke ovens in the United States, 1937 and 1950–51, by months, in net tons

Month	1937			1950			1951		
	Slot type	Beehive	Total	Slot type [1]	Beehive	Total	Slot type [2]	Beehive	Total
Jan	6,198,700	426,600	6,625,300	7,710,300	204,200	7,914,500	8,640,500	1,131,600	9,772,100
Feb	5,679,900	458,500	6,138,400	5,714,500	67,800	5,782,300	7,670,400	941,300	8,611,700
Mar	6,387,000	556,800	6,943,800	7,165,000	486,300	7,651,300	8,596,500	983,800	9,580,300
Apr	6,183,800	480,800	6,664,600	8,115,400	783,400	8,898,800	8,429,500	872,800	9,302,300
May	6,368,500	509,700	6,878,200	8,396,800	839,200	9,236,000	8,726,800	948,400	9,675,200
June	5,729,200	430,500	6,159,700	8,093,400	911,600	9,005,000	8,479,200	969,600	9,448,800
July	6,217,200	441,700	6,658,900	8,386,500	795,500	9,182,000	8,720,100	826,900	9,547,000
Aug	6,425,800	401,100	6,826,900	8,227,500	1,018,500	9,246,000	8,754,700	963,800	9,718,500
Sept	6,220,700	392,800	6,613,500	8,084,500	961,100	9,045,600	8,468,700	862,300	9,331,000
Oct	5,664,800	351,600	6,016,400	8,506,600	1,055,400	9,562,000	8,709,600	985,000	9,694,600
Nov	4,527,000	264,000	4,791,000	8,028,600	936,900	8,965,500	8,384,400	965,300	9,349,700
Dec	3,972,800	212,700	4,185,500	8,497,200	1,028,500	9,525,700	8,687,000	967,700	9,654,700
Total	69,575,400	4,926,800	74,502,200	94,926,300	9,088,400	104,014,700	102,267,400	11,418,500	113,685,900

[1] Includes 169,300 tons of anthracite fines.
[2] Includes 237,100 tons of anthracite fines.

TABLE 25.—Quantity and value at ovens of coal used in manufacturing coke in the United States in 1951, by States

State	Coal used (net tons)	Cost of coal		Coal per ton of coke	
		Total	Per ton	Net tons	Cost
Oven coke:					
Alabama	8,756,422	$64,721,797	$7.39	1.39	$10.29
California	924,537	(1)	(1)	1.63	(1)
Colorado	1,452,062	(1)	(1)	1.46	(1)
Illinois	5,214,085	53,453,852	10.25	1.41	14.50
Indiana	12,320,739	124,787,818	10.13	1.39	14.11
Maryland	3,955,067	(1)	(1)	1.39	(1)
Massachusetts	1,561,541	(1)	(1)	1.41	(1)
Michigan	4,001,353	36,718,819	9.18	1.37	12.57
Minnesota	1,338,937	13,974,534	10.44	1.38	14.38
New Jersey	2,124,486	(1)	(1)	1.38	(1)
New York	8,095,523	82,166,053	10.15	1.44	14.64
Ohio	15,858,101	138,035,734	8.70	1.42	12.38
Pennsylvania	25,127,515	201,625,769	8.02	1.46	11.69
Tennessee	322,037	(1)	(1)	1.28	(1)
Texas	1,041,766	(1)	(1)	1.38	(1)
Utah	1,934,422	(1)	(1)	1.58	(1)
West Virginia	5,366,963	35,107,340	6.54	1.40	9.17
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	2,871,861	27,858,784	9.70	1.35	13.06
Undistributed		135,692,202	10.19	1.43	14.59
Total	102,267,417	914,142,702	8.94	1.42	12.70
At merchant plants	18,322,799	174,070,715	9.50	1.39	13.20
At furnace plants	83,944,618	740,071,987	8.82	1.43	12.59
Beehive coke:					
Colorado	1,300	(1)	(1)	1.82	(1)
Kentucky	179,189	(1)	(1)	1.45	(1)
Pennsylvania	9,872,414	61,787,832	6.26	1.54	9.66
Tennessee	3,440	(1)	(1)	2.10	(1)
Utah	183,830	(1)	(1)	1.81	(1)
Virginia	492,062	2,826,791	5.74	1.71	9.85
West Virginia	686,230	3,659,248	5.33	1.59	8.47
Undistributed		1,938,246	5.27	1.61	8.51
Total	11,418,465	70,212,117	6.15	1.55	9.56

[1] Included with "Undistributed" to avoid disclosure of individual company operations.

TABLE 26.—Average cost per net ton of coal carbonized at oven-coke plants in the United States, 1937 and 1947–51, by States

State	1937	1947	1948	1949	1950	1951
Alabama	$2.33	$5.57	$6.48	$6.81	$6.96	$7.39
Illinois	4.62	8.00	9.38	9.75	9.98	10.25
Indiana	4.71	8.01	9.35	9.71	9.87	10.13
Michigan	4.16	6.79	8.26	8.99	9.01	9.18
Minnesota	5.24	8.33	9.90	10.10	10.21	10.44
New York	4.55	7.76	9.48	9.83	9.85	10.15
Ohio	3.76	6.76	8.11	8.42	8.51	8.70
Pennsylvania	2.98	5.87	7.22	7.64	7.82	8.02
West Virginia	2.54	4.72	6.14	6.37	6.72	6.54
Other States [1]	4.53	7.46	8.88	9.42	9.57	10.10
United States average	3.74	6.78	8.13	8.52	8.67	8.94
Cost of coal per ton of coke	5.27	9.60	11.58	12.18	12.30	12.70

[1] California, Colorado, Connecticut, Kentucky, Maryland, Massachusetts, Missouri, New Jersey, Rhode Island, Tennessee, Texas, Utah, and Wisconsin.

TABLE 27.—Cost of coal and value of products per net ton of coke produced in the United States, 1918, 1929, 1937, and 1948–51

Year	Oven coke				Beehive coke	
	Cost of coal per ton of coke	Value per ton of coke produced			Cost of coal per ton of coke	Value per ton
		Coke	Coal-chemical materials [1]	Total		
1918	$6.00	$7.42	$3.08	$10.50	$3.65	$6.21
1929	5.04	4.80	3.56	8.36	2.85	3.49
1937	5.27	5.03	2.97	8.00	3.14	4.31
1948	11.58	12.43	4.42	16.85	8.02	12.10
1949	12.18	13.26	4.45	17.71	8.50	12.87
1950	12.30	13.45	4.51	17.96	8.88	13.25
1951	12.70	14.13	4.93	19.06	9.56	13.95

[1] Includes value of breeze produced.

PREPARATION AND SOURCE OF COAL

Washed and Unwashed Coal.—An outstanding development in the coke industry in 1951 was the large increase in the percentage of washed coal carbonized in slot-type ovens. Although coal cleaning in the United States predates erection of the first oven-coke plant in 1893, the practice did not become an important factor in coke-plant operations until recent years. However, gradual depletion of the reserves of the best quality coking coals and steady rise in mechanized mining, with its attendant increase in impurities, has necessitated washing or cleaning a larger part of the available coals. This is due to the fact that the quality of the coke produced depends more upon the character and quality of coal carbonized than upon oven design and carbonizing practice. Coals having high ash and sulfur contents will produce a coke having similar chemical characteristics. Coke of high ash or sulfur content is not desirable for use in blast furnaces, foundry cupolas, miscellaneous industrial operations, or residential heating.

Washed coal charged into slot-type ovens in 1951, according to reports submitted by coke-plant operators, amounted to 50 percent of the total tonnage of bituminous coal carbonized, compared with 40 percent in 1950 and 28 percent in 1946. The proportion of washed coal charged into beehive ovens was less than in slot-type ovens, being 17 percent of the total in 1951. Most of the cleaning or washing was done at the coal mines. In 1951 bituminous coal cleaned at the mines was used by 50 oven- and 13 beehive-coke plants and amounted to 85 percent of the washed coal carbonized. The remainder (7.7 million tons) was washed at coke plants having cleaning facilities.

TABLE 28.—Washed and unwashed coal used in manufacturing coke in the United States in 1951, by State in which used, in net tons

State	Slot-type ovens				Beehive ovens		
	Bituminous		Anthracite	Total	Bituminous		
	Washed	Unwashed			Washed	Unwashed	Total
Alabama	8,301,639	415,751	39,032	8,756,422			
California	818,712	105,825		924,537			
Colorado	1,452,062			1,452,062		1,300	1,300
Illinois	2,172,062	3,022,601	19,422	5,214,085			
Indiana	8,145,854	4,174,885		12,320,739			
Maryland		3,955,067		3,955,067			
Massachusetts		1,539,313	22,228	1,561,541			
Michigan	749,483	3,251,870		4,001,353			
Minnesota	404,980	915,100	18,857	1,338,937			
New Jersey	686,352	1,430,691	7,443	2,124,486			
New York	2,589,234	5,504,174	2,115	8,095,523			
Ohio	8,153,948	7,704,153		15,858,101			
Pennsylvania	13,832,221	11,214,590	80,704	25,127,515	1,806,311	8,066,103	9,872,414
Tennessee		322,037		322,037		3,440	3,440
Texas	791,441	250,325		1,041,766			
Utah		1,934,422		1,934,422	183,830		183,830
Virginia						492,062	492,062
West Virginia	2,074,097	3,280,328	12,538	5,366,963		686,230	686,230
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	881,657	1,955,407	34,797	2,871,861		179,189	179,189
Total	51,053,742	50,976,539	237,136	102,267,417	1,990,141	9,428,324	11,418,465
At merchant plants	3,755,910	14,388,383	178,506	18,322,799			
At furnace plants	47,297,832	36,588,156	58,630	83,944,618			

TABLE 29.—Yield of coke from coal in the United States, 1937 and 1949–51, by States, in percent

State	1937		1949		1950		1951	
	Oven coke	Beehive coke	Oven coke	Beehive coke	Oven coke	Beehive coke	Oven coke	Beehive coke
Alabama	72.37		70.87		70.95		71.85	
California			59.91		60.60		61.46	
Colorado	67.36	55.71	66.61		68.12		68.55	55.08
Illinois	70.54		69.61		70.07		70.69	
Indiana	72.04		72.17		73.70		71.78	
Maryland	72.62		71.83		71.72		72.19	
Massachusetts	69.99		70.49		71.63		71.01	
Michigan	71.05		71.38		73.37		72.98	
Minnesota	70.27		71.17		72.77		72.59	
New Jersey	70.78		73.17		71.83		72.44	
New York	71.75		69.89		68.70		69.31	
Ohio	71.61		70.23		70.20		70.32	
Pennsylvania	68.83	65.50	68.22	64.53	69.08	64.42	68.65	64.79
Tennessee	69.00	53.89	69.98		73.38		77.84	47.62
Texas			70.09		71.40		72.51	
Utah	56.67	54.25	61.49	54.23	64.10	54.61	63.41	55.31
Virginia		58.33		59.78		61.29		58.35
Washington	56.11							
West Virginia	70.67	61.74	70.42	64.01	70.96	62.59	71.36	62.98
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	73.57		73.47	62.90	73.49	74.92	74.29	69.06
United States average	70.73	64.23	69.98	63.78	70.47	64.12	70.39	64.31

Blending.—The practice of blending or mixing various types of coal to obtain a coke relatively free from shrinkage, cracks, and with a minimum of breeze is a common practice among oven-coke plant operators. A better coke usually can be obtained from a proper blend of 2, 3, or more different coals than from any one alone. Blending has several objectives and involves many important factors which must be considered by the oven-coke plant operator if the primary objective of producing economically a quality coke is to be achieved. It also permits use of a coal that has good coking properties but may be objectionable due to an excessive ash, sulfur, or phosphorus content which makes it unsuitable as a 100-percent charge. Thus, in addition to providing a means of controlling the quality and strength of the coke and the yield of coproducts, blending permits flexible operations at oven-coke plants and use of a far wider variety of coals. All oven-coke plants mix or blend coals before charging them into ovens. The mixing of coal of different volatile content was practiced at 79 oven-coke plants in 1951. Of these, 55 used high- and low-volatile coals; 19, high-, medium-, and low-; 3, high- and medium-; and 2, low- and medium-volatile. Of the plants that did not blend coals of different volatile content, 2 plants used straight high-volatile and 3, medium-volatile. The proportion of coals of different volatile contents mixed before charging into ovens, where practiced, varies widely from plant to plant. Generally, about 20 percent low-volatile coal is mixed with high-volatile, although some plants reported the use of as much as 50 percent low-volatile. A study of the reported volatile content of all coal used by oven-coke plant operators in 1951 showed that about 63 percent was high-volatile, 13 percent medium-volatile, and 24 percent low-volatile. These proportions have changed but slightly during the past decade, with gradual increase in the use of low-volatile coals.

Sources.—More interest has been shown in recent years in the reserves and sources of coking coal than ever before. The tremendous demand for coking coal, caused by two great wars and the high level of industrial production since the end of World War II, has made serious inroads into the reserves of our better coals. Coke is essential in the manufacture of pig iron, which, in turn, is required to make steel—a vital element in our modern industrial economy. As all coals will not fuse and form a coherent, strong, porous structure when heated at high temperatures (above 1,000° C.), known reserves of established coking quality are extremely important to our economy. The Bureau of Mines has studied the coking qualities of a number of domestic coals. The results of this research have been compiled in a series of reports of investigations.

The largest concentration of coking coal in the United States is found in the Appalachian region, which extends from Alabama to Pennsylvania. States comprising this region supplied 94 percent of all coal carbonized in 1951. West Virginia furnished 35 percent; Pennsylvania, 34 percent; Kentucky, 13 percent; Alabama, 9 percent; and Virginia, 3 percent. The remainder was obtained from various other States, particularly Utah, Oklahoma, Colorado, and New Mexico. The better quality high-volatile and medium-volatile coking

TABLE 30.—Coal received for manufacturing oven coke in the United States in 1951, by State where consumed and volatile content [1]

State where coal was consumed	High-volatile		Medium-volatile		Low-volatile		Total coal received (net tons)
	Net tons	Percent of total	Net tons	Percent of total	Net tons	Percent of total	
Alabama:							
Merchant plants	24,073	2.0	939,899	76.6	263,518	21.4	1,227,490
Furnace plants	48,895	.6	7,753,926	99.3	8,135	.1	7,810,956
Total Alabama	72,968	.8	8,693,825	96.2	271,653	3.0	9,038,446
California: Furnace plant	848,881	88.7			108,464	11.3	957,345
Colorado: Furnace plant	1,507,539	88.2			201,636	11.8	1,709,175
Illinois:							
Merchant plants	151,315	18.4	341,976	41.5	330,073	40.1	823,364
Furnace plants	3,097,806	71.5	1,125	(2)	1,230,897	28.5	4,329,828
Total Illinois	3,249,121	63.1	343,101	6.6	1,560,970	30.3	5,153,192
Indiana:							
Merchant plants	500,095	46.0	127,088	11.7	459,372	42.3	1,086,555
Furnace plants	5,946,931	55.2			4,835,927	44.8	10,782,858
Total Indiana	6,447,026	54.3	127,088	1.1	5,295,299	44.6	11,869,413
Maryland: Furnace plant	2,596,672	64.9			1,402,775	35.1	3,999,447
Massachusetts: Merchant plant	809,458	52.6	364,780	23.7	365,075	23.7	1,539,313
Michigan:							
Merchant plants	544,224	54.5	35,488	3.6	418,045	41.9	997,757
Furnace plants	2,157,377	67.9			1,018,780	32.1	3,176,157
Total Michigan	2,701,601	64.7	35,488	0.9	1,436,825	34.4	4,173,914
Minnesota:							
Merchant plant	113,106	43.3	38,284	14.7	109,518	42.0	260,908
Furnace plants	670,904	60.7	26,485	2.4	408,077	36.9	1,105,466
Total Minnesota	784,010	57.4	64,769	4.7	517,595	37.9	1,366,374
New Jersey: Merchant plants	1,321,073	61.9	378,003	17.7	434,467	20.4	2,133,543
New York:							
Merchant plants	2,696,116	76.1	336,835	9.5	507,733	14.4	3,540,684
Furnace plants	2,719,689	61.9	759,801	17.3	915,985	20.8	4,395,475
Total New York	5,415,805	68.3	1,096,636	13.8	1,423,718	17.9	7,936,159
Ohio:							
Merchant plants	966,360	59.4	200,778	12.3	460,685	28.3	1,627,823
Furnace plants	9,875,143	69.4	381,312	2.7	3,978,920	27.9	14,235,375
Total Ohio	10,841,503	68.3	582,,090	3.7	4,439,605	28.0	15,863,198
Pennsylvania:							
Merchant plants	411,492	50.7	233,317	28.8	166,568	20.5	811,377
Furnace plants	18,650,372	75.7	786,080	3.2	5,198,016	21.1	24,634,468
Total Pennsylvania	19,061,864	74.9	1,019,397	4.0	5,364,584	21.1	25,445,845
Tennessee: Furnace plant	70,343	20.9	236,647	70.5	28,754	8.6	335,744
Texas: Furnace plants	498,987	48.3	411,394	39.8	122,875	11.9	1,033,256
Utah: Furnace plants	1,610,534	86.6			250,048	13.4	1,860,582
West Virginia:							
Merchant plants	1,029,890	89.5			120,815	10.5	1,150,705
Furnace plants	3,402,731	81.6			767,794	18.4	4,170,525
Total West Virginia	4,432,621	83.3			888,609	16.7	5,321,230
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin: Merchant plants	2,010,404	70.7			833,475	29.3	2,843,879
Grand total	64,280,410	62.7	13,353,218	13.0	24,946,427	24.3	102,580,055
At merchant plants	10,577,606	58.6	2,996,448	16.6	4,469,344	24.8	18,043,398
At furnace plants	53,702,804	63.5	10,356,770	12.3	20,477,083	24.2	84,536,657

[1] High-volatile—dry volatile matter 31 percent; medium-volatile—dry volatile matter 31 percent or less and over 22 percent; low-volatile—dry volatile matter 22 percent or less and over 14 percent.
[2] Less than 0.05 percent.

coals are found in West Virginia, Pennsylvania, eastern Kentucky, and Alabama. Low-volatile coking coal, important for improving the physical properties of metallurgical coke (particularly its strength), was mined largely in West Virginia and to a smaller extent in central Pennsylvania, eastern Oklahoma, and western Arkansas.

To maintain a more uniform quality of coking coal and to be assured of an adequate supply in periods of heavy demand, many larger coke-producing companies, particularly those connected with iron and steel works, own or control coal mines. These mines are generally referred to as "captive" mines, and the quantity of coal shipped by them in 1951 amounted to 57 percent of the total received for coking at oven-coke plants. Plants associated with iron and steel works (furnace plants) received 62 percent of their coal requirements from captive mines. Merchant or nonfurnace plants, however, obtained only 34 percent of their coking coal from captive mines.

TABLE 31.—Coal received for manufacturing oven coke in the United States in 1951, by field of origin and volatile content, in net tons

State and field [1] where coal was produced	Volatile content [2]			Total coal received
	High	Medium	Low	
Alabama	124,727	8,816,933		8,941,660
Arkansas			292,166	292,166
Colorado	1,007,119			1,007,119
Georgia			2,069	2,069
Illinois	450,641			450,641
Indiana	19,015			19,015
Kentucky:				
Elkhorn	5,470,687			5,470,687
Harlan	7,106,992			7,106,992
Hazard	49,016			49,016
Kenova-Thacker	1,025,768			1,025,768
New Mexico	500,420			500,420
Oklahoma	447,228	281,497	390,857	1,119,582
Pennsylvania:				
Anthracite			185,951	185,951
Bituminous:				
Central Pennsylvania	1,000,976	972,090	5,695,390	7,668,456
Connellsville	12,207,037	25,492		12,232,529
Freeport	3,026,416			3,026,416
Pittsburgh	10,849,332			10,849,332
Somerset			519,153	519,153
Westmoreland	352,433			352,433
Tennessee	114,402	243,436		357,838
Utah	2,459,415			2,459,415
Virginia:				
Clinch Valley	717,760	401,504		1,119,264
Pocahontas			1,035,186	1,035,186
Southwestern	910,335	10,469		920,804
West Virginia:				
Coal River	114,533			114,533
Fairmont	4,938,226	116,110		5,054,336
Kanawha	7,003,178	398,594		7,401,772
Kenova-Thacker	58,607	13,231		71,838
Logan	3,039,384			3,039,384
New River	296,038	122,577	495,177	913,792
Panhandle	88,389			88,389
Pocahontas			12,862,231	12,862,231
Preston-Taylor		16,209		16,209
Randolph-Barbour	516,707	396,511		913,218
Tug River			493,609	493,609
Webster-Gauley	385,629	817,434		1,203,063
Winding Gulf		721,131	2,974,638	3,695,769
Total	64,280,410	13,353,218	24,946,427	102,580,055

[1] As defined by the U. S. Coal Commission of 1922.

[2] High-volatile—dry volatile matter over 31 percent; medium-volatile—dry volatile matter 31 percent or less and over 22 percent; low-volatile—dry volatile matter 22 percent or less and over 14 percent.

TABLE 32.—Coal received for manufacturing oven coke in the United States in 1951, by State where produced and where consumed, in net tons

State where coal was consumed	Coal produced in—													
	Alabama	Arkansas	Colorado	Georgia	Illinois	Indiana	Kentucky	New Mexico	Oklahoma	Pennsylvania	Tennessee	Utah	Virginia	West Virginia	Total
Alabama:															
Merchant plants	963, 972									37, 897				225, 621	1, 227, 490
Furnace plants	7, 802, 821													8, 135	7, 810, 956
Total Alabama	8, 766, 793									37, 897				233, 756	9, 038, 446
California: Furnace plant		90, 146							18, 318			848, 881			957, 345
Colorado: Furnace plant		201, 636	1, 007, 119					500, 420							1, 709, 175
Illinois:															
Merchant plants							104, 836			19, 983	4, 690			693, 855	823, 364
Furnace plants					447, 053	89	2, 134, 054						117, 237	1, 631, 395	4, 329, 828
Total Illinois					447, 053	89	2, 238, 890			19, 983	4, 690		117, 237	2, 325, 250	5, 153, 192
Indiana:															
Merchant plants						18, 926							85, 149	982, 480	1, 086, 555
Furnace plants							5, 256, 211						1, 035, 647	4, 491, 000	10, 782, 858
Total Indiana						18, 926	5, 256, 211						1, 120, 796	5, 473, 480	11, 869, 413
Maryland: Furnace plant										526, 865			52, 708	3, 419, 874	3, 999, 447
Massachusetts: Merchant plant							103, 243							1, 436, 070	1, 539, 313
Michigan:															
Merchant plants										232, 669			35, 488	729, 600	997, 757
Furnace plants							1, 313, 382			104			437, 061	1, 425, 610	3, 176, 157
Total Michigan							1, 313, 382			232, 773			472, 549	2, 155, 210	4, 173, 914
Minnesota:															
Merchant plant										23, 570				237, 338	260, 908
Furnace plants							553, 444							552, 022	1, 105, 466
Total Minnesota							553, 444			23, 570				789, 360	1, 366, 374
New Jersey: Merchant plants							2, 375			7, 443			238, 346	1, 885, 379	2, 133, 543

New York:															
Merchant plants							548,011			864,310	87,848		367,884	1,672,631	3,540,684
Furnace plants							476,609			3,290,818			45,976	582,072	4,395,475
Total New York							1,024,620			4,155,128	87,848		413,860	2,254,703	7,936,159
Ohio:															
Merchant plants							275,805						225,047	1,126,971	1,627,823
Furnace plants							2,504,772			6,394,650			237,262	5,098,691	14,235,375
Total Ohio							2,780,577			6,394,650			462,309	6,225,662	15,863,198
Pennsylvania:															
Merchant plants										18,580			62,075	730,722	811,377
Furnace plants							271,984			20,465,956				3,896,528	24,634,468
Total Pennsylvania							271,984			20,484,536			62,075	4,627,250	25,445,845
Tennessee: Furnace plant				2,069							258,511		48,479	26,685	335,744
Texas: Furnace plants	174,867								851,600		6,789				1,033,256
Utah: Furnace plants		384							249,664			1,610,534			1,860,582
West Virginia:															
Merchant plants										117,543				1,033,162	1,150,705
Furnace plants										2,794,059				1,376,466	4,170,525
Total West Virginia										2,911,602				2,409,628	5,321,230
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin: Merchant plants					3,588		107,737			39,823			86,895	2,605,836	2,843,879
Grand total	8,941,660	292,166	1,007,119	2,069	450,641	19,015	13,652,463	500,420	1,119,582	34,834,270	357,838	2,459,415	3,075,254	35,868,143	102,580,055
At merchant plants	963,972				3,588	18,926	1,142,007			1,361,818	92,538		1,100,884	13,359,665	18,043,398
At furnace plants	7,977,688	292,166	1,007,119	2,069	447,053	89	12,510,456	500,420	1,119,582	33,472,452	265,300	2,459,415	1,974,370	22,508,478	84,536,657

SHIPMENTS BY RAIL, WATER, AND TRUCK

Rail shipments represented 92 percent of the total movement of large coke and 87 percent of the breeze in 1951. Truck shipments declined sharply from 1950 and represented only 5 percent of the total. Shipments of coke by water were relatively small, only 3 percent of the total.

Shipments of oven coke usually approximate less than 40 percent of the total production because many of the larger coke plants are integrated with iron blast furnaces; hence, the large coke suitable for metallurgical use is transferred to the furnaces without leaving the producing site. Only 26 percent of all coke produced at furnace plants moved outside the plants in 1951, whereas 83 percent of the coke produced by merchant plants was shipped.

Beehive-coke plants are generally at or near the mines, and virtually all of the production must be shipped to consuming centers. The bulk of the beehive coke moves by rail, only a small amount by boat and truck. The location of beehive plants precludes any large movement by water, and trucking long distances is seldom economical.

TABLE 33,—Coke and breeze sold and loaded at plants in the United States for shipment in 1951, in net tons

	Coke				Breeze			
	In railroad cars	In boats	In trucks	Total	In railroad cars	In boats	In trucks	Total
Oven coke:								
Alabama	1,118,440		5,081	1,123,521	216,795			216,795
California					27,504			27,504
Colorado	116,741		644	117,385	40,758		66	40,824
Illinois	1,754,647		16,717	1,771,364	124,579		21,077	145,656
Indiana	2,273,144		29,920	2,303,064	48,350		61,907	110,257
Maryland					10,480			10,480
Massachusetts	557,781	2,463	211,963	772,207			877	877
Michigan	845,334	19,649	53,781	918,764	25,087		237	25,324
Minnesota	283,732		8,250	291,982	32,968			32,968
New Jersey	991,934	93,302	224,621	1,309,857			7	7
New York	2,491,321	196,544	274,657	2,962,522	30,797	3,856	641	35,294
Ohio	2,773,555	39,835	46,218	2,859,608	191,512	7,708	38,641	237,861
Pennsylvania	7,153,258	300,607	167,296	7,621,161	139,841	8,912	739	149,492
Tennessee	114,111			114,111	266			266
Texas	77,467			77,467	34,627			34,627
Utah	233,442		8,448	241,890	99,361		5	99,366
West Virginia	1,518,574		417	1,518,991	48,689		108	48,797
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	1,646,941	58,919	271,873	1,977,733	8,161	2,984	10,248	21,393
Total	23,950,422	711,319	1,319,886	25,981,627	1,079,775	23,460	134,553	1,237,788
At merchant plants	9,344,118	393,017	1,186,279	10,923,414	111,602	19,025	13,415	144,042
At furnace plants	14,606,304	318,302	133,607	15,058,213	968,173	4,435	121,138	1,093,746
Beehive coke:								
Colorado	716			716				
Kentucky	123,753			123,753				
Pennsylvania	6,355,657	21,547	4,579	6,381,783	37,652	2,414		40,066
Tennessee	1,638			1,638				
Utah	77,345		48	77,393	24,906		1,833	26,739
Virginia	286,976		276	287,252	4,325			4,325
West Virginia	433,790		23	433,813	1,711		2,811	4,522
Total	7,279,875	21,547	4,926	7,306,348	68,594	2,414	4,644	75,652

TABLE 34.—Beehive coke loaded for shipment on originating railroads, waterways, and trucks in the United States in 1951, by routes, as reported by producers

Route	Producing State	Net tons		Percent of total
		By States	Total	
Railroads:				
Baltimore & Ohio	Pennsylvania	1,255,557	1,508,667	20.7
	West Virginia	253,110		
Chesapeake & Ohio	Kentucky	123,753	158,219	2.2
	West Virginia	34,466		
Denver & Rio Grande Western	Colorado	716	78,061	1.1
	Utah	77,345		
Huntingdon & Broadtop Mountain	Pennsylvania	8,166	8,166	.1
Interstate	Virginia	254,276	254,276	3.5
Ligonier Valley	Pennsylvania	9,863	9,863	.1
Monongahela	do	1,836,226	1,836,226	25.1
Nashville, Chattanooga, & St. Louis	Tennessee	1,638	1,638	(1)
New York Central	West Virginia	142,422	142,422	1.9
Norfolk & Western	Virginia	32,700	32,700	.4
Pennsylvania	Pennsylvania	3,140,572	3,140,572	43.0
Pittsburgh & Lake Erie	do	105,273	105,273	1.4
Western Maryland	West Virginia	3,792	3,792	.1
Total railroad shipments		7,279,875	7,279,875	99.6
Waterways: Monongahela and Ohio Rivers	Pennsylvania	21,547	21,547	.3
Trucks	(2)	4,926	4,926	.1
Grand total		7,306,348	7,306,348	100.0

[1] Less than 0.05 percent.
[2] Pennsylvania, Utah, Virginia, and West Virginia.

DISTRIBUTION OF OVEN AND BEEHIVE COKE

Table 35 summarizes the distribution of coke and breeze in 1951.[2] As large coke is separated into broad use classifications, the totals for each State are indicative, therefore, of the size and nature of the coke market in particular States.

Coke has numerous industrial applications to explain its widespread distribution; however, as the bulk of the coke consumption in the United States is for smelting iron ore, a few States, with a concentration of heavy industry, are the principal consumers. In 1951, Pennsylvania, the leading pig-iron-producing State also led in coke consumption, with 28 percent of the United States total. Ohio was second in consumption, with 18 percent of the total, followed by Indiana, Illinois, New York, and Alabama, in the order named. The last 4 States combined consumed 32 percent of the total; the 6 States mentioned therefore consumed over three-fourths of all the coke used in the United States. The remaining coke was distributed among the other 42 States and the District of Columbia, and less than 1 percent was exported by the producing companies.

Foundry coke was distributed more widely than coke for blast furnaces, as it was used in 46 States; Michigan alone consumed 17 percent. Coke was used in 9 States in manufacturing producer gas; gas utility companies in New York consumed 34 percent of the total. The use of coke in manufacturing water gas was reported for 23 States; New York, West Virginia, and Virginia consumed 55 percent of the total used for this purpose. Coke for "other industrial" uses was shipped to every State and the District of Columbia, and 38 States received coke for household heating.

Detailed statistics on coke distribution have been published by the Bureau of Mines in Mineral Market Report MMS No. 2092 available on request to the Anthracite and Coke Sections, Bureau of Mines, Washington 25, D. C.

TABLE 35.—Distribution of oven and beehive coke and breeze in 1951, in net tons

[Based upon reports from producers showing destination and principal end-use of coke used or sold in 1951. Does not include imported coke which totaled 161,639 tons in 1951]

Consuming State	Coke							Breeze
	Blast-furnace use	Foundry use	Making producer gas	Making water gas	Other industrial use	Domestic use	Total	
Alabama	5,162,439	245,332			98,878	31,684	5,538,333	229,853
Arizona		5,366			991		6,357	97
Arkansas		840			4,421		5,261	4,663
California	628,028	78,226		38	82,703		788,995	56,091
Colorado	846,017	15,641			42,094	424	904,176	46,834
Connecticut		68,529	87,843	143,801	6,846	100,652	407,671	47,446
Delaware		5,028		254	788	448	6,518	8,245
District of Columbia					178		178	
Florida		2,310		36,304	769	1,661	41,044	31,300
Georgia		17,496		5,126	5,592	17,017	45,231	
Idaho		713			4,197	200	5,110	70,498
Illinois	5,767,784	344,307		22,209	88,220	94,085	6,316,605	378,789
Indiana	6,929,415	229,853	2,839	19,786	179,578	87,767	7,449,238	572,604
Iowa		93,876			24,397	2,523	120,796	3,402
Kansas		16,301			1,564	20	17,885	2,850
Kentucky	677,848	46,865			52,766	42,490	819,969	49,660
Louisiana		7,410			58,095	798	66,303	168
Maine		6,554		12,476	390	15,000	34,420	
Maryland	3,193,457	28,435		538	22,738	530	3,245,698	258,383
Massachusetts	165,160	70,095	122,285	200,435	15,488	353,006	926,469	94,046
Michigan	1,859,065	634,729			237,346	42,729	2,773,869	233,546
Minnesota	659,784	38,715	4,541	167	26,626	49,461	779,294	91,892
Mississippi		1,072			100	105	1,277	24,309
Missouri		91,546		91	23,602	754	115,993	6,924
Montana		1,727			23,823		25,550	30,909
Nebraska		4,510			3,487	49	8,046	106
Nevada					7,781		7,781	
New Hampshire		4,230		10,364	339	16,779	31,712	
New Jersey		117,195	67,243	185,077	71,365	321,489	762,369	121,384
New Mexico		212			2,649		2,861	634
New York	4,092,617	166,455	199,005	474,718	296,255	342,895	5,571,945	502,792
North Carolina		16,258		1,510	10,232	2,630	30,630	1,420
North Dakota		730			211	276	1,217	
Ohio	13,023,209	403,442		293,004	366,171	208,284	14,294,110	758,146
Oklahoma		6,176			247		6,423	16,631
Oregon		6,734			12,055		18,789	1,754
Pennsylvania	20,754,028	356,763	67,513	54,196	264,157	168,407	21,665,064	1,293,640
Rhode Island		19,747	22,788	43,916	15,190	50,974	152,615	19,068
South Carolina		6,549		2,461	20,396	2,750	32,156	4,329
South Dakota		420			250	222	892	
Tennessee	99,259	108,349			70,447	5,451	283,506	102,945
Texas	676,889	55,426		35	55,681	58	788,089	88,354
Utah	1,147,090	18,766			44,568	3,740	1,214,164	103,758
Vermont		6,871			689	5,174	12,734	
Virginia	105,936	62,154		363,675	64,724	257	596,746	4,369
Washington		10,159			13,357		23,516	14,057
West Virginia	1,391,369	17,050		447,018	90,943	199	1,946,579	185,307
Wisconsin		204,436	4,227		15,618	70,051	294,332	42,488
Wyoming					2,000		2,000	
Total	67,179,394	3,643,598	578,284	2,317,199	2,431,002	2,041,039	78,190,516	5,503,691
Exported	261,593	162,088		4,944	271,833	46,895	747,353	15,621
Grand total	67,440,987	3,805,686	578,284	2,322,143	2,702,835	2,087,934	78,937,869	5,519,312

CONSUMPTION OF COKE

The apparent consumption of coke in the United States in 1951, based on production, imports, exports, and changes in producers' stocks, increased 6 percent over 1950 and reached 78.1 million net tons. This figure was the highest ever attained and exceeded the 1948 record by 4.3 million tons. Consumption by iron blast furnaces rose substantially over 1950—9 percent. These furnaces, which have always utilized the bulk of the coke produced in the United States, used 85 percent of the total apparent consumption in 1951 compared with only 73 percent in 1937. The recent changes in the consumption pattern for coke have been due to gradual expansion of blast-furnace capacity, while requirements for gas making and residential heating have declined because of increased competition from

natural gas and fuel oil. It was expected that coke consumption would continue the upward trend during the next several years after 1951, because blast-furnace coke requirements would increase in direct ratio to expansion of blast-furnace capacity.

The fuel efficiency of blast furnaces, after improving in 1949 and 1950, declined slightly in 1951 (table 37). The quantity of coke required to produce 1 ton of pig iron increased 5.6 pounds over 1950 to 1,848.7 pounds; and for pig iron, including ferroalloys, the increase was 5.2 pounds to 1,870.7.

TABLE 36.—Apparent consumption of coke in the United States, 1913, 1918, 1937, and 1949–51, in net tons

Year	Total production	Imports	Exports	Net change in stocks	Apparent United States consumption [1]	Consumed by iron furnaces [2]		Remainder consumed in other ways	
						Quantity	Percent	Quantity	Percent
1913	46,299,530	101,212	987,395	(3)	45,413,347	37,192,287	81.9	8,221,060	18.1
1918	56,478,372	30,168	1,687,824	(3)	54,820,716	45,703,594	83.4	9,117,122	16.6
1937	52,375,469	286,364	526,683	+863,221	51,271,929	37,599,911	73.3	13,672,018	26.7
1949	63,637,429	277,507	548,256	+176,015	63,190,665	51,356,617	81.3	11,834,048	18.7
1950	72,718,038	437,585	397,846	−658,742	73,416,519	61,039,227	83.1	12,377,292	16.9
1951	79,330,702	161,639	1,026,730	+372,258	78,093,353	66,623,205	85.3	11,470,148	14.7

[1] Production plus imports minus exports, plus or minus net changes in stocks.
[2] American Iron and Steel Institute; figures include coke consumed in manufacture of ferro-alloys.
[3] Data not available.

TABLE 37.—Coke and coking coal consumed per net ton of pig iron made in the United States, 1913, 1918, 1937, and 1949–51

Year	Coke per net ton of pig iron and ferro-alloys [1] (pounds)	Yield of coke from coal (percent)	Coking coal per net ton of pig iron and ferro-alloys (pounds calculated)	Year	Coke per net ton of pig iron and ferro-alloys [1] (pounds)	Yield of coke from coal (percent)	Coking coal per net ton of pig iron and ferro-alloys (pounds calculated)
1913	2,172.6	66.9	3,247.5	1949	1,895.8	69.6	2,723.9
1918	2,120.7	66.4	3,193.8	1950	1,865.5	69.9	2,668.8
1937	1,830.6	70.3	2,604.0	1951	1,870.7	69.8	2,680.1

[1] American Iron and Steel Institute; consumption per ton of pig iron only, excluding furnaces making ferro-alloys, was 2,172.6 pounds in 1913, 2,120.7 in 1918, 1,806.7 in 1937, 1,870.4 in 1949, 1,843.1 in 1950, and 1,848.7 in 1951.

Tables 38 and 39 summarize the disposal of oven and beehive coke in 1951, by principal end uses. A large proportion of the oven-coke output is used by producers in integrated blast furnaces, whereas nearly all of the beehive-coke production is shipped to consumers. The proportion of blast-furnace coke requirements supplied by furnace plants has been increasing in recent years, with substantial expansion of carbonizing facilities at the furnace plants. This group of plants supplied 93 percent of the total oven coke used in blast furnaces in 1951 compared with 91 percent in 1940. Merchant plants supply the bulk of the coke for other industrial purposes and domestic heating. In 1951 the merchant plants supplied 85 percent of all coke used in foundries, 81 percent for other industrial purposes (including gas manufacture), and 81 percent of the coke used for domestic heating. Beehive ovens normally ship a larger proportion of their production to blast furnaces than do the oven-coke plants. In 1951, 87 percent of total beehive-coke production was destined to blast furnaces.

TABLE 38.—Oven coke produced and sold or used by producers in the United States in 1951, by States

State	Produced		Used by producers—				Sold [1]	
			In blast furnaces		For other purposes [2]		Blast furnace [3]	
	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value
Alabama	6,291,280	$75,124,573	5,082,679	$53,719,336	24,238	$264,509	154,604	$2,491,214
California	568,216	(4)	583,537	(4)	491	(4)		
Colorado	995,332	(4)	846,017	(4)	4,092	(4)	61,120	(4)
Illinois	3,685,662	62,052,609	1,888,408	28,973,788	26,159	406,132	1,400,503	25,569,385
Indiana	8,843,452	156,205,401	6,451,645	109,904,769	60,616	937,678	1,563,787	29,509,566
Maryland	2,855,209	(4)	2,854,568	(4)	7,992	(4)		
Massachusetts	1,108,826	(4)	165,160	(4)	126,209	(4)	93,728	(4)
Michigan	2,920,082	44,321,098	1,826,875	(4)	131,739	1,895,618	8,800	(4)
Minnesota	971,913	16,143,039	659,784	(4)	9,620	80,376	35,308	(4)
New Jersey	1,538,953	(4)			196,877	(4)	680,622	(4)
New York	5,610,975	80,327,062	1,984,006	(4)	638,525	8,515,381	2,322,098	31,999,289
Ohio	11,151,201	146,140,699	8,211,252	103,048,925	82,918	1,194,558	1,691,145	22,680,871
Pennsylvania	17,250,217	220,910,330	9,394,994	112,259,191	116,505	1,392,641	6,880,103	93,059,316
Tennessee	250,658	(4)	97,621	(4)	24,707	(4)	52,664	(4)
Texas	755,418	(4)	672,916	(4)	8,280	(4)	47,819	(4)
Utah	1,226,536	(4)	979,475	(4)	1,918	(4)	128,293	(4)
West Virginia	3,829,879	44,416,343	2,930,190	34,077,004	414,321	3,282,979	354,934	5,306,722
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	2,133,363	34,211,525			130,013	1,758,425	921,391	11,659,686
Undistributed		137,212,872		153,494,213		4,929,499		17,221,222
Total 1951	71,987,172	1,017,065,551	44,629,127	595,477,226	2,005,220	24,657,796	16,396,919	239,497,271
At merchant plants	13,190,550	218,174,099	366,394	4,509,999	1,743,717	21,252,857	3,973,340	61,775,402
At furnace plants	58,796,622	798,891,452	44,262,733	590,967,227	261,503	3,404,939	12,423,579	177,721,869
Total 1950	66,890,618	899,667,327	40,728,294	528,032,395	2,682,692	33,665,620	14,933,004	199,396,872

State	Sold [1]—Continued							
	Foundry [5]		Other industrial (including water gas) [6]		Domestic [7]		Total	
	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value
Alabama	650,716	$13,063,953	241,881	$3,879,285	76,320	$856,725	1,123,521	$20,291,177
California								
Colorado	25,238	(4)	30,525	(4)	502	(4)	117,385	(4)
Illinois	241,745	5,340,039	66,311	884,366	62,805	881,068	1,771,364	32,674,858
Indiana	514,617	(4)	128,323	(4)	96,337	1,202,079	2,303,064	44,754,503
Maryland								
Massachusetts	133,580	(4)	214,587	(4)	330,312	(4)	772,207	(4)
Michigan	420,613	(4)	306,542	4,395,856	182,809	2,258,861	918,764	16,724,027
Minnesota	148,998	(4)	42,804	(4)	64,872	(4)	291,982	(4)
New Jersey	117,320	(4)	165,597	(4)	346,318	(4)	1,309,857	(4)
New York			335,636	4,966,547	304,788	4,390,067	2,962,522	41,355,903
Ohio	293,422	6,765,312	753,538	10,802,744	121,503	1,654,096	2,859,608	41,903,023
Pennsylvania	342,714	7,671,529	232,434	3,031,727	165,910	2,205,125	7,621,161	105,967,697
Tennessee	37,579	(4)	23,836	(4)	32	(4)	114,111	(4)
Texas	841	(4)	28,807	(4)			77,467	(4)
Utah			109,727	(4)	3,870	(4)	241,890	(4)
West Virginia	60,898	(4)	45,487	(4)	38,061	268,323	499,380	7,182,820
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	529,912	12,031,278	260,172	3,977,861	266,258	4,352,411	1,977,733	32,021,236
Undistributed		33,000,478		12,227,543		11,702,199		48,431,499
Total 1951	3,518,193	77,872,589	2,986,207	44,165,929	2,060,697	29,770,954	24,962,016	391,306,743
At merchant plants	3,048,849	67,766,217	2,236,108	34,726,313	1,665,117	25,478,287	10,923,414	189,746,219
At furnace plants	469,344	10,106,372	750,099	9,439,616	395,580	4,292,667	14,038,602	201,560,524
Total 1950	3,236,218	64,977,233	3,385,133	48,154,933	2,546,164	34,633,619	24,100,519	347,162,657

[1] Includes intracompany transfers.
[5] Comprises 59,397 tons valued at $967,508 used in foundries; 578,284 tons, $7,457,643 to make producer gas; 1,028,521 tons, $11,849,194 to make water gas; and 339,018 tons, $4,383,451 for other purposes.
[3] Includes 11,256,984 tons valued at $159,093,772 sold to financially affiliated companies.
[4] Included with "Undistributed" to avoid disclosure of individual company operations.
[5] Includes 57,665 tons valued at $1,093,956 sold to financially affiliated companies.
[6] Includes 663,144 tons valued at $10,056,072 for manufacture of water gas and 301,363 tons, $4,907,142 for other industrial use sold to financially affiliated companies; and 516,005 tons, $8,162,062 for manufacture of water gas sold to other consumers.
[7] Household and commercial.

TABLE 39.—Beehive coke produced and sold or used by producers in the United States in 1951, by States

State	Produced		Used by producers—				Sold [1]	
			In blast furnaces		For other purposes		Blast furnace [2]	
	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value
Colorado	716	(3)					65	(3)
Kentucky	123,753	(3)					103,082	(3)
Pennsylvania	6,396,480	$87,877,904	348,104	(3)	1,571	(3)	5,588,993	$76,330,256
Tennessee	1,638	(3)					1,638	(3)
Utah	101,672	(3)	22,628	(3)				
Virginia	287,116	4,453,445					110,071	1,699,180
West Virginia	432,155	6,407,259			8	(3)	240,360	3,394,039
Undistributed		3,669,527		$5,675,482		$22,632		1,469,557
Total: 1951	7,343,530	102,408,135	370,732	5,675,482	1,579	22,632	6,044,209	82,893,032
1950	5,827,420	77,235,875	67,434	795,163	2,732	38,011	5,189,817	68,449,049

State	Sold [1]—Continued							
	Foundry		Other industrial [4] (including water gas)		Domestic [5]		Total	
	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value
Colorado	21	(3)	630	(3)			716	(3)
Kentucky	20,671	(3)					123,753	(3)
Pennsylvania	142,607	$2,199,782	286,716	$3,823,998	26,314	$340,587	6,044,630	$82,694,623
Tennessee							1,638	(3)
Utah			77,393	(3)			77,393	(3)
Virginia	23,558	(3)	152,727	2,361,955	896	(3)	287,252	4,455,528
West Virginia	41,239	(3)	152,187	(3)	27	(3)	433,813	6,427,852
Undistributed		1,467,441		3,569,203		14,114		3,092,109
Total: 1951	228,096	3,667,223	669,653	9,755,156	27,237	354,701	6,969,195	96,670,112
1950	184,178	2,764,756	398,940	5,445,471	19,012	225,054	5,791,947	76,884,330

[1] Includes intracompany transfers.
[2] Includes 1,771,379 tons valued at $22,203,458 sold to financially affiliated companies.
[3] Included with "Undistributed" to avoid disclosure of individual company operations.
[4] Includes 5 tons valued at $77 sold to financially affiliated companies for other industrial use and 114,473 tons, $1,756,735 sold to other consumers for the manufacture of water gas.
[5] Household and commercial.

STOCKS OF COKE AND COKING COAL

Production was slightly higher than requirements of coke during 1951, and stocks at producers' plants at the year end were higher than at the beginning. Stocks of coke of all grades at oven-coke plants increased, blast-furnace coke rising 34 percent, foundry 91 percent, and domestic and other grades 34 percent. Normally, furnace plants carry only a few days' supply of coke in reserve because

of the vertical integration of their operations. Merchant plants, however, often find it necessary to stock coke, especially the domestic heating sizes. Oven coke stocked at furnace oven-coke plants on December 31, 1951, was equivalent to only 6 days' production. Reserves held by merchant plants were equivalent to 13 days' production. Producers' stocks of beehive coke, which usually are smaller than stocks carried by oven-coke plants, amounted to less than 1 day's production.

Stocks of coal at all oven-coke plants reached the highest figure on record during January 1951, when stocks were adequate for a calculated 60.9 days' operations at the rate of coal consumption prevailing at that time. Stocks declined to a low point of 50 days' supply in July but increased in subsequent months and, at the end of the year, sufficed for a 54.5 days' supply.

The maintenance of adequate stocks of bituminous coal at oven-coke plants is essential because of the continuous nature of the carbonizing process. A 30 days' supply is the minimum desired by most oven-coke plant operators to safeguard against disruption in the flow of coal to the ovens. Coke plants on the upper Great Lakes, which are supplied principally by Lake carriers, build up inventories during the shipping season to have enough tonnage to carry them through the winter. These plants usually have a stockpile aggregating 4 to 5 months' supply at the end of the Lake shipping season.

TABLE 40.—Summary of producers' stocks of coke at all coke plants in the United States on Jan. 1, 1937, and 1948–52, in net tons

	1937	1948	1949	1950	1951	1952
Oven-coke plants:						
Blast furnace	282,144	376,097	940,727	838,718	756,199	1,011,989
Foundry	8,981	12,362	7,003	13,120	8,466	16,140
Domestic and other	1,408,350	631,397	612,851	864,720	327,997	439,270
Total	1,699,475	1,019,856	1,560,581	1,716,558	1,092,662	1,467,399
Beehive-coke plants:						
Blast furnace	5,622	10,181	30,629	51,580	17,068	14,129
Foundry	8,508	50	964	1,118	884	1,344
Domestic and other	18,461	2,150	1,267	200	100	100
Total	32,591	12,381	32,860	2,898	18,052	15,573
Total:						
Blast furnace	287,766	386,278	971,356	890,298	773,267	1,026,118
Foundry	17,489	12,412	7,967	14,238	9,350	17,484
Domestic and other	1,426,811	633,547	614,118	864,920	328,097	439,370
Grand total	1,732,066	1,032,237	1,593,441	1,769,456	1,110,714	1,482,972

TABLE 41.—Producers' stocks of coke and breeze in the United States on January 1, 1952, by States, in net tons

State	Coke				Breeze
	Blast Furnace	Foundry	Domestic and other	Total	
Oven coke:					
Alabama	144,207	8,447	9,602	162,256	27,987
California	20,032			20,032	5,034
Colorado	32,327			32,327	4,950
Illinois	35,487	533	2,119	38,139	30,489
Indiana	38,863	1,711	39,331	79,905	94,046
Maryland	64,885			64,885	120,030
Massachusetts	143	245	75,382	75,770	2,244
Michigan	51,078	280	12,081	63,439	6,030
Minnesota	16,897		3,308	20,205	18,178
New Jersey	13,822	236	58,735	72,793	9,227
New York	31,820		106,905	138,725	139,322
Ohio	148,396	1,382	8,640	158,418	81,269
Pennsylvania	319,165	178	34,751	354,094	196,759
Tennessee	16,337			16,337	1,085
Texas	3,658	32	227	3,917	237
Utah	48,574		330	48,904	1,807
West Virginia	24,490		15,335	39,825	75,383
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	1,808	3,096	72,524	77,428	6,815
Total	1,011,989	16,140	439,270	1,467,399	820,892
At merchant plants	19,254	15,620	406,506	441,380	111,802
At furnace plants	992,735	520	32,764	1,026,019	709,090
Beehive coke:					
Pennsylvania	11,935	455		12,390	5,413
Utah	1,314			1,314	
Virginia	675		100	775	
West Virginia	205	889		1,094	
Total	14,129	1,344	100	15,573	5,413

TABLE 42.—Producers' stocks of oven coke in the United States at end of each month, 1950–51, in net tons

[Includes blast furnace, foundry, and domestic coke, but not breeze]

Month	Furnace plants		Merchant plants		Total	
	1950	1951	1950	1951	1950	1951
January	806,956	904,740	474,028	195,417	1,280,984	1,100,157
February	448,304	931,600	206,828	137,098	655,132	1,068,698
March	447,788	1,134,048	102,109	131,841	549,897	1,265,889
April	581,077	1,219,317	119,087	190,905	700,164	1,410,222
May	610,548	1,211,354	107,563	233,309	718,111	1,444,663
June	612,383	1,135,097	111,288	260,297	723,671	1,395,394
July	641,931	1,175,311	175,620	343,143	817,551	1,518,454
August	599,443	1,203,936	227,799	422,453	827,242	1,626,389
September	584,420	1,298,040	270,713	465,761	855,133	1,763,801
October	660,842	1,305,892	323,276	508,694	984,118	1,814,586
November	751,580	1,263,728	350,873	494,601	1,102,453	1,758,329
December	799,519	1,026,019	293,143	441,380	1,092,662	1,467,399

TABLE 43.—Stocks of bituminous coal at oven-coke plants in the United States at end of each month, 1937 and 1949–51, in net tons

Month	1937	1949	1950	1951
January	8,030,871	12,480,691	7,087,355	16,960,185
February	8,687,389	13,758,864	3,448,610	16,366,139
March	9,638,317	11,451,673	4,847,923	16,751,447
April	8,543,774	12,913,613	7,490,871	16,464,045
May	8,187,883	15,870,342	9,572,167	16,179,877
June	7,770,256	15,746,565	11,279,551	16,254,127
July	7,432,741	13,895,773	10,385,780	14,034,705
August	7,455,932	13,610,849	12,339,744	14,448,916
September	7,760,533	11,774,213	13,964,334	14,426,401
October	8,066,938	9,946,089	15,665,689	14,953,056
November	8,114,094	10,059,834	16,329,150	15,123,117
December	7,273,403	9,892,891	16,776,070	15,257,762

VALUE AND PRICE

The term "value," as used in this report, is the value of the coke at the ovens as reported by producers. For that part of the output sold, the value is the amount received for the coke f. o. b. ovens. However, the greater part of the coke produced in the United States is made in ovens operated by corporations, which not only mine the coal used in manufacturing coke but also operate blast furnaces and steel mills, consuming the entire output of their ovens. Under such conditions, fixing a value for coal charged and for coke produced is governed by established accounting procedures. For example, at some plants the costs of coke to the furnace department equals the cost of production; at others, a margin of profit is added; or the reported value is based on what the coke would cost if purchased. The line between sales and interdepartmental transfers is difficult to draw among such affiliated interests, as a large part of the furnace coke reported as sold actually goes to iron furnaces that are in some way connected with the coke producers.

The average value of all coke produced in 1951, measured in the above way, was $14.11 per ton, the highest figure ever recorded and a gain of 5 percent over 1950 (table 44).

The average price received for each ton of coke sold, f. o. b. ovens (merchant sales), in 1951 established a new record and was 7 percent over the 1950 figure. Table 45 shows average receipts from sales classified by uses and by States. It will be noted that prices vary notably with the distances from the mines. Thus, the highest average prices were those reported for the New England and Lake Dock States, where the coal must be hauled great distances.

TABLE 44.—Average value per net ton of coke produced and average receipts per net ton from coke sold (merchant sales) in the United States, 1937 and 1947–51

Year	Value per ton produced			Receipts per ton sold		
	Oven coke	Beehive coke	Total	Oven coke	Beehive coke	Total
1937	$5.03	$4.31	$4.98	$6.45	$4.25	$6.10
1947	10.65	9.77	10.57	11.98	10.31	11.54
1948	12.43	12.10	12.40	14.74	12.80	14.22
1949	13.26	12.87	13.24	15.12	13.52	14.85
1950	13.45	13.25	13.43	15.66	13.63	15.15
1951	14.13	13.95	14.11	17.04	14.33	16.25

TABLE 45.—Average receipts per net ton of coke sold (merchant sales) in the United States in 1951, by States

State	Oven coke				Beehive coke			
	Blast furnace	Foundry	Other industrial (including water gas)	Domestic [1]	Blast furnace	Foundry	Other industrial (including water gas)	Domestic [1]
Alabama	$17.57	$20.08	$16.04	$11.23				
California, Colorado, Texas, and Utah	17.05	22.40	13.54	8.97	(2)	(2)	(2)	(2)
Connecticut, Massachusetts, and Rhode Island	15.08	21.94	16.18	16.05				
Illinois	17.08	22.94	13.39	14.03				
Indiana	20.00	(2)	(2)	12.48				
Kentucky, Missouri, and Tennessee	11.73	22.21	14.53	14.81	(2)	(2)		
Michigan, Minnesota, and Wisconsin	17.67	23.27	14.43	13.80				
New Jersey and New York	16.18	(2)	14.49	15.06				
Ohio	16.54	23.07	11.54	13.61				
Pennsylvania	15.04	22.42	13.03	13.29	$14.18	$15.43	$13.34	$12.94
Virginia					15.44	(2)	15.47	(2)
West Virginia	14.95	(2)	(2)	7.05	14.12	(2)	(2)	(2)
Undistributed		22.28	14.32		14.02	17.17	15.50	15.29
United States average, 1951	15.64	22.19	14.44	14.45	14.20	16.08	14.57	13.02
At merchant plants	15.55	22.28	15.66	15.30				
At furnace plants	15.97	21.57	12.03	10.85				
United States average, 1950	14.31	20.05	14.10	13.60	13.56	15.01	13.65	11.84

[1] Household and commercial use.
[2] Included with "Undistributed" to avoid disclosure of individual company operations.

FOREIGN TRADE [3]

Imports.—Statistics on imports of coke into the United States include coke made either from coal or petroleum, although the two types are separated in the export statistics. The improvement in the supply of coke in the United States during 1951 resulted in a 63-percent decrease in imports. Canada, as in prior years, was the principal source of imported coke, supplying 98 percent of total imports in 1951. The bulk of the coke imported in 1951 passed through the Montana-

[3] Figures on imports and exports compiled by M. B. Price and E. D. Page, of the Bureau of Mines, from records of the U. S. Department of Commerce.

Idaho and Michigan customs districts. Coke entering through the Montana-Idaho customs district probably was used for smelting nonferrous metals, while that entering the Michigan gateway was used for miscellaneous industrial purposes and residential heating.

Exports.—Exports of metallurgical and foundry coke were placed under Government control for the first quarter of 1951. A quota of 15,000 short tons was established for all foreign countries, and similar quotas were set for each succeeding quarter. Shipments to Canada (not subject to licensing) were not included in these quotas. Licensing of exports was placed under the jurisdiction of the Office of International Trade, United States Department of Commerce. At the time the quotas were established, that agency announced that additional shipments of coke would be licensed if, after conference with the National Production Authority and Defense Solid Fuels Administration, it was found that production exceeded United States requirements. Quotas were exceeded in the last three quarters of 1951 as large quantities of coke, not required along the Atlantic seaboard, were licensed for shipment abroad. Consequently, exports to Europe were the highest on record, and the gain in shipments to Canada raised the total to over 1 million tons, the highest since 1946. This total, however, equaled only 1 percent of the apparent United States consumption for the year.

TABLE 46.—Coke imported for consumption in the United States, 1949–51, by country and by customs district

[U. S. Department of Commerce]

	1949		1950		1951	
	Net tons	Value	Net tons	Value	Net tons	Value
COUNTRY						
Brazil					23	$95
Canada	277,507	$3,975,785	365,615	$4,315,394	157,631	1,872,437
Germany			3,140	48,676	54	821
Netherlands			68,810	932,245		
Peru			20	198		
United Kingdom					3,931	58,932
Total	277,507	3,975,785	437,585	5,296,513	161,639	1,932,285
CUSTOMS DISTRICT						
Buffalo	83,053	1,338,461	27,593	425,636	3,696	57,331
Chicago	7,201	17,421	17,035	75,062	54	821
Connecticut	180	3,058				
Dakota	1,482	8,885	290	1,740	1,097	14,787
Duluth and Superior			44,796	190,326	44	355
Los Angeles			7,034	156,184		
Maine and New Hampshire	346	4,946	305	4,229	291	4,735
Massachusetts			55,347	673,451		
Michigan	114,722	1,813,986	203,445	2,837,749	63,339	799,930
Montana and Idaho	69,157	774,573	70,859	781,001	80,889	904,481
New York			20	198	23	95
Philadelphia					3,931	58,932
Puerto Rico			3,736	44,783		
St. Lawrence	458	6,491	2,454	34,646	4,971	78,398
San Francisco			2,693	57,827		
Vermont	316	4,689	363	5,589	141	2,270
Washington	592	3,275	1,577	7,474	3,163	10,150
Total	277,507	3,975,785	[1] 437,585	[1] 5,296,513	161,639	1,932,285

[1] Includes shipments on vessels operated by the U. S. Army or Navy as follows: 38 tons; value $618.

TABLE 47.—Coke exported from the United States, 1949–51, by country and by customs district

[U. S. Department of Commerce]

	1949		1950		1951	
	Net tons	Value	Net tons	Value	Net tons	Value
COUNTRY						
North America:						
Canada	428,535	$6,341,577	361,555	$5,621,051	610,343	$9,671,585
Mexico	88,393	1,118,491	30,570	352,165	20,504	382,911
Panama	11	312	51	2,862	56	3,553
West Indies:						
Cuba	13,859	242,473	2,910	74,429	8,020	169,276
Trinidad and Tobago	194	4,567.			207	4,572
Other North America	1,234	36,706	1,134	31,462	1,065	45,722
South America:						
Argentina					3,358	72,157
Bolivia	1,447	44,692	101	3,651	897	34,457
Brazil	1,882	78,752			22,359	593,337
Chile	5,929	144,107	10	350	875	21,759
Peru					839	19,156
Uruguay					1,431	46,832
Venezuela	590	22,274	187	6,714	527	18,695
Other South America	408	17,482	130	5,280	79	3,067
Europe:						
Denmark	10	214	6	118	13	329
Finland					150,987	2,964,883
France	755	33,950				
Ireland					1,369	31,399
Norway	123	3,633			1,699	23,938
Spain					78,310	1,381,359
Yugoslavia					121,641	2,160,840
Other Europe					283	6,163
Asia:						
Hong Kong	1,646	77,399				
Philippines	2,658	138,264	1,147	61,125	296	16,355
Thailand					451	18,714
Other Asia	582	18,032			6	584
Africa: Egypt					1,115	22,888
Total	548,256	8,322,925	397,801	6,159,207	1,026,730	17,714,531
CUSTOMS DISTRICT						
Buffalo	166,035	2,326,467	170,512	2,482,995	301,866	4,663,010
Dakota	17,812	321,473	13,230	244,005	14,951	289,106
Duluth and Superior	5,617	99,186	5,133	99,342	8,319	142,622
El Paso	30,938	464,378	255	895	280	3,874
Florida	975	25,482	2,767	70,761	3,420	95,490
Laredo	55,997	620,645	26,821	314,295	18,594	335,441
Los Angeles	10	445	2,413	12,596		
Maryland	3,187	140,944	70	2,792	171,072	3,174,366
Michigan	223,456	3,371,367	151,362	2,497,641	250,730	4,232,747
Mobile	2,346	65,878			6,949	247,163
Montana and Idaho	81	1,481	42	856	71	1,669
New Orleans	8,181	298,520	1,945	60,595	4,071	166,757
New York	6,290	106,583	96	4,012	92,834	1,609,962
Ohio	11,701	163,411	15,381	202,542	31,056	261,901
Philadelphia	338	7,509	10	350	114,337	2,289,978
Rhode Island	7,686	119,076				
St. Lawrence	1,876	14,506	2,657	32,513	252	4,440
San Diego	717	13,416	556	10,214	791	14,651
San Francisco	1,516	70,505	579	24,920	33	1,545
Vermont			189	4,451		
Virginia	1,081	36,815	205	17,024	3,566	88,697
Washington	1,902	43,245	3,049	56,706	3,058	75,193
Other districts	514	11,593	529	19,702	480	15,919
Total	548,256	8,322,925	397,801	6,159,207	1,026,730	17,714,531

TECHNOLOGY

Substantial contributions were made to coke technology in 1951 by Federal Government and State agencies, coal-research laboratories, colleges, and individual companies. Highlights of the Bureau of Mines work in 1951 were the following:

Development of a new experimental coke oven at the Tuscaloosa, Ala., Experiment Station. This experimental oven was wider and much larger than test ovens formerly used, and a limited number of tests indicated that the oven closely duplicated full-scale performance.[4]

An extraction technique was developed during 1951 that may be commercially applicable to the preparation of low-ash carbonaceous material in manufacturing electrode carbon.[5]

A résumé of the special studies made by the Bureau of Mines from July 1, 1950, to June 30, 1951, inclusive, on coking-coal reserves, carbonizing properties, plasticity, expansion, and oxidation of various coals was contained in the Sixteenth Annual Report of Research and Technologic Work on Coal.[6] This report listed the original publications containing detailed information on the individual studies.

Shortages of benzol and sulfur during 1951 intensified work on improved production methods for these commodities. In an effort to increase benzol production, the Donner-Hanna Coke Corp., Buffalo, N. Y., installed a refrigeration unit in its light-oil recovery system. By refrigerating the wash oil used to absorb the light oil from the gas stream, it was claimed that the scrubbing efficiency was improved, which, in turn, would increase benzol production substantially. The shortage of sulfur focused a great deal of attention on recovering it from coke-oven gas. The Szombathy liquid-catalyst process created new interest in the subject.[7] A pilot plant using this new process was installed by the Heinrich Koppers Co., Essen, Germany, at the Mainz coke plant.

A comprehensive review of significant technical developments throughout the world in the field of coal carbonization was published in 1951.[8] This review included lists of original publications concerned with studies of raw materials, coke and coal chemicals, improvements in coke-plant equipment and operations, and procedures for analysis and testing of coal, coke, and coal-chemical materials.

WORLD PRODUCTION

World production of coke in 1951, estimated at 203.7 million metric tons, established a new alltime peak, exceeding the 1950 record by 12 percent. The figure shown is for large coke produced at high temperatures in conventional slot-type or beehive-coke ovens only and does

[4] Gayle, John B., and Auvil, H. Stuart, Development of New Experimental Coke Oven: Bureau of Mines Rept. of Investigations 4923, 1952, 17 pp.
[5] Orchin, M., Golumbic, C., Anderson, J. E., and Storch, H. H., Studies of the Extraction and Coking of Coal and Their Significance in Relation to Its Structure: Bureau of Mines Bull. 505, 1951, 15 pp.
[6] Brown, R. L., and Carman, E. P., Annual Report of Research and Technologic Work on Coal for the Fiscal Year Ended 1951; Bureau of Mines Inf. Circ. 7647, 1952, 81 pp.
[7] Minchin, L. T., Liquid Purification—Some British and Continental Developments: Coke and Gas, January 1951, pp. 27–29.
[8] Preen, Charles H., Pyrolysis of Coal and Shale: Ind. Eng. Chem., vol. 43, No. 9, 1951, pp. 2006–2013.

not include coke breeze, gashouse (retort) coke, low-temperature coke, and char. As the data shown are for coke used principally for industrial purposes, it is evident that the more highly industrialized nations are the leading coke producers. The United States has led the world in coke production since 1938 and in 1951 supplied 35 percent of total world production. Germany assumed temporary leadership in 1938, but war damages and territorial changes reduced production drastically for several ensuing years. However, production in the famous Ruhr area has been increasing steadily for several years, and production in Western Germany (Federal Republic) in 1951 ranked second only to the United States. Little reliable information has been available from

TABLE 48.—World production of coke, 1938, 1943, and 1947–51, by countries, in thousands of metric tons [1]

[Compiled by Pauline Roberts]

Country	1938	1943	1947	1948	1949	1950	1951
Australia	1,185	1,608	1,341	[2] 1,406	[2] [3] 1,168	[2] [3] 1,183	[2] [4] 1,400
Austria	[4] 375	[4] 450	320	591	776	[3] 987	1,083
Belgium	4,399	[3] 4,411	[3] 4,788	[3] 5,587	5,007	[3] 4,585	6,106
Brazil		20	183	266	272	287	286
Bulgaria	4	[4] 5	[4] 5	[4] 9	[4] 8	[4] 10	[4] 10
Canada	1,809	2,709	2,697	3,116	3,041	[4] 3,100	3,086
China	[5] 12	[6] 380	[7] 109	[4] [7] 93	[4] [7] 100	[4] 1,000	[4] 1,300
Czechoslovakia	2,766	4,280	3,845	4,099	4,695	[4] 4,876	[4] 5,150
France	7,636	4,990	6,003	6,247	6,769	7,012	8,079
Saar	3,107	3,485	1,813	2,740	[3] 3,328	3,227	3,766
Germany:							
East Germany	} 40,404	[8] 47,804	16,154	{ [4] 225	[4] 275	[4] 300	[4] 300
West Germany				20,279	25,140	27,333	33,626
India	1,738	1,816	[3] 1,899	[3] 1,779	2,038	[3] 2,251	2,183
Indochina	4	5					
Italy	1,739	1,532	964	1,309	1,511	1,502	2,173
Japan	[9] 3,724	6,192	1,164	1,932	2,580	[3] 2,712	3,864
Korea:							
Korea, Republic of	} 378	851	{ 7	11	12	[4] 10	[4] 10
North Korea			[4] 250	[4] 300	[4] 400	[4] 500	[4] 250
Mexico	[4] 350	[4] 500	530	408	375	392	389
Netherlands	3,158	2,163	1,774	2,240	2,474	2,804	2,973
New Caledonia	50	[4] 80	[4] 70	[4] 80	[4] 80	[4] 80	[4] 80
New Zealand		5	4		5	6	6
Norway	[4] 100	110					
Peru			2	2			
Poland	2,291	3,250	3,763	5,091	5,751	5,924	[4] 6,300
Rumania	86	84	73	[4] 80	[4] 100	[4] 120	[4] 125
Southern Rhodesia	48	79	64	79	81	[4] 80	102
Spain	571	801	816	848	967	946	995
Sweden	112	82	[4] 60	74	83	72	
Taiwan (Formosa)	[4] 50	[4] 50	28	32	36	[4] 50	125
Trieste	(10)	(10)		98	[4] 103	99	99
Turkey	85	183	265	270	293	[3] 304	[4] 300
Union of South Africa [11]	361	655	666	802	956	1,036	[4] 1,200
U. S. S. R. (estimate)	20,700	8,301	17,000	20,000	24,000	27,000	30,000
United Kingdom	13,031	14,684	14,037	15,670	15,740	[3] 15,690	16,354
United States	29,480	65,023	66,629	67,913	57,731	65,968	71,967
Total (estimate)	[3] 139,800	[3] 176,600	[3] 147,300	[3] 163,700	[3] 165,900	[3] 181,400	203,700

[1] Excludes breeze and gas-house coke.
[2] Fiscal year ended June 30 of year stated.
[3] Revised figure.
[4] Estimate.
[5] Exports.
[6] Areas designated as Free China during the period of Japanese occupation.
[7] National Resources Commission only.
[8] Includes Silesian production.
[9] Preliminary data for fiscal year ended Mar. 31 of year following that stated.
[10] Included under Italy.
[11] Revised to include coke production of South African Iron and Steel Corporation, Ltd. (ISCOR).

the Soviet Union since 1937, but estimates for 1951 place this country third in coke production. Reports made by competent engineers who have returned to the United States from Russia indicated that remarkable progress had been made in constructing modern coke and coal-chemical recovery plants. Other important coke-producing countries in 1951 were Great Britain, France (including the Saar), Poland, Belgium, and Czechoslovakia, which combined produced 22 percent of the world total.

COAL-CHEMICAL MATERIALS

GENERAL SUMMARY

Coal chemicals are derived from the vapors and gases recovered from the distillation of coal in slot-type coke ovens. The principal or basic chemical raw materials are gas, ammonia, crude light oil, and tar. The term "coal chemicals" also includes those fractions and individual compounds that are made from the basic materials by a chain of chemical processes. Coal chemicals are used by many industries and sometimes pass from one industry to another, as the product of one becomes the raw material for the other in the production of the final commodity. For this reason, a direct relationship exists between the coke industry and the countless others that depend entirely or partly upon coke ovens as a source of supply for essential chemical raw materials. Increased requirements of explosives, fertilizer materials, plastics, synthetic rubber and fibers, pharmaceuticals, paints, and waterproofing compounds, etc., for essential military and civilian purposes have proportionately increased the demand for ammonium sulfate, benzol, toluol, xylol, solvent naphtha, naphthalene, phenol, pyridine, picoline, and other coke-oven products entering into their manufacture. This, in turn, has prompted operators of slot-type ovens to place more emphasis on increasing the recovery of the basic chemical materials in order that larger quantities of refined or pure aromatic hydrocarbon products can be produced. New light-oil-refining and tar-processing equipment has been installed at various coke plants. At the end of 1951, obsolete equipment was being replaced by new construction in order that the coke-plant operators could produce coal chemicals to meet the most exacting specifications for plastics, synthetic rubber, explosives, and numerous other essential products. Ammonia recovery and processing systems were also being modernized and improved to produce a better grade of ammonium sulfate. Serious consideration was also given by a number of operating companies to the installation of new equipment and improved processes for the recovery of sodium phenolate, crude pyridine bases, and sulfur which in the past had not been economical to manufacture.

In spite of the best efforts of the coke producers in this field, however, the financial returns from the sale of all coal-chemical materials did not keep pace with the rise in coal costs nor the value assigned to the coke produced. The average cost of coal, per ton of oven coke

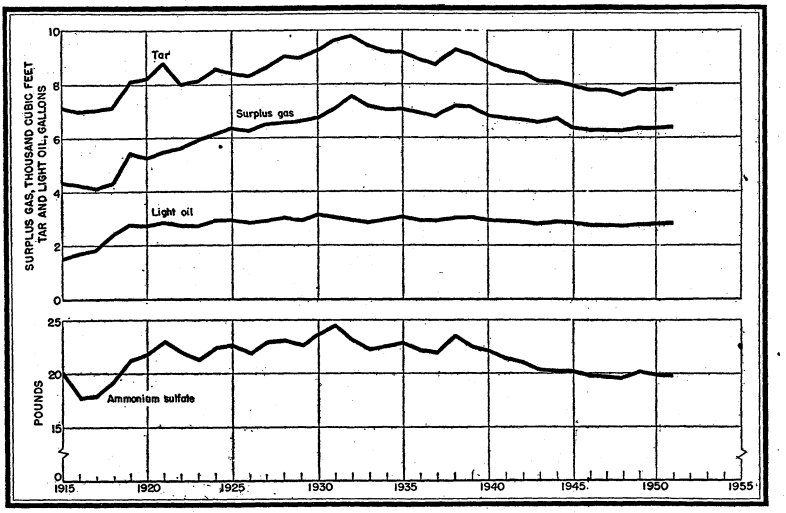

FIGURE 2.—Average yield of principal coal-chemical materials per net ton of coal carbonized in coke ovens, 1915–51. Yields of light-oil and ammonium sulfate equivalent represent average for plants recovering these products.

produced to oven-coke plant operators, increased 141 percent from 1937 to 1951, while the average value of oven coke produced increased 181 percent. Revenue from the sale of coal chemicals increased only 65 percent during the same period and in 1951 was equivalent to 24 percent of the total value of all products compared with 35 percent in 1937 (table 50). This reduction was due largely to the declining proportion of revenue received from the disposal of surplus gas, because the reported value of surplus gas in 1951 was equivalent to only 10 percent of the total value of all products, compared with 19 percent in 1937. These figures are arbitrary to the extent that the value assigned by some iron and steel companies to surplus gas used in their steelmaking furnaces is usually lower than the market price. The sale of surplus gas was still important to the merchant-coke plants in 1951, being responsible for about 20 percent of the total revenue derived from all products by this group. Should this important part of their revenue dollar be lost to competitive fuels, it might force more merchant plants out of business, in addition to those that had closed by 1951. Although prices on tar, ammonium sulfate, and light-oil derivatives have advanced, the gains made have not offset the decline in the percentage of revenue formerly accounted for by gas.

The increased quantity of coal-chemical materials produced, when coupled with modest gains in prices, resulted in the largest income ever reported from the sale of coal-chemical materials. The total received, $323.9 million, was $49.6 million (18 percent) higher than for the record year 1950.

TABLE 49.—Coal-chemical materials obtained from coke-oven operations in the United States in 1951 [1]

[Exclusive of breeze]

Product	Production	Sales			On hand Dec. 31
		Quantity	Value		
			Total	Average	
Tar—gallons	795,311,283	438,733,344	$43,546,155	$0.099	30,741,516
Tar derivatives:					
Creosote oil, distillate as such—do	35,251,642	34,168,687	6,226,175	.182	1,540,890
Creosote oil, in coal-tar solution—gallons	7,720,374	5,141,953	822,094	.160	371,902
Chemical oil—do	24,896,700	23,851,391	6,562,251	.275	318,955
Phenol—pounds	7,965,423	6,432,548	945,699	.147	156,610
Pitch of tar:					
Soft [2]—net tons	561,091	15,563	508,027	32.643	5,267
Hard [3]—do	285,345	26,635	531,605	19.959	2,602
Other tar derivatives [4]			1,887,681		
Ammonia:					
Sulfate [5]—pounds	1,796,525,451	1,823,499,518	34,240,859	.019	82,689,087
Liquor (NH_3 content)—do	49,755,387	45,295,654	1,791,246	.040	1,744,378
Total			36,032,105		
Sulfate equivalent of all forms—pounds	1,995,546,999	2,004,682,134			89,666,590
NH_3 equivalent of all forms—do	498,886,750	501,170,534			22,416,650
Gas:					
Used under boilers, etc.—M cubic feet	[6] 1,052,280,603	42,131,852	5,355,614	.127	
Used in steel or allied plants—do		428,652,885	73,824,951	.172	
Distributed through city mains—M cubic feet		137,617,776	51,850,508	.377	
Sold for industrial use—do		44,948,172	7,269,226	.162	
Total	[6] 1,052,280,603	653,350,685	138,300,299	.212	
Crude light oil—gallons	[7] 284,496,933	17,667,570	3,728,340	.211	4,270,644
Light-oil derviatives:					
Benzol:					
Motor—do	5,103,677	5,189,155	1,503,048	.290	355,916
All other grades—do	172,849,275	171,023,942	57,588,706	.337	4,904,522
Toluol, crude and refined—do	34,301,508	34,055,449	10,387,291	.305	910,124
Xylol, crude and refined—do	9,097,044	8,847,407	2,811,636	.318	618,979
Solvent naphtha—do	6,036,302	6,039,202	1,389,525	.230	354,679
Other light oil products—do	6,920,644	4,694,176	616,386	.131	311,998
Total	234,308,450	229,849,331	74,296,592	.323	7,456,218
Intermediate light oil—gallons	845,270	818,936	150,748	.184	64,597
Naphthalene, crude—pounds	125,579,578	130,200,785	6,849,831	.053	3,948,810
Pyridine:					
Crude bases (dry basis)—gallons	536,689	529,242	845,887	1.598	122,171
Refined or 2° C—pounds	1,478,750	1,484,909	1,440,530	.970	15,983
Sodium phenolate—gallons	2,800,251	2,483,119	598,806	.241	234,243
Sulfur—pounds	6,463,960	6,669,260	123,529	.019	1,284,000
Other coal-chemical materials [8]			551,603		
Value of all coal-chemical materials sold			323,947,957		

[1] Includes products of tar distillation conducted by coke-oven operators under same corporate name.
[2] Softening point, less than 110° F. Includes some medium pitch-of-tar reported by 2 producers.
[3] Softening point, over 160° F.
[4] Cresols, cresylic acid, fuel oil, pitch coke, road tar, tar paint, and topped tar.
[5] A small amount of sulfate from purchased synthetic ammonia was produced and sold by 1 producer but is not included.
[6] Includes gas used for heating ovens and gas wasted.
[7] 270,541,072 gallons refined by coke-oven operators to make derived products shown.
[8] Ammonium thiocyanate, picolines, secondary oil, and sodium prussiate.

TABLE 50.—Value of coal-chemical materials, coke, and breeze per ton of coke produced in the United States, 1937 and 1948–51

Product	1937	1948	1949	1950	1951
Ammonia and its compounds	$0.326	$0.545	$0.558	$0.468	$0.501
Light oil and its derivatives (including naphthalene)	.435	.686	.673	.871	1.179
Surplus gas sold or used	1.483	1.839	2.015	1.977	1.921
Tar:					
Sold	.375	.614	.520	.562	.605
Used by producers	.127	.213	.202	.129	.152
Miscellaneous products	.066	.228	.197	.224	.294
Total	2.812	4.125	4.165	4.231	4.652
Breeze produced	.162	.293	.281	.277	.275
Coke produced	5.026	12.429	13.264	13.450	14.129
Total coke and coal-chemical materials	8.000	16.847	17.710	17.958	19.056

TABLE 51.—Coal equivalent of coal-chemical materials produced at oven-coke plants in the United States, 1913, 1914, 1918, 1937, and 1949–51

Year	Quantity of coal-chemical materials produced				Estimated equivalent in heating value (billion B. t. u.)					Coal equivalent	
	Coke breeze (thousand net tons)	Surplus gas (billion cubic feet)	Tar (thousand gallons)	Light oil (thousand gallons)	Coke breeze	Surplus gas	Tar	Light oil	Total	Net tons	Percent this forms of coal made into coke
1913	735	64	115,145	3,000	14,700	35,200	17,272	390	67,562	2,600,000	3.8
1914	667	61	109,901	8,464	13,340	33,550	16,485	1,100	64,475	2,461,000	4.8
1918	1,999	158	263,299	87,562	39,980	86,900	39,495	11,383	177,758	6,785,000	8.0
1937	3,884	463	603,053	187,054	77,680	254,650	90,458	24,317	447,105	17,065,000	22.9
1949	4,929	546	672,407	228,754	98,582	300,300	100,861	29,738	529,481	20,209,000	22.1
1950	5,173	603	739,869	260,857	103,456	331,650	110,980	33,911	579,997	22,137,000	21.3
1951	5,126	653	795,311	284,497	102,516	359,150	119,297	36,985	617,948	23,586,000	20.7

COKE-OVEN GAS

After removal of the basic chemical raw materials (ammonia, tar, and crude light oil), coke-oven gas remains a potential source of chemicals, such as hydrogen, methane, ethylene, etc., but is not processed further for their recovery to any appreciable extent in the United States. About one-third of the gas recovered is used to heat the coke ovens, and the remainder (surplus gas) is used in integrated metallurgical operations as boiler fuel or distributed through city mains for public use.

Production of coke-oven gas totaled 1,052 billion cubic feet in 1951, a 7-percent increase over the 1950 output. The average unit value received for all surplus gas, whether used by producers or sold, declined slightly during 1951 to $0.212 per thousand cubic feet. The average value shown per thousand cubic feet for furnace plants was much lower than for merchant plants, as the latter include gas utilities. At coke plants integrated with iron and steel works, the bulk (88 percent) of the surplus gas was consumed within the works and was assigned a value in accordance with established accounting procedures. Gas utilities and, to a large extent, the merchant plants marketed the larger proportion of their gas production for residential and commercial use and thus realized a higher price. Merchant plants, including the coke plants operated by gas utilities, used only 12 percent of their surplus gas and sold 88 percent. Gas shown in table 53 as distributed through city mains was used principally for residential heating and cooking, although some part was undoubtedly used for industrial purposes.

TABLE 52.—Production and disposal of coke-oven gas in the United States in 1951, by States, in thousands of cubic feet

State	Active plants	Produced	Used in heating ovens	Surplus sold or used			Wasted
				Quantity	Value		
					Total	Average	
Alabama	7	89,042,055	40,989,672	45,637,942	$5,448,400	$0.119	2,414,441
California	1	10,409,598	44,601	9,783,128	(1)	(1)	581,869
Colorado	1	17,071,693	8,405,376	8,439,357	(1)	(1)	226,960
Illinois	8	52,195,449	17,923,211	33,398,613	5,471,906	.164	873,625
Indiana	5	119,195,358	44,041,143	74,439,602	17,464,411	.235	714,613
Maryland	1	42,876,220	12,055,645	30,015,968	(1)	(1)	804,607
Massachusetts	1	16,359,292	2,994,933	13,360,922	(1)	(1)	3,437
Michigan	4	40,671,107	6,219,845	34,334,447	5,077,555	.148	116,815
Minnesota	3	13,935,812	5,914,302	7,776,136	1,755,544	.226	245,374
New Jersey	2	23,456,551	7,350,168	16,106,383	(1)	(1)	
New York	8	86,513,055	25,719,172	59,803,704	19,607,302	.328	990,179
Ohio	15	158,740,967	67,102,974	88,954,714	16,288,191	.183	2,683,279
Pennsylvania	13	254,998,940	104,585,001	149,107,020	30,468,783	.204	1,306,919
Tennessee	1	2,957,703	1,274,335	1,683,053	(1)	(1)	315
Texas	2	11,367,322	4,440,292	5,528,496	(1)	(1)	1,398,534
Utah	2	23,179,190	6,022,518	14,071,989	(1)	(1)	3,084,683
West Virginia	5	58,747,389	16,639,150	39,447,440	6,386,314	.162	2,660,799
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	5	30,562,902	9,074,810	21,461,771	6,372,028	.297	26,321
Undistributed					23,959,865	.242	
Total 1951	84	1,052,280,603	380,797,148	653,350,685	138,300,299	.212	18,132,770
At merchant plants	28	187,996,768	50,322,750	134,632,879	47,098,386	.350	3,041,139
At furnace plants	56	864,283,835	330,474,398	518,717,806	91,201,913	.176	15,091,631
Total 1950	85	979,592,988	360,583,554	602,815,977	132,247,656	.219	16,193,457

[1] Included with "Undistributed" to avoid disclosure of individual company operations.

TABLE 53.—Disposal of surplus coke-oven gas in the United States in 1951, by States, in thousands of cubic feet

State	Used by producers—						Sold					
	Under boilers			In steel or allied plant			Distributed through city mains			For industrial purposes		
	Quantity	Value		Quantity	Value		Quantity	Value		Quantity	Value	
		Total	Average		Total	Average		Total	Average		Total	Average
Alabama	9,482,223	$1,113,628	$0.117	28,486,213	$3,531,504	$0.124	6,002,980	(1)	(1)	1,666,526	(1)	(1)
California	73,131	(1)	(1)	9,709,997	(1)	(1)						
Colorado				8,439,357	(1)	(1)						
Illinois	5,153,226	581,297	.113	7,741,839	(1)	(1)	20,448,476	$3,476,409	$0.170	55,072	(1)	(1)
Indiana	3,801,144	(1)	(1)	52,367,570	10,537,096	.201	7,962,975	3,920,599	.492	10,307,913	(1)	(1)
Maryland				30,015,968	(1)	(1)						
Massachusetts	723	(1)	(1)				13,360,199	(1)	(1)			
Michigan	1,592,602	(1)	(1)	30,541,244	4,421,042	.145				2,200,601	(1)	(1)
Minnesota	1,037,180	67,082	.065	3,320,879	(1)	(1)	2,353,426	(1)	(1)	1,064,651	(1)	(1)
New Jersey				376	(1)	(1)	16,106,007	(1)	(1)			
New York	1,681,281	198,679	.118	20,668,443	(1)	(1)	36,998,551	14,745,372	.399	455,429	(1)	(1)
Ohio	5,537,397	994,977	.180	71,485,971	13,264,512	.186	2,304,366	665,844	.289	9,626,980	$1,362,858	$0.142
Pennsylvania	4,873,665	722,569	.148	114,395,051	(1)	(1)	21,044,536	8,523,068	.405	8,793,768	(1)	(1)
Tennessee	381,162	(1)	(1)							1,301,891	(1)	(1)
Texas	3,777,586	(1)	(1)	1,679,891	(1)	(1)				71,019	(1)	(1)
Utah	23,945	(1)	(1)	13,663,719	(1)	(1)				384,325	(1)	(1)
West Virginia	2,664,149	312,889	.117	36,136,367	(1)	(1)				646,924	(1)	(1)
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	2,052,438	266,728	.130				11,036,260	5,057,207	.458	8,373,073	1,048,093	.125
Undistributed		1,097,765	.114		42,070,797	.171		15,462,009	.409		4,858,275	.180
Total 1951	42,131,852	5,355,614	.127	428,652,885	73,824,951	.172	137,617,776	51,850,508	.377	44,948,172	7,269,226	.162
At merchant plants	9,331,332	929,113	.100	7,032,098	1,567,057	.223	98,284,962	41,356,625	.421	19,984,487	3,245,591	.162
At furnace plants	32,800,520	4,426,501	.135	421,620,787	72,257,894	.171	39,332,814	10,493,883	.267	24,963,685	4,023,635	.161
Total 1950	35,856,065	4,440,208	.124	378,271,394	65,091,633	.172	149,429,729	56,504,724	.378	39,258,789	6,211,091	.158

[1] Included with "Undistributed" to avoid disclosure of individual company operations.

TABLE 54.—Coke-oven gas and other kinds of gas used in heating ovens in 1951, by States, in thousands of cubic feet [1]

State	Coke-oven gas	Producer gas	Blue water gas	Blast-furnace gas	Other gases [2]	Total coke-oven gas equivalent
Alabama	40,989,672				261,795	41,251,467
California	44,601			4,002,280		4,046,881
Colorado	8,405,376					8,405,376
Illinois	17,923,211			4,762,213	3,282,303	25,967,727
Indiana	44,041,143	413,948	190,308	1,793,991	760,981	47,200,371
Maryland	12,055,645			4,746,102		16,801,747
Massachusetts	2,994,933	3,845,392				6,840,325
Michigan	6,219,845			10,297,078		16,516,923
Minnesota	5,914,302	172,167	1,851		18,986	6,107,306
New Jersey	7,350,168	2,114,487			471,530	9,936,185
New York	25,719,172	8,477,193	1,136,923	210,712	2,599,630	38,143,630
Ohio	67,102,974			2,985,167		70,088,141
Pennsylvania	104,585,001	2,325,163		4,481,838	358,769	111,750,771
Tennessee	1,274,335					1,274,335
Texas	4,440,292					4,440,292
Utah	6,022,518			2,761,986		8,784,504
West Virginia	16,639,150			6,056,724	2,567,744	25,263,618
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	9,074,810	3,882,608			22,377	12,979,795
Total	380,797,148	21,230,958	1,329,082	42,098,091	10,344,115	455,799,394
At merchant plants	50,322,750	20,307,720	1,327,231		10,009,221	81,966,922
At furnace plants	330,474,398	923,238	1,851	42,098,091	334,894	373,832,472

[1] Adjusted to an equivalent of 550 B. t. u. per cubic foot.
[2] Butane, liquefied petroleum, natural, oil, propane, and spillage gases.

CRUDE COAL TAR AND DERIVATIVES

Crude coal tar is recovered at all oven-coke plants, and production is therefore geared to oven operations. Output in 1951 increased 7 percent over the 1950 figure and was the highest ever attained in the United States. The yield of tar varies widely from plant to plant, depending on the kind of coal used, the temperature at which the ovens are operated, the degree of tar recovery, and other factors. In 1951 the average tar yield per ton of coal carbonized for individual plants ranged from 5.19 gallons to 10.88 and for the entire industry averaged 7.78 gallons, a slight decline from 1950. Coal tar has been used principally as a raw material in manufacturing numerous organic chemicals and as a fuel. Tar processing was begun as a separate industry in the United States at the very beginning of the oven-coke industry. The early tar-refining plants were operated independently of the coke ovens, although many were established near the ovens to be close to the source of supply. In the late 1920's, several coke-plant operators initiated the practice of processing part of their tar production. The practice expanded in the ensuing years as more plants installed tar-processing equipment. At some plants coal tar is only partly refined, or "topped." The topping operation is done

primarily to strip from the crude tar the low-boiling fraction (distillation range, usually under 300° C.), which is rich in tar acids, bases, and naphthalene. The distillate or crude chemical oil is sold to tar refiners for further processing. The residual tar or soft pitch is generally used by the producers as fuel. Of the 252.3 million gallons of crude tar processed in 1951 by coke-plant operators (32 percent of the total output), 59 percent was topped. The remainder was distilled at a higher temperature range to produce creosote oil. Crude tar sold to refiners totaled 424.1 million gallons—equivalent to 53 percent of the 1951 production and 5 percent more than the quantity so disposed of in 1950. Coke-oven tar represented approximately 95 percent of the total tar distilled or processed in the United States in 1951; the remainder consisted of low-temperature coal tar, retort-coal tar, and water- and oil-gas tar.

The use of crude tar as a fuel has declined in recent years, but considerable quantities are still burned. In 1951, 123.1 million gallons, or 15 percent of the production, was used for this purpose. Iron and steel companies operating coke ovens either burn or sell their crude tar, depending upon the economics involved. Merchant-coke plants, however, do not burn tar and, unless tar-processing facilities are available, must market their entire output.

The principal commercial tar products produced by coke-oven operators are creosote oil and crude chemical oil (tar-acid oil). Production of creosote oil, used mainly for wood preservation, increased 14 percent over 1950 and brought in 40 percent of the total revenue obtained from the sale of tar derivatives. Crude chemical oil contains naphthalene and tar acids and bases and usually is sold to tar refiners for further processing into phenol, cresols, xylenols, pyridine, naphthalene, and other pure products. Crude chemical oil production increased 41 percent over 1950 and represented 38 percent of the total value of tar derivatives sold. In processing tar, however, more pitch was derived than any other product; as most of the tar processing plants were at coke plants integrated with steel works, the pitch was usually burned, thus explaining the small volume of sales reported in table 49.

TABLE 55.—Coke-oven tar produced, used by producers, and sold in the United States in 1951, by States, in gallons

State	Produced		Used by producers—				Sold					On hand Dec. 31
									Total			
	Total	Per ton of coal coked	For refining or topping	As fuel under boilers	In open hearth or allied plants	Otherwise	For use as fuel [1]	For refining into tar products	Quantity	Value		
										Total	Average	
Alabama	66,429,015	7.59	1,347,213	672,023	23,303,636	179,647		40,382,033	40,382,033	$3,801,684	$0.094	2,291,258
California	9,141,161	9.89	9,238,968									233,245
Colorado	13,855,357	9.54	12,874,736		960,229	15,350		44,482	44,482	(2)	(2)	472,654
Illinois	34,534,267	6.62	12,869,100	414,953		1,052,700		29,535,689	29,535,689	2,999,255	.102	2,058,394
Indiana	74,218,027	6.02	12,315,317		3,409,383	126,091		57,812,399	57,812,399	5,980,445	.103	4,476,751
Maryland	31,027,571	7.85			20,453,521			10,403,164	10,403,164	(2)	(2)	2,083,599
Massachusetts	11,839,783	7.58						11,789,975	11,789,975	(2)	(2)	198,823
Michigan	26,725,458	6.68				1,500		26,492,196	26,492,196	2,540,360	.096	1,495,054
Minnesota	9,014,502	6.73			4,140,322			4,851,007	4,851,007	(2)	(2)	748,023
New Jersey	17,208,469	8.10						17,107,449	17,107,449	(2)	(2)	660,400
New York	63,424,348	7.83	18,865,580			5,850	182,360	44,183,931	44,366,291	4,500,834	.101	2,431,223
Ohio	116,072,763	7.32	3,698,439	634,393	15,689,496	223,009	4,756,159	88,498,302	93,254,461	9,536,891	.102	4,298,681
Pennsylvania	222,081,780	8.84	162,359,109	83,335	26,672,350	436,765	100,547	32,065,537	32,166,084	3,273,206	.102	6,730,230
Tennessee	2,356,975	7.32						2,343,936	2,343,936	(2)	(2)	50,252
Texas	6,658,815	6.39				120		6,715,277	6,715,277	(2)	(2)	340,766
Utah	20,678,955	10.69			12,102,126	125		9,336,674	9,336,674	(2)	(2)	670,142
West Virginia	49,160,591	9.16	18,723,580				9,585,172	21,726,138	31,311,310	3,202,422	.102	643,189
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	20,883,446	7.27				26,972		20,820,917	20,820,917	1,968,566	.095	858,832
Undistributed										5,742,492	.092	
Total 1951	795,311,283	7.78	252,292,042	1,804,704	106,631,063	2,068,129	14,624,238	424,109,106	438,733,344	43,546,155	.099	30,741,516
At merchant plants	140,232,136	7.65	1,347,213			32,822		138,834,832	138,834,832	13,025,798	.094	4,534,339
At furnace plants	655,079,147	7.80	250,944,829	1,804,704	106,631,063	2,035,307	14,624,238	285,274,274	299,898,512	30,520,357	.102	26,207,177
Total 1950	739,868,767	7.79	203,320,038	2,612,833	95,280,053	2,842,043	31,317,586	403,928,257	435,245,843	37,558,999	.086	30,138,144

[1] Comprises 14,400,548 gallons sold to affiliated companies and 223,690 gallons sold to other purchasers.
[2] Included with "Undistributed" to avoid disclosure of individual company operations.

CRUDE LIGHT OIL AND DERIVATIVES

Crude light oil is the base from which benzol, toluol, xylol, etc., are made. The tremendous increase in the past decade in requirements of benzol for processing into styrene, phenol, aniline, nylon, etc., has emphasized the importance of this oil to our chemical industry. Crude light oil, when distilled fractionally, yields, roughly, 65 percent benzol. The yield of light oil varies from plant to plant, ranging from 1 to 4½ gallons per ton of coal carbonized, depending on the quality and kind of coal charged, the design and condition of the ovens, operating temperatures, and the type of scrubbing equipment. The average yield for the industry increased to 2.82 gallons in 1951, compared with 2.81 gallons in 1950.

Crude light oil is refined principally at coke-oven plants. In 1951, 270.5 million gallons (95 percent of the total output) was refined by the producers, and only 17.7 million gallons was sold for refining elsewhere. From the light oil refined, 234.3 million gallons (87 percent of the volume entering stills) was recovered in the form of salable products. The yields of products obtained from refining operations are given in table 57.

In the early days of the industry, the usual practice was to include as light oil all materials distilling up to 200° C. However, in modern benzol-refining plants, a secondary fraction is separated between 150° and 200°. This secondary fraction, known as "intermediate light oil," contains about 50 percent of polymerizable material, coumarone, indene, and dicyclopentadiene. The remainder is mainly polyalkylbenzenes and naphthalene. The intermediate light oil is generally sold by the coke-plant operators for the recovery of coumarone-indene resins, solvents, shingle-stain oils, etc. Production of intermediate light oil in 1951 amounted to 845,270 gallons, a slight decline from the 1950 figure.

Benzol production from coke-oven operations reached an alltime peak in 1951, when 178.0 million gallons of all grades was recovered. Specification or chemical grades (1°, 2°, and 90 percent) amounted to 172.8 million gallons and motor grade, 5.1 million gallons; however, the latter classification is somewhat misleading because only a small quantity of benzol was actually used as automotive fuel in 1951, the greater part of this grade being sold for further processing into the purer or chemical grades. Requirements for chemical grades of benzol exceeded the supply from domestic raw materials, and 68,539,583 gallons of crude and motor grade was imported for refining into the chemical grades. Production of benzol from petroleum also increased substantially and amounted to 12 percent of the total United States production of the chemical grades from all sources. The price of coke-oven benzol, which was limited by ceiling prices established by the Office of Price Stabilization, averaged $0.34 per gallon for 1951.

Toluol is another light-oil derivative having many important applications in the chemical field. It is used extensively as a solvent, particularly in the manufacture of synthetic plastics, and also for synthesizing a number of chemicals, such as benzoic acid. In wartime toluol is important in manufacturing explosives and for enriching aviation gasoline. Unlike benzol, which in the past has been made almost entirely from coal, the production of toluol from petroleum was begun on a large scale during World War II. In 1951 coke-oven operators produced 34 percent of the United States total of toluol.

Xylol is also an aromatic material being made from petroleum in increasing quantities. Coke-plant operators produced only 11 percent of the national total in 1951. Prices on all toluol, xylol, and other light oil derivatives were under price ceilings.

TABLE 56.—Coke-oven crude light oil produced in the United States and derived products obtained and sold in 1951, by States, in gallons

State	Active plants[1]	Produced		Refined on premises[2]	Derived products			On hand Dec. 31
		Total	Per ton of coal coked		Produced	Sold[3]		
						Quantity	Value	
Alabama	7	22,801,254	2.60	22,405,637	19,683,613	19,095,876	$5,967,470	335,798
California	1	3,040,203	3.29	3,037,365	2,566,379	2,333,441	(4)	18,404
Colorado	1	4,586,859	3.16	4,534,717	4,013,146	3,922,010	(4)	43,381
Illinois	7	13,210,119	2.58	9,169,957	7,760,638	7,790,532	2,504,232	310,243
Indiana	5	29,540,988	2.40	30,376,909	27,169,464	26,214,633	8,340,655	396,604
Maryland	1	13,111,116	3.32	15,685,240	13,681,765	13,796,082	(4)	192,444
Michigan	4	9,896,944	2.47	5,496,984	4,842,027	4,389,989	1,487,354	287,279
New York	8	22,694,004	2.80	31,164,743	27,626,181	27,792,746	9,517,062	293,291
Ohio	15	46,390,960	2.93	41,828,640	33,525,523	33,264,755	10,871,509	533,923
Pennsylvania	13	76,529,392	3.05	74,493,486	66,248,025	65,854,154	20,478,096	1,287,810
Tennessee	1	834,376	2.59	995,151	900,712	401,878	(4)	3,910
Texas	2	2,662,057	2.56	2,663,937	2,379,451	2,348,553	(4)	6,439
Utah	2	7,571,293	3.91	7,563,580	5,989,785	5,992,421	(4)	86,716
West Virginia	5	17,036,657	3.17	15,121,388	12,969,876	11,756,212	3,962,220	63,362
Connecticut, Kentucky, Massachusetts, Minnesota, Missouri, New Jersey, and Wisconsin	8	14,590,711	2.25	6,003,338	4,951,865	4,896,049	1,722,979	411,040
Undistributed							9,445,015	
Total 1951	80	284,496,933	2.82	270,541,072	234,308,450	229,849,331	74,296,592	4,270,644
At merchant plants	26	40,640,656	2.27	31,149,229	27,546,862	25,733,954	8,487,784	1,097,105
At furnace plants	54	243,856,277	2.94	239,391,843	206,761,588	204,115,377	65,808,808	3,173,539
Total 1950	80	260,856,875	2.81	244,872,337	213,746,380	206,828,342	50,945,690	4,866,091

[1] Number of plants that recovered crude light oil.
[2] Comprises 266,843,081 gallons of crude light oil from own production and 3,697,991 gallons purchased from other coke plants.
[3] Excludes 17,667,570 gallons of crude light oil valued at $3,728,340 sold as such.
[4] Included with "Undistributed" to avoid disclosure of individual company operations.

TABLE 57.—Trend in yields of products obtained from refining crude light oil at oven-coke plants in the United States, 1937 and 1941–51, in percent

Year	Benzol		Toluol, crude and refined	Xylol, crude and refined	Solvent naphtha	Other light-oil products
	Motor	All other grades				
1937	52.5	11.9	11.5	2.5	3.1	4.5
1941	47.2	16.8	13.0	3.4	2.3	3.6
1942	26.8	35.3	13.4	3.9	2.2	3.8
1943	8.6	53.9	13.1	3.6	2.1	3.6
1944	7.1	56.6	12.9	3.3	2.1	3.5
1945	12.3	53.9	11.5	3.2	2.0	3.3
1946	13.8	55.3	8.3	3.0	2.2	3.8
1947	6.5	60.1	10.9	3.0	2.3	3.5
1948	3.7	61.7	11.7	3.0	2.4	3.3
1949	9.5	55.6	12.5	3.3	2.3	3.2
1950	3.2	63.1	12.5	3.3	2.5	2.8
1951	1.9	63.9	12.7	3.4	2.2	2.6

TABLE 58.—Production of benzol and toluol, by grades, at oven-coke plants in the United States, 1941–51, in gallons

Year	Benzol				Toluol		
	Motor	Nitration or 1° C.	Pure commercial or 2° C.	All other	Nitration or 1° C.	Pure commercial or 2° C.	All other
1941	106,372,000	15,414,500	18,286,400	4,182,600	14,689,800	13,268,500	1,378,900
1942	64,797,600	25,624,400	53,617,900	6,014,700	25,160,200	5,044,800	2,109,600
1943	21,267,900	35,047,800	93,246,600	4,144,800	27,152,300	2,394,700	2,725,600
1944	18,556,600	41,285,800	102,436,500	3,187,600	29,771,100	2,149,600	1,607,500
1945	28,788,100	39,166,500	86,237,300	1,266,700	23,355,400	2,219,700	1,494,200
1946	27,398,900	35,739,300	71,681,700	2,308,000	12,518,000	2,796,400	1,205,400
1947	15,802,700	42,475,300	100,111,800	2,470,800	20,514,100	4,989,500	892,800
1948	9,014,300	43,541,200	103,356,300	3,101,400	22,899,700	5,280,800	267,800
1949	20,923,700	28,988,700	91,717,300	2,035,600	20,808,300	6,317,200	545,100
1950	7,727,300	41,324,900	110,114,300	3,027,200	22,108,600	7,785,800	770,400
1951	5,103,700	45,057,500	123,315,700	4,476,100	24,772,500	8,689,700	839,300

NAPHTHALENE

Crude naphthalene has become one of the most important basic raw materials of the aromatic-chemical industry because of the large number of essential products made from it. Its principal derivative is phthalic anhydride, used in the production of smokeless powder, alkyd paint resins, dyestuffs, insecticides, etc. Naphthalene is recovered at coke plants from the refining of crude light oil or tar and to a smaller extent from the final coolers. The commercial grades of crude naphthalene are defined in terms of melting points. Crude grades ranging from 74° to 79° are suitable for some industrial uses without further refining. Crude below 74° C. has virtually no direct commercial use and is sold by the coke-plant operators to tar refiners

for upgrading or refining. It is estimated that about 60 percent of the total amount of naphthalene recovered at coke plants in 1951 was less than 74° C. The production of all crude grades (below 79° C.) in 1951 totaled 125.6 million pounds, an increase of 26 percent over the 1950 output. Production of naphthalene at coke plants was expected to increase substantially upon completion of new facilities for its recovery from coke-oven tar being constructed at some operations.

TABLE 59.—Crude naphthalene produced and sold by coke-plant operators in the United States, 1937 and 1947–51

Year	Produced (pounds)	Sold			
		Pounds	Value		
			Total	Average per pound	Average per ton of oven coke
1937	60,797,108	60,315,581	$1,182,992	$0.020	$0.024
1947	98,654,485	95,315,607	3,128,389	.033	.047
1948	103,431,811	100,442,631	4,619,374	.046	.068
1949	70,823,436	56,643,829	2,654,815	.047	.044
1950	99,729,587	102,657,724	4,425,894	.043	.066
1951	125,579,578	130,200,785	6,849,831	.053	.095

COKE-OVEN AMMONIA

Ammonia is recovered at coke plants, either in water solution (ammonia liquor) or as a crystallized ammonium sulfate. In 1951, of the 84 active oven-coke plants, 80 recovered ammonia, 65 ammonium sulfate, and 17 ammonia liquor (2 plants produced sulfate and liquor). Usually 85 to 90 percent of the ammonia recovered from the ovens is converted into a sulfate, which is used almost exclusively for agricultural purposes. However, the merchant-coke plants recover a larger proportion of the ammonia in the form of liquor, and this group of plants produced 63 percent of the total liquor output in 1951. Ammonia liquor produced by coke-plant operators is employed for chemical and agricultural purposes. Although data are not available on the quantity of ammonia liquor used for each purpose, it is estimated that over half has been used industrially in the manufacture of soda ash, ammonium chloride, and sulfuric acid. Until recent years, coke ovens furnished the bulk of the ammonium sulfate consumed in the United States. However, a few producers have constructed large synthetic ammonia plants to produce ammonium sulfate; as a result, about half of the 1951 United States production of ammonium sulfate was made from synthetic ammonia.

TABLE 60.—Coke-oven ammonia produced and sold in the United States in 1951, by States, in pounds

State	Active plants[1]	Produced				Sold as—				On hand Dec. 31	
		Sulfate equivalent	Per ton of coal coked	As sulfate	As liquor (NH_3 content)	Sulfate		Liquor (NH_3 content)		Sulfate	Liquor (NH_3 content)
						Quantity	Value	Quantity	Value		
Alabama	7	201, 153, 376	22. 97	192, 925, 732	2, 056, 911	200, 626, 728	$4, 136, 003	2, 023, 150	(2)	1, 077, 839	46, 773
California	1	24, 353, 452	26. 34	24, 353, 452		24, 326, 820	(2)			273, 034	
Colorado	1	31, 453, 440	21. 66	31, 453, 440		31, 613, 465	(2)			5, 679, 535	
Illinois	6	84, 108, 757	18. 51	84, 108, 757		87, 193, 080	1, 610, 939			2, 472, 608	
Indiana	5	202, 010, 625	16. 40	176, 329, 421	6, 420, 301	185, 725, 452	3, 449, 030	5, 935, 196	$221, 361	12, 237, 157	452, 352
Maryland	1	80, 415, 625	20. 33	80, 415, 625		78, 848, 639	(2)			4, 136, 160	
Massachusetts	1	27, 683, 060	17. 73	27, 683, 060		28, 495, 280	(2)			276, 660	
Michigan	4	75, 121, 896	18. 77	24, 750, 280	12, 592, 904	24, 740, 681	(2)	10, 613, 295	(2)	291, 769	419, 674
Minnesota	3	23, 461, 213	17. 52	23, 461, 213		23, 033, 028	428, 059			1, 714, 806	
New Jersey	2	40, 476, 095	19. 05	40, 476, 095		39, 461, 000	(2)			3, 137, 495	
New York	8	157, 369, 369	19. 44	131, 860, 445	6, 377, 231	127, 761, 880	2, 365, 902	6, 071, 885	(2)	9, 917, 585	100, 803
Ohio	15	305, 812, 471	19. 28	250, 282, 763	13, 882, 427	253, 670, 810	4, 520, 233	12, 371, 053	473, 191	11, 670, 716	410, 781
Pennsylvania	13	520, 971, 742	20. 73	518, 240, 422	682, 830	525, 607, 701	9, 303, 536	648, 648	(2)	23, 996, 900	64, 842
Tennessee	1	6, 998, 120	21. 73	6, 998, 120		7, 024, 800	(2)			162, 574	
Texas	2	22, 241, 204	21. 35	22, 241, 204		22, 935, 301	(2)			211, 922	
Utah	2	44, 223, 264	22. 86	44, 223, 264		42, 486, 588	(2)			3, 136, 750	
West Virginia	4	98, 952, 873	20. 61	98, 952, 873		101, 201, 565	1, 786, 671			1, 911, 577	
Connecticut, Kentucky, Missouri, and Wisconsin	4	48, 740, 417	19. 31	17, 769, 285	7, 742, 783	18, 746, 700	390, 405	7, 632, 427	300, 257	384, 000	249, 153
Undistributed							6, 250, 081		796, 437		
Total 1951	80	1, 995, 546, 999	19. 82	1, 796, 525, 451	49, 755, 387	1, 823, 499, 518	34, 240, 859	45, 295, 654	1, 791, 246	82, 689, 087	1, 744, 378
At merchant plants	25	348, 454, 124	20. 11	222, 153, 544	31, 575, 145	225, 359, 920	4, 430, 375	34, 161, 103	1, 352, 875	9, 112, 477	1, 129, 983
At furnace plants	55	1, 647, 092, 875	19. 76	1, 574, 371, 907	18, 180, 242	1, 598, 139, 598	29, 810, 484	11, 134, 551	438, 371	73, 576, 610	614, 395
Total 1950	79	1, 849, 127, 582	19. 89	1, 662, 032, 906	46, 773, 669	1, 682, 331, 655	29, 755, 089	43, 162, 889	1, 567, 499	115, 377, 093	1, 273, 501

[1] Number of plants that recovered ammonia.
[2] Included with "Undistributed" to avoid disclosure of individual company operations.

COKE OVENS OWNED BY CITY GAS COMPANIES (PUBLIC UTILITIES)

Table 61 compares the operation of coke plants owned by gas utilities with those not so owned and is presented by the Bureau of Mines for the information of those interested in the coking activities of public utility plants. The development of slot-type coke ovens in the United States during the early part of the twentieth century and the adaptability of such ovens to the manufacture of city gas induced a number of utilities to install slot-type coke ovens to supplement or even replace coal-gas retorts. The number of coke plants operated by city gas companies reached a peak in 1934, when 23 such plants were active. In that year, gas utility plants produced 11 percent of the total United States oven-coke output, 12 percent of the coke-oven gas and tar, 9 percent of the coke-oven ammonia, and 4 percent of the crude light oil. However, development of long-distance pipelines has brought natural gas into many areas formerly served by coke-oven gas. This has resulted in the sale or retirement of some plants by the utilities. In 1951, the Niagara Mohawk Power Corp. permanently closed its plant at Utica, N. Y., and sold its Troy, N. Y., plant to the Republic Steel Corp. This action reduced the number of plants operated by gas utilities at the end of the year to nine. Several other companies were planning to substitute natural gas for coke-oven gas in 1952 and would close their coke plants unless they could be disposed of to other interests.

Economical operation of a coke plant requires a properly balanced market under favorable conditions for all products, since production of any one is almost invariably accompanied by production of all the others. Therefore, loss of a market for coke-oven gas makes it difficult for a city gas plant to operate profitably. Revenue from sales of surplus gas from these plants constituted 26 percent of the total revenue obtained from all products. City gas plants in 1951 contributed 5 percent of the total production of oven coke, gas, and tar; 3 percent of the crude light oil; and 4 percent of the ammonia.

TABLE 61.—Production of coke, breeze, and coal-chemical materials in the United States at oven-coke plants owned by city gas companies (public utilities)[1] compared with all other oven-coke plants, 1950–51

Product	1950			1951		
	Plants not owned by city gas companies	Plants owned by city gas companies (public utilities)	Total	Plants not owned by city gas companies	Plants owned by city gas companies (public utilities)	Total
Number of active plants	73	12	85	75	9	84
Coke:						
Production net tons	63,071,875	3,818,743	66,890,618	68,313,148	3,674,024	71,987,172
Value	$840,692,718	$58,974,609	$899,667,327	$955,730,967	$61,334,584	$1,017,065,551
Average per ton	$13.33	$15.44	$13.45	$13.99	$16.69	$14.13
Breeze:						
Production net tons	4,815,363	357,395	5,172,758	4,805,349	320,485	5,125,834
Sales do	1,388,594	18,447	1,407,041	1,227,822	9,966	1,237,788
Value of sales	$5,445,665	$68,744	$5,514,409	$5,754,176	$46,024	$5,800,200
Average per ton	$3.92	$3.73	$3.92	$4.69	$4.62	$4.69
Coal charged into ovens:						
Bituminous net tons	89,316,805	5,440,230	94,757,035	96,852,479	5,177,802	102,030,281
Anthracite do	137,797	31,478	169,275	217,714	19,422	237,136
Total do	89,454,602	5,471,708	94,926,310	97,070,193	5,197,224	102,267,417
Value	$767,420,831	$55,165,485	$822,586,316	$860,976,525	$53,166,177	$914,142,702
Average per ton	$8.58	$10.08	$8.67	$8.87	$10.23	$8.94

For footnote, see end of table.

TABLE 61.—Production of coke, breeze, and coal-chemical materials n the United States at oven-coke plants owned by city gas companies (public utilities)[1] compared with all other oven-coke plants, 1950–51—Continued

Product	1950			1951		
	Plants not owned by city gas companies	Plants owned by city gas companies (public utilities)	Total	Plants not owned by city gas companies	Plants owned by city gas companies (public utilities)	Total
Coke—						
Used by producers:						
Net tons	41,888,637	1,522,349	43,410,986	45,763,077	871,270	46,634,347
Value	$541,587,521	$20,110,494	$561,698,015	$608,298,343	$11,836,679	$620,135,022
Sold:						
Net tons	21,645,617	2,454,902	24,100,519	22,239,814	2,722,202	24,962,016
Value	$306,065,821	$41,096,836	$347,162,657	$343,178,010	$48,128,733	$391,306,743
Coal-chemical materials:						
Tar:						
Production gallons	694,028,547	45,840,220	739,868,767	751,712,284	43,598,999	795,311,283
Sales do	389,468,646	45,777,197	435,245,843	395,114,544	43,618,800	438,733,344
Value of sales	$33,895,971	$3,663,028	$37,558,999	$39,177,897	$4,368,258	$43,546,155
Ammonia:						
Production (NH_3 equivalent of all forms) pounds	438,832,283	23,449,612	462,281,895	476,751,230	22,135,520	498,886,750
Liquor (NH_3 content):						
Production pounds	44,734,763	2,038,906	46,773,669	47,895,032	1,860,355	49,755,387
Sales do	41,603,060	1,559,829	43,162,889	43,825,653	1,470,001	45,295,654
Value of sales	$1,516,954	$50,545	$1,567,499	$1,743,003	$48,243	$1,791,246
Sulfate:						
Production pounds	1,576,390,082	85,642,824	1,662,032,906	1,715,424,792	81,100,659	1,796,525,451
Sales do	1,598,907,955	83,423,700	1,682,331,655	1,739,872,378	83,627,140	1,823,499,518
Value of sales	$28,185,891	$1,569,198	$29,755,089	$32,643,149	$1,597,710	$34,240,859
Gas:						
Production M cubic feet	919,264,582	60,328,406	979,592,988	995,178,072	57,102,531	1,052,280,603
Disposal of surplus:						
Used under boilers, etc.						
M cubic feet	35,152,385	703,680	35,856,065	42,122,902	8,950	42,131,852
Value	$4,327,619	$112,589	$4,440,208	$5,352,732	$2,882	$5,355,614
Average per M cubic feet	$0.123	$0.160	$0.124	$0.127	$0.322	$0.127
Used in steel or allied plants:						
M cubic feet	378,268,133	3,261	378,271,394	428,650,905	1,980	428,652,885
Value	$65,089,728	$1,905	$65,091,633	$73,823,716	$1,235	$73,824,951
Average per M cubic feet	$0.172	$0.584	$0.172	$0.172	$0.624	$0.172
Distributed through city mains:						
M cubic feet	96,912,152	52,517,577	149,429,729	87,564,497	50,053,279	137,617,776
Value	$33,334,247	$23,170,477	$56,504,724	$32,892,440	$18,958,068	$51,850,508
Average per M cubic feet	$0.344	$0.441	$0.378	$0.376	$0.379	$0.377
Sold for industrial use:						
M cubic feet	37,421,513	1,837,276	39,258,789	43,092,408	1,855,764	44,948,172
Value	$5,382,212	$828,879	$6,211,091	$6,458,278	$810,948	$7,269,226
Average per M cubic feet	$0.144	$0.451	$0.158	$0.150	$0.437	$0.162
Crude light oil:						
Production gallons	252,042,937	8,813,938	260,856,875	277,374,026	7,122,907	284,496,933
Sales do	15,010,140	4,652,999	19,663,139	12,976,931	4,690,639	17,667,570
Value of sales	$2,352,159	$521,614	$2,873,773	$2,877,774	$850,566	$3,728,340
Light oil derivatives:						
Production gallons	209,795,642	3,950,738	213,746,380	231,809,205	2,499,245	234,308,450
Sales do	203,054,314	3,774,028	206,828,342	227,293,164	2,556,167	229,849,331
Value of sales	$50,178,099	$767,591	$50,945,690	$73,555,727	$740,865	$74,296,592
Naphthalene, crude:						
Production pounds	98,971,548	758,039	99,729,587	130,109,895	1,007,047	131,116,942
Sales do	101,899,685	758,039	102,657,724	129,193,738	1,007,047	130,200,785
Value of sales	$4,398,406	$27,488	$4,425,894	$6,809,039	$40,792	$6,849,831
All other coal-chemical materials, value	$14,852,695	$142,855	$14,995,550	$21,027,225	$167,410	$21,194,635

[1] Coke ovens built by city gas companies, some of which are operated in conjunction with coal- and water-gas plants. Does not include independent oven-coke plants that may sell gas to public-utility companies for distribution.

Copper

By Helena M. Meyer and Gertrude N. Greenspoon

GENERAL SUMMARY

EFFORTS of both Government and industry in 1951 were directed toward meeting the expanded United States demand for copper that resulted chiefly from the accelerated defense program; in the absence of success in this endeavor, the Government extended inventory, use, and other controls, inaugurated in late 1950. Provision had to be made also for further expansion in consumption in 1952, when the defense program was expected to attain still higher levels.

Despite all efforts to increase supplies, the copper made available for use in 1951 fell slightly below the total for 1950. Domestic mine output and smelter and refinery production from domestic crude primary materials were 2 to 3 percent above 1950 and the largest since 1944. Output of copper as refined copper and in alloys from old scrap, however, declined 6 percent from 1950. The 29-percent drop in receipts of copper from abroad, in the form of both refined and unrefined copper, to the lowest level since 1947 was the principal reason that supplies in 1951 were smaller than in 1950. A further cause was the low level of producers' stocks of refined metal on January 1, when they were smaller than at any time since 1906 and not only were too low for operating efficiency to be drawn upon further, but needed replenishment to a more practicable working tonnage. A 35-percent increase was made in such stocks in 1951, but otherwise they remained the smallest since 1906.

Mine output rose slightly in 1951 despite labor strikes. Production came within 20,000 to 25,000 tons of what may be considered the maximum practicable tonnage under the conditions of available labor and capacity prevailing in that year. The almost month-long strike at the American Smelting & Refining Co. smelter at Garfield, Utah, in July interrupted the smelting of concentrates from the Utah Copper mine, Bingham, Utah, the largest copper producer in the United States, but in the end may have merely delayed this copper in reaching its market. The widespread strike of mine, mill, and smelter workers (beginning in late August and ending about a week later when an 80-day Taft-Hartley national emergency injunction was invoked) adversely affected operations in all major copper-producing States. Smelter and refinery losses due to strikes were even greater, although some of the loss was made up, and some stored crude materials may have contributed to slightly higher smelter and refinery outputs early in 1952 than would otherwise have been possible.

The crisis caused by the loss in mine and plant production led to unprecedented release of 25,000 tons of copper from the United States National Stockpile in August and a subsequent authorization, October 1, for release of an additional 30,000 tons. The stockpile was to be reimbursed in metal for these withdrawals.

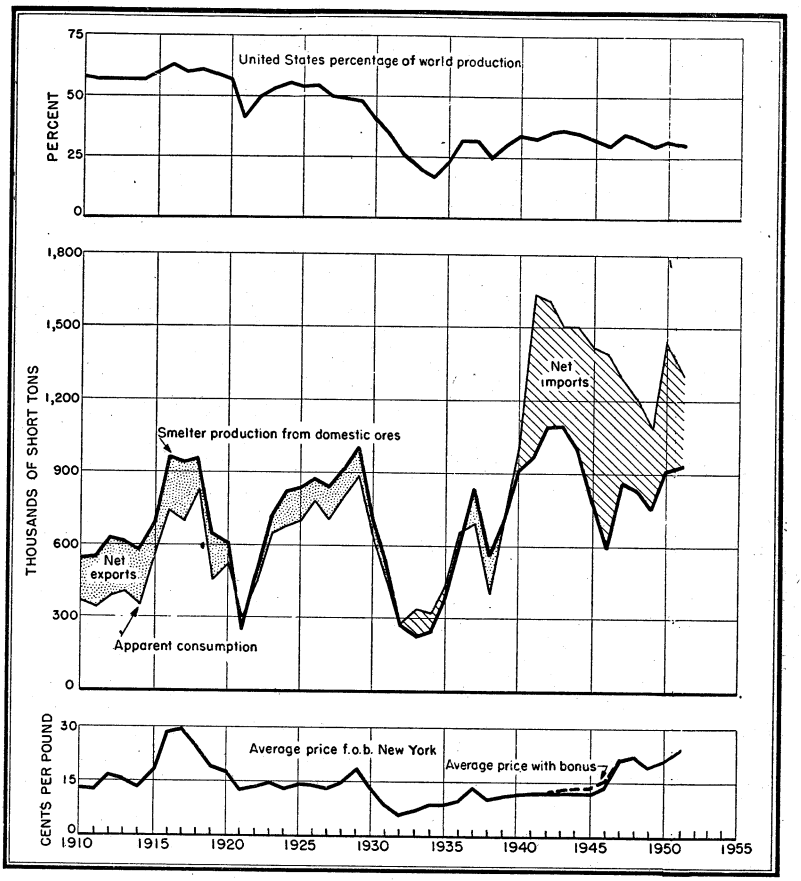

FIGURE 1.—Production, consumption, and price of copper in the United States, 1910–51.

Continuation of Government efforts to assure adequate supplies of copper and other materials for military requirements and to prevent—insofar as possible—dislocation of the industrial economy, was made possible by extension of the Defense Production Act. Under this act the Defense Minerals Administration in the Interior Department and its successor, the Defense Materials Procurement Agency, continued efforts to expand output. Copper production, however, does not lend itself to rapid expansion. To solve the immediate problem of filling expanding military and continuing large industrial requirements with static or reduced supplies, the National Production Authority reinstituted the Controlled Materials Plan, used effectively in World War II, for copper, steel, and aluminum, the three materials covered by that major war device of the earlier period. On July 13 the NPA announced that copper raw materials would be placed under complete allocation control, effective August 1.

Copper was one of the commodities for which ceiling prices were established by the General Ceiling Price Regulation, effective January

26. This order set maximum prices at not to exceed the highest prices received by individual producers between December 19, 1950, and January 25, 1951, inclusive. Primary producers in general had been selling electrolytic copper, delivered Connecticut Valley, at 24½ cents a pound; as a consequence, that figure became their ceiling price. There were, however, companies whose ceiling prices substantially exceeded the 24½-cent figure. The quantities to which higher ceilings applied were relatively small.

The Office of Price Stabilization announced that, effective July 25, the ceiling price for copper refined in the United States from imported crude materials was 27½ cents a pound delivered Connecticut Valley. The increased cost of foreign copper was not to be passed on to customers by the fabricators.

Trading in copper, lead, and zinc on the Commodity Exchange was terminated July 27.

The average quoted price for copper in 1951 was reported as 24½ cents a pound for electrolytic copper, delivered Connecticut Valley, and was higher than in any year since 1918. It would appear logical to assume that this price would encourage domestic production, despite increased costs since 1918. The high level of excess profits taxes in recent years, however, would tend to have the opposite effect. Response of copper production to price stimulation, in addition, is always slow because of the large capital expenditures required to bring new capacity into operation. Moreover, production would not increase, but decrease, if higher prices made lower grade material economic and unless excess mill capacity were available at properties mining such lower grade ores. If the quoted copper price is adjusted according to variations in the Bureau of Labor Statistics wholesale price index, however, the 1951 price is found to be below prices in 1947, 1940, 1939, 1937, and in most years from 1922–30, inclusive.

Rising costs threatened some loss of output from high-cost mines. In December the DMPA moved to prevent such losses by offering to negotiate over-the-ceiling contracts with high-cost mines then in actual production. Nine properties were involved in such negotiations at the end of the year.

Inability to increase imports in 1951, or even to maintain them at 1950 levels, was a major disappointment to defense officials trying to stretch supplies to meet expanding needs. Total imports, including scrap, for the year fell 29 percent, the unrefined classes—ores, matte, and blister—dropping 27 percent and the refined class 25 percent; scrap receipts fell 86 percent. All of the chief suppliers in 1950 sent smaller quantities to the United States in 1951: Canada dropped 34 percent, Mexico 24 percent, Chile 8 percent, and Peru 65 percent. Receipts of unrefined copper from Northern Rhodesia were halved, and the unusual imports of refined copper from Japan in 1950 were virtually discontinued in 1951.

Exports of refined copper in 1951 were substantially less than the relatively low rates of recent years.

An agreement between the United States and Chilean Governments in May 1951 provided for payment of an additional 3 cents a pound over the ceiling for Chilean copper sold in the United States. The agreement called for expansion in Chile's production and for Chile's discontinuance of abnormal trade in semiprocessed copper, by restrict-

ing to not more than 20 percent the withholding by Chile of production of American companies operating in Chile and providing for a Chilean embargo on exportation of copper to countries of the Soviet bloc.

The 2-cent copper excise tax was suspended from April 1, 1951, to February 15, 1953, or to termination of the national emergency, whichever is first, by a law signed by the President in May.

Partly because of expanded defense mobilization, world demand in 1951 was at a sharply accelerated rate, and world prices soared. Trustworthy information on prices for copper sold outside the United States, however, is not available. Press statements have called attention to fantastically high prices prevailing in foreign countries. It is known that such prices were paid, but there are no data to show what quantities were involved. There is little doubt, however, that the United States, because of ceiling price restrictions, contrasted with uncontrolled markets on the European Continent, was at a disadvantage in seeking foreign copper. This condition offset in part the longtime advantage resulting from the desire of foreign countries to obtain United States dollars.

TABLE 1.—Salient statistics of the copper industry in the United States, 1942–46 (average) and 1947–51, in short tons

	1942–46 (average)	1947	1948	1949	1950	1951
New (primary) copper produced—						
From domestic ores, as reported by—						
Mines	905,012	847,563	834,813	752,750	909,343	928,330
Ore produced:						
Copper ore [1]	84,234,867	87,864,898	84,729,043	76,032,531	94,585,792	95,494,214
Average yield of copper, percent	1.00	.90	.92	.91	.89	.90
Smelters	913,338	862,872	842,477	757,931	911,352	930,774
Percent of world total	34	34	32	29	31	30
Refineries	894,978	909,213	860,022	695,015	920,748	951,559
From foreign ores, matte, etc., refinery reports	305,477	250,757	247,424	232,912	319,086	255,429
Total new refined, domestic and foreign	1,200,455	1,159,970	1,107,446	927,927	1,239,834	1,206,988
Secondary copper recovered from old scrap only	442,980	503,376	505,464	383,548	485,211	458,124
Imports (unmanufactured) [2]	703,155	413,890	507,449	552,709	[3] 690,389	489,376
Refined	396,466	149,478	249,124	275,811	[3] 317,363	238,547
Exports of metallic copper [4]	194,513	196,999	207,022	195,990	192,339	166,274
Refined (ingots and bars)	95,366	147,642	142,598	137,827	144,561	133,305
Stocks at end of year (producers)	366,400	273,000	250,000	322,000	258,000	217,000
Refined copper	91,900	60,000	67,000	61,000	26,000	35,000
Blister and materials in solution	274,500	213,000	183,000	261,000	232,000	182,000
Withdrawals (apparent) from total supply on domestic account:						
Total new copper	1,484,000	1,286,000	1,214,000	1,072,000	1,447,000	1,303,000
Total new and old copper (old scrap only)	1,927,000	1,789,000	1,719,000	1,456,000	1,932,000	1,761,000
Price average [5]—cents per pound	12.3	20.9	21.7	19.7	20.8	[6] 24.2
World smelter production, new copper	2,688,000	2,513,000	2,623,000	2,640,000	[3] 2,960,000	3,142,000

[1] Includes old tailings smelted or re-treated. Not comparable with mine production figure shown in that latter includes recoverable copper content of ores not classified as "copper."

[2] Data are "general" imports; that is, they include copper imported for immediate consumption plus material entering country under bond. Comprises copper in ingots, plates, and bars, ores and concentrates, regulus, blister, and scrap.

[3] Revised figure.

[4] Total exports of copper, exclusive of ore, concentrates, composition metal, and unrefined copper. Exclusive also of "Other manufactures of copper," for which quantity figures are not recorded. (See table 26.)

[5] Exclusive of bonus payments of the Office of Metals Reserve under Premium Price Plan, which covered the period February 1, 1942, to June 30, 1947, inclusive.

[6] Exclusive of copper produced abroad and delivered in the United States.

The price for electrolytic copper in the United Kingdom was increased in April to the equivalent of 26.25 cents a pound, then in May to the equivalent of 29.25 cents, but subsequently dropped in September to 28.37½ cents where it held for the remainder of the year.

The world shortage of copper in 1951 led to placing copper under international allocation (Free World countries). Quotas were established by the International Materials Conference for the fourth quarter of 1951. The member countries voluntarily accepted restrictions upon quantities to be consumed, but no attempt was made to regulate prices or to interfere otherwise with distribution or with competition for preferred sources of supply. Chile insisted on the right to withhold from international agreement the copper retained by that Government under agreement with the United States State Department, already mentioned. Member countries agreed not to dispose of copper to countries in the Soviet bloc.

Expansion of Production Under the Defense Production Act.—A number of properties were certified in 1951 for Government assistance, under provisions of the Defense Production Act, for expansion of copper output at mines now operating or idle or for maintenance of production that might be lost without such aid. The properties were to receive Government loans, Government purchase contracts, or tax-amortization benefits, or combinations of the three types of assistance. The most important projects are outlined in the following paragraphs. Not yet approved but in an advanced stage of negotiation was the San Manuel project, Arizona.

The Government loan ($7,500,000) obtained by the Copper Cities Mining Co., Arizona, a subsidiary of the Miami Copper Co., was mentioned in the Copper chapter of Minerals Yearbook, 1950. A purchase agreement was obtained by the company under which the company may call on the Government to purchase, at 23 cents a pound (subject to escalation), a maximum of 85,000 tons out of the first 96,250 tons produced if it is unable to dispose of the tonnage at the same or higher prices. Production from the mine was scheduled to begin in the latter part of 1954. This would allow about 1 year to move the Castle Dome plant and mining equipment and reerect it at the new location at Copper Cities following conclusion of the Castle Dome operation.

On November 15 a loan of $57,185,000 was authorized to the White Pine Copper Co., Michigan, a new, wholly owned subsidiary of the Copper Range Co., by the Reconstruction Finance Corporation. The Defense Production Administration certified for accelerated amortization this project and certified a copper program which included provision for a contract with the Government for production by the company of an estimated 275,000 short tons of refined copper.

The Anaconda Copper Mining Co. entered into a contract with the Government under which the oxide ore body of the Yerington mine, Lyon County, Nev., was to be brought into production. The Government was to buy at not less than 25.5 cents a pound any copper that the company could not sell to industrial users at that minimum, up to a maximum of 128,000 tons during the first 6 years of operation. The ore body was said to contain approximately 35 million tons of oxide ore having a grade of 0.97 percent copper, which could be mined by open-pit methods; under it lies at least 15 million tons of sulfide ore of similar grade. Open-pit mining was expected to start in late 1953

at a rate of 30,000 tons a year, which was to be increased to an annual rate of 33,000 tons by 1955. The company acquired the Leviathan sulfur mine in Alpine County, Calif., as a source of the sulfuric acid required for leaching the oxide ores. Preparatory expenditures at Yerington and Leviathan were expected to approximate $38 million. The company was to finance this expenditure but was granted Certificates of Necessity permitting accelerated amortization for income-tax purposes of 75 percent of the amortizable portion of these expenditures over a 5-year period.

The American Smelting & Refining Co. entered into an agreement with the Government under which the company was to finance an estimated expenditure of $17 million to bring the Silver Bell unit, 40 miles northwest of Tucson, Ariz., into production. A Certificate of Necessity was also obtained. The ore reserves were estimated at 32 million tons assaying approximately 0.9 percent copper, in 2 separate ore bodies, which could be mined by open-pit methods. The Government was to purchase 88,500 tons of the first 98,500 tons produced at 24½ cents a pound, subject to adjustments for operating costs, provided this quantity could not be sold at that price or more in the open market. The Government was to be obligated for 5½ years from commencement of operations. Stripping of the ore body was begun in December 1951, and estimated production was to be at the rate of 18,130 tons annually. The property was expected to be in operation early in 1954, barring unforeseen delays.

The Government entered into a contract with the Phelps Dodge Corp. for copper from the Bisbee East ore body (Lavender pit), Arizona, mentioned in the Copper chapter of Minerals Yearbook, 1950. The corporation was to bear the entire cost of developing and equipping the property and of installing the necessary plant, such cost estimated at about $25 million. The corporation was given the right, under the contract, to call on the Government to purchase up to 112,500 short tons of copper out of the first 150,000 tons at 22 cents a pound, with an escalation clause, and the Government could purchase any part of the 150,000 tons at the floor price or the market price, whichever was higher. A Certificate of Necessity was also obtained. Barring unforeseen equipment and manpower problems, production should begin by the end of 1954. Estimates were that 38,000 tons a year would be produced annually for 11 or 12 years.

The Kennecott Copper Corp. undertook to prepare for production an undeveloped ore body near the corporation's existing open-pit operation at Ruth, Nev., known as the "Deep Ruth." It was to be an underground mine and was expected by the company to yield only a small margin of profit, based on 1951 price-cost relationship. The corporation received a Certificate of Necessity, permitting the chargeoff, over a 5-year period, of the portion of the cost allowed by the Bureau of Internal Revenue. No Government loan or purchase contract was requested. The ore averages 0.83 percent copper.

The corporation had explored and was preparing for development another, smaller ore body, known as the "Veteran," which lies 1½ miles from the Ruth open pit. The ore in this deposit averages 0.9 percent copper and could be mined by open-pit methods.

Bureau of Mines Reports.—The following Bureau of Mines reports of investigations, published recently, relate to copper in whole or in part.

4828. Investigation of Kasna Creek Copper Prospect, Lake Kontrashibuna, Lake Clark Region, Alaska.
4850. Copper Giant Deposits, Pima County, Ariz.
4860. Diamond Drilling at Torpedo Copper Mine, Organ Mining District, Dona Ana County, N. Mex.

The following Bureau of Mines information circulars likewise discussed copper.

7602. Mines and Mineral Deposits (Except Fuels), Judith Basin County, Mont.
7612. Safety in Hoisting at the United Verde Mine, Phelps Dodge Corp., Jerome, Ariz.
7623. Safety in Milling: Magma Copper Co., Superior, Ariz.
7626. Two-Way Radio Communication at Santa Rita Open Pit, Kennecott Copper Corp., Santa Rita, N. Mex.

DOMESTIC PRODUCTION

Statistics on copper production may be compiled upon a mine, smelter, or refinery basis. Mine data are most accurate for showing the geographic distribution of production; smelter figures are better than mine figures for showing the actual recovery of metal and more accurate than refinery figures for showing the source of production; and refinery statistics are best for showing recovery of metal but indicate only in a general way the source of crude materials treated. Mineral Resources of the United States, 1930, part I (pp. 701–702), discusses differences among the three sets of figures.

TABLE 2.—Copper produced from domestic ores, as reported by mines, smelters, and refineries, 1947–51, in short tons

Year	Mine [1]	Smelter	Refinery
1947	847,563	862,872	909,213
1948	834,813	842,477	860,022
1949	752,750	757,931	695,015
1950	909,343	911,352	920,748
1951	928,330	930,774	951,559

[1] Includes Alaska.

PRIMARY COPPER

Mine Production.—The figures for mine production are tabulated from reports supplied by all domestic mines that produce copper. These data are classified geographically, by metallurgical method, and by type of ore. Tables presenting the information in detail are to be found in the State chapters of this volume.

As usual, Arizona led all other States by a wide margin in production in 1951, supplying 45 percent of the total for the United States, followed by Utah, with 29 percent. Arizona's output comes from a number of important copper-producing districts and mines, whereas Utah's is predominantly from one mine, the largest copper producer in the United States. Production from New Mexico, Montana, Nevada, and Michigan, ranking next in importance as copper producers in 1951, made up 23 percent of the total. These 6 States produced 97 percent of the United States total.

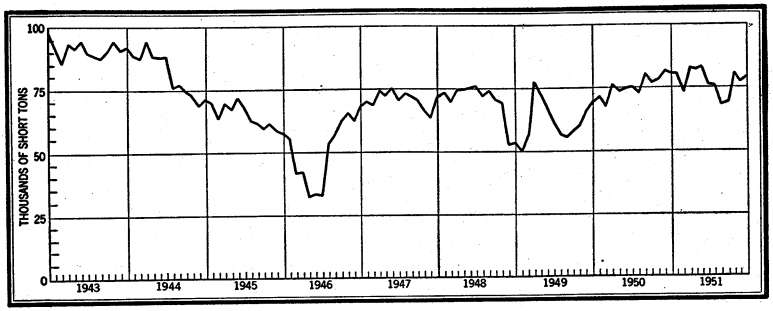

FIGURE 2.—Mine production of recoverable copper in the United States, 1943–51, by months, in short tons.

TABLE 3.—Mine production of recoverable copper in the United States in 1951, by months [1]

Month	Short tons	Month	Short tons
January	80,459	August	67,979
February	73,123	September	69,024
March	83,233	October	81,077
April	82,473	November	76,917
May	83,778	December	78,939
June	75,891		
July	75,437	Total	928,330

[1] Includes Alaska. Monthly figures adjusted to final annual mine production total.

TABLE 4.—Mine production of copper in the principal districts [1] of the United States, 1942–46 (average) and 1947–51, in terms of recoverable copper, in short tons

District or region	State	1942–46 (average)	1947	1948	1949	1950	1951
West Mountain (Bingham)	Utah	248,880	264,315	225,225	196,101	277,655	270,183
Copper Mountain (Morenci)	Arizona	89,564	147,899	148,316	141,934	154,689	143,921
Globe-Miami	do	91,457	91,032	88,478	80,189	84,688	90,225
Central (including Santa Rita)	New Mexico	[2] 62,575	57,071	[2] 72,784	[2] 53,276	63,694	71,526
Ajo	Arizona	53,230	49,687	55,615	58,350	64,400	63,093
Summit Valley (Butte)	Montana	107,427	57,187	57,712	55,945	53,897	56,826
Robinson (Ely)	Nevada	57,751	47,524	44,491	37,533	52,087	56,198
Mineral Creek (Ray)	Arizona	30,255	18,935	18,753	18,595	36,442	50,580
Warren (Bisbee)	do	30,784	17,059	19,204	9,840	13,345	27,271
Lake Superior	Michigan	37,386	24,184	27,777	19,506	25,608	24,979
Pioneer (Superior)	Arizona	14,570	15,922	18,720	21,616	22,636	17,662
Verde (Jerome)	do	28,135	14,603	14,544	17,215	13,291	9,742
Eureka (Bagdad)	do	3,806	6,491	7,247	7,906	10,673	9,087
Chelan Lake	Washington	6,318	2,214	5,654	[3] 5,249	[3] 4,904	3,932
San Juan Mountains	Colorado	791	1,430	1,865	1,974	2,582	2,712
Southeastern Missouri	Missouri	2,240	1,760	2,370	3,670	2,982	2,422
Coeur d' Alene	Idaho	1,619	1,312	1,388	1,171	1,896	1,874
Lordsburg	New Mexico	2,111	1,770	1,708	1,934	2,061	1,521
Cochise	Arizona	361	1,036	968	689	498	1,350
Burro Mountain	New Mexico	(2)	1,140	(2)	(2)		(4)
Cope	Nevada	(5)	1,105	14	[6] 13	2	
Lebanon (Cornwall mine) [7]	Pennsylvania	(5)	(5)	(5)	(5)	(5)	(5)
Ducktown [7]	Tennessee	(5)	(5)	(5)	(5)	(5)	(5)
Orange County [7]	Vermont	(5)	(5)	(5)	(5)	(5)	(5)

[1] Districts producing 1,000 short tons or more in any year of the period 1947–51.
[2] Burro Mountain included with Central to avoid disclosing individual company operations.
[3] Includes Peshastin Creek and Wenatchee to avoid disclosing individual company operations.
[4] Less than 0.5 ton.
[5] Figure withheld to avoid disclosing individual company operations.
[6] Includes Van Duzer to avoid disclosing individual company operations.
[7] Not listed in order of output.

TABLE 5.—Mine production of recoverable copper in the United States, 1941–51, with production of maximum year, and cumulative production from earliest record to end of 1951, by States, in short tons

State	Maximum production [1]		Production by years											Total production from earliest record to end of 1951
	Year	Quantity	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	
Western States and Alaska:														
Alaska	1916	59,927	72	22	27	2	5	2	12	16	4	6	1	685,905
Arizona	1951	415,870	326,317	393,387	403,181	358,303	287,203	289,223	366,218	375,121	359,010	403,301	415,870	13,097,612
California	1909	28,644	3,943	1,058	8,762	12,721	6,473	4,240	2,407	481	649	646	921	630,928
Colorado	1938	14,171	6,748	1,102	1,028	1,048	1,485	1,754	2,150	2,298	2,403	3,141	3,212	263,915
Idaho	1907	5,445	3,621	3,430	2,324	1,688	1,548	1,038	1,640	1,624	1,438	2,107	2,160	116,756
Montana	1916	176,464	128,036	141,194	134,525	118,190	88,506	58,481	57,900	58,252	56,611	54,478	57,406	6,863,000
Nevada	1942	83,663	78,911	83,663	71,068	61,232	52,595	48,616	49,603	45,242	38,058	52,569	56,474	2,024,614
New Mexico	1942	80,100	73,478	80,100	76,163	69,730	56,571	50,191	60,205	74,687	55,388	66,300	73,558	1,680,337
Oregon	1916	1,791	83	103	6	3	1	7	14	2	20	19	11	12,409
South Dakota	1918	32		1		1								106
Texas	1928	224	6	99	81	115	55	3	6	23	24	2	1	1,365
Utah	1943	323,989	266,838	306,691	323,989	282,575	226,376	114,284	266,533	227,007	197,245	278,630	271,086	6,140,942
Washington	1940	9,612	8,686	8,030	7,315	6,169	5,821	4,527	2,240	5,665	5,275	5,057	4,089	101,252
Wyoming	1900	2,102	4					1						16,326
Total			896,743	1,018,880	1,028,469	911,777	726,639	572,367	808,928	790,418	716,125	866,256	884,789	31,635,467
West Central States: Missouri	1949	3,670	1,400	1,300	1,340	3,302	3,399	1,857	1,760	2,370	3,670	2,982	2,422	[2] 32,882
States east of the Mississippi:														
Alabama	1907	42												[3]
Georgia	1917	465												[3]
Maine	1918	383												[3]
Maryland	1917	146												[3]
Massachusetts	1906	5												[3]
Michigan	1916	136,846	46,440	45,679	46,764	42,421	30,401	21,663	24,184	27,777	19,506	25,608	24,979	4,941,544
New Hampshire	1908	[4] 94												[3]
North Carolina	1930	[5]	[6]	[6]	[6]	[6]								[3]
Pennsylvania	1942	[5]	[6]	[6]	[6]	[6]	[6]	[6]	[6]	[6]	[6]	[6]	[6]	[3]
South Carolina	[3]	[3]	[7]	[7]	[7]									[3]
Tennessee	1930	[5]	[6] 13,566	[6] 14,174	[6] 13,855	[6] 12,860	[6] 12,385	[6] 12,850	[6] 12,686	[6] 14,248	[6] 13,449	[6] 14,497	[6] 16,140	[3]
Vermont	1946	[5]			290	1,898	[6]	[6]	[6]	[6]	[6]	[6]	[6]	[3]
Virginia	1944	291		28	100	291	70		5					[3]
Wisconsin	1914	5												[2]
Total			60,006	59,881	61,009	57,470	42,856	34,513	36,875	42,025	32,955	40,105	41,119	[8] 5,581,713
Grand total	1943	1,090,818	958,149	1,080,061	1,090,818	972,549	772,894	608,737	847,563	834,813	752,750	909,343	928,330	[9] 37,250,062

[1] For Missouri and States east of the Mississippi, maximum since 1905.
[2] Small quantity for Wisconsin included with Missouri.
[3] Data not available.
[4] The 1908 volume of Mineral Resources credits this figure to Massachusetts and New Hampshire; the 1909 volume credits it to New Hampshire alone.
[5] Figure withheld to avoid disclosing individual company operations.
[6] Tennessee includes other States indicated by footnote 6 to avoid disclosing individual company operations.
[7] Less than 0.5 ton.
[8] For States other than Michigan, figures represent largely smelter output. Excludes small quantity not separable, for Wisconsin shown with Missouri.
[9] Largely smelter production for States east of the Mississippi except Michigan.

TABLE 6.—Twenty-five leading copper-producing mines in the United States in 1951, in order of output

Rank	Mine	District	State	Operator	Source of copper
1	Utah Copper	West Mountain (Bingham)	Utah	Kennecott Copper Corp	Copper ore.
2	Morenci	Copper Mountain (Morenci)	Arizona	Phelps Dodge Corp	Do.
3	Chino	Central	New Mexico	Kennecott Copper Corp	Do.
4	New Cornelia	Ajo	Arizona	Phelps Dodge Corp	Do.
5	Butte Mines	Summit Valley (Butte)	Montana	Anaconda Copper Mining Co	Copper, zinc-lead ores.
6	Ray	Mineral Creek (Ray)	Arizona	Kennecott Copper Corp	Copper ore.
7	Inspiration	Globe-Miami	do	Inspiration Consolidated Copper Co	Do.
8	Ruth Pit	Robinson (Ely)	Nevada	Kennecott Copper Corp	Do.
9	Copper Queen	Warren (Bisbee)	Arizona	Phelps Dodge Corp	Copper, zinc-lead ores.
10	Miami	Globe-Miami	do	Miami Copper Co	Copper ore.
11	Castle Dome	do	do	Castle Dome Copper Co., Inc	Do.
12	Calumet & Hecla Consolidated	Lake Superior	Michigan	Calumet & Hecla Consolidated Copper Co	Copper ore and tailings.
13	Magma	Pioneer (Superior)	Arizona	Magma Copper Co	Copper, zinc-copper ores.
14	Morris Brooks Pit	Robinson (Ely)	Nevada	Consolidated Coppermines Corp	Do.
15	United Verde	Verde (Jerome)	Arizona	Phelps Dodge Corp	Do.
16	Bagdad	Eureka (Bagdad)	do	Bagdad Copper Corp	Copper ore.
17	Ruth Pit Extension	Robinson (Ely)	Nevada	Consolidated Coppermines Corp	Do.
18	Burra Burra, Calloway, Mary, Eureka, Boyd	Polk County	Tennessee	Tennessee Copper Co	Copper-bearing pyrites.
19	Cornwall	Lebanon County	Pennsylvania	Bethlehem Steel Co	Magnetite-pyrite-chalcopyrite ore.
20	Holden	Chelan Lake	Washington	Howe Sound Co	Zinc-copper ore.
21	Elizabeth	Orange County	Vermont	Vermont Copper Co., Inc	Copper ore.
22	Quincy	Lake Superior	Michigan	Quincy Mining Co	Copper-ore tailings.
23	Treasury Tunnel-Black Bear	Upper San Miguel	Colorado	Idarado Mining Co	Zinc-lead-copper ores.
24	Bonney-Miser's Chest	Lordsburg	New Mexico	Banner Mining Co	Copper ore.
25	United States & Lark	West Mountain (Bingham)	Utah	U. S. Smelting, Refining & Mining Co	Gold-silver, lead, silver, zinc-lead ores.

Classification of production by mining method showed that approximately 74 percent of the recoverable copper and 84 percent of the copper ore came from open pits in 1951. Most of the domestic copper ore was treated by flotation at or very near the mine of origin, and the resulting concentrates were shipped for smelting. Some copper ores were leached, and some were direct smelted either because of their high grade or because of their fluxing qualities.

The first 5 mines in table 6 produced 65 percent of the United States total, the first 10 produced 84 percent, and the entire 25 furnished 98 percent.

Quantity and Estimated Recoverable Content of Copper-Bearing Ores.—Tables 7 through 10 list the quantity and estimated recoverable copper content of the ore produced by copper mines in the United States in 1951. Of the total copper produced from copper ores in the United States during 1951 (1950 data in parentheses), 93 (94) percent was obtained from ores concentrated before smelting, 3 (2) percent from direct-smelting ores, and 4 (4) percent from ore treated by straight leaching.

Close agreement between the output as reported by smelters and the recoverable quantity as reported by mines indicates that estimated recoverable tenor is close to actual recovery. Classification of some of the complex western ores is difficult and more or less arbitrary. "Copper ores" include not only all those that contain 2.5 percent or more recoverable copper but also those that contain less than this percentage if they are valuable chiefly for copper, notably the "porphyry ores." Mines report considerable copper from ores mined primarily for other products. These include siliceous gold and silver ores, lead and zinc ores, and pyritic ores.

TABLE 7.—Copper ore, old tailings, etc., sold or treated in the United States in 1951, with copper, gold, and silver content in terms of recoverable metal [1]

State	Ore, old tailings, etc., sold or treated (short tons)	Recoverable metal content				Value of gold and silver per ton of ore
		Copper		Gold (fine ounces)	Silver (fine ounces)	
		Pounds	Percent			
Arizona	42,791,111	775,699,816	0.91	83,525	3,088,738	$0.13
California	1,709	176,000	5.15	519	5,176	13.37
Colorado	659	46,105	3.50	28	9,592	14.66
Idaho	29,942	361,584	.60	149	80,372	2.60
Michigan	4,471,334	49,958,000	.56			
Montana	1,169,143	95,757,052	4.10	2,904	1,553,708	1.29
Nevada	6,630,269	111,993,100	.84	59,863	168,242	.34
New Mexico	8,002,937	107,803,237	.67	2,324	113,509	.02
Oregon	87	8,700	5.00	2	32	1.14
Utah	30,454,456	527,443,279	.87	391,400	3,181,269	.54
Washington [2]	567,594	8,128,800	.72	21,314	81,677	1.44
East of the Mississippi (except Michigan)	1,374,973	[3] 32,280,000		2,443	79,835	
Total	[2] 95,494,214	[3] 1,709,655,673	.90	564,471	8,362,150	.29

[1] Excludes copper recovered from precipitates as follows: Arizona, 34,172,315 pounds; California, 97,300 pounds; Montana, 9,836,739 pounds; Nevada, 482,600 pounds; New Mexico, 37,765,686 pounds; and Utah, 10,981,202 pounds.

[2] Includes ore from Washington classed as zinc-copper ore and copper, gold, and silver recovered therefrom.

[3] Copper from magnetite-pyrite-chalcopyrite ore included with that from copper ore.

TABLE 8.—Copper ore, old tailings, etc., concentrated in the United States in 1951, with content in terms of recoverable copper

State	Ore, old tailings, etc., concentrated (short tons)	Recoverable copper content	
		Pounds	Percent
Arizona	[1] 38,545,214	[2] 662,877,431	0.86
Idaho	29,850	340,208	.57
Michigan	4,471,334	49,958,000	.56
Montana	1,124,434	94,062,169	4.18
Nevada	6,561,621	110,429,800	.84
New Mexico	7,894,475	105,222,560	.67
Utah	30,451,792	527,232,800	.87
Washington [3]	567,550	8,125,765	.72
East of the Mississippi (except Michigan)	1,374,973	[4] 32,280,000	
Total	91,021,243	[4] 1,590,528,733	.87

[1] In addition 3,696,413 tons was treated by straight leaching.
[2] In addition 62,774,397 pounds of copper was recovered by straight leaching.
[3] Mostly zinc-copper ore.
[4] Includes copper from magnetite-pyrite-chalcopyrite ore.

TABLE 9.—Copper ore, old tailings, etc., shipped to smelters in the United States in 1951, with content in terms of recoverable copper

State	Ore, old tailings, etc., shipped to smelters		
	Short tons	Recoverable copper content	
		Pounds	Percent
Arizona	549,484	50,047,988	4.55
California	1,709	176,000	5.15
Colorado	659	46,105	3.50
Idaho	92	21,376	11.62
Montana	44,709	1,694,883	1.90
Nevada	68,648	1,563,300	1.14
New Mexico	108,462	2,580,677	1.19
Oregon	87	8,700	5.00
Utah	2,664	210,479	3.95
Washington	44	3,035	3.45
Total	776,558	56,352,543	3.63

TABLE 10.—Copper ores [1] produced in the United States, 1942–46 (average) and 1947–51, and average yield in copper, gold, and silver

Year	Smelting ores		Concentrating ores		Total				
	Short tons	Yield in copper (percent)	Short tons [2]	Yield in copper (percent)	Short tons [2 3]	Yield in copper (percent)	Yield per ton in gold (ounce)	Yield per ton in silver (ounce)	Value per ton in gold and silver
1942–46 (average)	1,538,265	3.72	79,396,788	0.95	84,234,867	1.00	0.0053	0.132	$0.28
1947	910,018	3.66	83,283,080	.87	87,864,898	.90	.0058	.095	.29
1948	877,748	3.78	80,098,098	.89	84,729,043	.92	.0058	.094	.29
1949	645,520	3.46	72,019,010	.89	76,032,531	.91	.0057	.093	.28
1950	624,261	3.37	90,206,169	.88	94,585,792	.89	.0062	.089	.30
1951	776,558	3.63	91,021,243	.87	95,494,214	.90	.0059	.088	.29

[1] Includes old tailings, smelted or retreated, etc.
[2] Includes ore from Washington classed as zinc-copper ore.
[3] Includes copper ore leached.

Smelter Production.—The recovery of copper by smelters in the United States from ores of domestic origin totaled 930,774 short tons in 1951, a 2-percent increase from the 911,352 tons for 1950. Output of United States smelters from domestic ores constituted 30 percent of the world production for 1951 compared with 31 percent in 1950. (*See also* fig. 1.)

The figures for smelter production shown in table 11 are based upon returns from all primary smelters handling copper-bearing materials

TABLE 11.—Copper produced (smelter output from domestic ores) in the United States, 1942–46 (average) and 1947–51, and total, 1845–1951

Year	Short tons	Value [1] (thousands of dollars)
1942–46 (average)	913,338	221,784
1947	862,872	360,680
1948	842,477	365,635
1949	757,931	298,625
1950	911,352	379,122
1951	930,774	450,495
Total 1845–1951	37,336,647	11,443,491

[1] Excludes bonus payments of Office of Metals Reserve under Premium Price Plan in effect Feb. 1, 1942, to June 30, 1947.

produced in the United States. Blister copper is accounted for in terms of fine-copper content. Some casting and electrolytic copper produced direct from ore or matte is included in the smelter production, as well as in the refinery output. For Michigan, furnace-refined copper is included. Metallic and cement copper recovered by leaching is included in smelter production.

The quantity and value of copper produced from domestic ores by smelters in the United States are shown by years for 1845–1930 in Mineral Resources of the United States, 1930, part I (p. 703).

TABLE 12.—Primary and secondary copper produced by primary refineries in the United States, 1942–46 (average) and 1947–51, in short tons

	1942–46 (average)	1947	1948	1949	1950	1951
Primary:						
From domestic ores, etc.: [1]						
Electrolytic	776,854	805,718	745,102	606,826	821,803	835,419
Lake	36,910	23,998	26,511	17,608	29,555	25,309
Casting	81,214	79,497	88,409	70,581	69,390	90,831
Total	894,978	909,213	860,022	695,015	920,748	951,559
From foreign ores, etc.: [1]						
Electrolytic	297,343	250,757	247,424	232,912	319,086	255,429
Casting and best select	8,134	----------	----------	----------	----------	----------
Total refinery production of new copper	1,200,455	1,159,970	1,107,446	927,927	1,239,834	1,206,988
Secondary:						
Electrolytic [2]	91,480	249,560	222,602	196,850	173,063	127,347
Casting	7,768	19,525	22,774	15,542	16,683	7,676
Total secondary	99,248	269,085	245,376	212,392	189,746	135,023
Grand total	1,299,703	1,429,055	1,352,822	1,140,319	1,429,580	1,342,011

[1] The separation of refined copper into metal of domestic and foreign origin is only approximate, as an accurate separation at this stage of manufacture is not possible.
[2] Includes copper reported from foreign scrap.

Refinery Production.—The refinery output of primary copper in the United States in 1951 was made by the same 13 plants that supplied the 1950 production (*see* Copper chapter of Minerals Yearbook 1950, pp. 478, 479). The electrolytic plants produced at 78 percent of capacity in 1951 compared with 84 percent in 1950.

Tables 12 and 13 show the production of refined copper at primary refining plants, classified according to source of copper, grade, and form in which cast.

TABLE 13.—Copper cast in forms at primary refineries in the United States, 1949–51

Form	1949		1950		1951	
	Thousands of short tons	Percent	Thousands of short tons	Percent	Thousands of short tons	Percent
Wire bars	665	59	799	56	774	58
Cathodes	128	11	189	13	146	11
Ingots and ingot bars	117	10	111	8	142	11
Billets	108	10	172	12	141	10
Cakes	106	9	130	9	119	9
Other forms	16	1	29	2	20	1
Total	1,140	100	1,430	100	1,342	100

In addition to the primary refineries, many plants throughout the country operate on scrap exclusively, producing metallic copper and a variety of alloys. The output of these plants is not included in the statements of refined-copper production in tables 12 and 13 but is included in table 15 on secondary-copper production.

Copper Sulfate.—Production and shipments of copper sulfate in 1951 were greater than in 1950. Shipments were less than production in 1951, and stocks at the end of the year were more than double those at the end of 1950. Of the total shipments of 104,260 tons, producers' reports indicated that 43,960 tons was for agriculture, 27 008 tons for industrial, and 33,292 tons for other uses.

TABLE 14.—Production, shipments and stocks of copper sulfate in 1947–51, in short tons

Year	Production		Shipments (gross weight)	Stocks at end of year [1] (gross weight)
	Gross weight	Copper content		
1947	89,100	22,276	86,600	10,200
1948	96,700	24,186	93,100	11,800
1949	79,000	19,749	84,400	6,400
1950	87,300	21,814	91,300	2,200
1951	106,944	26,736	104,260	4,888

[1] Some small quantities are purchased and used by producing companies, so that the figures given do not balance exactly.

A booklet published recently contained considerable data on uses of copper sulfate.[1]

[1] British Sulphate of Copper Association, Ltd., Uses of Copper Sulphate: London, E. C. I., 30 pp.

SECONDARY COPPER

Copper recovered from copper scrap, copper-alloy scrap, and other copper-bearing scrap materials, as metal, as copper alloys without separation of the copper, or as copper compounds, is known as secondary copper. Quantities are reported in terms of copper content.

Secondary copper is produced from new and from old scrap. "New scrap" is defined as refuse produced during the manufacture of copper articles and includes defective finished or semifinished articles that must be reworked. Typical examples of new scrap are defective castings, clippings, punchings, turnings, borings, skimmings, drosses, and slag. "Old scrap" consists of metal articles that have been discarded after having been used. Such articles may be worn out, obsolete, or damaged. Typical examples are discarded trolley wire, fired cartridge cases, used pipe, and lithographers' plates.

Table 15 summarizes the production of secondary copper during 1942–51. Refined copper produced from scrap at primary refineries is included in the "unalloyed" class. Detailed information appears in the Secondary Metals—Nonferrous chapter of this volume.

TABLE 15.—Secondary copper produced in the United States, 1942–46 (average) and 1947–51, in short tons

	1942–46 (average)	1947	1948	1949	1950	1951
Copper recovered as unalloyed copper	120,886	303,092	284,026	250,089	260,704	186,462
Copper recovered in alloys [1]	834,075	658,649	688,762	463,054	716,535	745,820
Total secondary copper	954,961	961,741	972,788	713,143	977,239	932,282
From new scrap	511,981	458,365	467,324	329,595	492,028	474,158
From old scrap	442,980	503,376	505,464	383,548	485,211	458,124
Percentage equivalent of domestic mine output	106	113	117	95	107	100

[1] Includes copper in chemicals, as follows: 1942–46 (average), 16,338; 1947, 18,838; 1948, 17,612; 1949, 14,840; 1950, 17,413; 1951, 22,905.

CONSUMPTION

Apparent consumption of primary copper, which includes copper shipped to the National Stockpile, dropped 10 percent from the peacetime peak established in 1950, although demand was greater, and chiefly because less metal was obtained from abroad. Figures on apparent consumption, as well as the derivation of these figures, are shown in table 16; data for a long period are available on this basis. In estimating apparent consumption, it has been assumed that copper used in primary fabrication of copper is consumed. Although the table aims to show primary consumption only, it should be noted that exports and stocks, as well as the import component of "total supply," include some refined secondary copper that cannot be determined separately. Actual consumption of new copper would also differ from the figures shown in the table by changes in consumers' stocks. The figures on apparent consumption in 1947 and 1948 are especially distorted by the fact that during this period unusual quantities of copper were imported as scrap and reexported in refined form. Because refined exports cannot be broken down to show new and old copper,

TABLE 16.—New refined copper withdrawn from total year's supply on domestic account, 1947–51, in short tons

	1947	1948	1949	1950	1951
Production from domestic and foreign ores, etc	1,159,970	1,107,446	927,927	1,239,834	1,206,988
Imports [1]	149,478	249,124	275,811	[2] 317,363	238,547
Stock at beginning of year [1]	96,000	60,000	67,000	61,000	26,000
Total available supply	1,405,448	1,416,570	1,270,738	[2] 1,618,197	1,471,535
Copper exported [1]	147,642	142,598	137,827	144,561	133,305
Stock at end of year [1]	60,000	67,000	61,000	26,000	35,000
Total	207,642	209,598	198,827	170,561	168,305
Apparent withdrawals on domestic account [3]	1,286,000	[4] 1,214,000	[4] 1,072,000	[4] 1,447,000	[4] 1,303,000

[1] May include some copper refined from scrap.
[2] Revised figure.
[3] Adjusted for Office of Metals Reserve stock changes; OMR stocks consigned to National Stockpile late in 1948.
[4] Includes copper delivered by industry to the National Stockpile.

these reexports were necessarily deducted from apparent consumption, even though the scrap from which they were produced was not included in available supply.

The Bureau of Mines began to compile figures on actual consumption of refined copper in 1945. Details for 1949 to 1951, inclusive, are shown in table 17. Unlike table 16, in which all but new copper is eliminated so far as possible, table 17 does not distinguish between new and old copper but covers all copper consumed in refined form.

TABLE 17.—Refined copper consumed in 1949–51, by class of consumer, in short tons

Class of consumer	Cathodes	Wire bars	Ingots and ingot bars	Cakes and slabs	Billets	Other	Total
1949:							
Wire mills	19	605,430	18,230			34	623,713
Brass mills	72,777	45,033	72,559	163,982	123,656	119	478,126
Chemical plants	19		72			1,485	1,576
Secondary smelters	3,127		1,011	250	65	10	4,463
Foundries and miscellaneous	2,595	183	14,628	80	26	4,296	21,808
Total	78,537	650,646	106,500	164,312	123,747	5,944	1,129,686
1950:							
Wire mills	25	695,817	17,453	6		53	713,354
Brass mills	130,254	67,379	104,359	212,353	160,754	1	675,100
Chemical plants	17		110			2,995	3,122
Secondary smelters	4,584	192	1,155	248		30	6,209
Foundries and miscellaneous	1,783	537	18,198	70	426	5,635	26,649
Total	136,663	763,925	141,275	212,677	161,180	8,714	1,424,434
1951:							
Wire mills	23	692,656	17,311	152		57	710,199
Brass mills	131,531	72,415	124,614	187,041	135,058	308	650,967
Chemical plants			261			2,962	3,223
Secondary smelters	6,953	375	5,985	216	4	211	13,744
Foundries and miscellaneous	5,890	368	22,570	302	764	8,838	38,732
Total	144,397	765,814	170,741	187,711	135,826	12,376	1,416,865

Consumption by wire mills was notably higher in the period 1947 to 1951, compared with 1945 and 1946. In the latest 5-year period wire mills have regularly taken over half of the total refined copper used.

STOCKS

Producers' stocks of refined and unrefined copper declined 16 percent in 1951 and were the smallest since 1915. Year-end inventories of refined copper, however, rose over the low of 1950 but except for 1950 were the smallest since 1906. Only 16 percent of the total at the end of 1951 was in the form of refined copper, the remainder being in smelter shapes at smelters and in transit to refineries, and in smelter shapes and materials in process of refining at refineries. Table 18 gives stocks of copper including smelted and refined material of foreign and scrap origin as reported by primary smelting and refining plants.

TABLE 18.—Stocks of copper at primary smelting and refining plants in the United States at end of year, 1946–51, in short tons

Year	Refined copper [1]	Blister and materials in process of refining [2]	Year	Refined copper [1]	Blister and materials in process of refining [2]
1946	96,000	254,000	1949	61,000	261,000
1947	60,000	213,000	1950	26,000	232,000
1948	67,000	183,000	1951	35,000	182,000

[1] May include some copper refined from scrap.
[2] Includes copper in transit from smelters in the United States to refineries therein.

Fabricators' stocks of refined metal (including in-process copper and primary fabricated shapes), according to the United States Copper Association, were 280,402 tons at the end of 1951 or 3 percent less than at the beginning of the year, continuing the downtrend since 1947. Working stocks (see table 19) were 295,385 tons, or 2 percent more than those at the end of 1950. After unfilled sales of metal are accounted for, the deficiencies in stocks in relation to unfilled orders rose 67,055 tons to 285,886 tons at the end of 1951. The latter figure represented the largest deficiency since the end of 1946.

TABLE 19.—Stocks of copper in fabricators' hands at end of year, 1947–51, in short tons

[U. S. Copper Association]

	Stocks of refined copper [1]	Unfilled purchases of refined copper from producers	Working stocks	Unfilled sales to customers	Excess stocks over orders booked [2]
	(1)	(2)	(3)	(4)	(5)
1947	423,432	103,765	293,859	338,260	−104,922
1948	379,346	81,496	295,958	315,944	−151,060
1949	354,992	82,798	285,298	189,407	−36,920
1950	290,241	92,372	288,392	313,052	−218,831
1951	280,402	32,147	295,385	303,050	−285,886

[1] Includes in-process metal and primary fabricated shapes. Also includes small quantities of refined copper held at refineries for fabricators' account.
[2] Column (1) plus (2) minus (3) and minus (4) equals column (5).

Figures compiled by the Copper Institute show that domestic stocks of refined copper increased from 49,040 tons at the end of 1950 to 71,528 tons at the end of 1951. Inventory data of the Bureau of Mines and the Copper Institute always differ owing to somewhat different bases. Before 1947 a primary reason was that the Copper Institute coverage was limited to duty-free copper. Inclusion by the Copper Institute of all copper after January 1, 1947, reduced the differences chiefly to variations in interpretation. In the Bureau of Mines classification, cathodes to be used chiefly for casting into shapes are considered stocks in process and not refined stocks.

PRICES

Reports to the Bureau of Mines from copper-selling agencies indicated that 998,000 tons of domestic refined copper was delivered to purchasers in 1951, at an average price (f. o. b. refinery, except for that part sold by the Kennecott Sales Corp., whose sales are on the basis of copper delivered to consumers' plants) of 24.2 cents a pound. This figure is not comparable to data for earlier years, which included deliveries of foreign copper to United States buyers. After the first part of May Chilean copper was sold for 3 cents a pound more than the domestic ceiling price (*see* Summary section of this chapter), and beginning July 25 the ceiling price for copper refined in the United States from imported crude materials was raised 3 cents. The average price for foreign copper delivered in the United States in 1951, including that sold before the agreement with Chile in May, was 26.2 cents a pound. The average for the foregoing classes together was 24.7 cents a pound, which may be compared with the price of 20.8 cents for copper delivered in 1950.

The General Ceiling Price Regulation is discussed in the opening section of this chapter. Quoted prices for domestic electrolytic copper, delivered Connecticut Valley, continued at 24.5 cents a pound throughout the year.

TABLE 20.—Average monthly quoted prices of electrolytic copper for domestic and export shipments, f. o. b. refineries, in the United States, 1950–51, in cents per pound

Month	1950			1951		
	Domestic f. o. b. refinery [1]	Domestic f. o. b. refinery [2]	Export f. o. b. refinery [2]	Domestic f. o. b. refinery [1]	Domestic f. o. b. refinery [2]	Export f. o. b. refinery [2]
January	18.37	18.200	18.420	24.37	24.200	24.425
February	18.37	18.200	18.425	24.37	24.200	24.425
March	18.37	18.200	18.425	24.37	24.200	24.425
April	18.83	18.640	18.825	24.37	24.200	24.425
May	19.80	19.609	19.876	24.37	24.200	25.471
June	22.11	21.995	22.117	24.37	24.200	27.374
July	22.37	22.200	22.425	24.37	24.200	27.425
August	22.74	22.272	22.499	24.37	24.200	27.425
September	23.37	22.900	24.299	24.37	24.200	27.425
October	24.37	24.200	24.425	24.37	24.200	27.425
November	24.37	24.200	24.425	24.37	24.200	27.425
December	24.37	24.200	24.425	24.37	24.200	27.425
Average for year	21.46	21.235	21.549	24.37	24.200	26.258

[1] American Metal Market.
[2] E&MJ Metal and Mineral Markets.

TABLE 21.—Average yearly quoted prices of electrolytic copper for domestic and export shipments, f. o. b. refineries, in the United States, 1942–51, in cents per pound

	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951
Domestic f. o. b. refinery[1]	11.87	11.87	11.87	11.87	13.92	21.15	22.20	19.36	21.46	24.37
Domestic f. o. b. refinery [2]	11.775	11.775	11.775	11.775	13.820	20.958	22.038	19.202	21.235	24.200
Export f. o. b. refinery [2]	11.684	11.700	11.700	11.700	14.791	21.624	22.348	19.421	21.549	26.258

[1] American Metal Market.
[2] E&MJ Metal and Mineral Markets.

The excise tax on copper, which was reinstituted July 1, 1950, was again suspended effective April 1, 1951. (*See* section on Foreign Trade—Tariff of this chapter.)

The quoted price for export copper, f. o. b. refinery, was approximately 0.225 cent a pound above the domestic quotation until May, when the price for Chilean copper was raised. From June the differential was 3.225 cents a pound for the remainder of the year.

Trading in copper, lead, and zinc on the Commodity Exchange was terminated July 27, as a result of certain effects of the general price-ceiling regulation and upon virtual liquidation of outstanding contracts.

London Price.—The official maximum price of the British Ministry of Supply was £202 per long ton (equivalent to 25.25 cents a pound) when the year began and was increased £8 to £210 (26.25 cents) in April and another £24 to £234 (29.25 cents), the highest sterling price on record, in May. The drop of £7 to £227 (28.375 cents) in September was announced by the British Ministry of Materials, which took over metal-purchasing functions from the Ministry of Supply in July. There were no further changes before the end of the year.

FOREIGN TRADE [2]

Imports of copper in 1951 dropped sharply from 1950 levels despite increasing United States requirements for the metal. Meanwhile exports continued subject to export control and were below the reduced rates of other recent years. Before World War II the United States generally produced more than enough copper for its own needs and had a surplus available for export. In 1920 to 1939, for example, 6,500,000 tons of copper was exported in refined shapes, whereas refined copper produced from imported crude primary materials and imports of refined copper together amounted to 5,800,000 tons. The relationship between imports and exports for 1920 to 1939 by no means gives the complete story, because much of the copper exported cannot be measured quantitatively, being in such end items as electric motors, automobiles, and equipment of various types.

For years the excess capacity of domestic smelting and refining facilities was used to treat foreign materials, largely for reexportation as refined copper, in fabricated shapes, and in end products. United States smelters and refineries continue to treat foreign crude materials, both purchased and toll copper.

[2] Figures on imports and exports compiled by M. B. Price and E. D. Page, of the Bureau of Mines, from records of the U. S. Department of Commerce.

TARIFF

The 2-cent import excise tax, which had gone into effect on July 1, 1950, following a long period of ineffectiveness for one reason or another (*see* Copper chapter of Minerals Yearbook, 1950, p. 485), was suspended again on April 1, 1951, to February 15, 1953, or to termination of the national emergency, whichever came first. The law provided that the Tariff Commission must notify the President within 15 days after the end of any calendar month in which the average price dropped below 24 cents a pound, delivered Connecticut Valley, and within 20 days thereafter the President had to revoke the suspension.

IMPORTS

Imports dropped 29 percent in 1951 and were the smallest since 1947. Refined imports, which declined 25 percent, represented 49 percent of the total, and unrefined copper (blister, converter, etc.) fell 36 percent and made up 29 percent of the total. The usually small scrap class, following an enormous gain in 1950 because unusually large tonnages were received from Japan, had the largest proportionate decrease (86 percent). As usual, Chile was by far the chief source of copper from abroad, supplying 55 percent of the total but 8 percent less than in 1950. Canada, Mexico, and Northern Rhodesia ranked next in importance as sources of United States imports, supplying 9 to 11 percent of the total received. Most, if not all, Rhodesian metal was treated on toll and reexported. All of these countries shipped less copper to the United States in 1951 than in 1950. Peru was the source of 28,502 tons of copper imported in 1950 but only 10,054 in 1951. The Philippines supplied the only increase of consequence—from 10,129 tons in 1950 to 12,608 in 1951.

TABLE 22.—Copper (unmanufactured) imported into the United States, 1942–46 (average) and 1947–51 [1]

[U. S. Department of Commerce]

Year	Short tons of contained copper	Year	Short tons of contained copper
1942–46 (average)	703,155	1949	552,709
1947	413,890	1950	[2] 690,389
1948	507,449	1951	489,376

[1] Data are "general" imports; that is, they include copper imported for immediate consumption plus material entering country under bond.
[2] Revised figure.

EXPORTS

Most of the copper exported from the United States is in advanced forms of manufacture, in which the copper content is not calculable, and in the form of refined copper. Refined-copper exports were 8 percent less than in 1950 and the smallest since 1946. The United Kingdom, as usual, received most of the exports of this class of copper or 53 percent, while the following European countries took most of

TABLE 23.—Copper (unmanufactured) imported into the United States, 1947–51, in short tons, in terms of copper content [1]

[U. S. Department of Commerce]

	Ore	Concentrates	Regulus black or coarse copper, and cement copper	Unrefined, black, blister, and converter copper in pigs or converter bars	Refined in ingots, plates, or bars	Old and scrap copper, fit only for remanufacture; and scale and clippings	Total
1947	14,665	71,193	5,223	167,378	149,478	5,953	413,890
1948	8,197	81,301	3,657	155,836	249,124	9,334	507,449
1949	6,823	108,814	2,084	152,376	275,811	6,801	552,709
1950							
Australia	115	[2] 584				608	[2] 1,307
Bolivia	297	4,909	14				5,220
Canada	124	24,379	980		52,099	4,783	82,365
Chile	1,208	12,143	424	64,527	[2] 213,754	159	[2] 292,215
Cuba	18	22,411				462	22,891
Ecuador	24	616					640
France			[2] 126		135	3,540	[2] 3,801
Japan			[3]	595	[2] 27,590	26,215	54,400
Malta, Gozo, and Cyprus		6,530					6,530
Mexico	27	9,162	86	48,660	4,782	31	62,748
Northern Rhodesia [4]		233		87,062		5	87,300
Norway					4,098		4,008
Peru	740	6,578	905	5,851	14,428		28,592
Philippines	[5]	[5] 10,004				125	10,129
Turkey				3,266			3,266
Union of South Africa	36	6,475	10	3,276		62	9,859
Yugoslavia				10,985		13	10,998
Other countries	11	144	688		477	2,800	4,120
Total	2,600	[2] 104,168	[2] 3,233	224,222	[2] 317,363	38,803	[2] 690,389
1951							
Australia	4	706				426	1,136
Bolivia	219	4,230					4,449
Canada	15	24,728	658	135	28,354	664	54,554
Chile	862	11,235		47,178	208,294	633	268,202
Cuba	58	21,837				407	22,302
Japan				521	632	756	1,909
Malta, Gozo, and Cyprus		5,556					5,556
Mexico	47	6,378	1,946	38,656	702	94	47,823
Northern Rhodesia				44,190			44,190
Peru	818	6,533	440	1,885	377	1	10,054
Philippines	[5]	[5] 12,608					12,608
Union of South Africa		3,626		3,698		8	7,332
Yugoslavia				6,223	[6]		6,223
Other countries	12	147	7	109	188	2,575	3,038
Total	2,035	97,584	3,051	142,595	238,547	5,564	489,376

[1] Data are "general" imports, that is, they include copper imported for immediate consumption plus material entering the country under bond.
[2] Revised figure.
[3] Revised to none.
[4] Tonnages credited to Southern Rhodesia by the Department of Commerce have been added to Northern Rhodesia.
[5] Some copper in "Ore" and "Other" from Republic of the Philippines is not separately classified and is included with "Concentrates."
[6] Less than 0.5 ton.

the remainder: France, 14; Germany, 8; Netherlands, 6; Italy, 6; and Switzerland, 4. Other individual countries received 3 percent or less of the refined copper shipped from the United States. The United Kingdom received 6 percent less than in 1950 and Italy only about half as much, while the shares of France and Switzerland were little changed and Germany and the Netherlands received about 3 times as much, and one-third more, respectively.

Exports of rods dropped precipitously in 1951, or from 10,073 to 521 tons. Noteworthy changes in exports of other classes were absent.

TABLE 24.—Copper (unmanufactured) imported into the United States, 1947–51, by countries, in short tons, in terms of copper content [1]

[U. S. Department of Commerce]

Country	1947	1948	1949	1950	1951
Australia	518	1,570	941	[2] 1,307	1,136
Belgian Congo				103	
Bolivia	6,752	6,729	4,671	5,220	4,449
Brazil		1,137	67		
Canada	26,484	43,569	82,821	82,365	54,554
Newfoundland-Labrador	3,962	3,698			
Chile	223,120	320,703	285,386	[2] 292,215	268,202
Cuba	14,953	16,270	15,849	22,891	22,302
Czechoslovakia	1,096				
Ecuador	190	482	812	640	
France				[2] 3,801	1,587
Japan	3,226		1,167	54,400	1,909
Malta-Gozo-Cyprus		2,689	6,888	6,530	5,556
Mexico	75,906	57,593	64,706	62,748	47,823
Netherlands		791	234	352	47
Northern Rhodesia		[3] 19,061	[3] 27,244	[3] 87,300	44,190
Norway				4,098	
Peru	32,597	19,318	22,316	28,502	10,054
Philippines	2,185	2,252	7,969	10,129	12,608
Turkey	1,933		4,572	3,266	
Union of South Africa	9,766	5,926	8,919	9,859	7,332
United Kingdom		995	1,925	940	6
Yugoslavia	10,317	2,298	14,727	10,998	6,223
Other countries	885	2,368	1,495	2,725	1,398
Total	413,890	507,449	552,709	[2] 690,389	489,376

[1] Data are "general" imports; that is, they include copper imported for immediate consumption plus material entering the country under bond.
[2] Revised figure.
[3] Tonnages credited to Southern Rhodesia by the U. S. Department of Commerce have been added to Northern Rhodesia, inasmuch as copper of the grades reported does not originate currently in Southern Rhodesia.

TABLE 25.—Copper exported from the United States, 1942–46 (average) and 1947–51

[U. S. Department of Commerce]

Year	Ore, concentrates, composition metal, and unrefined copper (copper content)	Refined copper and semimanufactures	Total (except "Other copper manufactures")	Other copper manufactures [1]	Grand total
	Short tons			Value	
1942–46 (average)	944	194,513	194,457	$75,870,220	$1,642,545	$77,512,765
1947	115	196,999	197,114	99,907,924	2,580,974	102,488,898
1948	2,473	207,022	209,495	111,313,040	2,249,857	113,562,897
1949	200	195,990	196,190	95,342,124	1,655,349	96,997,473
1950	616	192,339	192,955	86,934,184	1,502,917	88,437,101
1951	234	166,274	166,508	99,011,054	1,982,042	100,993,096

[1] Weight not recorded.

TABLE 26.—Copper exported from the United States, 1947–51, in short tons

[U. S. Department of Commerce]

	Ore, concentrates, composition metal, and unrefined copper (copper content)	Refined in bars, ingots, or other forms	Rods	Old and scrap	Pipes and tubes	Plates and sheets	Wire and cable, bare	Wire and cable insulated	Other cop per manufactures
1947	115	147,642	2,416	969	5,107	4,374	11,197	25,294	[1]
1948	2,473	142,598	8,101	2,266	5,246	2,853	10,694	35,264	[1]
1949	200	137,827	12,678	8,284	3,344	1,088	7,881	24,888	[1]
1950	616	144,561	10,073	9,445	1,988	581	7,009	18,682	[1]
1951									
Argentina		1,276			24		16	338	
Australia		650				1	18	36	
Austria		655		193			1	22	
Belgium-Luxembourg		562	[2]	13	35	1	12	27	
Bolivia			1		1	2	15	128	
Brazil	2	3,621	1		70	15	707	234	
Canada	4	37	181	705	614	205	1,822	1,680	
Canal Zone		[2]	1		75	16	2	352	
Chile			3		13	11	81	489	
Colombia	1	[2]			50	23	123	489	
Cuba		4	4		394	21	269	1,028	
Denmark		1,372	112		[2]		[2]	94	
France		18,626			4		4	26	
Germany		10,273		5,650		1	11	7	
Greece		637			9	2	2	237	
Guatemala			[2]		9	1	13	61	
India		217		682	42		138	52	[1]
Indonesia		106	1		9	1	67	291	
Italy		7,948		365	11		997	1,345	
Mexico	71	28	77		399	149	968	773	
Netherlands		8,190	117	91	40		8	39	
Norway		1,911			11			5	
Peru			2		30	7	90	475	
Philippines	1				13	22	193	926	
Saudi Arabia			[2]		13	[2]	17	209	
Sweden		593			1	1		11	
Switzerland		5,415	12		14		1	11	
Turkey			1		11	1	26	661	
Union of South Africa		560			17	2	1,191	312	
United Kingdom	153	70,161			1		1	29	
Venezuela	1	1			106	13	469	1,007	
Other countries	1	462	8	2	144	77	721	2,638	
Total:									
Short tons	234	133,305	521	7,701	2,160	572	7,983	14,032	[1]
Value	$174,298	$71,903,924	$380,012	$3,834,485	$2,478,242	$570,657	$4,753,582	$14,915,854	$1,982,042

[1] Weight not recorded. [2] Less than 0.5 ton.

TABLE 27.—Unfabricated brass (ingots, bars, rods, shapes, plates, and sheets), exported from the United States, 1946–51

[U. S. Department of Commerce]

Year	Short tons	Value	Year	Short tons	Value
1946	9,030	$3,879,189	1949	4,287	$3,080,509
1947	12,622	7,640,678	1950	2,334	1,694,488
1948	6,395	4,499,160	1951	3,815	2,951,881

TABLE 28.—Brass and bronze exported from the United States, 1950–51, by classes

[U. S. Department of Commerce]

Class	1950		1951	
	Short tons	Value	Short tons	Value
Ingots	531	$202,641	2,077	$1,299,044
Scrap and old	[1] 9,054	[1] 2,654,264	4,857	2,090,573
Bars, rods, and shapes	866	652,692	914	865,660
Plates and sheets	937	839,155	824	787,177
Pipes and tubes	1,029	1,039,860	1,458	1,679,240
Pipe fittings	814	1,339,570	707	1,571,038
Plumbers' brass goods	1,922	4,009,753	2,242	5,770,986
Wire of brass or bronze	1,153	1,293,773	1,446	1,959,620
Hardware of brass or bronze	[2]	781,063	[2]	924,366
Other brass or bronze manufactures	[2]	4,394,231	[2]	5,792,815
Total	[2]	[1] 17,207,002	[2]	22,740,519

[1] Revised figure.
[2] Weight not recorded.

TABLE 29.—Copper sulfate (blue vitriol) exported from the United States, 1946–51

[U. S. Department of Commerce]

Year	Short tons	Value	Year	Short tons	Value
1946	41,345	$4,076,850	1949	31,717	$4,320,726
1947	34,021	4,099,551	1950	30,149	4,151,265
1948	42,135	6,514,960	1951	43,129	8,753,641

WORLD REVIEW

Demand for copper was greater in most important copper-consuming countries of the world in 1951, and mine production rose 5 percent to the highest level since 1943. All large copper-producing nations helped to supply the larger quantities made available in 1951. Mine output in Belgian Congo and Northern Rhodesia increased 9 and 7 percent, respectively, above 1950, and both countries established new peak rates; the United States gained 2, Chile 5, and Canada 2 percent.

Belgian Congo.—The rise in copper production to a new peak in 1951 resulted from the expansion program of the Union Minière du Haut Katanga in progress actively since 1947. The improvements were reported by the chairman to have been chiefly commissioning of facilities at the Bia power station, extension of the copper and cobalt electrolytic plant at Jadotville, and extension of the Kolwezi concentrator.

TABLE 30.—World mine production of copper, 1945–51, in metric tons

[Compiled by Berenice B. Mitchell]

Country	1945	1946	1947	1948	1949	1950	1951
North America:							
Canada	215,416	166,892	204,897	218,387	239,003	[1] 239,685	245,377
Newfoundland	4,693	4,458	3,853	4,126			
Cuba	9,067	11,323	13,729	16,300	17,400	20,420	19,700
Mexico	61,680	61,054	64,811	59,076	57,246	61,699	67,351
United States	701,154	552,234	768,892	757,326	682,880	824,938	842,162
Total North America	992,010	795,961	1,056,182	1,055,215	996,529	[1] 1,146,742	1,174,590
South America:							
Bolivia [2]	6,097	6,127	6,241	6,616	5,074	4,704	4,846
Chile	470,181	[1] 361,038	426,671	[1] 445,067	371,095	[1] 362,757	379,726
Ecuador	[3] 3,289	[3] 2,699	166	474	704	526	2
Peru	31,916	24,592	22,492	18,068	27,959	29,930	32,274
Total South America	511,483	[1] 394,456	455,570	[1] 470,225	404,832	[1] 397,917	416,848
Europe:							
Austria	320	125	259	982	1,296	1,635	1,838
Finland	14,978	13,550	15,409	18,384	18,741	15,600	[4] 27,000
France	327	353	386	458	(5)	(5)	(5)
Germany: [4]							
East Germany	6,000	18,300	17,500	(5)	(5)	(5)	(5)
West Germany				[6] 364	864	1,360	1,679
Hungary	(5)	160	[4] 300	(5)	(5)	(5)	(5)
Italy	[1] 579	[1] 137	[1] 133	30	6	34	172
Norway	5,203	12,249	14,707	15,112	14,875	[1] 15,458	[4] 14,400
Spain [7 8]	8,300	8,600	6,454	5,503	6,702	[1] 6,171	[4] 6,804
Sweden	14,926	15,362	13,144	14,835	16,273	[1] 16,100	14,424
U. S. S. R. [4 9 10]	140,000	150,000	165,000	180,000	200,000	218,000	254,000
Yugoslavia [10]	[4] 12,500	[4] 32,250	[4] 40,500	[4] 52,500	[4] 34,000	40,080	32,011
Total Europe [4 9]	[1] 204,000	[1] 251,000	[1] 274,000	[1] 303,000	[1] 308,000	330,000	367,000
Asia:							
China [10]	623	947	915	472	1,874	[4] 4,000	[4] 6,000
Cyprus [2]		71	12,681	15,735	23,936	23,301	22,811
India	6,230	6,060	5,462	6,316	6,305	7,000	7,388
Japan	[1] 29,064	[1] 16,608	21,892	25,765	32,741	39,322	42,298
Korea, Republic of	1,251	522	389	66	28	27	6
Philippines	(5)		2,502	3,350	7,007	[1] 10,384	12,712
Saudi Arabia		9	253	67	49	41	(5)
Taiwan (Formosa)	(5)	(5)	(5)	1,183	(5)	(5)	(5)
Turkey	[10] 9,858	[10] 10,050	[10] 10,080	12,367	13,130	13,300	11,850
U. S. S. R.	(9)	(9)	(9)	(9)	(9)	(9)	(9)
Total Asia [4 9 11]	48,000	[1] 35,000	[1] 55,000	[1] 65,321	[1] 86,000	[1] 99,000	105,000
Africa:							
Algeria	76					81	120
Angola	52	88	28	394	[1] 742	[1] 1,279	1,100
Belgian Congo [10]	160,200	143,885	150,840	155,481	141,399	175,920	191,959
French Morocco	43	60	[1] 49	518	360	18	28
Northern Rhodesia	199,337	191,546	197,288	226,472	259,084	297,487	319,373
Southern Rhodesia	157	145	174	131	80	117	95
South-West Africa			3,100	8,270	9,622	10,961	12,355
Union of South Africa	24,016	27,004	29,330	29,450	30,454	33,982	33,731
Total Africa	383,881	362,728	380,800	420,716	[1] 441,741	[1] 519,845	558,761
Australia	24,914	18,040	13,334	12,567	13,678	[1] 15,144	16,874
World total [4 11]	2,165,000	[1] 1,860,000	2,235,000	2,330,000	2,250,000	[1] 2,510,000	2,640,000

[1] Revised figure.
[2] Copper content of exports.
[3] United States imports.
[4] Approximate production.
[5] Data not available; estimate by authors of chapter included in continental and world totals.
[6] American and British zones only.
[7] According to Yearbook of American Bureau of Metal Statistics.
[8] Starting in 1947 does not include content of iron pyrites, the copper content of which may or may not be recovered.
[9] Output from U. S. S. R. in Asia included with U. S. S. R. in Europe.
[10] Smelter production.
[11] Includes estimates for Burma.

TABLE 31.—World smelter production of copper, 1945–51, in metric tons

[Compiled by Berenice B. Mitchell]

Country	1945	1946	1947	1948	1949	1950	1951
North America:							
Canada	[1] 198,427	[1] 151,434	179,997	200,736	205,098	[2] 216,094	223,227
Mexico	53,287	52,371	58,475	48,761	49,359	48,477	59,241
United States [3]	784,173	592,229	857,007	839,550	779,842	914,917	940,416
Total North America	1,035,887	796,034	1,095,479	1,089,047	1,034,299	[2] 1,179,488	1,222,884
South America:							
Chile	462,080	[2] 358,602	408,400	[2] 424,910	350,737	[2] 345,460	360,099
Ecuador [4]	3,285	2,659					
Peru	[2] 25,298	[2] 19,400	17,824	11,824	21,119	[2] 23,227	24,316
Total South America	[2] 490,663	[2] 380,661	426,224	[2] 436,734	371,856	[2] 368,687	384,415
Europe:							
Austria	1,454		378	2,143	3,761	[2] 5,369	6,450
Belgium [5]							(6)
Finland	13,686	20,952	21,087	20,672	18,224	13,572	17,851
France [7]	25	2	318	277	(6)	(6)	(6)
Germany:							
East Germany	[8] 18,200	[9] 38,809	(6)	(6)	(6)	(6)	(6)
West Germany			[9 10] 32,016	[9 10] 62,244	[9] 145,536	[2 9] 202,500	[9] 212,868
Italy	[2] 400	7	105	167	30	[2] 18	60
Norway	1,692	7,549	7,920	8,935	9,306	[2] 9,035	8,651
Rumania	(6)	1,116	(6)	(6)	(6)	200	(6)
Spain	4,465	8,147	5,971	5,069	6,155	[2] 5,211	5,836
Sweden	18,249	14,471	14,258	17,180	14,359	16,708	14,968
U. S. S. R. [8 11]	140,000	150,000	165,000	180,000	200,000	218,000	254,000
Yugoslavia	[8] 12,500	[8] 32,250	[8] 40,500	[8] 52,500	[8] 34,000	40,080	32,011
Total Europe [8 11]	215,000	275,000	305,000	365,000	445,000	525,000	570,000
Asia:							
China	623	947	915	472	1,874	[8] 4,000	[8] 6,000
India	6,096	6,412	6,426	5,957	6,493	6,720	7,197
Japan	45,737	23,043	36,812	54,330	74,037	84,749	90,948
Korea:							
Korea, Republic of	427	527	392	514	308	(6)	(6)
North Korea	(6)	[8] 2,000	[8] 3,000	(6)	(6)	(6)	(6)
Taiwan (Formosa)	654	808	456	575	465	360	[8] 629
Turkey	9,858	10,050	10,080	10,979	11,283	11,700	16,445
Total Asia [8 11]	68,000	[2] 44,000	[2] 58,000	[2] 76,000	[2] 97,000	110,000	123,000
Africa:							
Belgian Congo	160,200	143,885	150,840	155,481	141,399	175,920	191,959
Northern Rhodesia	197,192	185,607	[2] 195,866	217,044	263,491	279,987	314,103
Union of South Africa	23,665	26,723	29,026	28,993	29,717	33,342	32,922
Total Africa	381,057	356,215	[2] 375,732	401,518	434,607	489,249	538,984
Australia	20,827	23,023	19,818	11,572	10,016	[2] 13,726	12,683
World total [8]	2,210,000	1,875,000	2,280,000	2,380,000	2,395,000	[2] 2,685,000	2,850,000

[1] Copper content of blister produced.
[2] Revised figure.
[3] Smelter output from domestic and foreign ores, exclusive of scrap. Production from domestic ores only, exclusive of scrap, was as follows: 1945, 710,073; 1946, 543,996; 1947, 782,780; 1948, 764,278; 1949, 687,580; 1950, 826,760; 1951, 844,379. Diversion during the war of Belgian Congo matte from its previous destination, Belgium, for resmelting in the United States results in some duplication. The movement ended in 1945.
[4] United States imports.
[5] Figures represent blister copper only. Belgium reports a large output of refined copper, which is not included above as it is believed produced principally from crude copper from Belgian Congo and would therefore duplicate output reported under the latter country.
[6] Data not available; estimate by authors of chapter included in continental and world totals.
[7] Exclusive of material from scrap.
[8] Approximate production.
[9] Includes scrap.
[10] American and British zones only.
[11] Output from U. S. S. R. in Asia included with U. S. S. R. in Europe.

The company's earliest mines were in the accessible oxidized deposits, and these are still the most important source of production in the Belgian Congo. Originally supplied by the southern mines, the oxide ore now comes chiefly from the Western group (Kolwezi, Musonoi, and Ruwe), and to a lesser extent from smaller mines to the east (Lukuni, Luiswishi, and Shituru). The ores are concentrated at the mill at Kolwezi and the oxide concentrates sent to the Shituru electrolytic plant [3] at Jadotville. The Jadotville-Panda concentrator suspended operations in mid 1951 owing to exhaustion of oxidized reserves in the Central Group of mines.

Sulfide ore is obtained mainly from the Prince Leopold mine at Kipushi, one of the southeastern group, described in a recent report. It is the source of ore for the Lubumbashi smelter after being concentrated at the Kipushi mill.[4] In two articles published in 1951 describing the mining and treatment of Belgian Congo ores it was stated that the Prince Leopold mine would assure the sulfide supply of the smelter for several years to come. It produces 700,000 tons of ore a year. These articles also gave information regarding cobalt, zinc, and other products of the Union Minière operation.[5]

Canada.—Mine output rose 2 percent in 1951 and was the greatest since 1944; it was, however, 17 percent below the alltime peak of 327,797 short tons in 1940. Refinery output rose 3 percent to 246,312 tons in 1951. Refined-copper consumption was 134,174 tons in 1951, an alltime peak, compared with 106,868 tons in 1950.

TABLE 32.—Copper produced (mine output) in Canada, 1947–51, by Provinces, in short tons [1]

Province	1947	1948	1949	1950	1951 (preliminary)
British Columbia	20,900	21,502	27,055	21,088	21,906
Manitoba	15,316	18,960	16,960	20,817	15,460
Newfoundland (not Canadian 1947–48)			3,617	3,221	2,755
Ontario	113,934	120,383	113,043	117,210	128,889
Quebec	42,561	48,813	67,822	72,891	69,896
Saskatchewan	33,151	31,074	34,960	28,982	31,577
Total	225,862	240,732	263,457	264,209	270,483

[1] Dominion Bureau of Statistics, Department of Trade and Commerce, Government of Canada, Preliminary Report on Mineral Production, 1951.

Ontario produced over half of Canada's total for many years but from 1949 to 1951 only 43 to 48 percent. The copper regularly is derived from the nickel-copper ores of the Sudbury district. The International Nickel Co. of Canada, Ltd., is by far the chief producer of copper in the Province and in Canada, despite the fact that the principal product of the company's mines is nickel. The company delivered 118,477 tons of copper in 1951 compared with 106,474 in 1950 and 110,538 in 1949. The quantities of nickel produced were of the same general order of magnitude but brought much higher prices per unit. Noteworthy progress was made during the year in

[3] *See* Murdock, Thos. G., The Shituru Electrolytic Copper Plant of the Union Minière: Consular Rept. 25, Elisabethville, Belgian Congo, May 7, 1952, 22 pp.
[4] Bureau of Mines, Mineral Trade Notes: Vol. 33, No. 5, November 1951, pp. 5–11.
[5] Sengier, Edgar B., Katanga's Mineral Empire Based on Many Metals: Eng. and Min. Jour., vol. 152, No. 11, November 1951, pp. 86–89.
Katanga Is Well Equipped For Treating Its Diverse Ores: Eng. and Min. Jour., vol. 152, No. 12, December 1951, pp. 92–96.

the program to develop underground production to offset the approaching exhaustion of open-pit reserves. Mining of the Stobie open pit was completed in August, but production at the Frood open pit was at a rate calculated to preserve the flow from this source until underground mining facilities are ready for planned capacity operations. Underground ore mined was 7,780,143 tons compared with 5,733,269 in 1950 and with a program goal of 13,000,000 tons. Open-pit ore production in 1951 was 4,019,177 tons and in 1950 4,115,755 tons. Proved ore reserves at the end of the year were 253,704,771 tons compared with 252,859,725 tons at the end of 1950. The nickel-copper content was 7,693,122 and 7,669,219 tons, respectively.

Water-borne sand filling from the Copper Cliff concentrator continued to be used in the lower levels of the Frood section of the Frood-Stobie mine for stabilizing older areas as well as for filling current stopes on these levels. Complete change from rock fill to sand fill was expected in 1952. Mill tailings from the Creighton concentrator are similarly employed at lower level stopes of the Creighton mine and are expected to effect the same benefits of more economical mining and higher production from individual working places. A special type of smelting furnace which will use oxygen for flash smelting of copper concentrates instead of smelting with pulverized coal was completed and in experimental operation at the end of the year. The process is expected to permit curtailment of costly coal requirements and greater utilization of sulfur from smelter gases.

The Falconbridge Nickel Mines, Ltd.—the other important producer in Ontario—hoisted 930,164 tons of ore at the Falconbridge mine compared with 881,838 tons in 1950. The McKim mine exceeded its rated production capacity of 500 tons a day, delivering 155,961 tons to the smelter compared with 46,997 tons in 1950. Metallurgical plants at Falconbridge treated 1,083,670 tons, the greatest tonnage on record, of which 679,036 tons was milled and the remainder smelted directly. Ore reserves were increased to 10,102,500 tons of developed ore, averaging 1.64 percent nickel and 0.87 percent copper, and 9,014,000 tons of indicated ore, averaging 1.85 percent nickel and 1.14 percent copper. Inclusion of an ore body found at depth under Fecunis Lake, about 2½ miles east of the Hardy mine, in indicated reserves caused the net increase of 3,235,500 tons in that category.

Quebec is regularly Canada's second most important copper Province. The largest producer here is Noranda Mines, Ltd., operating the Horne mine. A total of 1,328,368 tons of ore was mined in 1951, of which 555,113 tons was direct smelting ore, averaging 2.27 percent copper, 0.186 ounce gold, and 0.42 ounce silver per ton, and 773,255 tons was concentrating ore, averaging 1.90 percent copper, 0.140 ounce gold, and 0.30 ounce silver per ton. The smelter produced 68,943 tons of copper from newly mined material, of which 25,315 tons was from Horne mine ores and concentrates. Developed ore reserves above the 2,975-foot level were 15,626,140 tons of sulfide ore averaging 2.24 percent copper and 0.186 ounce gold per ton. In addition, there was an estimated reserve of 1,500,000 tons averaging 0.7 percent copper in the No. 5 zone of the mine, as well as siliceous fluxing ore and other ore containing little or no copper.

East Sullivan Mines had a record year, with an output of 904,762 tons of ore. Ore reserves approximate 4,950,000 tons, of which 4,375,000 is classified as positive, averaging 1.63 percent copper, 1.27 percent zinc, with gold and silver values. A new zinc ore body being developed contains 207,000 tons averaging 8.81 percent zinc and 0.87 percent copper, with gold and silver contents.

The Quemont Mining Corp., Ltd., in which Noranda has a substantial interest and which adjoins the Horne mine, produced 772,781 tons of ore, averaging 1.59 percent copper, and 2.15 percent zinc, with gold and silver values. Metal shipments included 11,468 tons of copper, 12,363 tons of zinc, and gold and silver. The copper concentrate is treated at the Noranda smelter, the zinc concentrate going to the United States. Of the ore produced, about 60 percent was obtained by the cut-and-fill method and 37 percent by sublevel mining; the remainder came from development headings. Ore reserves were virtually unchanged from the beginning of the year at 9,438,000 tons, averaging 1.44 percent copper, 2.65 percent zinc, 0.159 ounce gold, and 0.98 ounce silver per ton.

The Normetal Mining Corp., Ltd., milled 359,266 tons of ore, averaging 2.26 percent copper and 7.41 percent zinc, with gold and silver values; 32,410 tons of concentrates was produced and 130 tons of direct-smelting ore smelted at the Noranda smelter, and zinc concentrates were shipped to the United States. Metals produced were 7,032 tons of copper, 21,354 tons of zinc, 4,637 ounces of gold, and 446,723 ounces of silver. Ore reserves at the end of 1951 were estimated as 2,434,300 tons containing 2.67 percent copper and 8.32 percent zinc, a noteworthy increase over 12 months before.

At the property of the Waite Amulet Mines, Ltd. (controlled by Noranda), 387,754 tons of ore was milled and 12,776 tons of copper, 14,292 tons of zinc, 9,620 ounces of gold, and 346,150 ounces of silver produced. Ore reserves at the Waite mine were increased to 1,037,800 tons owing chiefly to developments at "East Waite," where 1,028,000 tons, averaging 4.1 percent copper, and 3.15 percent zinc, with gold and silver values, was in sight at the year end. Ore reserves at Amulet Dufault dropped to 920,000 tons, of which 695,887 tons averaged 5.7 percent copper and 4.05 percent zinc, 200,000 averaged 2.75 percent copper and 0.6 percent zinc, and 25,000 averaged 1.05 and 5.6 percent, respectively.

The Canadian Copper Refiners, Ltd. (controlled by Noranda), produced 118,000 tons of refined copper compared with 123,200 tons in 1950.

A large additional area of ore was found at the Gaspé Copper property of Noranda Mines, Ltd., in 1951. The ore found in 1951 was 8,025,000 tons, which, combined with the tonnage previously reported, makes a total of 65,000,000 tons. Exploration is expected to develop additional ore. Of the new tonnage, 5,580,000 tons of zone 2 ore averaged 1.45 percent copper, 2,175,000 tons of zone 3 ore averaged 1.76 percent, and 270,000 tons of zone 3 ore averaged 1.45 percent. The 57,000,000 tons had been reported as averaging about 1 percent.

Copper produced in *Saskatchewan* and *Manitoba* regularly has come almost entirely from the Flin Flon mine of the Hudson Bay Mining & Smelting Co., Ltd., and the Sherridon operation of Sherritt Gordon Mines, Ltd. At Hudson Bay's mine 1,823,870 tons of ore

was mined, of which 1,820,805 tons, containing 2.40 percent copper and 4.9 percent zinc, with gold and silver values, was milled; in addition, 3,748 tons of direct smelting ore was taken from the stockpile and treated. After allowing for metals due on account of custom concentrates treated on toll, the company shipped blister to the refinery containing 41,878 tons of copper, 146,459 ounces of gold, 1,975,195 ounces of silver, and 128,448 pounds of selenium. Ore reserves at the end of the year, including properties wholly owned or controlled and within trucking distance of Flin Flon, but excluding Cyprus Mines, Ltd., were 18,102,439 tons, averaging 3.15 percent copper and 4.1 percent zinc, with gold and silver values. Cyprus Mines, Ltd., controlled by Hudson Bay, mined 86,514 tons of ore, averaging 3.26 percent copper and 6.9 percent zinc, with gold and silver values. Ore reserves total 129,045 tons.

Following a 1951 output of 248,009 tons of ore containing 5,411 tons of copper, 6,694 tons of zinc concentrate, 2,916 ounces of gold, and 87,495 ounces of silver, reserves at the Sherridon mine were exhausted. From the beginning of operations in 1931 through 1951, 8,531,352 tons of ore were milled and 183,122 tons of copper, 148,961 tons of zinc concentrate, 101,026 ounces of gold, and 3,218,324 ounces of silver produced. At the Bob Lake deposit about 3 miles from the Sherridon, 2,380,000 tons of material, averaging 1.33 percent copper and 1.18 percent zinc, uneconomic at present, has been delimited. Work of moving equipment to Lynn Lake progressed. The small amount of development work carried on during the year confirmed all previous ore indications; the reserves remain at 14,055,000 tons, averaging 1.223 percent nickel and 0.618 percent copper. Sherritt Gordon's program was discussed in the Copper chapter of Minerals Yearbook, 1950. Plans called for construction of a chemical-metallurgical plant at Fort Saskatchewan, 15 miles northeast of Edmonton. An article describing the Lynn Lake operation was published during the year. The new metallurgical process, which will leach the ores with ammonia, is being tested in a pilot plant.[6]

In *Newfoundland* the Falconbridge Nickel Mines, Ltd., entered into an agreement with the Government of the Province, obtaining a 3-year concession comprising about 2,000 square miles. The optional properties of Gull Pond, Rambler, and Tilt Cove, are in the area. Drilling on Gull Pond confirmed the presence of 2,000,000 tons of 1.9-percent copper ore.

Chief producers in *British Columbia* were the Granby Consolidated Mining, Smelting & Power Co., Ltd., and the Britannia Mining & Smelting Co., Ltd. A total of 1,794,882 tons of ore, averaging 0.899 percent copper, was mined at the Copper Mountain property of Granby and treated in the concentrator. Production of salable metals amounted to 12,987 tons of copper, 7,947 ounces of gold, and 172,331 ounces of silver. Ore reserves at the end of the year were 3,100,000 tons plus 600,000 tons of additional possible ore, and excluding all ore that may be reclaimed from caved areas. An extensive new development program was begun in 1951 in the hope of adding a considerable tonnage to that in sight. According to the Yearbook of the American Bureau of Metal Statistics, Britannia produced 7,540 tons of copper

[6] Waldron, Howard L., Sherritt Gordon Develops Lynn Lake Nickel-Copper: Eng. and Min. Jour., vol. 152, No. 11, November 1951, pp. 72–78.

in 1951 compared with 7,949 in 1950. Normally concentrates from British Columbia move to the United States for smelting.

Exports of ingots, bars, and billets from Canada in 1951 as compared with 1950 were as follows, by countries of destination, in short tons:

Destination:	1950	1951
United Kingdom	64, 326	51, 918
United States	50, 425	28, 843
France	5, 064	5, 700
Sweden	-------	3, 998
India	6, 683	3, 649
Brazil	858	2, 688
Italy	1, 075	2, 451
Germany	55	1, 258
Switzerland	1, 867	224
Netherlands	1, 872	-------
Other	2, 019	1, 103
	134, 244	101, 832

Exports of copper in ore, matte, regulus, etc., totaled 36,853 (32,299 in 1950) tons, of which the United States was the destination of 28,941 (25,495) tons, Norway 6,310 (6,118) tons, the United Kingdom 1,044 (686) tons, and Germany 558 (no) tons. In addition, 13,291 (15,941) tons of rods, strips, sheet and tubing and 993 (6,233) tons of old and scrap copper were shipped from the country.

Imports of refined copper totaled 1,511 tons in 1951.

Chile.—Mine production of copper rose 5 percent in 1951, or to the highest level since 1948; it was 15 percent less than in 1948 and 24 percent below the peak rate for 1944. Over 20,000 tons of copper was estimated to have been lost in 1951 because of labor strikes, which also affected production adversely in 1950. Strikes at Chuquicamata in May, at all three large mines in June, the Chilean dock strike lasting 2 weeks in September, and the month-long dock strike at New York ports ended November 9 combined to reduce the flow of copper to United States and other markets.

The 1951 annual reports of the Kennecott Copper Corp. and Anaconda Copper Mining Co. to stockholders described the agreement reached between the Governments of Chile and the United States in May with regard to sales of Chilean copper (discussed in the Summary section of this chapter, and efforts of American producers and the Chilean Government to reach agreement with regard to incentive investments. Kennecott's report is quoted as follows:

> In making this agreement it was contemplated that the American companies would increase productive capacity, in return for which, as an incentive for the investment of the necessary amounts of capital, the Chilean Government would revise the existing tax and exchange regulations. Subsequently, the American copper companies and representatives of the Chilean Government reached agreement on the terms of a contract, which contract would be subject to ratification by the Chilean Congress. The contract would grant to the companies the open market exchange rate for their costs of operations, and would provide a straight income tax of 50 per cent and surtax of 17.3 per cent, which surtax would be reduced in direct proportion to increased production of copper over a base established in the contract. While the terms of this contract were agreed upon in November 1951, the contract has not yet been presented to the Chilean Congress for ratification.
>
> The net exchange rate allowed the company for money spent on operations was maintained at 19.32 pesos to the dollar throughout the year; for construction expenditures the rate was held at 60 pesos. At the beginning of 1951, the open market rate was 72.75 pesos, and at the end of the year 92.60 pesos to the dollar.

Outputs of the three leading mines were reported, in metric tons, as follows:

	Ore treated	*Bar copper produced*
Andes	8, 042, 887	41, 586
Braden	8, 842, 464	155, 564
Chuquicamata	15, 122, 102	163, 521

Failure of production to reach World War II levels despite urgent world demand for copper was caused, in addition to strike losses, substantially by the necessity of noteworthy shifts in methods of production to accommodate changes in the nature of ore bodies at Andes and Chuquicamata from oxide to sulfide mineralization. The loss of oxide ores at Andes was not expected to be made up by increased production from sulfide ores. Replacement of lost oxide tonnages at Chuquicamata, on the other hand, appeared to be optional and may be determined in large part by whether or not a favorable atmosphere for increased capital expenditures exists in the country.

The new sulfide plant under construction by the Chile Exploration Co., a subsidiary of the Anaconda Copper Mining Co., since 1949 and described in the Copper Chapter of Minerals Yearbook, 1950, was expected to begin operations in 1952 as planned. The dock strike at New York City delayed shipment of materials and equipment to Chile and moved anticipated full production at the original seven units to the third quarter of 1952. In 1951 it was decided to increase the new concentrator from 7 to 10 units and to enlarge the smelter capacity correspondingly. These changes increased the estimated cost from $90,000,000 to $111,000,000. The full plant was expected to be in operation early in 1953. Output of the new plant and existing oxide plant was expected to exceed 250,000 short tons a year. According to a brochure published by Anaconda in 1952, the Chuquicamata pit produced 4,980,000 short (4,517,756 metric) tons of copper from the start of operations in 1915 to December 31, 1951. To obtain this production, 502,844,000 short (456,170,020 metric) tons of material was mined, of which 350,796,000 (318,235,115 metric) tons was copper oxide ore and 152,048,000 (137,934,905 metric) tons waste material. Remaining in the pit to be mined was 260,000,000 tons, of which 140,000,000 tons was sulfide ore. In addition, a vast body of copper sulfide ore underlay the pit.

At the Braden mine of the Kennecott Copper Corp. further substantial economies were reported as a result of the changeover in progress in 1950. The corporation appropriated $4,794,000 to increase capacity of the mill and began construction. At the smelter, work was in progress on a 40-foot extension of the No. 1 reverberatory furnace to provide for increased production. Efforts to increase available water supply brought favorable results, and increased snowfall also promised an additional supply during winter months.

On December 29 the Government-owned Paipote smelter poured its first blister copper. The plant is near the city of Copiapó, Atacama Province. The Mining Credit Bank (Caja de Crédito Minero) stockpiled raw material for Paipote from midyear, a substantial part of the tonnage being from mines that had previously exported their ores and concentrates. Production of 15,000 tons of blister was expected in 1952; annual capacity is about 18,000 tons.

Chilean exports of the chief types of copper in 1951, by countries, are shown in table 33. Other copper exports from Chile were 3,780 tons of ore (1,418 to Germany, 1,200 to Belgium, 1,000 to Japan, and 162 to the United States); 17,613 tons of concentrates (16,460 to the United States, 1,053 to Germany, and 100 to Sweden); 1,091 tons of scrap (570 to Belgium and 521 to the United States); 1,630 tons of cement copper (800 to Japan, 628 to Belgium, 85 to Argentina, 66 to Germany, and 51 to Italy); and 180 tons of precipitates (all to Germany).

TABLE 33.—Principal types of copper exported from Chile in 1951, by countries, in metric tons

	Refined		Standard (blister)	Total
	Electrolytic	Fire-refined		
United States	96,466	103,308	39,898	239,672
Italy	4,693	928	9,640	15,261
France	4,877	10,244		15,121
Great Britain		6,172	3,827	9,999
Germany	104	3,038	5,008	8,150
Brazil	5,680	1,129		6,809
Sweden	4,302	12		4,314
Algiers	2,081			2,081
Denmark		1,524		1,524
Switzerland		838		838
Other countries	134	1,178	203	1,515
Total	118,337	128,371	58,576	305,284

Japan.—Production of copper in Japan had trended upward since the lowest of recent years was established in 1946, and this pattern was followed in 1951. Consumption likewise rose. According to the American Bureau of Metal Statistics Yearbook, Japanese consumption of copper was 95,398 metric tons in 1951 compared with 27,240 in 1946. Of the 1951 total, nearly 50 percent was estimated to have come from scrap.

Northern Rhodesia.—Copper production in Northern Rhodesia established a new alltime peak in 1951 for the second successive year. The 1951 output was 7 percent above 1950 and 20 percent over the earlier record in 1940.

The expansion in 1951 resulted despite continuing shortages of coal owing, in large part, to inadequate transportation facilities. According to a recent report, Rhodesia Railways was to receive a £5,000,000 Economic Cooperation Administration loan with provision, among other things, that 21 percent of Southern Rhodesia's output, when production of salable coal and coke equals 200,000 tons a month, was to be made available to Northern Rhodesian copper mines. Moreover, expansion of coal production under way at the Wankie colliery was expected to provide more fuel to Northern Rhodesian copper mines. Part of the additional supplies of coal was expected merely to replace wood burning. The report stated that 125 square miles of forest had been cut to provide fuel equivalent to 780,000 tons of coal. New companies were formed or planned to further exploit Northern Rhodesian mineral deposits, the first of which was the Chibuluma Mines, Ltd., a subsidiary of Mufulira. The ECA granted a loan, the equivalent of about £8,000,000, to this company for developin the

mine. The firm will repay the agency in shipments of copper and cobalt to the United States stockpile. Development was proceeding, with annual production of 16,000 tons of copper and 250 tons of cobalt in prospect. Active prospecting was being carried out by a new company, Rhodesian Selection Trust (Services), Ltd., on behalf of four other new companies formed in 1951 (Chisangwa, Mwinilunga, Kadola, and Luapula). Several thousand square miles west of existing copper mines were covered by the exclusive prospecting licenses granted to these companies by the British South Africa Co.[7] Copper companies assigned some of their own labor to the Wankie colliery to alleviate its labor shortage and obtained additional coal as a result. Another report indicated that the Interterritorial Hydroelectric Power Commission had recommended a gigantic hydroelectric power project to provide an eventual capacity of 1,000 megawatts. The project would involve creation of a lake 200 miles long at Karika Gorge on the Zambesi River at a cost of £174,504,000. The commission estimated that at an initial cost of £43,519,000, 385 megawatts could be made available by 1961 for transmission to the copper fields.[8]

A total of 3,970,400 short dry tons of ore, averaging 2.38 percent copper, was mined by Roan Antelope Copper Mines, Ltd., in the fiscal year ended June 30, 1951, or 18 percent above production in 1950. Company concentrates smelted during the year yielded 83,462 short tons of blister copper, compared with 71,184 tons in the year ended June 30, 1950. Blister copper was produced in addition for Nchanga, as reported later. Ore reserves at the end of June 1951 were reported as 90,302,734 short tons of ore averaging 3.27 percent copper.

The Rhokana Corp., Ltd., smelter produced 137,923 short tons of copper in the fiscal year ended June 30, 1951, compared with 134,218 tons in the fiscal year ended June 30, 1950. Of the 1950–51 total, 5,952 tons (17,557 in 1949–50) was blister and 87,193 (72,309) anode copper for Nkana, and 9,648 tons (39,866) was blister and 35,130 (4,486) anode copper for Nchanga. Ore reserves at the end of June 30, 1951, were as follows:

	Short tons	*Copper (percent)*
Nkana north ore body	30, 124, 000	2. 97
Nkana south ore body	20, 165, 000	2. 78
Mindola ore body	52, 316, 800	3. 53
Total	100, 605, 800	3. 21

Rhodesia Copper Refineries, Ltd., produced 68,865 long (77,129 short) tons for Rhokana in 1951 compared with 64,864 long (72,648 short) tons in 1950. The operations of the electrolytic plant were reported hampered by coal shortage, so that the company's expectation that total production would be electrolytic copper in the fiscal year ended June 30, 1951, was not realized. Total electrolytic copper production of Rhodesia Copper Refineries, Ltd., was 107,935 short tons compared with 72.648 tons in the year ending June 30, 1950.

In the year ended March 31, 1951, 1,379,198 short tons of ore averaging 6.47 percent copper was mined by Nchanga Consolidated Copper Mines, Ltd. Developed and partly developed reserves in

[7] Mining Journal (London), Annual Review Number—1952 Edition: Northern Rhodesia, May 1952, p. 119.
[8] Mining World, Rhodesia Gets ECA Funds for Rail Expansion: Vol. 13, No. 10, September 1951, p. 47.

Nchanga West ore body, as of April 1, were 10,438,731 tons, averaging 7.31 percent copper, a net increase of 1,727,820 tons after allowing for ore mined and adjustments. The total reserves on April 1 were as follows:

	Short tons	Copper (percent) Total	Oxide
Nchanga West	42, 999, 491	6.99	3.03
Nchanga River Lode	2, 280, 000	4.21	2.92
Chingola	2, 000, 000	7.00	6.60
Nchanga	89, 580, 000	3.48	2.19
Total	136, 859, 491	4.65	2.53

Company plans called for expansion of production from 64,000 long (nearly 72,000 short) to 108,000 long (121,000 short) tons, possibly by the end of 1952. In addition to the copper smelted for Nchanga by Rhokana, already reported, the Roan Antelope and Mufulira plants produced from Nchanga concentrates 16,572 and 4,917 short tons of blister, respectively, in the year ended June 30, 1951.

Mufulira Copper Mines, Ltd., mined 3,355,143 short tons of ore, averaging 3.36 percent copper, in the fiscal year ended June 30, 1951. Blister copper production amounted to 86,046 long (96,372 short) tons from company ore, in addition to which Rhokana obtained fluxing ore from Mufulira which yielded 635 long (711 short) tons of blister. Concentrates smelted for Nchanga were additional to the foregoing. Good progress was reported on construction of the new electrolytic refinery. The first section of 36,000 tons was expected to start production in 1952 and doubling of capacity to be effective by 1954. The end product was to be electrolytic cathodes at first but refined shapes when the plant was completed. Estimated ore reserves at the end of the fiscal year follow:

	Short tons	Copper (percent)
Mufulira	114, 132, 000	4.07
Chambishi	25, 000, 000	3.46
Baluba	21, 000, 000	3.47
Chibuluma	7, 300, 000	5.23
Total	167, 432, 000	3.95

Peru.—Mine output of copper rose to 32,274 metric tons in 1951 and to the highest annual total since 1944. The chief copper-producing company is the Cerro de Pasco Corp., which also produces important tonnages of lead, zinc, and silver. The annual report of the company to stockholders reported on conditions in Peru as follows:

> Political and economic conditions in Peru were stable throughout the year. The Government's removal of economic controls and elimination of subsidies of various kinds during the past two years were acts of farsighted statesmanship and were well justified.
>
> Due to the increased volume of metal production and higher metal prices, the first year of the operation of the Mining Code, despite reduced tax rates for the mining industry, witnessed a sharp increase in the total amount of taxes payable to the Peruvian Government by the industry. The experience of the past year justifies the expectation that the Mining Code will continue to be advantageous to Peru through stimulating new capital investment in the industry, increased employment and higher production of metals.

The American Smelting & Refining Co. program of diamond drilling on the Toquepala copper project, a porphyry-type deposit in Southern Peru, was almost completed at the end of the year. The company stated that tentative ore-reserve estimates indicated an economic deposit of large size susceptible to mining by open-pit methods. Decision with respect to placing either Toquepala or Quellaveco, 20 miles away and exploration of which was completed in 1950, on an operating basis depended upon detailed investigations of power, water, railway, and port facilities.

Feldspar

By Brooke L. Gunsallus and F. P. Uswald

GENERAL SUMMARY

CRUDE feldspar production in 1951 decreased 2 percent in tonnage but increased 10 percent in value over 1950, according to reports by producers. Imports of crude increased but remained a minor part of the total supply picture. Sales of ground feldspar by merchant mills increased 2 percent in quantity and 9 percent in value. Receipts of crude by merchant mills did not match the increased demand for ground, the difference being met by net withdrawals from stocks. The quantity of ground feldspar sales shipped to the pottery industry increased 17 percent. Sales to the enamel industry decreased 34 percent and to the glass industry 7 percent in 1951 over 1950. In 1951, as in 1950, the output of the pottery industry kept pace with the increase in the demand for its products brought about by postwar expansion in other fields. The production of whiteware, sanitary ware, and high-tension electrical insulators accounted for the greater part of the increase.

Certain restrictions in the use of steel, cobalt, and other materials, imposed in emergency regulations, caused a decided drop in enamel production and resulted in a proportional decrease in the consumption of feldspar. The automotive industry's inability to procure steel automatically lessened the demand for flat glass, a large consumer of feldspar. The substitution of aplite, nepheline syenite, and blast-furnace slag in glass-container formulas also curtailed the demand for feldspar.

Imports of crude feldspar from Canada increased 38 percent in 1951 compared with 1950. Imports of crude nepheline syenite dropped to a negligible quantity in 1951, after having decreased sharply in 1950. Imports of ground nepheline syenite, on the other hand, increased 21 percent in 1951 compared with 1950. These changes were mainly the result of the transfer in 1950 of the grinding operations of the American Nepheline, Ltd., from Rochester, N. Y., to Lakefield, Ontario, Canada. Except for a few scattered shipments, all future imports were expected to be in the ground form. Total sales of aplite in 1951 decreased 5 percent over 1950. Substitution of blast-furnace slag for aplite in glass-container production accounted in part for this decrease.

TABLE 1.—Salient statistics of the feldspar industry in the United States, 1942–46 (average), and 1947–51

	1942–46 (average)	1947	1948	1949	1950	1951
Crude feldspar:						
Domestic sales:						
Long tons	366,658	459,910	460,713	369,378	407,925	400,439
Value	$1,924,509	$2,410,940	$2,564,387	$2,278,441	$2,558,390	$2,815,587
Average per long ton	$5.25	$5.24	$5.57	$6.17	$6.27	$7.03
Imports:						
Long tons	12,652	16,685	31,047	15,826	12,367	17,128
Value	$98,280	$124,587	$219,785	$107,925	$84,136	$146,565
Average per long ton	$7.77	$7.47	$7.08	$6.82	$6.80	$8.56
Ground feldspar:						
Sales by merchant mills:						
Short tons	371,745	482,700	506,451	386,707	446,523	454,615
Value	$4,114,606	$5,861,141	$6,462,231	$5,609,101	$6,343,619	$6,932,878
Average per short ton	$11.07	$12.14	$12.76	$14.50	$14.21	$15.25

DOMESTIC PRODUCTION

CRUDE FELDSPAR

Production of crude feldspar in 1951 decreased 2 percent over 1950, but the total value increased 10 percent. The average value per long ton was $7.03 compared with $6.27 in 1950. Eleven states reported production in 1951 the same as in 1950.

TABLE 2.—Crude feldspar sold or used by producers in the United States, 1946–51

Year	Long tons	Value		Year	Long tons	Value	
		Total	Average			Total	Average
1946	508,380	$2,594,099	$5.10	1949	369,378	$2,278,441	$6.17
1947	459,910	2,410,940	5.24	1950	407,925	2,558,390	6.27
1948	460,713	2,564,387	5.57	1951	400,439	2,815,587	7.03

TABLE 3.—Crude feldspar sold or used by producers in the United States, 1949–51, by States

State	1949		1950		1951	
	Long tons	Value	Long tons	Value	Long tons	Value
Colorado	60,966	$341,049	59,457	$329,120	50,451	$283,153
Connecticut	12,659	95,044	13,580	101,851	13,811	107,083
Maine	18,286	130,275	17,487	124,821	19,273	154,695
North Carolina	160,916	973,431	183,027	1,107,061	166,361	1,230,404
South Dakota	32,272	156,548	43,875	249,176	48,559	290,520
Virginia	33,936	234,442	26,879	188,153	30,979	232,099
Other States [1]	50,343	347,652	63,620	458,208	71,005	517,633
Total	369,378	2,278,441	407,925	2,558,390	400,439	2,815,587

[1] Includes Arizona, California, Georgia, New Hampshire, New York (1949), Texas, and Wyoming (1949).

Colorado, New Hampshire, and North Carolina showed decreases from 1950 output. The principal producer was North Carolina with 166,361 long tons (42 percent of total), Colorado was second with 50,451 long tons (13 percent of total), and South Dakota third with 48,559 long tons (12 percent of total).

GROUND FELDSPAR

Sales of ground feldspar by merchant mills in 1951 reached 454,615 short tons, an increase of 2 percent over 1950, but lower than in 1947 and 1948. The total value increased 9 percent over 1950, and the average selling price per ton was $15.25, an increase of 7 percent. The number of producing States was 14, the same as in 1950.

TABLE 4.—Ground feldspar sold by merchant mills [1] in the United States, 1947–51

Year	Active mills	Domestic feldspar			Canadian feldspar			Total	
		Short tons	Value		Short tons	Value		Short tons	Value
			Total	Average		Total	Average		
1947	26	464,179	$5,461,576	$11.77	18,521	$399,565	$21.57	482,700	$5,861,141
1948	28	487,070	5,991,059	12.30	19,381	471,172	24.31	506,451	6,462,231
1949	27	369,824	5,212,246	14.09	16,883	396,855	23.51	386,707	5,609,101
1950	23	429,787	5,952,019	13.85	16,736	391,600	23.40	446,523	6,343,619
1951	23	441,816	6,633,378	15.01	12,799	299,500	23.40	454,615	6,932,878

[1] Excludes potters and others who grind for consumption in their own plants.

As had been the case for several years, North Carolina again was by far the largest grinder of feldspar, followed by Colorado, South Dakota, and Tennessee. Colorado was the only State among the large grinders to show a decrease in 1951; but production in Illinois, New Jersey, New York, and Tennessee also declined. Increases were shown ranging from 1 percent for Connecticut-New Jersey to 33 percent for Georgia-Virginia.

TABLE 5.—Ground feldspar sold by merchant mills [1] in the United States, 1949–51, by States

State	1949			1950			1951		
	Active mills	Short tons	Value	Active mills	Short tons	Value	Active mills	Short tons	Value
Colorado	2	69,294	$727,989	2	62,879	$663,712	(2)	(2)	(2)
Connecticut	2	21,572	437,030	2	25,532	510,501	2	25,740	$528,246
New Jersey	1			1			1		
Georgia	(2)	(2)	(2)	(2)	(2)	(2)	1	47,755	668,347
Virginia	(2)	(2)	(2)	(2)	(2)	(2)	2		
Maine	3	16,742	295,227	3	19,938	352,809	3	20,504	376,258
New Hampshire	(2)	(2)	(2)	(2)	(2)	(2)	2	34,149	716,660
New York	(2)	(2)	(2)	(2)	(2)	(2)	1		
North Carolina	4	159,768	2,203,604	3	200,373	2,526,268	3	197,704	2,886,655
Tennessee	1			1			1		
Undistributed [3]	14	119,331	1,945,251	11	137,801	2,290,329	7	128,763	1,756,712
Total	27	386,707	5,609,101	23	446,523	6,343,619	23	454,615	6,932,878

[1] Excludes potters and others who grind for consumption in their own plants.
[2] Included with "Undistributed."
[3] Includes (number of active mills in parentheses) Arizona (1), California (1), Colorado (2 in 1951), Georgia (1 in 1949–50), Illinois (1), New Hampshire (3 in 1949, 2 in 1950), New York (3 in 1949, 1 in 1950), South Dakota (2), and Virginia (2 in 1949–50).

The percentage of total shipments from several States was: North Carolina-Tennessee, 43 percent (45 percent in 1950); Georgia-Virginia, 11 percent; New York-New Hampshire, 7 percent; Connecticut-New Jersey, 6 percent (same in 1950); and Maine, 5 percent (4 percent in 1950).

The Appalachian Minerals Co., Monticello, Ga., lost its plant by fire in November 1951 and was not expected to resume operations until the early part of 1953. The feldspar quarries worked by this company were among the few deposits of high potash spar in operation in the United States.

CONSUMPTION AND USES

CRUDE FELDSPAR

Many merchant grinders also mine feldspar, either themselves or through affiliated firms. A large part of their supply of crude feldspar, however, is obtained from small operators who sell their product principally to the merchant mills. The tonnage of feldspar and feldspathic rock treated in flotation plants is increasing.

Most of the consumers of feldspar buy material already ground, sized, and ready for use in their products. Some pottery, enamel, and soap manufacturers, however, purchase all or part of their requirements crude and crush, or grind it to their own specifications in their own mills. Some Canadian crude feldspar is purchased direct by consumers in this country. Manufacturers of artificial teeth annually consume a small tonnage of very carefully selected crude feldspar, which must be free from grit and is marketed at a considerable premium over No. 1 grade commercial feldspar.

GROUND FELDSPAR

The glass, pottery, and enamel industries consumed 99 percent of all ground feldspar in 1951 compared with a like percentage in 1950 and 1949. In 1951, glass accounted for 43 percent, pottery 51 percent, enamel 5 percent, and other industries, including soaps and abrasives, the remaining 1 percent. The tonnage shipped to the pottery industry increased 17 percent, but shipments to the enamel industry decreased 34 percent and to the glass industry 7 percent. Shipments to all other industries using ground feldspar increased about 14 percent in 1951.

TABLE 6.—Ground feldspar sold by merchant mills in the United States, 1949–51, by uses

Use	1949		1950		1951	
	Short tons	Percent of total	Short tons	Percent of total	Short tons	Percent of total
Ceramic:						
Glass	199,852	51.7	212,481	47.6	197,483	43.4
Pottery	158,218	40.9	197,817	44.3	231,725	51.0
Enamel	25,351	6.6	33,037	7.4	21,778	4.8
Other ceramic uses	30	(1)				
Soaps and abrasives	3,142	.8	3,028	.7	2,832	.6
Other uses	114	(1)	160	(1)	797	.2
Total	386,707	100.0	446,523	100.0	454,615	100.0

[1] Less than 0.05 percent.

The percentage of total consumption for the principal States in 1951 was as follows, the comparable 1950 figures being shown in parentheses: Ohio, 15 percent (15 percent); Pennsylvania, 13 percent (13

percent); Illinois, 12 percent (13 percent); New Jersey, 12 percent (12 percent); West Virginia, 8 percent (8 percent); and New York, 7 percent (5 percent).

Shipments to all States held their own in 1951, except for slight decreases in Indiana, Maryland, and Tennessee.

Names and addresses of merchant grinders of feldspar in the United States are listed below:

Abingdon Potteries, Inc., Abingdon, Ill.
Appalachian Minerals Co., Monticello, Ga.
Black Hills Tin Co., Tinton, S. Dak.
Carolina Mineral Co., Inc., Kona, N. C.
Clinchfield Sand & Feldspar Corp., 618 Mercantile Bldg., Baltimore, Md.
Consolidated Feldspar Corp., Trenton Trust Bldg., Trenton, N. J.
Eureka Mica Mining & Milling Co., Portland, Conn. (Eureka Flint & Spar Co., Inc., 190 West State St., Trenton, N. J., sales agent).
Feldspar Flotation, Inc., Spruce Pine, N. C.
Feldspar Milling Co., Burnsville, N. C.
Genesee Feldspar Co., 3600 Boxart St., Rochester 12, N. Y.
Golding-Keene Co., 1401 New York Ave., Trenton, N. J.
J. F. Morton, Inc., P. O. Box 246, Bellows Falls, Vt.
North Carolina Feldspar Corp., Erwin, Tenn.
Northern Feldspars Corp., West Rumney, N. H.
Standard Flint & Spar Corp., New York Ave., Trenton 8, N. J.
Topsham Feldspar Co., Topsham, Maine.
United Feldspar & Minerals Corp., 10 East 40th St., New York 16, N. Y.
Western Feldspar Milling Co., 1333 W. Maple Ave., Denver, Colo.
Worth Spar Co., P. O. Box 763, Middletown, Conn.

Aplite

Carolina Mineral Co., Inc., Kona, N. C.
Dominion Minerals, Inc., Piney River, Va.

TABLE 7.—Ground feldspar shipped from merchant mills in the United States 1946–51, by State of destination, in short tons

Destination	1946	1947	1948	1949	1950	1951
California	8,641	7,395	8,406	8,385	(1)	(1)
Illinois	68,737	72,212	66,064	51,202	56,513	53,940
Indiana	47,756	44,864	37,774	25,962	28,875	25,692
Maryland	18,374	19,531	19,832	16,371	20,861	19,109
Massachusetts	3,009	3,906	4,437	1,944	5,733	6,176
New Jersey	41,340	43,969	52,587	44,243	53,430	54,968
New York	19,420	20,279	20,887	19,900	22,362	31,086
Ohio	47,031	63,939	64,805	52,533	68,186	70,245
Oklahoma	14,411	13,248	13,315	15,722	(1)	(1)
Pennsylvania	70,706	84,026	87,021	57,160	57,190	60,306
Tennessee	18,337	10,263	10,211	7,917	11,202	10,679
West Virginia	66,024	51,129	60,310	30,393	37,246	37,062
Wisconsin	10,317	9,958	11,741	10,749	12,580	11,558
Other destinations [2]	36,096	37,981	49,061	44,226	72,345	73,794
Total	470,199	482,700	506,451	386,707	446,523	454,615

[1] Included with "Other destinations"; separate figure for State not available.
[2] Includes Arkansas, California (1950–51), Colorado, Connecticut, Kentucky, Louisiana, Michigan, Minnesota, Mississippi, Missouri, Oklahoma (1950–51), Puerto Rico (1946–50), Rhode Island, Texas, Washington (1946–50), shipments that cannot be segregated by States, and small shipments to Canada, England, Mexico, and other countries. Also includes specified shipments to Alabama (1949), District of Columbia (1947), Florida (1949), Iowa (1947), Kansas (1948), Maine (1948 and 1950), and North Carolina (1947).

PRICES

Quotations of prices for crude feldspar do not appear in the trade press. Average values are computed from the returns of producers reporting their output annually to the Bureau of Mines. In 1951

the average selling price per long ton for all feldspar mined in the United States was $7.03 compared with $6.27 in 1950 and $6.17 in 1949.

The average realization per short ton for ground feldspar in 1951 was $15.25, an increase of over 7 percent from 1950. Of the large producing States, the State having the highest average value per short ton was New Jersey ($26.64), followed by New York ($23.40) and Illinois ($20.47). The lowest average value per short ton was for Colorado ($11.11).

Quotations on ground feldspar appearing in E&MJ Metal and Mineral Market reports for 1951 were the same as in 1949 and 1950 as follows: North Carolina, bulk carlots, 200-mesh, $18.50 per short ton; 325-mesh, $22.50; glass feldspar, No. 18, $12.50; and semigranular, $11.75 (add $3.00 per ton to bulk quotation for bags and bagging). Virginia feldspar presented the same price picture in 1951 as in 1949 and 1950, as follows: No. 1, 230-mesh, $18.50 per ton, and 200-mesh, $17.50; No. 17 glassmakers' feldspar, $11.75, and No. 18, $12.50. Enamelers' feldspar was listed at $15 to $18 throughout 1951.

FOREIGN TRADE [1]

Imports for consumption of crude feldspar in 1951 totaled 17,128 long tons (all from Canada), valued at $146,565. Compared with 1950, there was a 38-percent increase in tonnage and a 74-percent increase in value. This tonnage of crude feldspar imported was the largest since 1948.

TABLE 8.—Feldspar imported for consumption in the United States, 1946–51

[U. S. Department of Commerce]

Year	Crude		Ground		Year	Crude		Ground	
	Long tons	Value	Long tons	Value		Long tons	Value	Long tons	Value
1946	16,365	$127,517	(1)	$2	1949	15,826	$107,925		
1947	16,685	124,587			1950	12,367	84,136		
1948	31,047	219,785	(1)	328	1951	17,128	146,565	(1)	$26

[1] Less than 0.5 ton.

Ground feldspar exported from the United States, as reported by merchant grinders in 1951, totaled 2,406 short tons, a drop of 41 percent below 1950. Countries of destination were Mexico, Canada, and the United Kingdom.

Cornwall Stone.—Unmanufactured cornwall-stone imports for consumption for 1951 amounted to 944 long tons compared to 1,128 long tons for 1950. Imports of ground cornwall stone were 110 long tons for 1951, about the same as for 1950. The source of imports, either crude or ground, is the United Kingdom.

[1] Figures on imports are compiled by M. B. Price and E. D. Page of the Bureau of Mines, from records of the United States Department of Commerce.

TABLE 9.—Cornwall stone imported for consumption in the United States, 1946–51

[U. S. Department of Commerce]

Year	Unmanufactured		Ground		Year	Unmanufactured		Ground	
	Long tons	Value	Long tons	Value		Long tons	Value	Long tons	Value
1946	456	$6,031	80	$1,806	1949	772	$11,200	20	$572
1947	706	9,522	148	3,124	1950	1,128	11,792	111	2,160
1948	1,124	15,633	117	2,719	1951	944	9,453	110	3,462

NEPHELINE SYENITE

Nepheline syenite is a quartz-free crystalline rock consisting largely of nephelite and albite and microcline feldspar. Impurities may be iron-bearing minerals, such as black mica and magnetite, and other minerals, such as zircon and corundum. Used originally almost entirely in glass manufacture, substantial quantities now are consumed in making pottery.

Domestic Deposits.—Nepheline syenite occurs in New Jersey, Arkansas, and other localities in the United States, but all the domestic material found thus far in any appreciable tonnage has contained too much iron for ceramic purposes. A thorough study of the Arkansas syenite was initiated in 1950 to determine a method for removing the iron-bearing minerals.[2]

Uses.—Since its first known commercial use about 15 years ago, nepheline syenite has found wide application in the ceramic industry. In the whiteware industry it is used both as a body and as a glaze ingredient for sanitary and electrical porcelain, semivitreous dinnerware, hotel china, fine translucent china, floor- and wall-tile, art pottery, porcelain liners and balls, and kitchenware. The glass industry favors its use because of its high alumina content. In enamels nepheline syenite is used as a frit ingredient in ground and cover coats for sheet steel and cast iron. It is used as a mill addition material for ground-coat enamels. Other industrial applications include its use as a fired bond in abrasive grinding wheels and as an intermediate bond for refractory cements.

Prices.—Quotations on crude nepheline syenite are not reported in trade journals; for years before 1951 the average values per ton of imports for consumption into the United States were taken as an approximation of the crude value for this material. However, the average value of imports for 1951 cannot be taken to be representative of crude values in general because of the small tonnage imported. Only small scattered shipments of crude material were imported in 1951, because the American Nepheline, Ltd., of Ontario, Canada, had closed its grinding plant at Rochester, N. Y., the only syenite grinding plant in the United States. According to the Oil, Paint and Drug Reporter for December 1951, quotations on ground nepheline syenite were as follows: Glass grade (24-mesh), bulk, f.o.b. Rochester, N. Y., $14.25; and pottery grade (200-mesh), bulk, f.o.b. Rochester, N. Y., $18.25. These prices were the same as in December 1950.

Foreign Trade.—Imports of crude nepheline syenite decreased 97 percent from 1950, while imports of ground material increased 21

[2] Manufacturers Record, vol. 120, No. 2, February 1951, p. 76.

percent. The average value per ton (foreign market value) of ground nepheline syenite imported was $14.23 in 1951. Canada was the sole supplier of both crude and ground material.

TABLE 10.—Nepheline syenite imported for consumption in the United States 1946–51

[U. S. Department of Commerce]

Year	Crude		Ground		Year	Crude		Ground	
	Short tons	Value	Short tons	Value		Short tons	Value	Short tons	Value
1946	51,852	$206,613	1,018	$11,137	1949	41,215	$167,567	18,779	$248,224
1947	54,382	194,283			1950	8,966	36,453	54,242	703,008
1948	53,570	214,747	7 577	130,860	1951	251	3,595	65,522	932,661

Canada.—The American Nepheline, Ltd., Lakefield, Ontario, Canada, instituted a large expansion of production facilities which would make available an additional 2,000 tons per month of glass and pottery grade material to take care of the steadily increasing demand.[3] The history of this company and the details of the expansion program were given in an article published in 1951.[4]

Europe and Asia.—Deposits of nepheline syenite are known to exist in U. S. S. R. and have been tested for use in the ceramic industry, but production data are not available. Deposits in India and Finland have been reported, but no development work has been recorded.

APLITE

The tonnage of aplite produced in 1951, as well as its value, showed slight decreases under 1950. The only producers of aplite were Dominion Minerals, Inc., Piney River, Va., and Carolina Mineral Co., Inc., Kona, N. C. The operations were in Amherst and Nelson Counties, Va., near Piney River. The Bureau of Mines is not at liberty to publish production or sales data.

New York State College of Ceramics reported substantial progress on aplite research. Aplite appeared to have wider prospective markets in the glass field.

TECHNOLOGY

Although the feldspars vary considerably in chemical composition, their structural form is quite simple, and the properties of the various groups are explained by crystal chemistry concepts.[5]

The practice of froth flotation in the feldspar industry is increasing. A plant to produce 20-mesh glass-grade feldspar with a capacity of 3,500 short tons per month began operations at Spruce Pine, N. C., in August 1951.[6] The demand for high potash feldspar has encouraged the use of flotation in processing feldspar in pegmatite dikes.[7] The origin, classification, and uses of feldspar were discussed in a 1951 article.[8]

[3] The Glass Industry, vol. 32, No. 3, March 1951, p. 147.
[4] Trauffer, Walta E., American Nepheline's Output Upped: Pit and Quarry, vol. 44, No. 5, November 1951, pp. 90–94.
[5] Hauth, W. E. Jr., Crystal Chemistry: Ceramic Bull., vol. 30, No. 4, April 1951, pp. 137–139.
[6] Rock Products, vol. 54, No. 5, May 1951, p. 87; Mining World, vol. 13, No. 6, p. 74.
[7] Mining Engineering, vol. 190, No. 2, February 1951, p. 131.
[8] Fliener, Frank L. and Wilson, Ben Hur, News item: Mineralogist, vol. 19, No. 6, June 1951, pp. 290–296.

WORLD REVIEW

The estimated world production of feldspar in 1951, as shown in table 11, was 725,000 metric tons, an increase of 4 percent compared with 1950. The output of China and U. S. S. R., for which no data are available, was not included in the total.

The production of feldspar in the United States and some other world production districts decreased. Countries showing increases were Argentina, Canada, France, Italy, Japan, and Norway. The ratio of United States output to estimated world output in 1951 was 56 percent compared with 59 percent in 1950. The Department of Natural Resources of Canada announced analysis of samples from Saskatchewan's first major feldspar discovery showed it to be high-quality feldspar suitable for the manufacture of pottery and glass.[9]

TABLE 11.—World production of feldspar, 1947–51, by countries, in metric tons[1]

[Compiled by Helen L. Hunt]

Country[1]	1947	1948	1949	1950	1951
Argentina (shipments)	5,000	(2)	(2)	(2)	(2)
Australia[3]	8,566	9,767	10,902	[4] 13,276	14,328
Austria	951	[4] 1,106	1,912	3,802	3,751
Brazil	(2)	189	11,111	[5] 12,000	(2)
Canada (shipments)	32,753	49,760	33,518	[4] 32,248	33,224
Chile	217	885	125	871	(2)
Eritrea	150	300	200		
Finland	6,781	6,064	10,074	8,000	(2)
France	44,104	55,343	45,000	42,000	66,000
Germany, West	21,251	32,921	49,544	57,899	46,095
India	1,750	1,003	863	1,800	(2)
Israel	19	(2)	(2)	(2)	(2)
Italy	[4] 10,031	[4] 15,309	[4] 13,522	14,254	22,630
Japan	21,496	[6] 25,077	[6] 20,055	[4] 13,187	[6] 26,528
Kenya	36	10	20		
Norway	22,140	33,117	[4] 27,482	[4] 23,695	24,000
Peru	29	210	300		(2)
Portugal	1,137	1,560	1,240	(2)	(2)
Southern Rhodesia				3,520	1,148
Spain (quarry)[7]	3,333	6,600	396	1,650	800
Sweden	37,953	38,687	38,959	(2)	(2)
Union of South Africa	1,676	[4] 2,574	[4] 3,549	[4] 6,001	3,343
United States (sold or used)	467,292	468,107	375,307	414,472	406,866
Uruguay	843	4,877	811	710	675
Total (estimate)	700,000	[4] 770,000	[4] 660,000	[4] 700,000	725,000

[1] In addition to countries listed, feldspar is produced in China, Czechoslovakia, Rumania, and U. S. S. R., but data are not available, and no estimates are included in the total except for Rumania and Czechoslovakia.
[2] Data not available; estimate by author of chapter included in total.
[3] Includes some china stone.
[4] Revised figure.
[5] Estimate.
[6] In addition, the following quantities of aplite and other feldspathic rock were produced: 1948: 35,840 tons; 1949: 50,943 tons; 1950: 45,679 tons; and 1951: 59,919 tons.
[7] There is some additional production of feldspar, but comparable figures are not available.

[9] The Glass Industry, vol. 32, No. 1, January 1951, p. 32; Rock Products, vol. 54, No. 3, March 1951, p. 122.

Ferroalloys

By Robert W. Geehan



GENERAL SUMMARY

NEW HIGHS in production and shipments of ferroalloys reached in 1951 reflected increased steel production and particularly the increased demand for and production of alloy steels. Imports of ferroalloys and of the ores needed to produce them increased. Domestic production of these ores also was higher than in 1950. However, demand levels exceeded the supply of many alloying metals; this led to allocations and use restrictions. The value of shipments of ferroalloys in 1951 was $411,294,096.

The ores used to produce ferroalloys are discussed in detail in the following chapters of this volume dealing with particular metals: Chromium, Manganese, Molybdenum, Titanium, Tungsten, Vanadium, and Minor Metals. Cobalt and nickel, which are ordinarily used in alloy steels without the preliminary ferroalloy stage, are also discussed in separate chapters.

PRODUCTION AND SHIPMENTS

Production of ferroalloys reached a new high in 1951 with a total of 2,193,750 short tons. This compares with a previous high of 2,032,980 tons in 1943 and with 1,871,000 tons in 1950 and represents a 17-percent increase over the 1950 production. In 1951 ferroalloys were made in 12 blast-furnace plants, 33 electric-furnace plants, and 2 aluminothermic-furnace plants. Shipments of all classes of ferroalloys from furnaces increased 11 percent in quantity and 22 percent in value over 1950.

Pennsylvania again led all other States in quantity of production (31 percent), shipments (31 percent), and value of shipments (36 percent) of United States ferroalloy transactions. New York followed Pennsylvania in production and value of shipments, but Ohio had the second largest quantity of shipments in 1951. Production and shipments of ferroalloys also were reported from Alabama, California, Florida, Indiana, Idaho, Iowa, Kentucky, Montana, New Jersey, Oregon, South Carolina, Tennessee, Virginia, Washington, and West Virginia.

Ferroalloys containing manganese are used to remove oxygen and sulfur from steel, but their most important function is to provide manganese in amounts sufficient to combine with any sulfur that remains in the steel. Steel containing sulfur becomes brittle when hot; if the sulfur is combined with manganese it forms relatively harmless segregations and the difficulties in hot-working are minimized. As sulfur is present in the raw materials from which nearly all steel is produced, nearly all steel requires manganese. Another important use is in the production of manganese-type alloy steels and castings.

TABLE 1.—Ferroalloys produced and shipped from furnaces in the United States, 1950–51

Alloy	1950			1951		
	Production (short tons)	Shipments		Production (short tons)	Shipments	
		Short tons	Value		Short tons	Value
Ferromanganese	719,680	731,421	$116,043,055	791,260	795,745	$122,346,198
Spiegeleisen	42,375	65,163	3,875,823	77,017	79,168	5,368,989
Ferrosilicon	742,407	795,072	75,984,345	861,889	846,111	93,668,232
Ferrophosphorus	50,288	60,502	1,368,548	52,145	67,891	1,573,215
Ferrotungsten	721	1,064	3,818,904	1,491	1,458	9,454,342
Ferrotitanium	8,772	9,411		12,261	12,165	
Ferrovanadium						
Ferromolybdenum						
Molybdic oxide	25,626	29,720	136,040,609	33,133	34,893	178,883,120
Calcium molybdate and compounds						
Other ferroalloys [1]	281,131	289,863		364,557	369,919	
Total	1,871,000	1,982,216	337,131,284	2,193,753	2,207,350	411,294,096

[1] Silicomanganese, manganese briquets, ferrochromium, ferrocolumbium, ferroboron, zirconium-ferrosilicon, and miscellaneous ferroalloys.

Ferroalloys containing silicon have uses similar to those containing manganese; both may be considered scavengers, in that they either remove objectionable impurities or render them relatively harmless, and both are used to produce alloys. Silicon compounds are used mainly to remove oxygen from steel, and the consumption follows the trend for total steel production. Both silicon and manganese are frequently added to the same heat of steel; silico-manganese is often used when the combined action is desired. Silicon metal is not a ferroalloy but is included in this chapter because it has similar uses.

Ferromanganese.—The ferromanganese produced in 1951 averaged 76.05 percent manganese, a decrease of 0.91 percent from 1950, and came from 8 electric-furnace and 8 blast-furnace plants; this was an increase of 2 electric-furnace plants over 1950. Of the manganese ore used in 1951 for manufacturing ferromanganese, 93 percent was foreign, the same percentage as in 1950. The steel industry consumed nearly all of the ferromanganese used in 1951.

Canada replaced Norway as the source of the largest amount of imported ferromanganese in 1951, while Norway and France continued to be important sources, and very small quantities were received from Germany, Japan, and Yugoslavia. Expansions of plant facilities were described.[1]

[1] Daily Metal Reporter, Tenn-Tex Alloy To Build New Ferromanganese Plant: Vol. 51, No. 201, Oct. 19 1951, p. 1.
Bureau of Mines Mineral Trade Notes, Manganese in Chile: Vol. 32, No. 6, June 1951, p. 15.
Bureau of Mines Mineral Trade Notes, Manganese in Portugal: Vol. 32, No. 5, May 1951, p. 27.
Mining Journal (London), Manganese in India: Vol. 32, No. 6039, May 18, 1951, p. 476.
Mining World, Mexico: Vol. 13, No. 6, May 1951, p. 52.

TABLE 2.—Producers of ferroalloys in the United States in 1951

Producer	Plant	Alloy
American Agricultural Chemical Co.	South Amboy, N. J.	Ferrophosphorus (byproduct).
Anaconda Copper Mining Co	Anaconda, Mont. Black Eagle, Mont.	Ferromanganese.
Bethlehem Steel Co	Johnstown, Pa.	Do.
Climax Molybdenum Co	Langeloth, Pa.	Ferromolybdenum, calcium molybdate, molybdenum oxide, molybdenum silicide, ammonium molybdate, oxide briquets, molybdenum trioxide, sodium molybdate, cobalt molybdenum, molybdenum sulfide.
Electro Metallurgical Co	Alloy, W. Va. Ashtabula, Ohio Columbiana, Ohio Holcomb Rock, Va. Niagara Falls, N. Y. Portland, Oreg. Sheffield, Ala.	Ferromanganese, silicomanganese, manganese briquets, ferrosilicon, silicon briquets, zirconium-ferrosilicon, ferrochromium, chromium briquets, ferrotungsten, ferrovanadium, ferroboron, ferrocolumbium, ferrotitanium.
General Abrasive Co., Inc.	Niagara Falls, N. Y.	Ferrosilicon (byproduct).
Globe Iron Co	Jackson, Ohio	Silvery pig iron.
Hanna Furnace Corp	Buffalo, N. Y.	Do.
Inland Steel Co	E. Chicago, Ind.	Spiegeleisen.
Jackson Iron & Steel Co	Jackson, Ohio	Silvery pig iron.
Kaiser Aluminum & Chemical Corp.	Permanente, Calif.	Ferrosilicon.
Keokuk Electro-Metals Co	Keokuk, Iowa Wenatchee, Wash.	Ferrosilicon, silvery pig iron.
E. J. Lavino & Co	Reusens, Va. Sheridan, Pa.	Ferromanganese.
Metal & Thermit Corp	Carteret, N. J.	Ferrotitanium.
Molybdenum Corp. of America	Washington, Pa.	Ferrotungsten, ferromolybdenum, molybdic oxide, ferroboron, manganese boride, calcium molybdate.
Monsanto Chemical Co	Anniston, Ala. Columbia, Tenn.	Ferrosilicon (byproduct), ferrophosphorus (byproduct).
New Jersey Zinc Co	Palmerton, Pa.	Spiegeleisen, ferromanganese.
Ohio Ferro-Alloys Co	Philo, Ohio Tacoma, Wash.	Ferrosilicon, simanal, ferrochromium, ferrosilicon boron.
Oldbury Electro-Chemical Co	Niagara Falls, N. Y.	Ferrophosphorus (byproduct).
Pacific Northwest Alloys, Inc.	Mead, Wash.	Ferrosilicon, ferrochromium, ferrochrome silicon.
Pittsburgh Metallurgical Co	Calvert City, Ky. Charleston, S. C. Niagara Falls, N. Y.	Ferrosilicon, silvery pig iron, ferrochromium, ferrochrome silicon.
Tennessee Products & Chemical Corp. (Southern Ferro-Alloys Div.).	Chattanooga, Tenn.	Ferromanganese, manganese briquets, ferrosilicon, silicon briquets.
Tennessee Valley Authority	Muscle Shoals, Ala.	Ferrophosphorus (byproduct).
Titanium Alloy Mfg. Div., National Lead Co.	Niagara Falls, N. Y.	Ferrotitanium, ferrocarbontitanium.
U. S. Steel Corp. subsidiaries	Clairton, Pa. Etna, Pa. Duquesne, Pa. Ensley, Ala.	Ferromanganese, speigeleisen.
Vanadium Corp. of America	Niagara Falls, N. Y. Bridgeville, Pa.	Ferrosilicon, silicon briquets, alsifer, ferrochromium, ferrochromium briquets, ferrovanadium, ferrotitanium, grainals, ammonium meta vanadate, titanium aluminum, ferrocarbontitanium, cupro vanadium, manganese vanadium, alumino vanadium.
Victor Chemical Works	Mt. Pleasant, Tenn.	Ferrophosphorus (byproduct).
Virginia-Carolina Chemical Corp.	Nichols, Fla. Charleston, S. C.	Do.
Westvaco Chemical Div., Food Machinery & Chemical Corp.	Pocatello, Idaho	Do.

Spiegeleisen.—Production of this alloy increased 82 percent in 1951 as compared to 1950; this is the first increase in the production of this alloy since 1947. Spiegeleisen is in effect a high (15 to 30 percent) manganese pig iron containing 4.5 to 6.5 percent carbon; it is made from the lower grade manganese-bearing material.

Silicomanganese.—The silicomanganese produced in 1951 averaged 67 percent manganese. This alloy is used to introduce manganese into low-carbon killed steels because of its low carbon-manganese ratio.

Manganese Briquets.—Manganese briquets are made from ferromanganese or silicomanganese that has been crushed and bonded into briquets containing 2 pounds of manganese.

Ferrosilicon.—From the standpoint of tonnage, more ferrosilicon is produced than any other ferroalloy. Ferrosilicon production and shipments, listed in table 1, includes silvery pig iron, ferrosilicon of various grades, and ferrosilicon briquets. The average percent of silicon content of these products in 1951 was 9.3, 40, and 40, respectively. Silvery pig iron is produced in blast furnaces, ferrosilicon is manufactured in electric furnaces, and ferrosilicon briquets are produced from the latter and are standardized as to silicon content.

TABLE 3.—Consumption of ferrosilicon, silicon metal, and miscellaneous silicon alloys in the United States in 1951, by end use, in short tons

Alloy	Percent silicon content	Steel ingots and castings [1]	Steel castings [1]	Iron-foundry and miscellaneous	Total
Silvery pig iron	5–13	12,742	21,357	197,529	231,628
Do	14–20	60,618	9,931	126,827	197,376
Ferrosilicon	[2] 21–55	168,135	21,996	23,229	213,360
Do	56–70	19,576	371	559	20,506
Do	71–80	45,174	1,289	11.757	58,220
Do	81–89	4,610	81	1,966	6,657
Do	90–95	6,005	121	1,990	8,116
Silicon metal or refined silicon		8	5	11,936	11,949
Other silicon alloys [3]		24,641	5,357	48,675	78,673
Total		341,509	60,508	424,468	826,485

[1] Data for castings made by companies that also produce steel ingots are included with "Steel ingots and castings" and excluded from "Steel castings."
[2] Nearly all this material is in the range from 40 to 55 percent silicon.
[3] Including Sil-X, alsifer, and ferrosilicon briquets.

Table 3 lists the various grades of ferrosilicon and the silicon metal consumed, along with a breakdown of the end use based on a tabulation that lists the entire consumption of each reporting plant under the most important use at that location. Silvery pig iron is used chiefly by iron foundries. Standard-grade ferrosilicon (about 50 percent silicon), consumed mainly by the steel industry, is used as a deoxidizer and solidifier in manufacturing most grades of killed and semikilled steel. The higher grade alloys are used in ladle additions in gray-iron foundries, in the manufacture of high-silicon steel for use in electrical equipment and spring steel, and in plants producing magnesium by the ferrosilicon method. Ferrosilicon briquets are used at both steel plants and iron foundries. Silicon alloys containing other elements are produced for special uses.

Silicon Metal.—Nearly three-quarters of the silicon metal consumed is used by the aluminum industry. Much of the remainder is used at plants producing "silicone" products and at establishments manufacturing low-carbon alloys.

Ferrophosphorus.—All ferrophosphorus in 1951 was produced in electric furnaces as a byproduct in the manufacture of phosphate fertilizers and other chemicals. Ferrophosphorus is used primarily as an addition agent in manufacturing certain open-hearth sheet steels to prevent sticking of sheets on packrolling. Exports were at a new high level of 55,044 tons; the previous high was 52,988 tons in 1948.

Ferrotungsten.—The ferrotungsten produced in the United States during 1951 was made in electric furnaces from both foreign and domestic ores. The total consumption of tungsten concentrates in the United States during the year was 11,989 short tons (60 percent WO_3 basis), 2,310 tons of which was consumed in manufacturing ferrotungsten. This product is mainly used as a source of tungsten in high-speed steels. However, the present practice in the industry is to charge high-purity scheelite concentrates to supply much of the needed tungsten and to use ferrotungsten to bring the tungsten up to exact specifications.

Ferrochromium.—All ferrochromium produced in the United States in 1951 was made in electric furnaces, chiefly from foreign ores. Ferrochromes are divided into two main classes—high-carbon, containing 65 to 70 percent chromium with carbon contents ranging from 4.5 percent to 8.5 percent in the various grades; and low-carbon, containing 67 to 72 percent chromium with carbon ranging from a maximum of 0.03 percent to 2.00 percent. Special ferrochromes, such as nitrogen-bearing and silicon-manganese ferrochromes are manufactured for special uses. The low-carbon grades of ferrochromium are used in the stainless steels and high-temperature alloys, which contain relatively high percentages of chromium and low percentages of carbon, and the high-carbon grades in other types of chromium-bearing steels. Reported consumption of ferrochromium in the United States in 1951 was 195,307 short tons compared with 147,911 tons in 1950 and 87,764 tons in 1949. This consumption was reported by consumers that normally use about 85 percent of the total. Imports increased 18 percent over those of 1950, but exports declined 31 percent in the same period.

Ferrochrome Silicon.—During 1951 there was an increased use of ferrochrome silicon. This product, also referred to as chrome silicide, is sold at lower prices, in terms of chromium content, than low-carbon ferrochromium. A similar alloy, containing aluminum in addition to the chromium and silicon, is also produced; still another variation contains sodium nitrate.

Ferromolybdenum.—The ferromolybdenum produced in 1951 was made by the aluminothermic and electric furnace processes and used domestic concentrates. The alloy was produced in only two plants during the year. The average molybdenum content of the material produced in 1951 was 61 percent.

Molybdic Oxide, Calcium Molybdate, and Other Molybdenum Compounds.—Molybdenum compounds used as alloying agents in the production of iron and steel are included with ferroalloys. These materials are used more extensively than ferromolybdenum because of their lower cost.

Ferrotitanium.—Most of the ferrotitanium in 1951 was produced in electric furnaces, but a small quantity was made by the aluminothermic process. The ferrotitanium produced in 1951 contained a higher percentage of titanium than in the preceding year, the average of all grades in 1951 being 24.5 percent Ti compared with 24.0 percent in 1950. Both foreign and domestic ores of titanium (ilmenite and rutile) were consumed in its manufacture. A number of grades of ferrotitanium are available for use in steel making. The low-carbon grades are used chiefly in manufacturing stabilized austenitic stainless

steels to render them resistant to intergranular corrosion in service. The high-carbon grades are used as deoxidizers and scavengers. In medium- and high-carbon killed steels the higher-carbon varieties of ferrotitanium are used as the final deoxidizer to prevent segregation and the occurrence of objectionable inclusions, and in some cases to control grain size.

Ferrovanadium.—Nearly all the ferrovanadium produced in 1951 was made in electric furnaces, but a small amount was produced by the aluminothermic method. Both foreign and domestic ores were used. This alloy averaged 53.5 percent vanadium in 1951, compared with 53 percent in 1950 and 50 percent in 1949. Up to 0.10 to 0.25 percent of vanadium is added to engineering steels—usually to the ladle in open-hearth practice and to the furnace in basic electric practice. In high-speed steels the percentage ranges from approximately 1.00 to 2.50 percent, and some steels are made with a higher vanadium content. Vanadium is also employed to prevent age hardening in low-carbon rimmed steels.

Ferrocolumbium.—Columbium is used chiefly in manufacturing stabilized austenitic stainless (Cr–Ni) steels. It is also employed to reduce the air hardening characteristic of straight chromium steels of the corrosion-resistant type. In both 1950 and 1951 the output of ferrocolumbium averaged 56 percent columbium compared with 57 percent in 1949 and was produced in electric furnaces.

Zirconium-Ferrosilicon.—The zirconium-ferrosilicon produced in 1951 averaged 14 percent Zr, as in the previous year. Zirconium, a deoxidizer and scavenger, combines readily with oxygen, nitrogen, and sulfur, eliminating them from the steel bath or minimizing their effect. Formation of zirconium nitride reduces age hardening in deep-drawing steels; and the formation of zirconium sulfide, as with manganese sulfide, diminishes hot shortness. The addition of over 0.10 percent zirconium to steels usually results in grain refinement. The alloy is used in place of ordinary ferrosilicon but is more effective for the purposes stated.

Ferroboron.—The scarcity of many of the elements used in ferroalloys was an added factor in the development of boron steels during 1951, and the production of ferroboron in 1951 was eight times that of 1950. Boron is used in steel to increase the hardenability—the depth to which the steel will harden when quenched. The amount of boron added is ordinarily only a few thousandths of 1 percent, and it is most effective in the lower carbon steels. Boron can replace part of the other alloying elements, such as manganese, chromium, molybdenum, and nickel, if they are intended only to aid hardenability, but does not provide effects such as retarding softening or resisting creep at elevated temperatures. The uses of boron steel were described in several technical articles.[2]

[2] Brown, D. I., Boron Steels—Only Hope for Civilian Users: Iron Age, vol. 167, No. 25, June 21, 1951, pp. 107 and 108.
Patton, Walter, Use in Steel Alloys Grows: Iron Age, vol. 168, No. 11, Sept. 13, 1951, p. 106.
Wray, Porter R., Boron Steels for Constructional Parts and for Carburizing: Metal Progress, vol. 80, No. 1, July 1951, pp. 52–55.
Materials and Methods, The Role of Boron Steels in the Present Emergency: Vol. 34, No. 2 August 1951, pp. 57–60.
Brown, D. I., Boron Steels: Iron Age, vol. 168, Nos. 1, 2, 3, 4, 5, 6, July 5, 12, 19, 26, Aug. 9, 1951, pp. 79–85. 85–90. 102–106, 68–72, 75–80.

FOREIGN TRADE [3]

Canada, Norway, and France continued to be the important sources of ferromanganese. The original sources of the manganese ore used to produce the imported ferromanganese were largely French Morocco and the Gold Coast. Canada and Norway supplied most of the imports of ferrosilicon, Japan was the source of most of the imported ferrotungsten, and Canada and Sweden were the important sources of ferrochromium.

TABLE 4.—Ferroalloys and ferroalloy metals imported for consumption in the United States, 1950–51, by varieties

[U. S. Department of Commerce]

Variety of alloy	1950			1951		
	Gross weight (short tons)	Content (short tons)	Value	Gross weight (short tons)	Content (short tons)	Value
Calcium silicide	246	(1)	$11,479			
Chromium metal	59	(1)	88,057	93	(1)	$149,808
Chromium silicon				5	(1)	438
Ferrocerium and other cerium alloys				(2)	(1)	4,543
Ferrochrome or ferrochromium:						
Containing 3 percent or more carbon	21,633	[3] 12,718	4,167,546	24,255	14,370	5,209,687
Containing less than 3 percent of carbon	1,493	[3] 1,047	362,701	3,036	2,062	913,399
Ferrochromium tungsten, chromium tungsten, and chromium cobalt tungsten (tungsten content)	(1)	(4)	4,222	(1)	(5)	9,013
Ferromanganese:						
Containing not over 1 percent carbon	372	302	109,466	235	197	75,561
Containing over 1 and less than 4 percent carbon	23,440	19,304	5,059,189	18,924	15,618	4,426,898
Containing not less than 4 percent carbon	86,136	67,887	11,069,120	100,605	79,131	15,543,680
Ferromolybdenum, molybdenum metal and powder, calcium molybdate and other compounds and alloys of molybdenum (molybdenum content)				(1)	(6)	46
Ferrosilicon	14,742	3,785	797,588	29,482	10,997	2,532,821
Ferrosilicon-aluminum, ferroaluminum silicon, and alsimin	(7)	(1)	80	248	(1)	97,224
Ferrotitanium	[3] 126	(1)	[3] 69,458	248	(1)	147,478
Ferrotungsten	880	690	1,078,760	1,009	787	3,535,033
Ferrovanadium	65	(1)	91,193	62	(1)	100,261
Manganese-boron, manganese metal, and spiegeleisen not more than 1 percent carbon (manganese content)	(1)	57	16,614	(1)	(8)	91
Manganese silicon	(1)	142	25,794	(1)	106	28,165
Silicon-aluminum and aluminum-silicon				37	(1)	20,548
Silicon metal (silicon content)	(9)	(9)	517	169	164	54,590
Spiegeleisen	8,595	(1)	474,259			
Tungsten and combinations, in lump, grains, or powder:						
Tungsten metal (tungsten content)	(1)	105	322,131	(1)	43	141,206
Tungsten carbide (tungsten content)	(1)	(9)	164			
Combinations containing tungsten or tungsten carbide (tungsten content)	(1)	(10)	80			
Tungsten nickel, and other compounds of tungsten, n. s. p. f. (tungsten content)	(1)	(11)	132			
Tungstic acid and other alloys of tungsten, n. s. p. f. (tungsten content)	(1)	2	1,720	(1)	1	13,020

[1] Not recorded.
[2] 699 pounds.
[3] Revised figure.
[4] 134 pounds.
[5] 114 pounds.
[6] 70 pounds.
[7] 1,000 pounds.
[8] 100 pounds.
[9] 1 pound.
[10] 40 pounds.
[11] 32 pounds.

[3] Figures on imports and exports compiled by M. B. Price and E. D. Page, of the Bureau of Mines, from records of the U. S. Department of Commerce.

TABLE 5.—Ferromanganese and ferrosilicon imported for consumption in the United States, 1950–51, by countries

[U. S. Department of Commerce]

Country	Ferromanganese (manganese content)				Ferrosilicon (silicon content)			
	1950		1951		1950		1951	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Belgium-Luxembourg	169	$28,133						
Canada	19,100	3,315,823	52,878	$10,918,197	3,699	$787,241	8,942	$2,187,418
Chile	87	14,494						
France	15,533	2,578,054	10,444	1,714,963				
Germany	95	26,636	32	5,198				
Japan	504	80,467	133	22,773	86	10,347	59	21,066
Netherlands							11	4,189
Norway	48,378	9,542,794	31,344	7,358,514			1,985	320,148
Sweden	44	11,160						
U. S. S. R.	3,215	574,080						
United Kingdom	45	12,464						
Yugoslavia	323	53,670	115	26,494				
Total	87,493	16,237,775	94,946	20,046,139	3,785	797,588	10,997	2,532,821

TABLE 6.—Ferroalloys and ferroalloy metals exported from the United States, 1947–51, by varieties

[U. S. Department of Commerce]

Variety of alloy	1947		1948		1949		1950		1951	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Spiegeleisen	305	$12,632	51	$2,227			363	$21,351	85	$4,130
Ferrochrome	3,081	1,057,359	6,754	2,371,367	2,200	$942,792	347	134,341	240	96,635
Ferromanganese	20,168	2,811,653	19,696	2,990,645	6,627	1,360,279	580	139,876	633	206,614
Ferromolybdenum	477	630,813	594	806,420	478	718,722	589	927,271	742	1,224,257
Ferrophosphorus	34,535	919,877	52,988	1,310,260	5,050	168,205	42,789	868,480	55,044	2,218,790
Ferrosilicon	1,357	187,973	2,476	427,259	2,555	436,402	1,983	242,245	2,775	387,664
Ferrotitanium and ferrocarbon-titanium	509	80,590	480	82,874	179	40,918	171	42,741	175	107,718
Ferrotungsten	41	134,546	628	1,838,397	310	861,189	166	408,958	142	1,007,424
Ferrovanadium	89	266,040	119	390,428	97	350,558	41	183,307	61	190,346
Other ferroalloys	206	88,289	183	102,709	316	161,297	88	31,969	274	131,641
Total	60,768	6,189,772	83,969	10,322,586	17,812	5,040,362	47,117	3,000,539	60,171	5,575,219

Fluorspar and Cryolite

By Hubert W. Davis

GENERAL SUMMARY

RECORD consumption and imports of fluorspar, higher prices, reduction in rate of duty on acid-grade fluorspar, an increase in the rate for lower grade, and a shortage of acid-grade were outstanding features of the fluorspar industry in 1951.

Although shipments of fluorspar from mines in the United States established a postwar high and were 15 percent greater than in 1950, they fell far short of meeting industry's requirements. The deficit was met by imports, which established a new record and were 10 percent greater than in the former record year 1950. Record consumption of fluorspar at basic open-hearth steel and hydrofluoric-acid plants and a slight gain in consumers' stocks were chiefly responsible for the accelerated activity in fluorspar in 1951.

Illinois, which established a new record, maintained its rank as the premier producer of fluorspar in 1951 by supplying 59 percent of the total domestic shipments. Moreover, shipments from Illinois were 32 percent greater than in 1950 and 3 percent over 1943, the previous record year. Arizona, Colorado, Idaho, New Mexico, and Tennessee also shipped more fluorspar than in 1950, but Kentucky, Montana, Nevada, and Utah shipped less. Shipments from Idaho were reported for the first time, and the shipments from Tennessee were the first since 1943.

For the eleventh consecutive year, Mexico was the largest supplier of foreign fluorspar to the United States; however, it supplied proportionately less in 1951 than in recent years. Despite the fact that imports from Mexico were 12 percent less than in 1950, they were the third highest on record. Less fluorspar was also received from France and Spain. These losses, however, were more than offset by larger imports from Algeria, Canada, Germany, Italy, and Union of South Africa.

The steel industry, which set a new production record in 1951, continued to be the predominant user of fluorspar; and, despite the fact that its total consumption of fluorspar established a new record, it absorbed proportionately less (55.7 percent) of the total consumed in 1951 than in 1950 (56.5 percent). Use by the industry exceeded that in 1950 by 15 percent; and, because of the higher steel output in 1951 and the larger utilization of fluorspar per ton of steel made than in 1950, its total consumption exceeded the record made in 1942 by 14 percent. The average consumption of fluorspar per long ton of basic open-hearth steel produced was 5.8 pounds in 1951 com-

pared with 5.5 pounds in 1950 and 6.4 pounds in 1942. The hydrofluoric-acid industry—the second largest utilizer of fluorspar—consumed 22 percent more than in 1950 and 17 percent more than in the former record year 1944, or 31 percent of the total in 1951 compared with 29 percent in 1950. Consumption of fluorspar by the glass industry was greater, but less was used by the enamel trade.

Deliveries of fluorspar to steel plants in the United States increased to 287,031 short tons (271,869 tons in 1950), and those to glass and enamel plants rose to 43,624 (41,534 tons in 1950).

The average composite selling price ($40.15 a short ton) of all grades of fluorspar (both domestic and foreign) delivered to consumers in the United States in 1951 was $6.60 more than in 1950.

The total quantity of fluorspar shipped from mines and imported into the United States from about 1870 through 1951 was approximately 10,136,000 short tons—about 81 percent from domestic mines and 19 percent from foreign sources.

TABLE 1.—Salient statistics of fluorspar in the United States, 1942–51, in short tons

Year	Shipments from domestic mines	Foreign trade		Consumption	Industry stocks at end of year		
		Imports for consumption	Exports		Domestic mines [1]	Consumers' plants	Total
1942	360,316	2,151	9,020	360,800	19,429	96,000	115,429
1943	406,016	43,769	9,068	388,885	19,026	105,933	124,959
1944	413,781	87,200	1,980	410,170	19,021	98,446	117,467
1945	323,961	104,925	1,420	356,090	19,863	103,148	123,011
1946	277,940	29,852	1,729	303,190	18,957	98,663	117,620
1947	329,484	78,725	1,180	376,138	33,101	114,150	147,251
1948	331,749	111,626	666	406,269	37,344	146,869	184,213
1949	236,704	95,619	802	345,221	37,039	130,621	[2] 167,660
1950	301,510	164,634	740	426,121	19,038	164,685	[2] 183,723
1951	347,024	181,275	1,173	497,012	13,283	169,126	[2] 182,409

[1] Finished fluorspar only.
[2] In addition, importers held 11,000 tons in 1949, 7,500 tons in 1950, and 2,845 tons in 1951 (none in 1942–48).

PRODUCTION

Production of finished fluorspar totaled 341,300 short tons, including 183,624 tons of flotation concentrates; however, this output also included 2,300 tons of finished fluorspar recovered from milling crude ore that had been mined before 1951. Thus, total new production (expressed in terms of finished fluorspar) was 339,000 tons in 1951, compared with 274,100 tons in 1950. Of the mine output in 1951, 8 mines (producing over 10,000 tons each) supplied 142,300 tons or 42 percent; 11 mines (producing 5,000 to 10,000 tons each) supplied 86,700 tons or 26 percent; 29 mines (producing 1,000 to 5,000 tons each) supplied 74,900 tons or 22 percent; and 10 mines (producing 500 to 1,000 tons each) supplied 7,100 tons or 2 percent. Thus 58 mines produced 311,000 tons or 92 percent of the total. Of the remaining output (28,000 tons or 8 percent), some (in quantities ranging from a few tons to 500 tons) came from an undetermined

number of small mines and prospects, but much was derived from treated tailings from previous milling operations.

In 1951 mines operated by consumers produced 85,200 tons of finished fluorspar compared with 73,700 tons in 1950.

Fluorspar shipments from domestic mines in 1951 aggregated 347,024 short tons valued at $14,369,521, increases of 15 percent in quantity and 35 percent in value over 1950. Of the 1951 total, 63,290 tons was shipped by river or river-rail for delivery to consumers compared with 68,933 tons in 1950.

Illinois (59 percent) and Kentucky (20 percent) supplied 79 percent of the fluorspar shipped in 1951 compared with 78 percent in 1950. Shipments from Illinois and Kentucky were 16 percent more than in 1950 compared with a gain of 11 percent from other producing States.

The average value of all grades of domestic finished fluorspar shipped in 1951 ($41.41) established a new peak and was $6.19 more than the previous high in 1950.

Fluorspar shipments in 1951 comprised 160,666 tons of fluxing gravel (including 19,660 tons of flotation concentrates, which were blended with fluxing gravel) and foundry lump and 186,358 tons of ground and flotation concentrates. The bulk of the fluxing-gravel and foundry-lump fluorspar was shipped to steel plants and iron foundries, but a comparatively small tonnage moved to plants making cement, ferro-alloys, nickel, basic refractories, and fluxing compounds and to smelters of secondary metals. Of the ground and flotation concentrates shipped in 1951, hydrofluoric-acid plants took 66 percent (includes quantities going to the National Stockpile), and glass and enamel plants 21 percent; the remainder went chiefly to aluminum- and magnesium-reduction works; to manufacturers of steel, ferro-alloys, and welding rods; and to smelters of secondary metals.

TABLE 2.—Fluorspar shipped from mines in the United States, 1950–51, by States

State	1950			1951		
	Short tons	Value		Short tons	Value	
		Total	Average		Total	Average
Colorado	18,489	$654,089	$35.38	20,661	$820,322	$39.70
Illinois	154,623	6,110,765	39.52	204,328	9,294,703	45.49
Kentucky	80,137	2,554,668	31.88	68,635	2,334,485	34.01
New Mexico	20,036	742,408	37.05	24,402	1,163,098	47.66
Utah	18,936	337,912	17.84	17,827	398,480	22.35
Other States:						
Tennessee				140	358,433	32.09
Idaho				9,408		
Nevada	7,577	219,875	23.67	1,623		
Arizona	952					
Montana	41					
Texas	719					
Total	301,510	10,619,717	35.22	347,024	14,369,521	41.41

TABLE 3.—Fluorspar shipped [1] from mines in the United States, by States, 1947–51, with shipments of maximum year and cumulative shipments from earliest record to end of 1951, in short tons [2]

State	Maximum shipments		Shipments by years						Total shipments [1] from earliest record to end of 1951	
	Year	Short tons	1947	1948	1949	1950	1951			
							Short tons	Percent of total	Short tons	Percent of total
Arizona	1951	1,623	1,601	1,271	846	952	1,623	0.5	18,717	0.2
California	1934	181							341	[3]
Colorado [4]	1944	65,209	32,153	27,698	22,324	18,489	20,661	6.0	595,278	7.3
Idaho	1951	[5]					9,408	2.7	109,934	1.3
Nevada	1948	9,615	8,042	9,615	5,847	7,577				
Illinois [4]	1951	204,328	167,157	172,561	120,881	154,623	204,328	58.9	4,348,506	53.2
Kentucky [4]	1941	142,862	90,256	84,889	63,438	80,137	68,635	19.8	2,663,112	32.6
Montana	1949	422		318	422	41			781	[3]
New Hampshire	1917	1,274							8,302	.1
New Mexico	1944	42,973	27,526	24,968	12,844	20,036	24,402	7.0	345,435	4.2
Tennessee	1906	360					140	[3]	1,337	[3]
Texas	1944	4,769	1,019	906	1,770	719			14,779	.2
Utah	1950	18,936	1,730	9,523	8,332	18,936	17,827	5.1	70,086	.9
Washington	1945	132							382	[3]
Wyoming	1944	19							19	[3]
Total	1944	413,781	329,484	331,749	236,704	301,510	347,024	100.0	8,177,009	100.0

[1] Figures for 1880–1905 represent production.
[2] Quantity and value figures, by States, for 1880–1925 in Mineral Resources, 1925, pt. 2, pp. 13–14, and for 1910–40 in Minerals Yearbook, Review of 1940, p. 1297.
[3] Less than 0.05 percent.
[4] Figures on production not recorded for Colorado before 1905, for Illinois before 1880, and for Kentucky before 1886 and for 1888–95. Total unrecorded production (estimated) included in "Total shipments" column as follows: Colorado, 4,400 tons; Illinois, 20,000 tons; and Kentucky, 600 tons.
[5] Figure withheld to avoid disclosure of individual company operations.

TABLE 4.—Fluorspar shipped from mines in the United States, 1950–51, by grade and industry, in short tons

Grade and industry	1950	1951	Grade and industry	1950	1951
Fluxing gravel and foundry lump:			Ground and flotation concentrates—Continued		
Ferrous	[1] 141,375	[1] 158,346	Exported	720	1,009
Nonferrous	826	975			
Cement	525	330	Total	[1] 155,481	[1] 186,358
Miscellaneous	3,295	876			
Exported	8	139	All grades:		
			Ferrous	156,519	173,399
Total	[1] 146,029	[1] 160,666	Nonferrous	2,290	4,135
			Cement	606	330
Ground and flotation concentrates:			Glass and enamel	38,282	39,392
Ferrous [2]	[1] 15,144	[1] 15,053	Hydrofluoric acid	97,659	[3] 123,125
Nonferrous	1,464	3,160	Miscellaneous	5,426	5,495
Glass and enamel	38,282	39,392	Exported	728	1,148
Hydrofluoric acid	97,659	[3] 123,125			
Cement	81		Grand total	301,510	347,024
Miscellaneous	2,131	4,619			

[1] Fluxing gravel includes (and flotation concentrates exclude) the following quantities of flotation concentrates blended with fluxing gravel: 1950, 11,240 tons; 1951, 19,660 tons.
[2] Includes pelletized gravel.
[3] Includes shipments to National Stockpile.

Shipments, by Uses.—As is evident from table 5 and figure 1, the predominant purchaser of fluorspar is the steel industry, which also consumes substantial quantities of hydrofluoric acid and sodium fluoride, for which fluorspar is the basic material.

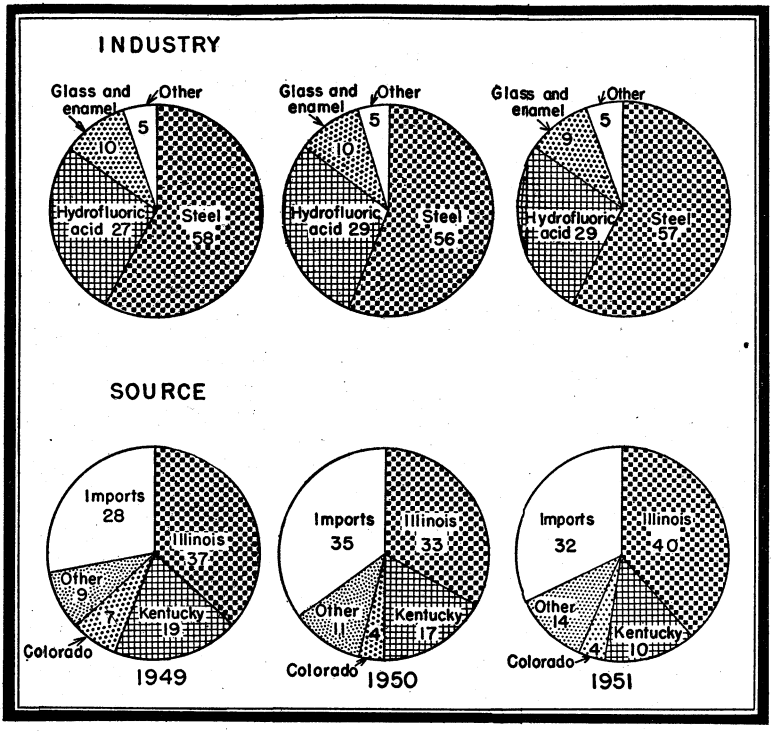

FIGURE 1.—Fluorspar sales (domestic and foreign) to consumers in the United States, 1949–51, by consuming industry and by source, in percent.

TABLE 5.—Fluorspar shipped from mines in the United States, 1950–51, by uses

Use	1950				1951			
	Quantity		Value		Quantity		Value	
	Percent of total	Short tons	Total	Average	Percent of total	Short tons	Total	Average
Steel	49.6	149,410	$4,384,271	$29.34	48.2	167,042	$5,742,358	$34.38
Iron foundry	1.3	3,945	134,929	34.20	1.2	4,139	170,051	41.09
Glass	10.1	30,450	1,176,994	38.65	9.5	33,036	1,407,741	42.61
Enamel	2.6	7,832	327,081	41.76	1.8	6,356	293,359	46.15
Hydrofluoric acid	32.4	97,659	4,164,901	42.65	35.5	[1] 123,125	[1] 6,162,064	[1] 50.05
Miscellaneous	3.8	11,486	401,795	34.98	3.5	12,178	542,139	44.52
Exported	.2	728	29,746	40.86	.3	1,148	51,809	45.13
Total	100.0	301,510	10,619,717	35.22	100.0	347,024	14,369,521	41.41

[1] Includes shipments to National Stockpile.

Stocks at Mines.—According to the reports of producers, the quantity of fluorspar in stock at mines or shipping points at the close of 1951 totaled 75,116 tons, or virtually the same as in 1950. These stocks comprised 13,283 tons of finished fluorspar and 61,833 tons of crude fluorspar (calculated to be equivalent to 25,000 tons of finished fluorspar).

TABLE 6.—Stocks of fluorspar at mines or shipping points in the United States at end of year, 1949–51, by States, in short tons

State	1949		1950		1951	
	Crude [1]	Finished	Crude [1]	Finished	Crude [1]	Finished
Colorado	7,995	851	6,837	869	14,986	812
Idaho					150	
Illinois	39,684	9,903	29,954	5,822	32,541	6,781
Kentucky	15,212	25,469	5,789	10,076	6,598	5,092
Nevada		217		100		150
New Mexico	21,186	440	13,472	392	7,558	348
Tennessee						100
Texas	400	70				
Utah		89		1,779		
Total	84,477	37,039	56,052	19,038	61,833	13,283

[1] This crude (run-of-mine) fluorspar must be beneficiated before it can be marketed.

CONSUMPTION

Tables 7 and 8 give data on consumption and consumers' stocks of fluorspar.

TABLE 7.—Fluorspar (domestic and foreign) consumed and in stock in the United States, 1950–51, by industries, in short tons

Industry	1950			1951		
	Consumption	Stocks at consumers' plants Dec. 31	In transit to consumers' plants Dec. 31	Consumption	Stocks at consumers' plants Dec. 31	In transit to consumers' plants Dec. 31
Basic open-hearth steel	212,928	131,924	4,307	242,180	138,113	5,062
Electric-furnace steel	27,567			34,058		
Bessemer steel	307			416		
Iron foundry	5,956	1,709	118	6,460	2,354	41
Ferro-alloys	3,753	753	39	2,888	1,051	
Hydrofluoric acid [1]	124,440	19,417	223	151,698	15,253	1,285
Primary aluminum [2]	1,167	820	50	1,489	948	
Primary magnesium				1,262	226	170
Glass	33,440	5,134	908	35,505	6,731	735
Enamel	7,723	1,468	281	6,736	1,467	218
Cement	485	1,060	25	213	1,174	
Miscellaneous	8,355	2,400	94	14,107	1,809	38
Total	426,121	164,685	6,045	497,012	169,126	7,549

[1] Fluorspar used in making artificial cryolite and aluminum fluoride (aluminum raw materials) is included in the figures for hydrofluoric acid, an intermediate in their manufacture.
[2] Figures on consumption represent fluorspar used as a flux; *see* footnote 1.

TABLE 8.—Production of basic open-hearth steel and consumption and stocks of fluorspar (domestic and foreign) at basic open-hearth steel plants, 1947–51

	1947	1948	1949	1950	1951
Production of basic open-hearth steel ingots and castings—long tons	68,506,000	70,830,000	62,634,000	76,873,000	83,118,000
Consumption of fluorspar in basic open-hearth steel production—short tons	189,773	207,342	183,045	212,928	242,180
Consumption of fluorspar per long ton of basic open-hearth steel made—pounds	5.5	5.9	5.8	5.5	5.8
Stocks of fluorspar at basic open-hearth steel plants at end of year—short tons	68,400	106,300	97,400	128,300	133,100

Fluorspar was reported consumed in 42 States and the District of Columbia in 1951, but 3 States—Illinois, Ohio, and Pennsylvania—used 246,664 tons or 50 percent of the total consumption. Pennsylvania was again the chief consuming State; it ranked first in consumption of fluorspar in both steel and glass. Illinois maintained its rank in 1951 as the largest consumer of fluorspar in hydrofluoric acid.

Table 9 shows, so far as possible without revealing the figures of individual companies, the consumption of fluorspar by States in 1950 and 1951.

TABLE 9.—Fluorspar (domestic and foreign) consumed in the United States, 1950–51, by States, in short tons

State	1950	1951	State	1950	1951
Alabama	12,882	14,068	Kentucky	15,238	20,760
Georgia			Maine		
Arkansas			Massachusetts	1,530	2,078
Florida			Rhode Island		
Louisiana	26,017	32,637	New Hampshire		
Mississippi			Maryland	7,437	8,240
North Carolina			Michigan	13,799	19,779
South Carolina			Minnesota	6,441	5,970
California	10,725	12,886	Wisconsin		
Colorado			Missouri	3,809	4,359
Iowa	16,841	18,289	New York	15,648	18,805
Utah			Ohio	67,182	75,593
Connecticut	887	927	Oklahoma	1,110	1,163
Delaware			Oregon	1,387	2,188
District of Columbia	33,112	33,985	Washington		
New Jersey			Pennsylvania	78,205	89,346
Illinois	69,011	81,725	Tennessee	715	571
Indiana	30,465	27,179	Texas	9,576	19,902
Kansas	80	195	Virginia	87	601
Nebraska			West Virginia	3,937	5,766
South Dakota			Total	426,121	497,012
Wyoming					
Nevada					

REVIEW BY STATES

Arizona.—Fluorspar production in Arizona in 1951 established a new record—1,623 short tons compared with 952 tons in 1950 and with 1,608 tons in the previous record year 1939. The 1951 output came chiefly from the Lone Star mine in Cochise County, and most of it was shipped to the flotation mill at Los Lunas, N. Mex. Some of the output, however, was shipped to the Illinois-Kentucky district for blending with other fluorspar, and some was shipped direct to steel plants. Small outputs were made by the Jumbo, Lucky Strike, and West End Spar mines in Maricopa County and shipped to steel and cement plants; and the small output in Greenlee County was shipped to the flotation mill at Los Lunas, N. Mex.

Colorado.—The output of 20,600 short tons of finished fluorspar in Colorado in 1951 compared with 18,500 tons in 1950 reversed a downward trend that had persisted for six consecutive years. In addition, crude ore equivalent to 1,300 tons of finished fluorspar was mined but not milled in 1951. Thus, new production (expressed in terms of finished fluorspar) totaled 21,900 tons compared with 17,952 tons in 1950. Output came from Boulder, Chaffee, Douglas, Jackson, and Park Counties.

Shipments of fluorspar from Colorado likewise increased after declining for six consecutive years and were 20,661 tons compared with 18,489 tons in 1950.

The Ozark-Mahoning Co., operating a flotation mill near Jamestown, produced 3.5 percent more flotation concentrates in 1951 than in 1950. The flotation-mill feed comprised ore from the Afterthought, Argo, Blue Jay, Emmett, and Spartan No. 5 mines in Boulder County, Northgate mine in Jackson County, and White Eagle mine in Luna County, N. Mex. The concentrate recovered from White Eagle ore, as well as that shipped, has been credited in the statistics to New Mexico. The company acquired the Northgate mine in October 1951. Under an agreement between Defense Materials Procurement Agency and Ozark-Mahoning Co. a flotation plant to produce about 25,000 tons of acid-grade concentrates annually was under construction at Northgate, Colo., the latter part of 1951. Ore will come from company mines adjoining the mill, which was expected to be completed mid-1952.

The flotation mill of the General Chemical Division, Allied Chemical & Dye Corp., near Jamestown produced 57 percent more concentrates than in 1950. The flotation-mill feed came from the company-owned Burlington mine in Boulder County.

Reynolds Mining Corp. acquired the Poncha mine and the flotation mill serving it near Chaffee County, Salida, Colo.; production of concentrates was begun in November. Development of the mine and improvements in the mill were begun.

Small outputs of fluorspar were made from the Bear Cat prospect in Park County and from a prospect in Douglas County.

Idaho.—The first commercial production of fluorspar in Idaho was made in 1951 by Fluorspar Mines, Inc., which had acquired the Chamac fluorspar deposits and a flotation mill near Myers Cove, Lemhi County. The flotation mill was rehabilitated and production of acid-grade concentrates begun August 1. Development was being done in conjunction with mining operations. Expansion of mill facilities was contemplated. The flotation mill was completed in 1944 by Chamac Mining Co., but no commercial concentrates were produced by that company.

Illinois.—Illinois continued to lead the fluorspar-producing States in 1951 with an output of finished fluorspar totaling 205,300 short tons compared with 150,500 tons in 1950. New production (expressed in terms of finished fluorspar) also was 205,300 tons in 1951 compared with 146,700 tons in 1950. About 92 percent of the 1951 production came from Hardin County and the remainder from Pope County. Some Kentucky fluorspar is milled in Illinois, and some Illinois fluorspar is milled in Kentucky; the finished fluorspar so recovered, as well as that shipped, is credited in the statistics to the State of origin. The Argo, Blue Diggings, Crystal, Deardorff, Douglas, East Green, Empire, Fairview, Geely Shaft, Hawkins, Interstate, Jefferson, Mahoning Shafts Nos. 2, 3, 4, and 5, Minerva, North Boundary, Pell Shaft, Redd, Rosiclare, Recovery Shaft, North Green, and Victory properties supplied about 95 percent of the fluorspar produced in Illinois in 1951. Some of the remainder came from many mines and prospects, chiefly the Austin, Baker, Blue Valley, Grandpier, Hamp, Pell, Hillside, Jackson, Knox, Lead Hill, Humm, Mahoning Shaft

No. 16, Rose Creek, Dimick, Tems, Twitchell, Eureka-Deatherage, Wall, and Tri-State; some was recovered from tailings from previous milling operations, chiefly the Hillside mine tailings.

Shipments of flourspar from Illinois (204,328 tons) established a new record in 1951; they exceeded those in 1950 by 32 percent and contributed 59 percent of the total domestic shipped. Of the 1951 total, 45,056 tons was shipped by river or river-rail to consumers compared with 31,699 tons in 1950.

The Alcoa Mining Co. produced 22 percent more flotation concentrates in 1951 than in 1950. The mill feed comprised ore from the company-operated Argo, Blue Diggings, Hamp, and Fairview mines. The Argo-Blue Diggings vein system was worked through the Fairview shaft. Work was begun during 1951 to develop the Good Hope vein by means of crosscuts from the Fairview shaft. The Good Hope vein has not been mined for more than 30 years. Output of acid-grade concentrates in 1951 was the third-largest in the company history, being exceeded only by that in 1943 and 1944.

Production of finished fluorspar by Crystal Fluorspar Co., Inc., was 72 percent larger in 1951 than in 1950. The Crystal mine was flooded 6½ months in 1950. The company also operated the Jefferson mine, which produced 2.5 times more fluorspar than in 1950.

Output of fluorspar flotation concentrates at the Rosiclare plant of Ozark-Mahoning Co. established a new record in 1951; it was 14 percent more than in 1950 and 7 percent more than the previous high of 1948. The mill feed comprised ore from the Deardorff, East Green, Mahoning Shafts Nos. 2, 3, 4, 5, and 16, and North Green mines near Cave in Rock, Ill., the Rose Creek mine near Herod, Ill., the Delhi-Babb mine near Salem, Ky., the Commodore mine near Marion, Ky., the Northgate mine near Northgate, Colo., the White Eagle mine near Deming, N. Mex., and some purchased ore, chiefly from the Alcoa Mining Co., Crystal Fluorspar Co., Inc., and Rosiclare Lead & Fluorspar Mining Co. The concentrates recovered from milling ore from Kentucky, Colorado, and New Mexico, as well as that shipped, has been credited in the statistics to the State of origin. Production of finished fluorspar in 1951 comprised 73 percent acid-grade, 22.5 percent pelletized gravel, and 4.5 percent filter cake; the filter cake was sold to local producers for blending with fluxing gravel. The Ozark-Mahoning Co. was the largest producer of fluorspar in the United States in 1951.

The Rosiclare Lead & Fluorspar Mining Co. operated the Eureka-Deatherage, Geely, Hawkins, Hillside, Interstate, North Boundary, Pell, South Boundary-Recovery, and Rosiclare properties in 1951, but the Rosiclare and North Boundary were the chief producing mines of the company. The company also purchased finished fluorspar and milling ore from local producers. The ore produced and purchased is mill feed for the company heavy-medium, jig, and flotation mills. Production of finished fluorspar of all grades was 74 percent more than in 1950, and shipments were 35 percent greater.

Operations at the mine and flotation mill of Minerva Oil Co. were again at increased rates in 1951. Production of fluorspar flotation concentrates was 7 percent greater than in 1950, but shipments were 19 percent larger. Diesel-driven haulage trucks were introduced in

the east half of the mine. The Diesel-driven shovel continued in use about half time.

Throughout 1951 Frazer & Hettiger operated its flotation mill at Rosiclare on tailings from the Hillside mill-site.

Production at the Victory mine of Victory Fluorspar Mining Co. in 1951 tripled that in 1950.

At the Douglas mine in Pope County, operated by Hicks Creek Fluorspar Mining Co. and P. M. T. Mining Co., production in 1951 was 25 percent more than in 1950. The Redd mine operated by Redd Mining Co., Grandpier mine operated by Grandpier Mining Corp., and the Empire mine operated by Egyptian Mining Co.—all in Pope County—and the Baker mine operated by Golconda Illinois Mining Co., Inc., Jackson mine operated by Gibbons Mining Co., Knox mine operated by Knox Spar Co., Humm mine operated by C. C. Mackey, Rose Creek mine operated by S. C. Yingling, Dimick mine operated by Cullum Bros., Hamp mine operated by Trammel & Guard, and Pell mine operated by Thurmond Coal Co.—all in Hardin County—were the largest of the many smaller mines worked in Illinois in 1951.

Kentucky.—Production of finished fluorspar in Kentucky in 1951 dropped for the fourth consecutive year and was 63,700 short tons compared with 64,700 tons in 1950. However, the 1951 output includes 500 tons of finished fluorspar recovered from milling crude ore mined before 1951. Consequently, new production (expressed in terms of finished fluorspar) totaled 63,200 tons in 1951 compared with 63,600 tons in 1950. Shipments were 68,635 tons compared with 80,137 tons in 1950. Of the 1951 shipments, 18,234 tons was shipped to consumers by river or river-rail compared with 37,234 tons in 1950.

Production of fluorspar in Caldwell County in 1951 came chiefly from the Marble, Hughett, Williamson, and Schwenck mines.

The major part of the 1951 output in Crittenden County came from the Delhi-Babb, Pigmy, Davenport, Tabb No. 1, Ainsworth, Watkins-Settles, and Yandell No. 22 mines. Some of the remainder came from many smaller producing mines, but much was recovered from tailings from previous milling operations.

United States Steel Co. production and shipments of fluorspar in 1951 were 15 and 1.2 percent, respectively, smaller than in 1950. Output came from the Tabb No. 1 and Yandell No. 22 mines.

The Kentucky Fluor Spar Co. and affiliates shipped 19 percent more fluorspar and "fluorbarite" than in 1950. The company operates mills at Marion, Ky., and Rosiclare, Ill., and, through its mining division (Roberts & Frazer) operates the Carr mine in Livingston County, Ky. About 47 percent of the supply came from company mines in 1951. Most of it was furnished by the Empire, Blue Valley, Pell, Douglas, Humm, Grandpier, Baker, Dimick, Rose Creek, Wall, Jackson, and Knox mines in Illinois; Cox, Ainsworth, Williamson, and Watkins-Settles mines in Kentucky; the flotation mill of Minerva Oil Co.; and mines in Mexico. The Mexican fluorspar, which was used to raise the grade of locally purchased fluorspar, has not been included in the Kentucky statistics.

The heavy-medium mill of Inland Steel Co. near Marion treated purchased crude ore and concentrates recovered by washing tailings from the Keystone, Klondike, and other properties.

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Output of fluxing-gravel fluorspar at the Pigmy mine of the Pigmy Corp. (subsidiary of the Rosiclare Lead & Fluorspar Mining Co.) doubled that in 1950. However, less flotation concentrates was recovered from Pigmy pond fines at the flotation mill of Crider Bros. Fluorspar Co. for the Pigmy Corp. in 1951.

All of the supply of Delhi Fluorspar Corp. in 1951 was purchased from local producers and from Mexico; the Mexican fluorspar was blended with domestic. The Mexican fluorspar so blended and shipped has not been included in Kentucky statistics. Total sales were 24 percent more in 1951 than in 1950.

L. Conyer, who depends on purchased ore from local producers for his supply, shipped 41 percent more fluorspar in 1951 than in 1950.

B. E. Clement, who also depends on purchased fluorspar from local mines, shipped 2.5 times more fluorspar than in 1950.

Crider Bros. Fluorspar Co. and its successor (J. Willis Crider Fluorspar Co.) operated the Marble mine in Caldwell County, reclaimed some fluorspar from the Blue and Haffaw dumps, and purchased fluorspar from local producers, Arizona, Tennessee, and Mexico. The company also operates gravity-concentrating and flotation mills. Sales of fluorspar doubled those in 1950. The company produced flotation concentrates on a custom basis for Pigmy Corp., Inland Steel Co., and United States Steel Co.

C & L Fluorspar operated its flotation mill in 1951 on tailings and purchased fluorspar from local producers, chiefly Minerva Oil Co., Hicks Creek Fluorspar Mining Co., and Cardinal Fluorspar Co. Total sales by C & L Fluorspar Co. were 39 percent more than in 1950. It sold its flotation mill to Pennsylvania Salt Manufacturing Co.

The Davenport mine was reopened in 1951 by Davenport Mines, Inc., and the ore was treated in its heavy-medium mill. The mill was operated on accumulated dump piles in 1950. Output of concentrates was 2.3 times greater than in 1950.

The Marimex Fluorspar Co., Inc., was organized late in 1951 to purchase and sell local and Mexican fluorspar.

The Pennsylvania Salt Manufacturing Co. acquired two flotation mills near Marion during 1951 and produced a small quantity of flotation concentrates in December. It also purchased about 70,000 tons of tailings averaging about 29 percent calcium fluoride from C & L Fluorspar Co.

In Livingston County production of fluorspar in 1951 came chiefly from the Carr mine and from reworking the Klondike tailings.

No fluorspar was mined in the Central Kentucky fluorspar district in 1951.

Nevada.—Shipments of fluorspar from Nevada decreased in 1951.

The chief producing mine in Nevada in 1951 was the Daisy in Nye County, operated by J. Irving Crowell, Jr. Small outputs of fluorspar were made at the Baxter mine in Mineral County by Fallon Fluorspar Mines, Inc., at the Cirac Revenue Group in Churchill County by C. P. Cirac, and at a prospect near Grantsville, Nye County, by Gant & Pugh. The Baxter mine, which was purchased late in 1950 by H. W. Gould & Co. (Fallon Fluorspar Mines, Inc.), was sold to Kaiser Aluminum & Chemical Co., which plans to build a flotation mill to treat the ore. H. W. Gould & Co. purchased a two-thirds interest in the Nyco fluorspar prospect in Nye County.

New Mexico.—New Mexico produced 24,300 short tons of finished fluorspar in 1951, a 22-percent gain over 1950. This output includes 3,200 tons of finished fluorspar recovered from milling crude ore mined before 1951; consequently, new production (expressed in terms of finished fluorspar) totaled 21,100 tons in 1951 compared with 16,300 tons in 1950. The 1951 output came from Dona Ana, Grant, Lincoln, Luna, Rio Arriba, Sierra, and Valencia Counties. The Zuñi mines in Valencia County, Shrine mine in Grant County, Greenleaf and White Eagle mines in Luna County, and Universal and Blue Jacket mines in Sierra County supplied about 88 percent of the fluorspar produced in New Mexico in 1951. Most of the remainder came from many mines and prospects, chiefly the Clum, Florida, Greenspar, Sadler No. 2, Nakaye, Linda Vista, and Mirabal.

The flotation mill of General Chemical Division, Allied Chemical & Dye Corp., at Deming produced 6 percent more concentrates in 1951 than in 1950. The mill feed comprised ore from the company-operated Shrine mine in Grant County and Florida mine in Luna County and purchased ore from local mines, chiefly the Greenleaf and Sadler No. 2 mines in Luna County and the Clum and Linda Vista mines in Grant County.

The flotation mill of Zuñi Milling Co. at Los Lunas produced 74 percent more fluorspar in 1951 than in 1950. The mill feed comprised ore chiefly from the company mines near Grants in Valencia County and purchased ore chiefly from the Universal, Blue Jacket, Nakaye, and Cox mines in Sierra County, the Lone Star mine near Benson, Cochise County, Ariz., and ore from Mexican mines. The concentrate recovered from ore from the Lone Star mine, as well as that shipped, has been credited to Arizona in the statistics. The concentrate recovered from Mexican ore, as well as that shipped, has not been included in the statistics on production and shipments. The Zuñi Milling Co. milled 1,007 tons of ore from the White Eagle mine for the Ozark-Mahoning Co.

Tennessee.—The Tennessee output of fluorspar in 1951 was 240 short tons compared with none in 1950.

In 1951 about 100 tons of commercial calcium fluoride was produced by the Tennessee Valley Authority as a byproduct of a fluorine-recovery system under development at TVA's experimental fused-tricalcium phosphate fertilizer plant near Columbia. The product contains 78 to 84 percent calcium fluoride, 2 to 2.6 percent silica, and 1.3 to 2.2 percent sulfur.

Utah.—Finished fluorspar produced in Utah in 1951 totaled 16,109 short tons, compared with 20,626 tons in 1950. The production came from Juab County near Delta, where Bell Hill Mining Co., Carlson & Schmidt, Chesley & Black, T. A. Claridge, E. D. Harris, Fred Staats et al., and Willden Bros. operated.

MILLING

Output of flotation concentrates from domestic ore totaled 183,624 short tons in 1951 compared with 146,631 tons in 1950. In addition, 1,348 tons of flotation concentrates were recovered from milling 1,766 tons of Mexican ore at a plant in the United States.

The Ozark-Mahoning Co., which operates flotation plants at Rosiclare, Ill., and Jamestown, Colo., began to construct a flotation

plant at Northgate, Colo. It was to have a capacity of 25,000 tons of concentrates annually and to be completed about July 1, 1952.

At the flotation plant of Minerva Oil Co., near Cave in Rock, Ill., a new screen to increase storage in the mill bin and a new ball mill for a third stage of grinding primary ore were added. As a consequence, the over-all grind is finer than before and has resulted in improved grades of zinc concentrate and improved recovery of fluorspar.

Butler & Moodie installed a washing plant near Mullikin, Livingston County, Ky., for treating ore in old dumps at the Klondike mine. The washed ore recovered is hauled to the heavy-medium mill of Inland Steel Co. near Marion, Ky., where it is beneficiated further.

The flotation mill built in 1944 by Chamac Mining Co. to treat ore from the Chamac fluorspar deposit near Myers Cove, Lemhi County, Idaho, was acquired by Fluorspar Mines, Inc., and rehabilitated; production of acid-grade concentrates was begun August 1.

Reynolds Mining Corp. purchased the flotation mill of Fluorspar, Inc., near Salida, Colo. The mill, which had been under construction, was completed and put into operation in December.

The recovery of fluorspar by the treatment of mine waste rock in a heavy-medium mill at the Davenport mine 10 miles southwest of Marion, Ky., has been described.[1] The nodulization and pelletization of fluorspar flotation concentrates have also been described.[2]

PRICES

Metallurgical-grade fluorspar containing 70 percent or more effective calcium fluoride was quoted at $41 a short ton f. o. b. Illinois-Kentucky mines until February 1, when it was advanced to $43; that containing 60 percent or less effective calcium fluoride was increased $3 a ton to $41, but pellets were quoted at $34 throughout the year. Imported metallurgical-grade fluorspar was quoted throughout 1951 at $36 to $40 a short ton at Atlantic Seaboard, duty paid. Acid-grade fluorspar containing a minumum of 97 percent calcium fluoride was quoted at $50 a short ton f. o. b. Illinois mines until October 1, when it was advanced to $60. On October 1 acid-grade fluorspar was quoted at $65 a short ton f. o. b. Los Lunas, N. Mex.

The average selling price of all grades of domestic fluorspar shipped in 1951 was $41.41 a short ton—a new peak—compared with $35.22 in 1950.

Price Control.—Throughout 1951 the price of domestic metallurgical-grade fluorspar was controlled by provisions of the General Ceiling Price Regulation, which froze prices at the highest charged between December 19, 1950, and January 25, 1951. The prices for acid-grade and imported metallurgical-grade were likewise frozen until August 10 and September 6, respectively; however, on August 10 acid-grade fluorspar was exempted from price control, and on September 6 sellers of imported fluorspar were permitted to add increases in landed costs.

[1] Pfunder, O. S., and Jones, P. J., Fluorspar Recovered Profitably from Kentucky Mine Waste: Pit and Quarry, vol. 43, No. 12, June 1951, pp. 88–94.

[2] Kenworthy, H., Nodulization and Pelletization of Fluorite Flotation Concentrates: Bureau of Mines Rept. of Investigations 4829, 1951, 13 pp.

FOREIGN TRADE [3]

Imports.—A new record of 181,275 short tons of fluorspar was imported into the United States in 1951, a 10-percent gain over 1950, the former record year. Of the 1951 total, 52,991 tons contained over 97 percent calcium fluoride and 128,284 tons was of lower grade. Imports in 1951 were valued at $4,110,081.[4]

TABLE 10.—Fluorspar imported for consumption in the United States in 1951, by country and customs district

[U. S. Department of Commerce]

Country and customs district	Containing more than 97 percent calcium fluoride		Containing not more than 97 percent calcium fluoride		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
Canada:						
Buffalo	----------	----------	1,187	$42,126	1,187	$42,126
Ohio	----------	----------	4,984	179,410	4,984	179,410
Philadelphia	15,289	$491,644	----------	----------	15,289	491,644
Total	15,289	491,644	6,171	221,536	21,460	713,180
Mexico:						
Arizona	903	13,297	12,173	182,097	13,076	195,394
Duluth and Superior	----------	----------	189	2,786	189	2,786
El Paso	393	4,599	6,687	78,225	7,080	82,824
Galveston	60	1,740	42	637	102	2,377
Laredo	2,463	59,967	41,115	676,342	43,578	736,309
Total	3,819	79,603	60,206	940,087	64,025	1,019,690
France: Philadelphia	849	22,461	566	10,270	1,415	32,731
Germany:						
Maryland	142	3,987	14,461	297,175	14,603	301,162
Philadelphia	14,185	558,381	19,102	315,195	33,287	873,576
Total	14,327	562,368	33,563	612,370	47,890	1,174,738
Spain:						
New York	----------	----------	3	86	3	86
Philadelphia	11,583	448,139	21,279	322,279	32,862	770,418
Total	11,583	448,139	21,282	322,365	32,865	770,504
Italy: Philadelphia	6,492	282,376	5,312	67,581	11,804	349,957
Algeria: Philadelphia	560	11,000	----------	----------	560	11,000
Union of South Africa: Philadelphia	72	1,490	----------	----------	72	1,490
Netherlands: [1]						
Maryland	----------	----------	633	26,260	633	26,260
Washington	----------	----------	551	10,531	551	10,531
Total	----------	----------	1,184	36,791	1,184	36,791
Total: 1951	52,991	1,899,081	128,284	2,211,000	181,275	4,110,081
1950	43,488	1,050,305	121,146	1,529,362	164,634	2,579,667

[1] Reported as Netherlands, but is believed to have originated in Germany.

The higher-grade fluorspar averaged $35.84 a ton and the lower-grade $17.24. As a consequence of abrogation of the reciprocal trade agreement between the United States and Mexico on December 31, 1950, the duty on fluorspar containing not over 97 percent calcium fluoride reverted to $7.50 a short ton and the duty on higher-grade

[3] Figures on imports and exports (unless otherwise indicated) compiled by M. B. Price and E. D. Page, of the Bureau of Mines, from records of the U. S. Department of Commerce.

[4] Values are at country of origin. The cost to consumers in the United States also includes ocean freight, import duties, etc.

to $5 a short ton. However, effective June 7, 1951, the rate of duty on fluorspar containing over 97 percent calcium fluoride was lowered to $1.87½ a short ton under the Torquay Agreement.

The bulk of the fluorspar received in the United States in 1951 was for use by domestic consumers; however, a substantial tonnage of of acid-grade fluorspar was delivered to the National Stockpile.

In 1951, 8,788 tons of Mexican fluorspar was blended with fluxing-gravel fluorspar from the Illinois-Kentucky district. The Mexican fluorspar so blended has been excluded from the statistics on shipments from mines in the United States and included in the figures on imports.

Table 11, compiled from data supplied to the Bureau of Mines by importers and domestic companies milling foreign fluorspar, shows the quantities of imported fluorspar delivered to consumers in the United States. The quantities are based on the actual outturn weights and represent the finished fluorspar recovered from milling and drying foreign ore rather than the ore milled or concentrates dried.

TABLE 11.—Imported fluorspar delivered to consumers in the United States, 1950–51, by uses

Use	1950			1951		
	Short tons	Selling price at tidewater, border, or f. o. b. mill in the United States, including duty		Short tons	Selling price at tidewater, border, or f. o. b. mill in the United States, including duty	
		Total	Average		Total	Average
Steel	122,459	$3,250,070	$26.54	119,989	$4,105,764	$34.22
Hydrofluoric acid	29,742	1,316,595	44.27	26,506	1,341,339	50.61
Ferro-alloys	458	10,207	22.29	1,124	33,894	30.15
Glass and enamel	3,252	154,180	47.41	4,232	220,665	52.14
Other	6,626	223,669	33.76	8,568	349,151	40.75
Total	162,537	4,954,721	30.48	160,419	6,050,813	37.72

Exports.—Fluorspar producers reported exports of 1,148 short tons of fluorspar valued at $51,809 in 1951 compared with 728 tons valued at $29,746 in 1950. The exports comprised 61 tons of metallurgical-grade to Canada and 20 tons to Venezuela; and 673 tons of flotation concentrates to Canada, 3 tons to Colombia, 24 tons to Chile, 320 tons to Peru, 44 tons to Mexico, and 3 tons to the Philippines. In addition to the fluorspar exported by producers in 1951, dealers exported 20 tons to Chile and 5 tons to Uruguay.

TABLE 12.—Fluorspar reported by producers as exported from the United States, 1946–51

Year	Short tons	Value		Year	Short tons	Value	
		Total	Average			Total	Average
1946	1,729	$63,797	$36.90	1949	783	$32,521	$41.53
1947	1,180	43,679	37.02	1950	728	29,746	40.86
1948	644	24,819	38.54	1951	1,148	51,809	45.13

WORLD REVIEW

Canada.—According to the Dominion Bureau of Statistics, production of fluorspar in Canada was 78,870 metric tons [5] in 1951 compared with 58,253 tons in 1950.

The St. Lawrence Corp. of Newfoundland, Ltd., and Newfoundland Fluorspar, Ltd., both in the Province of Newfoundland, are the chief Canadian producers of fluorspar. There is a comparatively small production in the Province of Ontario.

The St. Lawrence Corp. of Newfoundland, Ltd., has a gravity-concentration mill and a flotation mill in Newfoundland for treating the ore from its several mines; a subsidiary, St. Lawrence Fluorspar, Inc., has a plant at Wilmington, Del., for drying the flotation concentrate. Shipments by the St. Lawrence Corp. of Newfoundland, Ltd., totaled 29,421 short tons in 1951 (18,125 tons in 1950)—15,891 tons of acid-grade filter cake and 13,530 tons of fluxing-gravel fluorspar.

TABLE 13.—World production of fluorspar, 1945–51, by countries, in metric tons

[Compiled by Pauline Roberts]

Country [1]	1945	1946	1947	1948	1949	1950	1951
Argentina (shipments)	3,012	2,133	2,400	(2)	(2)	(2)	(2)
Australia	946	1,201	1,219	520	571	585	[3] 250
Bolivia (exports)	19		28	227	264	61	38
Brazil			841	751	537	[3] 600	(2)
Canada:							
Newfoundland (shipments)	25,300	23,366	36,191	47,833	[4] 58,492	[4] 58,253	78,870
Other Provinces	6,685	7,296	6,519	10,287			
France	14,535	19,235	31,596	[4] 33,442	39,954	35,400	50,000
French Morocco				[4] 10	445	40	1,968
Germany:							
East Germany	(2)	14,000	21,000	(2)	(2)	(2)	(2)
West Germany		[3] 16,910	19,235	[4] 49,344	[3 4] 50,000	92,520	143,741
India	438						
Italy	3,333	[4] 7,806	20,860	[4] 40,635	[4] 20,810	31,611	40,838
Japan	3,207	[4] 312	[4] 84	68	960	2,425	3,996
Korea:							
North Korea	19,434	(2)	(2)	(2)	(2)	(2)	(2)
Korea, Republic of			2,600		1,230	(2)	(2)
Mexico (exports)	50,251	21,949	45,737	75,381	55,772	65,667	66,761
Norway	3,142	4,590	1,089	1,120	895	838	[3] 700
Southern Rhodesia			154	12	239	447	111
South-West Africa						73	779
Spain	9,643	8,712	13,885	42,549	59,594	32,669	54,789
Sweden	3,448	3,722	2,780	4,303		(2)	(2)
Tunisia				560	352		(2)
Union of South Africa	3,657	4,821	4,815	3,754	4,857	[4] 6,948	12,313
United Kingdom	44,281	47,200	45,016	[4] 58,948	[4] 52,867	50,294	(2)
United States (shipments)	293,891	252,142	298,901	300,956	214,733	273,524	314,813
Total (estimate)	674,000	524,000	[4] 653,000	[4] 792,000	[4] 686,000	[4] 789,000	957,000

[1] In addition to countries listed, China, Switzerland, and U. S. S. R., produce fluorspar, but data on output are not available; estimates by author of chapter included in total.
[2] Data not available; estimate by author of chapter included in total.
[3] Estimate.
[4] Revised figure.

Newfoundland Fluorspar, Ltd., has two mines and ships crushed fluorspar principally to Arvida, Quebec, where the Aluminum Co. of Canada, Ltd., has a flotation plant.

France.—Production of fluorspar in France in 1951—50,000 metric tons—was the largest since 1939 and an increase of 41 percent over 1950.

[5] 1 metric ton is equivalent to 1.10231 short tons.

Germany.—Before World War II Germany was a leading producer and exporter of fluorspar; in fact, 1939 output was 161,963 metric tons. Until the outbreak of war exports were maintained at 30,000 to 40,000 tons annually. Production in West Germany has ranged from 16,900 to 50,000 tons during the 4 years 1946–49. Since 1950, however, Germany has shown much enterprise in regaining its former position as a producer and exporter. Production of fluorspar in West Germany was 92,520 and 143,741 metric tons, respectively, in 1950 and 1951. The United States was an important customer; imports of German fluorspar into the United States were 26,874 and 44,519 metric tons, respectively, in 1950 and 1951. In 1951 fluorspar was also exported to Austria, Australia, Belgium, Luxembourg, Denmark, Netherlands, Sweden, Poland, Switzerland, and Japan.

Italy.—Fluorspar production in Italy established a new record in 1951 and was 40,838 metric tons compared with 31,611 tons in 1950 and the former high of 40,635 tons in 1948. The United States was an important customer; imports of Italian fluorspar into the United States were 10,708 and 8,820 metric tons, respectively, in 1951 and 1950. Substantial shipments were also made to Japan in 1951.

Mexico.—Chiefly as a result of record demand for fluorspar in the United States—the principal market for Mexican fluorspar—production (as measured by exports) in Mexico was 1.7 percent greater than in 1950, or 66,761 metric tons. About 2,200 tons of Mexican fluorspar is used at local metallurgical plants, and some is exported to Canada. Imports of Mexican fluorspar into the United States were 58,082 and 66,270 metric tons, respectively, in 1951 and 1950. Several American producers and consumers have been greatly interested in recent discoveries of important deposits of fluorspar in Chihuahua and Coahuila. Because of the nearness of these deposits to the American border and their favorable location for truck transportation, they promise to make a major contribution to the United States supply. A flotation mill to serve the General Escobedo mine about 35 miles northwest of Taxco was completed at Zacualpan by Fluorspar Tolteca, S. A., in 1951.

Spain.—Chiefly as a result of sustained demand in the United States and a greater demand in Europe and Japan, fluorspar output in Spain increased to 54,789 metric tons in 1951 from 32,669 tons in 1950. Consumption of fluorspar in Spain is small; consequently, the industry depends largely on the export market for survival. The United States and Japan were the chief markets in 1951; imports of Spanish fluorspar into the United States were 29,814 short tons in 1951 compared with 32,025 tons in 1950. The imports into the United States in 1951 comprised 10,508 metric tons of acid-grade filter cake, chiefly from the flotation mill serving the Osor mine in the Gerona district, and 19,306 tons of metallurgical-grade fluorspar, chiefly from the Caravia and Collada mines in Asturias. About 20,000 tons is believed to have been exported to Japan in 1951.

The largest producers of fluorspar in Spain in 1951 were Fluoruros, S. A., which operated the Collada and Caravia mines in the Province of Oviedo, and Minerales y Productos Derivados, S. A., which operates the Osor mine in the Gerona district. Fluoruros, S. A., the largest producer of metallurgical-grade fluorspar in Spain, installed a washing plant and a flotation unit in 1951 and began to produce acid-grade

concentrates at the rate of 500 tons a month. About 800 tons of acid-grade filter cake was exported to the United States in December 1951. Minerales y Productos Derivados, S. A., is the largest producer of acid-grade flotation concentrates in Spain.

South-West Africa.—The South African Iron & Steel Industrial Corp., Ltd. (Iscor), is planning to bring its fluorspar property into production at a rate of 4,000 tons of concentrates a month and to export all surplus over the Union's present requirements of 10,000 tons annually. However, no appropriation has yet been made for the proposed operation. The fluorspar deposit is on Farm Okorusu some 40 miles northwest of Otjiwarongo, 14 miles west of the narrow-gage railway to Usakos and Walvia Bay. It has been held by Iscor since 1946 under a bond and lease covering approximately 2 square miles. Considerable diamond drilling and underground development have been done, and assured and probable reserves of 2,500,000 and 500,000 tons, respectively, carrying 60 percent CaF_2, 7 percent apatite, and 20 percent SiO_2 have been determined. Production may be expected by 1954.[6]

The Tsumeb Corp. holds a number of claims surrounding Iscor's deposits on which it has developed approximately 250,000 tons of excellent-grade ore and about 1,000,000 tons of 25-percent CaF_2 ore. Because of the interest being shown in fluorspar, the Tsumeb Corp. is planning a new study of its fluorspar deposits with the hope of developing more extensive reserves.[7]

CRYOLITE

The only known commercial-size deposit of natural cryolite is at Ivigtut, Greenland, where this unique mineral is mined.

Synthetic cryolite was manufactured in the United States in 1951 by the Aluminum Ore Co. at East St. Louis, Ill., and the Reynolds Metals Co. at Bauxite (Hurricane Creek), Ark.

Cryolite is used principally in the aluminum industry, where it acts as the electrolyte in reducing alumina to the metal. Smaller quantities are used chiefly in abrasives, insecticides, glass, and enamel.

Imports of natural and artificial cryolite into the United States totaled 34,688 long tons valued at $2,190,123 in 1951 compared with 15,298 tons valued at $978,175 in 1950; of these, 34,531 tons came from Greenland, 98 tons from Denmark, and 59 tons from Germany.

Exports of cryolite from the United States were 1,426 long tons valued at $317,413 in 1951 compared with 1,850 tons valued at $404,931 in 1950. Of the 1951 exports, 1,300 tons went to Canada, 77 tons to Mexico, 23 tons to Union of South Africa, and the remainder to Argentina, Brazil, Chile, Colombia, Philippines, and Surinam.

The preparation and use of natural cryolite were described in a report issued several years ago.[8]

[6] Frisbie, B. R. (mineral attaché, American Embassy, Pretoria, Union of South Africa), Probability of Fluorspar Being Produced in South-West Africa by Iscor: Nov. 7, 1951, 2 pp. (unpub. rept.).
[7] Work cited in footnote 6.
[8] Mudd, Henry T., Fluorspar and Cryolite: Am. Inst. Min. and Met. Eng., Industrial Minerals and Rocks, New York, 1949, pp. 398–401, 403.

Fuel Briquets and Packaged Fuel[1]

By J. A. Corgan and Golden V. Chiriaco

GENERAL SUMMARY

OUTPUT of fuel briquets and packaged fuel in 1951 totaled 2,387,219 and 119,535 net tons, respectively, 14- and 12-percent decreases from 1950. Briquets were shipped to 36 States and the District of Columbia in 1951. Exports, virtually all destined to Canada, totaled 168,780 tons; all of the 123 tons imported came from Canada.

Bituminous coal and Pennsylvania anthracite were the principal raw fuels employed manufacturing fuel briquets in 1951, and asphaltic binders were used exclusively. Bituminous coal and petroleum coke were the principal raw fuels used in making packaged fuel, and asphalt, starch, and a small amount of cement were employed as binders.

The fuel-briquetting industry consists of plants producing a small, hard, pillow briquet suitable for shipment. The packaged-fuel industry consists of plants producing 3- to 4-inch, more or less friable cubes wrapped (six to eight to the package) in sturdy paper, suitable for local consumption but not as a rule for transportation over long distances.

FUEL BRIQUETS

Pertinent data on the fuel-briquetting industry from 1947 to 1951 are summarized in table 1. Production, by regions, from 1919 to 1951 is illustrated in figure 1.

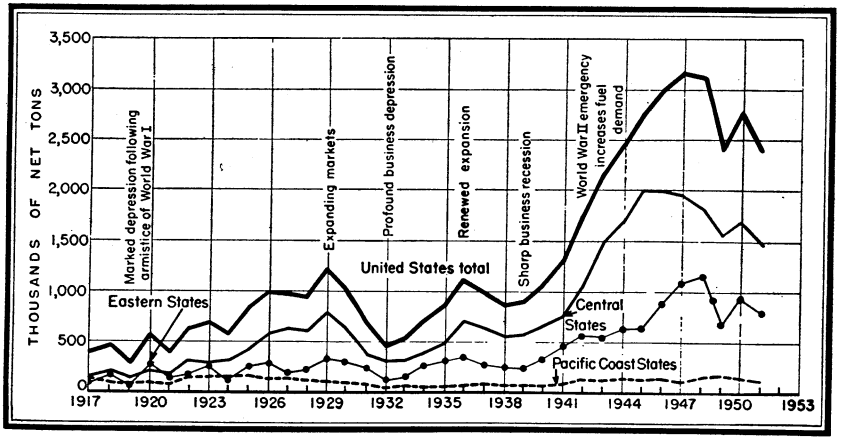

FIGURE 1.—Production of fuel briquets in the United States, 1917–51, by regions.

[1] Excludes briquets made from charcoal, wood scrap, and fruit pits, which are not included in Bureau of Mines surveys.

TABLE 1.—Salient statistics of the fuel-briquetting industry in the United States, 1935–39 (average) and 1947–51

	1935–39 (average)	1947 [1]	1948	1949	1950	1951
Production:						
Eastern States...net tons	285,248	1,089,705	1,151,041	674,938	934,635	796,359
Central States...do	588,573	1,966,834	1,820,074	1,557,819	1,691,914	1,464,185
Pacific Coast States...do	75,196	115,057	157,362	171,214	143,471	126,675
Total...do	949,017	3,171,596	3,128,477	2,403,971	2,770,020	2,387,219
Imports...do	11,792	387	329	365	804	123
Exports...do	[2] 18,206	248,760	207,885	167,140	175,768	168,780
Consumption, apparent [3] net tons	942,603	2,923,223	2,920,921	2,237,196	2,595,056	2,218,562
Plants in operation	32	35	36	33	31	28
Value of production	$6,083,308	$30,762,253	$36,011,322	$28,641,424	$32,039,379	$27,454,638
Average value per net ton f. o. b. plant:						
Eastern States	$4.28	$7.82	$9.55	$9.65	$9.50	$9.79
Central States	$7.08	$10.56	$12.58	$12.59	$12.46	$12.31
Pacific Coast States	$9.23	$12.77	$13.51	$14.67	$14.49	$12.90
World production, metric tons	62,000,000	[4] 57,000,000	[4] 64,000,000	[4] 66,000,000	[4] 76,000,000	82,000,000

[1] Peak year of United States fuel-briquet production.
[2] 1937–39 average. Not reported separately before 1937.
[3] Production plus imports minus exports.
[4] Revised figure.

DOMESTIC PRODUCTION

The 14-percent decrease in the output of fuel briquets in 1951, when a total of 2,387,219 net tons was produced, can be attributed largely to competition of fuel oil and natural gas.

As shown in table 2, 28 plants produced briquets in 1951.[2] Eleven States contributed to the 1951 production, the Central States, with 20 plants, accounting for 61 percent of the total. Wisconsin, with 10 plants and about 42 percent of the national output, was the largest individual fuel-briquet-producing State. West Virginia followed with two plants, and Pennsylvania ranked third with four plants operating. Other producing States, in order of output, were: Missouri, Oregon, Illinois, Indiana, North Dakota, Michigan, Arkansas, and Nebraska.

TABLE 2.—Production of fuel briquets in the United States, 1950–51

	1950			1951				
	Plants	Net tons	Value	Plants	Net tons	Value	Percent of change from 1950 in—	
							Tonnage	Value
Eastern States	6	934,635	$8,880,434	6	796,359	$7,795,910	−14.8	−12.2
Central States	22	1,691,914	21,080,670	20	1,464,185	18,024,459	−13.5	−14.5
Pacific Coast States	3	143,471	2,078,275	2	126,675	1,634,269	−11.7	−21.4
Total	31	2,770,020	32,039,379	28	2,387,219	27,454,638	−13.8	−14.3

[2] Directories of fuel-briquet and packaged-fuel operations and a list of manufacturers of briquetting machinery (M. M. S. 2062, 2063, and 2064, respectively) are obtainable on request from the Bureau of Mines, Washington 25, D. C.

TABLE 3.—Annual capacity and production of briquetting plants in the United States, 1947–51

	Number of active plants	Annual capacity (net tons)	Production	
			Net tons	Percent of annual capacity
1947	35	4,615,160	3,171,596	68.7
1948	36	4,670,510	3,128,477	67.0
1949	33	4,616,360	2,403,971	52.1
1950	31	4,455,000	2,770,020	62.2
1951:				
Capacity of—				
Less than 25,000 tons	4	42,180	18,703	44.3
25,000 to less than 100,000	7	384,000	165,034	43.0
100,000 to less than 200,000	8	870,500	420,569	48.3
200,000 to less than 400,000	6	1,610,000	956,491	59.4
400,000 or more	3	1,500,000	826,422	55.1
Total	28	4,406,680	2,387,219	54.2
Production of—				
Less than 5,000 tons	3	22,180	7,453	33.6
5,000 to less than 10,000	2	140,000	14,626	10.4
10,000 to less than 25,000	2	70,000	28,350	40.5
25,000 to less than 100,000	13	1,264,500	644,906	51.0
100,000 or more	8	2,910,000	1,691,884	58.1
Total	28	4,406,680	2,387,219	54.2

The total value of the 1951 production, $27,454,638, reflects a decrease of about 14 percent from the value of $32,039,379 reported for 1950.

Capacity.—The rate of production in 1951 (54 percent of capacity) was considerably lower than in 1950, when the industry produced at 62 percent of capacity (*see* table 3). Nine plants, with an annual capacity of 200,000 tons or more each, furnished 1,782,913 tons or about 75 percent of the total production, utilizing 57 percent of their combined capacity. Seventeen plants, with an annual capacity of 100,000 tons or more each, supplied 92 percent of the total production in 1951, utilizing 55 percent of their combined capacity.

Raw Fuels.—Bituminous coal was the principal raw fuel used in manufacturing fuel briquets in 1951, followed in order by Pennsylvania anthracite and petroleum coke. These accounted for 90 percent of the raw fuels used. Residual carbon from the manufacture of oil gas, anthracite other than Pennsylvania anthracite, semi-anthracite, and lignite char also were used as raw fuels. Yard screenings used at 12 plants were the source of 15 percent of all raw fuels.

TABLE 4.—Raw fuels used in making fuel briquets in the United States, 1951

Type of raw fuel used	Plants using	Net tons used	Source of raw fuel used	Plants using	Net tons used		
					Yard screenings	Other raw fuels	Total
Pennsylvania anthracite	13	507,687	Yard screenings exclusively (from own or other yards)	4	60,814	----------	60,814
Arkansas hard coals	4	56,865	Raw fuels (other than yard screenings) exclusively	16	----------	1,207,458	1,207,458
Bituminous low-volatile coal	17	1,255,317	Both yard screenings and other raw fuels	8	271,699	700,706	972,405
Bituminous high-volatile coal	4	114,257					
Semicoke (lignite char)	1	35,826					
Residual carbon from manufacture of oil gas	2	126,675					
Petroleum coke	4	144,050					
Total	[1] 28	2,240,677	Total	28	332,513	1,908,164	2,240,677

[1] A number of plants used more than 1 kind of raw fuel; hence, the sum of the plants is greater than the actual number of plants active (28) in 1951.

Pennsylvania anthracite was used extensively, either alone or in combination with bituminous coal, in Pennsylvania and Wisconsin. Large quantities of bituminous coal were used widely in the Eastern and Central States. Residual carbon from oil gas was the only raw material used in the Pacific Coast States.

Binders.—Asphaltic binders were utilized exclusively in making briquets in the United States in 1951, when 26 operators used 146,542 net tons. Two operators employed no binder. The percentage of binder in the briquets (by weight) ranged generally from about 5 to 9 percent. Eleven plants (producing 57 percent of the 1951 output) used binders representing about 7 percent of the weight of the briquets. Eight plants (supplying 32 percent of the production) used binders representing about 6 percent of the weight of the briquets; four plants used binders representing 8 to 9 percent of the weight of the briquets, and the remaining three plants less than 6 percent.

TABLE 5.—Classification of briquetting plants in the United States, 1948–51, by type of binder used

	1948		1949		1950		1951	
	Plants	Percent of total briquet production	Plants	Percent of total briquet production	Plants	Percent of total briquet production	Plants	Percent of total briquet production
Type of binder used:								
No binder [1]	2	95.9	2	100.0	2	100.0	2	100.0
Asphalt	31		30		28		26	
Asphalt and coal-tar pitch	1		1		1		----	----
Asphalt and starch	----	4.1	----	----	----	----	----	----
Oil-gas tar pitch	1		----	----	----	----	----	----
Rosin and wax	1		----	----	----	----	----	----
Total	36	100.0	33	100.0	31	100.0	28	100.0

[1] Residual carbon from manufacture of oil gas was used at plants employing no binder.

SHIPMENTS

Weight and Shape.—In 1951 briquets ranged in weight from 1⅞ to 20 ounces. Pillow shapes, all under 5 ounces except for an 11-ounce bituminous high-volatile pillow, were made at 25 plants and represented 77 percent of the total production; 2½-ounce cylindrical (barrel-shaped) and 18- and 20-ounce cubes supplied 23 percent of the total production.

In addition to the 2,174,599 tons of fuel briquets shipped to 36 States and the District of Columbia in 1951, 168,676 tons were exported to Canada. Wisconsin, Minnesota, Missouri, and Michigan received 1,245,544 tons of the total briquets shipped. The difference between production in 1951 (2,387,219 tons) and shipments within the United States (2,174,599 tons), or 212,620 tons, represents exports, briquets used at plants for power or heat, and changes in producers' stocks. Briquets are used almost entirely for space heating, but in 1951 operators reported 8,073 tons used for power or heat at their plants.

Of the 2,373,548 tons of fuel briquets reported by producers as shipped in 1951 (domestic and foreign) about 92 percent was destined to 36 States and the District of Columbia; 77 percent of the total shipments moved by rail and 23 percent by truck or scow. In the Eastern States about 97 percent was shipped by rail and 3 percent by truck; in the Central States 69 percent moved by rail and 31 percent, by truck; and in the Pacific Coast States about 46 percent moved by rail and 54 percent by truck and scow.

TABLE 6.—Shipments of fuel briquets of domestic manufacture in the United States, 1950–51, as reported by producers, by State of destination, in net tons [1]

State of destination	1950	1951	State of destination	1950	1951
Arkansas	1,941	2,775	New Hampshire	3,292	3,007
California	20,796	1,314	New Jersey	13,242	25,260
Connecticut	2,623	2,099	New York	23,076	17,441
Delaware	319	162	North Carolina	29,691	22,266
District of Columbia	2,509	1,786	North Dakota	126,927	95,423
Florida	379	227	Ohio	89,086	78,319
Georgia	51		Oklahoma		52
Idaho	149		Oregon	69,190	59,904
Illinois	167,509	173,191	Pennsylvania	39,279	26,778
Indiana	120,003	116,672	Rhode Island	1,964	1,369
Iowa	89,500	71,256	South Carolina	6,821	2,784
Kansas	15,615	7,587	South Dakota	101,273	86,394
Kentucky	8,413	5,718	Tennessee	3,459	2,757
Maine	6,345	6,070	Texas		109
Maryland	22,117	17,163	Vermont	2,401	2,194
Massachusetts	19,306	27,074	Virginia	36,310	30,428
Michigan	278,841	219,939	Washington	30,477	17,628
Minnesota	378,996	312,851	West Virginia	2,495	2,070
Missouri	291,946	271,957	Wisconsin	521,112	440,797
Montana	35				
Nebraska	36,223	21,778	Total	2,563,711	2,174,599

[1] For shipments outside the United States, *see* export statistics, table 8.

TABLE 7.—Direct shipments of fuel briquets, 1950–51, by method of transportation, as reported by producers, in net tons [1]

Produced in—	1950			1951		
	Rail	Truck	Total	Rail	Truck	Total
Eastern States	901,653	28,160	929,813	777,134	20,342	797,476
Central States	1,196,665	489,149	1,685,814	998,367	454,773	1,453,140
Pacific Coast States	67,205	[2] 73,719	140,924	55,980	[2] 66,952	122,932
Total United States	2,165,523	[2] 591,028	[3] 2,756,551	1,831,481	[2] 542,067	[3] 2,373,548

[1] Includes shipments outside the United States, as reported by producers (differs somewhat from export statistics).
[2] Includes quantities shipped by scow.
[3] An additional 11,737 tons was used by 4 producers as fuel at their plants in 1950 and 8,073 tons by 3 producers in 1951.

PRICES

Although the average value per ton of briquets (f. o. b. plant) produced in the Eastern States in 1951 showed a slight increase from 1950 (about 3 percent), the average per ton values for the Central and Pacific Coast States continued the downward trend began in 1950, reflecting decreases from 1950 of about 1 percent and 11 percent, respectively (*see* table 1). Gross realization per ton (f. o. b. plant) varies greatly because of the different local conditions under which briquets are made. In the Eastern States briquets are made relatively near the coal fields; hence the cost of raw material does not involve large freight charges, and the f. o. b. plant price is relatively low. In the Central States briquets generally are made at plants great distances from the original source of coal; consequently, raw-fuel costs at these plants include a considerable freight charge, which is reflected in higher prices per ton f. o. b. plant. The highest plant values are shown in the Pacific Coast States, where the raw fuel used is residual carbon from the manufacture of oil gas.

These f. o. b. plant values vary considerably from the prices paid for briquets by consumers, as retail prices include transportation costs and retail dealers' margins. Information on retail prices of fuel briquets for selected cities may be obtained from the Bureau of Labor Statistics, United States Department of Labor, Washington 25, D. C.

FOREIGN TRADE [3]

Imports of fuel briquets into the United States reached a peak of 123,593 net tons in 1926, when a strike during the winter of 1925–26 in the Pennsylvania anthracite fields created a shortage of fuels in this country. Imports have been negligible since 1941, amounting to only a few hundred tons a year; in 1951, 123 tons was imported, all from Canada.

In 1951 exports of fuel briquets, virtually all of which were destined to Canada, totaled 168,780 tons, a 4-percent decrease from 1950. The value of 1951 exports was $2,389,657, a 9-percent decrease from 1950.

[3] Figures on imports and exports compiled by M. B. Price and E. D. Page, of the Bureau of Mines, from records of the U. S. Department of Commerce.

TABLE 8.—Briquets (coal and coke) exported from the United States, 1949–51, by country of destination and customs district

[U. S. Department of Commerce]

	1949		1950		1951	
	Net tons	Value	Net tons	Value	Net tons	Value
COUNTRY						
Afghanistan					3	$186
Canada	166,961	$2,436,004	175,768	$2,617,007	168,676	2,387,477
Newfoundland-Labrador	179	2,280				
El Salvador					101	2,000
Total	167,140	2,438,284	175,768	2,617,007	168,780	2,389,657
CUSTOMS DISTRICT						
Buffalo	84,750	1,285,958	97,550	1,545,754	85,488	1,392,942
Dakota	35,871	481,934	28,249	357,911	24,324	302,515
Duluth and Superior	16,733	224,708	21,834	272,951	21,196	267,837
Maine and New Hampshire	1,077	19,361	498	8,124	1,077	18,955
Michigan	4,629	61,222	1,839	17,783	4,941	44,605
Montana and Idaho			1,779	22,726		
New Orleans					101	2,000
New York					16,741	65,391
Philadelphia	740	9,397	448	5,951		
Rochester	4,123	28,907	800	11,098		
St. Lawrence	12,555	243,713	12,268	269,258	14,855	294,632
San Francisco					3	180
Vermont	64	512	11	120	54	600
Washington	6,598	82,572	10,492	105,331		
Total	167,140	2,438,284	175,768	2,617,007	168,780	2,389,657

PACKAGED FUEL

Salient statistics of the packaged-fuel industry in the United States from 1947 to 1951 are given in table 9.

TABLE 9.—Salient statistics of the packaged-fuel industry in the United States, 1935–39 (average), 1940, and 1947–51

	1935–39 (average)	1940 (peak year of production)	1947	1948	1949	1950	1951
Production:							
Eastern States net tons	5,052	6,349	2,153	1,859	125,948	135,682	119,535
Central States do	116,218	276,994	180,728	155,154			
Pacific Coast States do	1,563	1,170					
Total do	122,833	284,513	182,881	157,013	125,948	135,682	119,535
Plants in operation	63	106	62	62	57	54	53
Value of production	$1,050,566	$2,391,922	$2,882,105	$2,735,861	$2,236,748	$2,430,847	$2,169,539
Average value per net ton f. o. b. plant:							
Eastern States	$9.45	$9.02	$16.58	$17.64	$17.77	$17.19	$18.08
Central States	$8.50	$8.36	$15.75	$17.42	$17.76	$17.92	$18.15
Pacific Coast States	$9.91	$12.82					

DOMESTIC PRODUCTION

In 1951, 53 plants operated in the United States as compared with 54 plants in 1950 and produced 119,535 net tons of packaged fuel

valued at $2,169,539, a decrease of 12 percent in tonnage and 11 percent in value from the preceding year. Michigan, Wisconsin, and Ohio, in the order named, were the three largest producing States and supplied about 69 percent of the 1951 output. The average value per net ton (f. o. b. plant) of packaged fuel increased consistently in the Central States from 1947 through 1951. Except for a slight drop in 1950, the average value per ton in the Eastern States increased steadily from 1947 through 1951 (*see* table 9). Proceeds received by the manufacturers are equivalent to cost of coal at the mine, freight to factory, direct and indirect manufacturing cost, and profit. For this reason, the values may vary greatly from plant to plant, depending on the local conditions under which the product is manufactured. Production of packaged fuel, by States, for 1950–51 is shown in table 10.

TABLE 10.—Production of packaged fuel in the United States, 1950–51, by States

State	1950			1951		
	Plants	Net tons	Value	Plants	Net tons	Value
Indiana	3	16,355	$297,102	3	14,561	$267,818
Michigan	20	43,786	735,326	17	37,604	636,215
Minnesota	4	19,814	421,553	4	17,489	383,834
Ohio	15	24,150	430,660	14	18,494	338,272
Wisconsin	5	27,082	456,631	7	26,889	458,383
Other States	[1] 7	4,495	89,575	[2] 8	4,498	85,017
Total	54	135,682	2,430,847	53	119,535	2,169,539

[1] Comprises 2 plants in Virginia and 1 plant each in Illinois, Iowa, Kentucky, Missouri, and Nebraska.
[2] Comprises 2 plants each in Virginia and Illinois and 1 plant each in Iowa, Kentucky, Missouri, and Nebraska.

Number of Plants.—Of the 53 plants producing packaged fuel in 1951,[6] 17 Michigan plants furnished 31 percent of the total output, 7 plants in Wisconsin 22 percent, and 14 plants in Ohio 15 percent.

Capacity of Plants.—Table 11 gives comparative data on capacity and production for 1947 to 1951 as reported by packaged-fuel operations active in those years. In 1951, 13 plants with a capacity of 5,000 tons or more, operating at 49 percent of their combined capacity, produced 91,938 tons of packaged fuel or 77 percent of the total 1951 output. Forty plants, each with an annual capacity under 5,000 tons, produced 27,597 tons (23 percent of the total production), utilizing about 31 percent of their combined capacity.

Raw Fuels.—Five kinds of raw fuel were employed in manufacturing packaged fuel in 1951. Bituminous low-volatile coal (used at 48 plants, either alone or in combination with other fuels) comprised 86 percent of the total raw fuel used. Small quantities of bituminous high-volatile coal, Pennsylvania anthracite, semianthracite, and petroleum coke also were consumed in manufacturing packaged fuel in 1951.

[6] *See* footnote 2.

TABLE 11.—Annual capacity and production of packaged-fuel plants in the United States, 1947–51

	Number of active plants	Annual capacity (net tons)	Production	
			Net tons	Percent of annual capacity
1947	62	427,200	182,881	42.8
1948	62	397,620	157,013	39.5
1949	57	331,300	125,948	38.0
1950	54	293,560	135,682	46.2
1951:				
Capacity of—				
Less than 5,000 tons	40	89,810	27,597	30.7
5,000 to less than 10,000	7	44,200	16,573	37.5
10,000 to less than 15,000	2	20,000	8,425	42.1
15,000 to less than 25,000	2	33,000	19,952	60.5
25,000 or more	2	90,000	46,988	52.2
Total	53	277,010	119,535	43.2
Production of—				
Less than 1,000	31	59,410	11,450	19.3
1,000 to less than 3,000	15	69,600	25,961	37.3
3,000 to less than 5,000	1	40,000	23,309	58.3
5,000 to less than 10,000	3			
10,000 to less than 30,000	3	108,000	58,815	54.5
Total	53	277,010	119,535	43.2

Yard screenings were used exclusively at 30 plants to produce 21 percent of the total output; raw fuels other than yard screenings were used exclusively at 10 plants to manufacture 35 percent; and screenings and other raw fuels combined were used at 13 plants to produce 44 percent of the total 1951 production.

TABLE 12.—Raw fuels used in making packaged fuel in the United States, 1951

Type of raw fuel used	Plants using	Net tons used	Source of raw fuel used	Plants using	Net tons used		
					Yard screenings	Other raw fuels	Total
Bituminous low-volatile coal	48	100,937	Yard screenings exclusively (from own or other yards)	30	24,938	----	24,938
Bituminous high-volatile coal	4	3,946	Raw fuels (other than yard screenings) exclusively	10	----	39,471	39,471
Pennsylvania anthracite	----	----	Both yard screenings and other raw fuels	13	19,435	32,987	52,422
Semianthracite	2	2,695					
Petroleum coke	5	9,253					
Total	[1] 53	116,831	Total	53	44,373	72,458	116,831

[1] A number of plants used more than 1 kind of raw fuel; hence, the sum of the plants above is greater than the actual number of plants active (53) in 1951.

Binders.—Starch totaling 593 tons (an average of about 14 pounds per ton of packaged fuel produced) was the principal binder employed at 49 plants producing about 73 percent of the total 1951 output. Asphalt and cement were used exclusively at a few of the plants. Table 13 gives details on binders employed in manufacturing packaged fuel in 1948–51.

TABLE 13.—Classification of packaged-fuel plants in the United States, 1948–51, by type of binder used

	1948		1949		1950		1951	
	Plants	Percent of total packaged-fuel production	Plants	Percent of total packaged-fuel production	Plants	Percent of total packaged-fuel production	Plants	Percent of total packaged-fuel production
Type of binder used:								
Starch	57	79.8	52	78.3	48	74.6	48	71.3
Asphalt	3	19.5	3	20.6	2		2	
Starch and asphalt	1	.7	1	1.1	1	25.4		28.7
Cement	2		2		2		2	
Starch and cement							1	
Coal-tar pitch					1			
Total	[1] 62	100.0	[1] 57	100.0	54	100.0	53	100.0

[1] 1 plant making 2 types of packaged fuel used starch binder for 1 and asphalt and starch for the other; hence, the sum of the items shown exceeds the number of active plants.

SHIPMENTS

Sales of packaged fuel in 1951 totaled 119,840 net tons, of which 98,324 tons (82 percent) was listed as local sales (by truck) and 21,516 tons (about 18 percent) was reported as other than local sales. Of the 21,516 tons shipped outside the local area, 13,566 tons (about 63 percent) went by truck and 7,950 tons (37 percent) by rail.

TABLE 14.—Shipments of packaged fuel in the United States, 1947–51, by method of transportation, in net tons

Year	Shipped by truck			Shipped by rail	Total
	Local sales [1]	Other than local sales	Total truck		
1947	147,599	23,749	171,348	11,270	182,618
1948	128,661	17,753	146,414	10,272	156,686
1949	108,606	11,036	119,642	6,306	125,948
1950	112,962	13,774	126,736	7,814	134,550
1951	98,324	13,566	111,890	7,950	119,840

[1] Includes sales both called for and delivered.

TECHNOLOGY

The Bureau of Mines conducted an investigation to determine the combustion characteristics of packaged fuels made of high-volatile and low-volatile bituminous coals, and the results were published in Report of Investigations 4797.[4] In this investigation, particular attention was given to the smoke-producing properties of the packaged fuels, because of the increasing demands for reduction of smoke from hand-fired domestic-heating furnaces.

[4] Myers, J. W., and Corey, R. C., Combustion Characteristics and Physical Properties of Packaged Fuels Containing Bituminous Coals: Bureau of Mines Rep. of Investigations 4797, 1951, 30 pp.

The Anthracite Institute continued to make briquets from fine sizes of anthracite by extrusion and coking in a continuous shaft. The institute hopes that the product will have application as a fuel for cupolas and blast furnaces.

The Natural Resources Research Institute at the University of Wyoming has done considerable detailed research on matters relating to briquetting various kinds of coals. The institute sponsored the first briquetting conference at Laramie, Wyo., in June 1949, and a second briquetting conference was held at Superior, Wis., in August 1951. The proceedings of the 1951 conference were published in University of Wyoming Information Circular 5.[5]

The papers presented related to the position of briquets in the energy and fuels markets, briquetting of coal in Canada and other foreign countries, briquetting machinery, binders, the drying of coal for briquets, etc. The institute has conducted studies on briquetting low-rank western coals, drying and briquetting high-moisture coals, and use of special binders in briquetting.

WORLD PRODUCTION

As indicated in table 15, world production of fuel briquets increased substantially in 1951. Virtually all countries shared in this increase; however, the United States was one country that showed a marked decline in output. This drop in United States production can be attributed primarily to competition from other space-heating fuels, which were in ample supply. In 1951, as in former years, Germany was the world's largest producer of fuel briquets.

[5] University of Wyoming, Natural Resources Research Institute, Proceedings of a Coal Briquetting Conference, Inf. Cir. 5, October 1951.

TABLE 15.—World production of fuel briquets (and packaged fuel), 1947–51, by countries, in metric tons

[Compiled by Pauline Roberts]

Country	1947	1948	1949	1950	1951
Algeria	82,888	77,820	56,616	65,589	65,100
Australia [1]	[2] 498,208	553,987	567,869	598,010	[3] 590,000
Austria		69	27,827	45,897	79,594
Belgium	1,348,480	970,180	[2] 764,358	1,014,290	1,801,810
Bulgaria [3]	100,000	150,000	150,000	200,000	200,000
Canada	290,707	323,133	459,908	410,219	359,200
Czechoslovakia:					
Bituminous coal	259,130	331,489	[3] 350,000	387,500	395,000
Lignite	283,645	291,326	[3] 297,000	[3] 303,300	[3] 400,000
Denmark	18,546	16,543	38,932	[3] 40,000	[3] 40,000
Finland				80,000	80,000
France	5,118,830	[2] 5,828,020	6,365,000	6,307,000	8,049,000
French Morocco	46,215	[2] 31,735	[2] 14,611	34,573	24,755
Germany:					
East Germany: Lignite [3]	26,000,000	30,000,000	30,000,000	[2] 38,000,000	39,500,000
West Germany:					
Bituminous coal	2,176,000	[2] 2,972,300	[2] 3,586,100	[2] 3,721,600	4,104,100
Lignite	11,840,000	[2] 12,898,100	[2] 14,249,700	[2] 14,912,400	15,924,400
Hungary	70,970	[3] 90,000	[3] 100,000	[3] 125,000	[3] 150,000
Indochina	[3] 7,000	12,000	[3] 12,000	[3] 12,000	[3] 12,000
Indonesia	[3] 2,000	9,420	25,323	25,278	26,705
Ireland [4]	53,311	23,626	[2] 16,812	27,637	[3] 40,000
Italy:					
Anthracite	11,240	3,030	[3] 10,000	[3] 10,000	[3] 25,000
Lignite	15,428	1,590			
Japan [3]	600,000	800,000	1,000,000	1,500,000	1,800,000
Korea, South	200,994	76,724	168,358	[3] 75,000	[3] 100,000
Netherlands:					
Bituminous coal	910,046	935,865	[2] 991,700	[2] 1,049,200	1,062,400
Lignite	41,673	62,988	[2] 61,100	[2] 56,500	72,700
New Zealand	11,592	13,113	13,935	11,311	[3] 11,500
Pakistan	2,281	4,670	8,972	[3] 7,300	[3] 7,500
Poland:					
Bituminous coal	631,915	717,508	[2] 694,800	[3] 631,300	[3] 622,000
Lignite	41,697	113,633	[2] 170,000	[2] 169,300	[3] 159,000
Portugal	97,418	73,821	71,607	[2] 79,585	87,600
Rumania [3]	175,000	200,000	200,000	250,000	250,000
Spain	789,535	1,005,285	1,135,859	[2] 1,130,362	1,160,542
Sweden	86,900	[2] 111,329	[2] 59,498	[5]	[5]
Switzerland [3]	100,000	100,000	100,000	100,000	100,000
Tunisia	36,764	45,746	[2] 44,100	41,800	37,593
Turkey	15,130	7,426	40,102	29,100	[3] 30,000
United Kingdom	1,870,548	1,489,529	1,536,268	[2] 1,419,422	1,775,039
United States:					
Briquets	2,877,208	2,838,092	2,180,834	2,512,907	2,165,637
Packaged fuel	165,906	142,439	114,258	123,088	108,440
Yugoslavia [3]	125,000	150,000	175,000	200,000	200,000
Total (excluding U. S. S. R.) [3]	57,000,000	64,000,000	66,000,000	76,000,000	82,000,000

[1] Fiscal year ended June 30 of year stated.
[2] Revised figure.
[3] Estimate.
[4] Including peat briquets.
[5] Negligible.

Gem Stones

By W. F. Foshag,[1] George Switzer,[1] and Robert D. Thomson

GENERAL

DOMESTIC PRODUCTION

AS IN THE PAST, the United States continues to be an unimportant factor in world gem production. A wide variety of gems is produced but in small quantity. Gem mining is, and probably will continue to be, a minor industry.

Most gem-stone production in the United States results from the interest of thousands of amateur lapidaries, who pursue their hobby with great vigor and spend their vacations and weekends searching for materials suitable for cutting and polishing. Much of what they collect passes into the hands of numerous small mineral and lapidary supply dealers or roadside curio shops and changes hands through sale or exchange. The many varieties of quartz, such as agate, jasper, and petrified wood, are the chief materials produced in this way.

There are no large gem-mining companies in the United States. A few small companies operate certain deposits from time to time, such as turquoise, tourmaline, and jade, but they employ only a few miners. Since such a small percentage of the total gem production is mined on a commercial scale, no reliable statistics of the value of the domestic output of gems can be compiled. The value may approximate $400,000 to $500,000.

The many forms of quartz—chiefly the crypto-crystalline varieties—were produced in greatest quantity and value in 1951. Other gems produced, but in very much smaller quantity, were jade, kunzite, and turquoise, and a number of others in almost insignificant quantity. Of the producing States, California, Oregon, Texas, Washington, and Wyoming were the leaders.

Agate.—As far as could be ascertained, there was no appreciable change in agate production (including all varities of chalcedony) from that of 1950.

The Alpine-Big Bend area in Texas was one of the leading producers. A single locality near Alpine was reported to have yielded approximately 6,000 pounds of agate during the year, with an average value of 25 cents per pound.

Production from New Mexico was reported as essentially unchanged from the previous year.

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[1] Smithsonian Institution, consulting mineralogist to Bureau of Mines.

Large quantities of agate also were found in California, Oregon, and Washington, with smaller quantities in Arizona, Montana, and Wyoming. Small quantities of all forms of chalcedonic quartz, such as agate, jasper, petrified wood, and chert, were collected in nearly every State. A small quantity of chrysoprase was said to have been recovered at Porterville, Calif.

Kunzite.—Renewed mining activity in the Pala district, San Diego County, Calif., in the years 1949–51 yielded important quantities of kunzite. In the Vandenberg mine pockets were struck in July and October 1951 which yielded about 150 pounds of kunzite, of which about 10 percent was fine gem quality. The larger of these two pockets contained material of exceptionally good color. The value of this find was estimated at about $16,000.

Jade.—The available supply of Wyoming nephrite jade continued to diminish. Material of good color was reportedly selling for $30 to $60 per pound. A new find was reported in Shirley Basin, north of Medicine Bow, yielding some material of good medium-green color, selling at $5 to $10 per pound.

In California some jade (nephrite) was found along the coast near Monterey, and some jadeite jade was collected at Clear Creek, San Benito County. No production was reported from the Porterville locality. Reports published in 1951 described the jade deposits in Marin, Monterey, and San Benito Counties, Calif.[2]

No production of nephrite jade was reported for the year from the Kobuk area, northwestern Alaska.

Turquoise.—Turquoise production continued to decline in the Southwest. There was no large-scale activity in any turquoise localities, although undoubtedly small quantities were produced from various mines in Nevada, Arizona, and Colorado.

Other Gem Stones.—No diamonds were produced from the Arkansas diamond mines in 1951.

The Barton Mines Corp., North Creek, N. Y., reported a 1951 production of 60 pounds of gem-quality garnet, valued at $85.

No sapphire was produced in Montana from the Yogo Gulch area. The Yogo Sapphire Mining Corp. was negotiating to buy all the properties of the British-owned New Mine Sapphire Syndicate and planned to open the mines if negotiations were successful.

No variscite was produced from the Fairfield, Utah, locality during 1951 because of litigation. A small quantity was obtained by collectors at Grantsville and Lucin, Utah, and a new variscite deposit was reported near Snowville, Box Elder County, Utah.

A number of good-size pieces (single pieces up to several hundred carats) of pale-blue topaz were recovered by collectors in Mason County, Tex. The Thomas Mountains, Utah, topaz locality was visited by many collectors, but no important production resulted.

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[2] Chesterman, Charles W., Nephrite in Marin County, Calif.: California Div. of Mines Spec. Rept. 10-B, 1951, 11 pp.
Crippen, Richard A., Jr., Nephrite Jade and Associated Rocks of the Cape San Martin Region, Monterey County, Calif.: California Div. of Mines Spec. Rept. 10-A, 1951, 14 pp.
Yoder, H. S. and Chesterman, C. W., Jadeite of San Benito County, Calif.: California Div. of Mines Spec. Rept. 10-C, 1951, 8 pp.

Small quantities of tourmaline and morganite were produced in San Diego County, Calif., and some tourmaline and aquamarine in the various New England pegmatite localities, chiefly in Maine and New Hampshire.

Rose-quartz production from South Dakota was small. Some of the rock-crystal quartz from Arkansas undoubtedly went into the gem trade.

The total value of these miscellaneous gems probably was not more than a few hundred dollars.

CONSUMPTION AND USES

Business conditions in the jewelry industry remained essentially the same as in 1950. In general, sales were slow, particularly in the early months of the year, and even the traditional Christmas rush did not come up to the expectations of most retailers. Continuation of the Korean War eliminated any immediate chance of a reduction in the 20-percent excise tax on jewelry. This, plus continually rising living costs, caused a slump in the jewelry industry.

Again in 1951, the United States was the principal world market for diamonds. There was no significant change in the volume of diamonds sold by jewelers. Diamond jewelry sales represented about one-quarter of total jewelry sales of the typical dealer in 1951. Most jewelers had no trouble in obtaining an adequate supply of diamonds, although fine-quality stones in the larger sizes were said to be in short supply.

Fashion in Jewels.—During 1951 women continued to wear a large quantity of jewelry of conspicuous sizes. There was a steady rise in the production and use of baguette diamonds, as well as other fancy cuts, such as the pear and marquise. Large, emerald-cut diamonds were the most coveted solitaires, but because of their high price few could afford them.

Paris jewelry went to no extremes and made no radical departure in style. Leaf forms from many trees and shrubs inspired the designers. The scale continued large, but forms were light and airy.

Paris continued to set trends for the world of fashion in 1951, but three Italian cities—Rome, Florence, and Milan—also emerged as sources of inspiration. Since the Italian jewelry designers sometimes come from the ranks of painters, sculptors, and even architects, great diversity of artistic creation may be expected from this source.

IMPORTS [3]

Imports of gem stones, exclusive of industrial diamonds, in 1951, as reported by the United States Department of Commerce, totaled $129.3 million, compared with $118.5 million in 1950, an increase of about 9 percent. Diamonds were the more important, totaling $110.6 million (86 percent) of the total value of imports, with "cut but unset" representing 56 percent of the diamond imports.

[3] Figures on imports and exports compiled by M. B. Price and E. D. Page, of the Bureau of Mines, from records of the U. S. Department of Commerce.

TABLE 1.—Precious and semiprecious stones (exclusive of industrial diamonds) imported for consumption in the United States, 1950–51

[U. S. Department of Commerce]

Commodity	1950		1951	
	Carats	Value	Carats	Value
Diamonds:				
Rough or uncut (suitable for cutting into gem stones), duty-free	[1] 673,699	[1] $43,655,706	697,981	$48,704,819
Cut but unset, suitable for jewelry, dutiable	[1] 492,741	[1] 58,531,035	480,516	61,858,003
Emeralds:				
Rough or uncut, duty-free	12,142	7,991	2,706	2,698
Cut but not set, dutiable	9,706	237,446	20,148	264,527
Pearls and parts, not strung or set, dutiable:				
Natural	----------	410,970	----------	449,379
Cultured or cultivated	----------	3,192,334	----------	2,747,653
Other precious and semiprecious stones:				
Rough or uncut, duty-free	----------	[1] 304,167	----------	160,609
Cut but not set, dutiable	----------	2,429,992	----------	2,686,137
Imitation, except opaque, dutiable:				
Not cut or faceted	----------	19,088	----------	87,162
Cut or faceted:				
Synthetic	----------	811,372	----------	888,629
Other	----------	[1] 8,753,307	----------	11,307,401
Imitation, opaque, including imitation pearls, dutiable	----------	14,854	----------	26,394
Marcasites, dutiable:				
Real	----------	136,768	----------	88,395
Imitation	----------	3,019	----------	3,836
Total	----------	[1] 118,508,049	----------	129,275,642

[1] Revised figure.

TECHNOLOGY

The emphasis in gem-stone research was on diamonds. The Diamond Research Laboratory of Johannesburg, Union of South Africa, sponsored and supported by Industrial Distributors (1946), Ltd., investigated many problems in mining and utilization of diamonds.

Articles published recently dealt with the investigation of the Slipper diamond, a 7.25-carat octahedron with a small included octahedron [4] and the luminescence of polished cleavage plates of diamond; [5] description of the unusual twinned tetrahedral diamonds from the Belgian Congo; [6] a fractographic study of the cleavage face of a 34½-carat diamond from the Premier mine, South Africa, which had a cleavage pattern partly characteristic of type I and partly of type II diamond; [7] description of the effects of treating diamonds in a cyclotron; [8] and measurement of the thermo conductivity of diamond, sapphire, and quartz.[9]

An excellent summary of the chief scientific and industrial development regarding diamonds that took place during 1951 was prepared by

[4] Kohn, J. A., Observations on the Slipper Diamond: Gems and Gemology, vol. 6, No. 11, Fall 1950, pp. 347–348.
[5] Raman, C. V., The Luminiscence of Diamond–II: Curr. Sci. (India), vol. 20, No. 1, January 1951, pp. 1–7.
[6] Polinard, E., Sur une forme titraedrique du diamant: Bull. soc. geol. Belg., vol. 74, No. 3, 1950, pp. 59–63.
[7] Custers, J. F. H., Laminations in Type II Diamonds: Research, vol. 4, No. 3, March 1951, pp. 131–136.
[8] Ehrmann, M., Bombarded Diamonds: Gems and Gemology, vol. 6, No. 10, summer 1950, p. 295.
Pough, F. H. and Schulke, A. A., The Recognition of Surface Irradiated Diamonds: Gems and Gemology, vol. 7, No. 1, Spring 1951, pp. 3–11.
[9] Berman, R., Simon, F. E., and Wilks, J., Thermal Conductivity of Dielectric Crystals; the "Umklapp" Process: Nature, vol. 168, No. 4268, Aug. 18, 1951, pp. 277–280.

P. Grodzinski and his associates and distributed by the Industrial Diamond Information Bureau, 32–34 Holborn Viaduct, London, E. C. 1.

In the field of colored gem stones, taaffeite, a pale mauve gem resembling spinel but chemically a beryllium magnesium-aluminum oxide, was described.[10]

DIAMONDS[11]

The year 1951 was another record-breaking year in the diamond industry. The value of diamonds sold through the Central Selling Organization, on behalf of South African and other producers, amounted to £65 million. Sale of diamonds produced in Brazil, British Guiana, and Venezuela raised the overall total to approximately £68 million, an increase of about 30 percent over 1950. A 15-percent increase in diamond prices in March 1951 brought sterling prices to full parity with dollar prices, which were in effect before the devaluation of sterling in 1949. The increased sales for 1951, however, are only partly attributable to this cause, also being influenced by increased production of rough diamonds through increased mining activity and better milling practices.

A sharp increase in sales of industrial diamonds featured the 1951 market. Sales by the Central Selling Organization were divided as follows:

Gem diamonds	£46,780,632
Industrial diamonds	18,277,333
	65,057,965

A new record also was set for world production of diamonds in 1951, with a total of 16,800,000 carats, compared with 15,250,000 carats in 1950.

Cutting.—The strong demand for gem diamonds continued unabated during 1951.

In spite of this high level of activity, the cutting industry continued to be plagued with unemployment, indicating a surplus of workers in the industry.

Means to eliminate the disparity in cutting costs, wages, and working hours in the various cutting centers was widely considered, but no uniform wage basis could be determined. Neither the efforts of the Netherlands and Belgian cutters and manufacturers to arrive at some satisfactory arrangement, nor the efforts of the Universal Alliance of Diamond Workers to work out an agreement with the German diamond workers' organization on time, tariffs, and apprenticeships, were successful.

Belgium continued to be the largest cutting center, followed by Germany, Netherlands, Israel, and the United States. Smaller cutting centers were in England, South Africa, France, India, Brazil, and Puerto Rico.

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[10] Anderson, B. W., A Rare New Gem Stone: Gemologist, vol. 20, No. 237, April 1951, pp. 75–77.

[11] Foshag, W. F. and Switzer, G., The Diamond Industry in 1951: Jewelers' Circular-Keystone, vol. 122, No. 10, July 1952, pp. 88, 90, 116–117, and 118; No. 11, August 1952, pp. 130, 132, and 168–169; and No. 12, September 1952, pp. 126, 128, and 149.

TABLE 2.—Diamonds (exclusive of industrial diamonds) imported for consumption in the United States, 1950–51, by countries

[U. S. Department of Commerce]

Country	Rough or uncut			Cut but unset		
	Carats	Value		Carats	Value	
		Total	Average		Total	Average
1950						
Argentina				109	$11,847	$108.69
Australia				12	6,500	541.67
Belgian Congo	[1] 200	[1] $10,000	[1] $50.00			
Belgium-Luxembourg	[1] 336	[1] 43,454	[1] 129.33	257,942	29,115,318	112.88
Brazil	[1] 28,096	[1] 777,164	[1] 27.66	2,125	190,562	89.68
British Guiana	[1] 375	[1] 22,378	[1] 59.67	1	148	148.00
British West Africa, n. e. s	[1] 9,955	[1] 317,412	[1] 31.88			
Canada	([2])	([2])	([2])	657	98,343	149.68
China				90	12,738	141.53
Cuba				261	34,893	133.69
Denmark				104	7,118	68.44
France				4,497	517,574	115.09
French Equatorial Africa	215	14,009	65.16			
French Morocco				156	14,779	94.74
Germany	3	41	13.67	7,317	603,797	82.52
Hong Kong				321	64,126	199.77
Hungary				5	120	24.00
India				8	1,277	159.63
Iran				16	1,551	96.94
Israel and Palestine	98	5,938	60.59	[1] 86,262	[1] 6,840,496	[1] 79.30
Italy				5	900	180.00
Kuwait				2	542	271.00
Lebanon				217	37,770	174.06
Netherlands	480	13,932	29.03	44,978	4,845.140	107.72
Philippines				30	8,500	283.33
Portuguese Asia				39	11,329	290.49
Southern-Southeastern Asia, n. e. s				75	4,621	61.61
Switzerland	[1] 151	[1] 7,324	[1] 48.50	3,251	740,125	227.66
Thailand				418	81,596	195.21
Union of South Africa	[1] 588,551	[1]41,149,102	[1] 69.92	74,476	14,313,316	192.19
U. S. S. R				3,919	190,000	48.48
United Kingdom	[1] 5,117	[1] 350,706	[1] 68.54	5,448	776,009	142.44
Venezuela	[1] 40,122	[1] 944,246	[1] 23.53			
Total 1950	[1] 673,699	[1] 3,655,706	[1] 64.80	[1] 492,741	[1]58,531,035	118.79
1951						
Australia	765	97,086	126.91	12	1,200	100.00
Bahrein	50	20,878	417.56			
Belgian Congo	2,645	215,173	81.35			
Blegium-Luxembourg	4,582	409,071	89.28	251,617	31,317,834	124.47
Brazil	7,749	523,453	67.55	452	79,078	174.95
British Guiana	1,563	55,513	35.52	6	646	107.67
British Malaya				161	26,700	165.84
Canada	6,112	174,167	28.50	7	1,751	250.14
Ceylon				9	121	13.44
Czechoslovakia				10	1,150	115.00
Denmark				17	2,348	138.12
France	286	13,990	48.92	3,208	425,507	132.64
Germany				9,691	789,720	81.49
India				2	260	130.00
Iran				30	3,600	120.00
Israel and Palestine	207	1,656	8.00	104,194	9,128,630	87.61
Italy				62	12,372	199.55
Japan				50	5,670	113.40
Kuwait				1	800	800.00
Liberia	180	10,000	55.56			
Mexico				6	1,871	311.83
Netherlands	19,329	1,481,908	76.67	35,940	4,398,388	122.38
Southern British Africa				154	27,853	180.86
Switzerland	85,110	5,533,669	65.02	7,229	1,259,918	174.29
Union of South Africa	66,930	1,856,217	27.73	64,537	13,835,217	214.38
United Kingdom	475,927	37,557,682	78.91	3,120	536,944	172.10
Uruguay				1	425	425.00
Venezuela	26,546	754,356	28.42			
Total 1951	697,981	48,704,819	69.78	480,516	61,858,003	128.73

[1] Revised figure.
[2] Revised to none.

In the United States employment in the diamond-cutting industry reached a low level in 1951. During the year less than 50 percent of the enrolled members of the Diamond Workers Protective Union had steady employment, and work in the non-union shops was seasonal. High labor costs in the United States permitted only cutting of the larger and finer grade stones.

Imports.—Imports of gem-grade diamonds into the United States amounted to $110,563,000 in 1951 compared with $102,187,000 (revised) in 1950, an increase of slightly less than 1 percent. The United Kingdom furnished most of the rough or uncut and Belgium-Luxembourg most of the cut in 1951.

World Production.—Official figures on diamond production are not available for all countries, but the figures in the accompanying table are believed to be reasonably accurate. World production in 1951 (gems and industrials) is estimated to have been 16,800,000 metric carats, which compares with 15,250,000 carats for 1950, an increase of nearly 10 percent.

Belgian Congo was again the leading producer by weight, but only about 5 percent of the Belgian Congo production was of gem quality. South Africa, although producing much less by weight, lead in value owing to a higher percentage of gem stones.

TABLE 3.—World production of diamonds, 1948–51, by countries, in metric carats

[Including industrial diamonds]

Country	1948	1949	1950	1951
Africa:				
Angola	795,509	769,981	538,867	751,447
Belgian Congo	5,824,567	9,649,896	10,147,471	10,564,667
French Equatorial Africa	118,300	122,928	[4] 111,407	[2] 136,000
French West Africa	77,970	94,996	126,346	101,000
Gold Coast	[2] 850,000	[1] 972,976	[2] 950,000	[2] 1,600,000
Sierra Leone	465,518	494,119	655,474	475,759
Southwest Africa	200,691	280,134	488,422	478,075
Tanganyika	148,169	191,787	195,274	108,625
Union of South Africa:				
Lode	[2] 930,000	964,266	1,516,194	1,967,272
Alluvial	[2] 270,000	[3] 289,756	[3] 231,674	[3] 289,063
Brazil [2]	250,000	250,000	200,000	200,000
British Guiana	36,562	34,790	37,462	43,260
Venezuela	75,513	56,362	60,389	63,226
Other countries [2]	3,500	3,000	3,000	3,000
Grand total (round figures)	10,050,000	14,175,000	[4] 15,250,000	16,800,000

[1] Exports.
[2] Estimated.
[3] Includes an estimated 100,000 carats for State mines of Namaqualand.
[4] Revised.

Industrial Diamonds.—Details regarding imports, production, sales, and uses of industrial diamonds will be found in the Abrasive Materials chapter of this volume.

OTHER GEM STONES

The price of most gem stones other than diamonds continued to hold steady owing to a short supply of newly mined stones of fine quality.

Ceylon maintained its output of important quantities of a variety of gems, chiefly ruby, sapphire, chrysoberyl, spinel, garnet, zircon,

topaz, and tourmaline. The gems came from the alluvial gravels of the Ratnapura district. The gem mining was done by individuals or small companies, and no official production figures are available.

Australian opal production [12] for 1951 was valued at £65,474, an increase of £9,255 over that produced in 1950. Good-quality material was scarce. The Andamooka and Coober Pedy fields in South Australia were the main producing centers. The Hayricks mine in the Quilpie district was the only one operating in Queensland, and a few men worked intermittently at Lightning Ridge, New South Wales. The value of opal exports in 1951 amounted to £79,972, as compared with £40,040 in 1950. The United States was the largest buyer in both years.

Australian sapphire production [12] during 1951 was valued at £1,135, compared with £3,181 in 1950. Production, which amounted to 63 ounces, was chiefly from the areas of Rubyvale and Sapphire, Queensland. Three cutting plants were operated at the fields, and lapidaries in Brisbane and other cities cut Queensland sapphires for the local market and export. No export statistics are available.

Cultured-pearl production in Japan during 1951 amounted to 3,375 kilograms. Production had risen steadily from none in 1945 to 938 kilograms in 1948 and 2,625 kilograms in 1950. The 1951 export value of cultured pearls was $4,354,000. An interesting change took place in the export market after World War II. In 1938, 40 percent of the cultured-pearl exports went to the United States, while in 1951 the corresponding figure was 61 percent.

Production of emeralds in Colombia was reported by the Ministry of Development to be about 68,000 carats in 1951. This represents only the production of the Government-owned Muzo and Cosquez mines, which had been closed the last quarter of 1949 but were opened again during the latter part of 1951; production was, however, erratic. Production of the privately owned Chivor mine is not known. The Chivor Emerald Mines, Inc., the owner, went into bankruptcy in April 1951. Some production was continued by the workers, but all of the stones went into the black market. Despite this trouble, it was reported that a new vein was found at Chivor, and the emeralds produced were said to be the best quality ever taken from the mine.

Brazil continued to produce a large quantity of amethyst, aquamarine, citrine, topaz, and tourmaline and smaller quantities of chrysoberyl, andalusite, euclase, and other gems.

Gem-stone production in other well-known districts, such as Burma, Thailand, Mozambique, Madagascar, and India, apparently was small, and no official figures are available.

SYNTHETIC GEM STONES

Synthetic Emerald.—This synthetic gem, so far as known, is produced only by the Chatham Research Laboratories in San Francisco, Calif. Production in 1951 averaged 5,000 carats per month in crystals averaging 40 carats each. The total production of 60,000

[12] Australian Bureau of Mineral Resources, Geology and Geophysics, Australian Mineral Industry—1951: 1952, p. 165.

carats for the year was an increase of about 20 percent over 1950. Production was broken down as follows: 50 percent very low grade (opaque) but good color, 40 percent medium grade, and 10 percent fine gem quality. Retail prices of top-quality stones remained about the same at $90 to $120 per carat. Flawless stones over 2 carats in size were not produced.

Corundum and Spinel.—The year 1951 found conditions in the American synthetic gem industry at a very low ebb owing to recovery of the European industry after World War II, chiefly in Germany and France.

It was reported that one shop in the United States continued to cut synthetics on a large scale, by offering well-cut and well-sized stones at higher prices than the European goods but with the added advantage of good deliveries. Most of the material cut from American sources was for educational jewelry (for example, class rings), the most popular style being the buff-top flat back. Ruby-colored corundum predominated, the distribution being 70 percent ruby corundum and 30 percent blue spinel.

The sales of rough synthetic gem stones manufactured in the United States virtually vanished. European manufactured synthetic gem stones—principally from Germany—reached manufacturing jewelers directly rather than through the normal channels of gem-stone dealers. Thus, by obtaining their gem stones directly from Europe the manufacturing jewelers bypassed wholesalers and realized some price advantage.

There was some increase in the use of synthetic star rubies and sapphires in 1951 over 1950. Also, some synthetic stars of European manufacture were seen and at much lower prices than those made in the United States.

Synthetic Rutile (Titania).—During 1951 titania sales increased somewhat, with a greater number of manufacturing jewelers incorporating this stone in their designs. However, there had not been great popular acceptance of this material, and it had not become a serious threat to the diamond trade, as was at first feared by some.

Gold and Silver

By James E. Bell

GENERAL SUMMARY

MINE production of gold and silver in the United States in 1951 failed to maintain the gains made in the preceding year. The domestic output of recoverable gold was 17 percent less in 1951 than in 1950. Further, it was smaller than in any other year since 1894, with the exception of those in the period 1943–46. The decline was general in all of the principal gold-producing States and was due to various combinations of factors in different areas, including lack of labor, depletion of reserves at some properties, lower average gold content of base-metal ores mined in 1951, smaller output of base-metal ores containing gold because of strikes, and curtailment or abandonment of straight gold-mining operations owing to high costs and the fixed price of gold. The output of recoverable silver was 6 percent smaller in 1951 than in 1950 but higher than in any of the years 1944–49; however, it was less than in any other year since 1934. Lower output prevailed in most of the principal silver-producing States owing to a smaller production in some areas of base-metal ores containing silver and to a lower average silver content of base-metal ores mined in other areas.

South Dakota was the leading gold-producing State in 1951, followed in order by Utah and California, the same as in 1950. These three States, with Alaska, produced 74 percent of the United States total output. The South Dakota output was obtained almost entirely from gold ore mined at the Homestake property in Lawrence County; Utah gold was principally a byproduct of copper mining in the West Mountain (Bingham district); California yield came mainly from straight gold-mining operations, both lode and placer; and Alaska production was almost entirely from placer operations, mainly bucket-line dredging. Of the gold produced in 1951, 25 percent was recovered by placer methods, 34 percent by amalgamation and cyanidation, and 41 percent in smelting ores and concentrates.

Idaho continued its rank as the leading silver-producing State, followed by Utah, Montana, and Arizona, an order unchanged since 1943. These four States furnished 84 percent of the domestic silver production of 1951. The Idaho output was recovered largely from dry ores, but most of the output from the other three leading States was byproduct silver from ores mined principally for base metals. Nearly 99 percent of the total domestic silver production of 1951 was recovered in the treatment of ores and concentrates.

Production of gold outside the United States was moderately greater in 1951 than in the preceding year owing mostly to a higher (estimated) production in the U. S. S. R. In the Rand district of Union of South Africa a little less ore of slightly lower average grade was mined, but operating profits were down considerably because of rising costs;

however, the sale of some of the output at premium prices sustained the overall revenue to gold producers. Production of silver outside the United States in 1951 was slightly above that in 1950 due mostly to increases in Peru, West Germany, and South-West Africa. The world production rates of gold and silver in recent years have been far below prewar averages.

Two properties reached the production stage late in 1951 in the new gold district of the Orange Free State (Union of South Africa) 150 miles south-southwest of Johannesburg. Eleven other properties were in development in this field, and 4 were expected to go into production in 1952. Extensive exploratory drilling and development work have indicated that the new field has an ultimate gold-production potential comparable to that of the famous Rand district.

The United States Treasury continued to purchase gold at $35 per fine troy ounce in 1951 and to purchase silver mined domestically after July 1, 1946, at $0.9050505 per fine troy ounce. Late in September 1951 the International Monetary Fund bowed to demands by most gold-producing countries to relax its policy regarding the sale of gold at premium prices on the free market. The New York price of silver continued to represent the basis for most international transactions in silver; prices in 1951 ranged from a low of $0.8000 to a high of $0.9016 per troy ounce 0.999 fine, compared with $0.7175 and $0.8000 in 1950. Some silver was diverted from United States Treasury stocks to satisfy trade requirements. International trade in silver continued to be dominated by regulations of various governments. The London market was hampered by exchange regulations, and India continued its ban on imports and exports of silver; Mexico limited exports to current production. Demand for silver by governments for coinage was approximately 89 million ounces in 1951 compared with 42 million ounces in 1950.

The net outflow of gold from the United States that began in September 1949 continued almost without interruption through June 1951; however, the situation was reversed in July, with the result that the net 1951 loss in United States monetary stocks was slight. Continuing a trend resumed in 1946, the net inflow of silver into the United States was maintained in 1951; however, it was 9 percent below that of 1950.

PREMIUM PRICES FOR GOLD

Developments in transactions in gold at premium prices and in private hoarding of gold have been reported in the chapters on Gold and Silver of Minerals Yearbooks for the past several years.

In a statement issued on September 28, 1951, the International Monetary Fund yielded to growing pressure to permit the member gold-producing countries to form their own regulations for disposal of their gold at premium prices.

Most of the gold-producing countries reacted to the announcement of the IMF by giving permission to their gold producers to sell, with certain restrictions, part or all their current output at premium prices on the free market. Even before the announcement, the Union of South Africa had sold as much as 40 percent of its current gold production in the free market, and no radical change in the volume of supply from this source was anticipated. Southern Rhodesia and

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TABLE 1.—Salient statistics of gold and silver in the United States,[1] 1942–46 (average) and 1947–51

	1942–46 (average)	1947	1948	1949	1950	1951
Mine production, fine ounces:						
Gold	1,669,679	2,109,185	2,014,257	1,991,783	2,394,231	1,980,663
Silver	36,392,786	35,823,563	38,096,031	34,674,952	42,459,014	39,766,779
Ore (dry and siliceous) produced (short tons):						
Gold ore	3,795,709	3,523,715	3,261,194	3,376,139	3,584,360	2,606,202
Gold-silver ore	549,689	366,454	569,760	412,378	433,461	368,184
Silver ore	496,695	344,649	370,647	476,960	627,349	492,143
Percentage derived from—						
Dry and siliceous ores:						
Gold	41	39	39	45	43	39
Silver	27	26	27	24	33	32
Base-metal ores:						
Gold	34	29	31	28	31	36
Silver	73	74	73	76	67	68
Placers:						
Gold	25	32	30	27	26	25
Silver	(2)	(2)	(2)	(2)	(2)	(2)
Net consumption in industry and the arts:						
Gold	$98,713,556	$48,900,000	$44,986,000	$108,842,471	$97,845,753	$69,476,979
Silver, fine ounces	110,559,739	98,500,000	105,289,000	88,000,000	110,000,000	105,000,000
Imports:						
Gold	$231,617,728	$2,079,588,406	$1,981,175,178	$771,390,261	$162,748,661	$81,258,502
Silver	$35,447,086	$68,140,343	$70,884,513	$73,535,694	$110,035,107	$103,468,510
Exports:						
Gold	$282,724,043	$213,240,800	$300,771,144	$84,935,678	$534,035,794	$630,381,566
Silver	$57,399,164	$30,648,742	$12,400,060	$23,281,043	$6,201,874	$8,590,185
Monetary stocks (end of year):[3]						
Gold		$22,754,000,000	$24,244,000,000	$24,427,000,000	$22,706,000,000	$22,695,000,000
Silver, fine ounces		1,953,000,000	1,952,000,000	1,978,000,000	1,983,000,000	1,965,000,000
Price, average, per fine ounce:						
Gold[4]	$35.00	$35.00	$35.00	$35.00	$35.00	$35.00
Silver[5]	$0.730+	$0.905+	$0.905+	$0.905+	$0.905+	$0.905+
World production, fine ounces (estimated):						
Gold	29,000,000	29,000,000	29,800,000	30,800,000	32,500,000	33,500,000
Silver	187,360,000	167,700,000	173,200,000	173,800,000	198,600,000	198,600,000

[1] Includes Alaska.
[2] Less than 0.5 percent.
[3] Owned by Treasury Department; privately held coinage not included.
[4] Price under authority of Gold Reserve Act of Jan. 31, 1934.
[5] Treasury buying price for newly mined silver.

the British Colonies of Gold Coast, Tanganyika, and Kenya announced permission to gold producers to sell up to 40 percent of their respective outputs on lines broadly similar to those adopted by South Africa. Canadian authorities allowed Canadian gold producers the choice of selling their production on the free market, or of selling at the IMF price with participation (if eligible) in subsidies under the Emergency Gold Mining Assistance Act. The Australian Government ruled that the entire current Australian gold output could be sold in the free market.

It was estimated that, following the changes in policy of the IMF, the potential supplies of gold available for premium-price sales might amount to as much as 12 million ounces in 1952, provided the free market could continue to pay an appreciable premium. It was also estimated that about one-third of this quantity would be absorbed by the European markets, one-third by the Middle East, and one-third by the Far East. As a result of the September announcement of the IMF, the price of gold in the European free markets declined from about $40 per ounce to between $38 and $39.

The action of September 28, 1951, of the IMF brought no change in policy of the United States Government on the premium market for gold. The legality of domestic trade and holding of gold in its natural state was established under section 19 of the Provisional Regulations of the Gold Reserve Act of 1934, in these terms:

> Gold in its natural state may be acquired, transported within the United States * * * without the necessity of holding a license therefor.

However, production that could qualify as "natural" gold, eligible for trading, was limited to placer gold recoverable without the use of quicksilver and to free lode gold recoverable from the ore mechanically or by washing.

Special canvasses were made by the Bureau of Mines during recent years to determine the quantity of domestic "natural" gold sold in the market at premium prices and the amount of the premiums. Most of the producers reported no such sales, and some of those reporting were unwilling to furnish data on quantities sold or premiums received. However, it has been estimated that, in recent years, "natural" gold containing approximately 25,000 ounces of fine gold reached the domestic premium market annually and that approximately 75 percent of this metal was mined in Alaska and most of the remainder in California; prices were reported to have averaged $39 to $40 an ounce in 1949.

DOMESTIC PRODUCTION

Production of gold and silver in the United States is measured at mines and refineries. Both measures are tabulated by States of origin, but there is a small annual variation between them, explained largely by time lag. Over a period of years, the deviations are found to be negligible. (*See* table 2.)

TABLE 2.—Gold and silver produced in the United States,[1] 1905–51, according to mine and mint returns, in fine ounces of recoverable metal

Year	Mine		Mint	
	Gold	Silver	Gold	Silver
1905–46	145,268,212	2,338,877,010	145,455,053	2,350,543,943
1947	2,109,185	35,823,563	2,165,318	38,587,069
1948	2,014,257	38,096,031	2,025,480	39,228,468
1949	1,991,783	34,674,952	1,921,949	34,944,554
1950	2,394,231	42,459,014	2,288,708	42,308,739
1951	1,980,663	39,766,779	1,894,726	39,907,257
Total 1905–51	155,758,331	2,529,697,349	155,751,234	2,545,520,030

[1] Includes Alaska.

MINE PRODUCTION

Following the rescinding in mid-1945 of War Production Board Order L–208 that restricted gold mining in the United States during a period in World War II, recovery in domestic straight gold mining proceeded slowly because of high wages, difficulties in recruiting labor forces, high prices for equipment and supplies, depletion of reserves, and the fixed price of gold. Operations at base-metal mines that yield byproduct gold were suspended at times by strikes. Despite these adverse factors, gold production recovered considerably in 1946 and 1947. It turned downward slightly in 1948 and 1949, rose sharply in 1950, then declined below the 1949 level in 1951. However, in no postwar year has the gold-production rate reached even half the alltime peak of 1940.

Since the low point in silver output of recent years established in 1946, silver production increased in 1947 and 1948. It dropped moderately in 1949, rose sharply in 1950, then dropped moderately in 1951. Approximately three-fourths of the output of silver from 1945 to 1951 was recovered as a byproduct of base-metal mining and gold mining. The current rate of silver production is far below the prewar average.

TABLE 3.—Mine production of gold and silver in the United States[1] in 1951, by months, in fine ounces

	Gold	Silver		Gold	Silver
January	158,013	3,495,004	August	189,571	2,772,075
February	148,824	3,438,952	September	175,928	2,753,640
March	158,319	3,791,562	October	190,247	3,208,315
April	155,425	3,648,888	November	148,482	3,212,297
May	162,465	3,637,631	December	147,973	3,323,040
June	172,722	3,382,335			
July	172,694	3,103,040	Total	1,980,663	39,766,779

[1] Includes Alaska.

All tonnage figures used in this section are short tons of 2,000 pounds "dry weight"; that is, they do not include moisture. Figures in cubic yards used in measuring material treated in placer operations are "bank measure"; that is, the material is measured in the ground before excavation. The weight unit for gold and silver is the troy ounce (480 grains). The totals are calculated upon the basis of recovered or recoverable fine gold and silver shown by assays to be contained in ore, bullion, and other material produced.

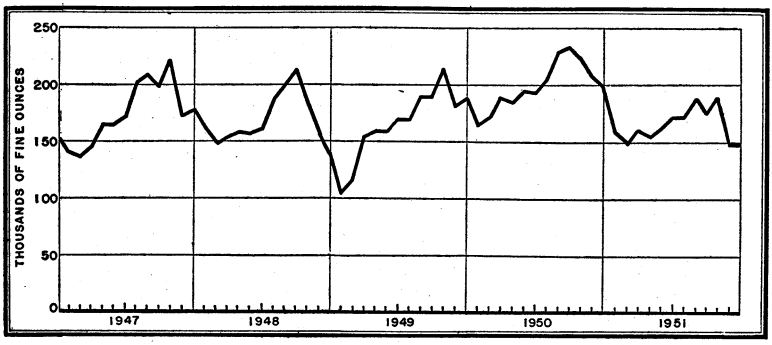

FIGURE 1.—Mine production of gold in the United States, 1947–51, by months, in terms of recoverable gold.

Mines are grouped in two main classes—placers and lodes. The placers are those in which gold and silver (and, in a few placers, platinum) are recovered from gravel as native metals or in natural alloy. Except for such small-scale hand methods as those utilizing the gold pan, the rocker, or the dry washer, all placer recovery methods employ sluice boxes; methods are distinguished by the means used for delivering the gravel to the sluices. Those methods where gravel is delivered mechanically include bucket-line dredging, dragline dredging, and treatment in nonfloating washing plants of gravel delivered by power shovel, dragline excavator, truck, slackline scraper, or other mechanical means. In the hydraulic method the gravel is mined from the bank by a powerful jet of water; in some small-scale hand methods the gravel is shoveled into sluices; and in drift operations the gravel is mined underground and delivered to sluices at the surface. The lode mines are those yielding gold and silver from ore (as distinguished from gravel), mainly from underground workings, and, in addition to those worked chiefly for one or both of the precious metals, include those that yield ore mined chiefly for copper, lead, zinc, or other metals but contribute the precious metals as byproducts. As far as possible, the mine unit used is not the operator but the mining claim or group of claims.

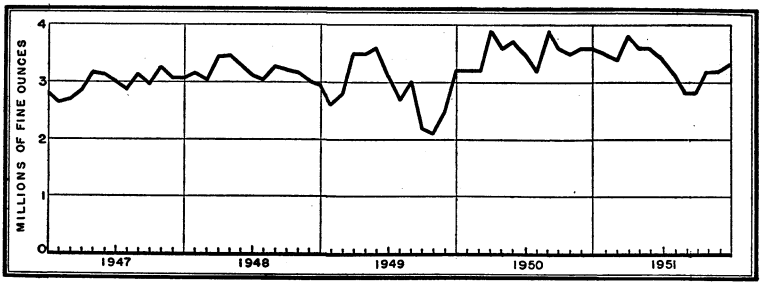

FIGURE 2.—Mine production of silver in the United States, 1947–51, by months, in terms of recoverable silver.

PRINCIPAL MINING DISTRICTS AND LEADING MINES

Lawrence County (Lead), S. Dak., which had been the leading gold producer for many years, was surpassed in 1943, 1944, and 1945 by the West Mountain (Bingham), Utah, copper district, as a consequence of restrictions imposed on straight gold mining by War Production Board Order L–208 during the war. However, Lawrence County regained the lead in 1946 and has held this position through 1951; the West Mountain district ranked second in this period. Third place was held by the Grass Valley-Nevada City gold ore district in California in 1949, 1950, and 1951.

The leading silver-producing districts for many years have included many distinguished more for base-metal output than for silver yield, and this condition prevailed again in 1951. The three leading districts produced about 62 percent of the total United States output of silver in 1951.

Of the 25 leading gold-producing mines, 9 were lode gold mines, 5 were placers (of which 4 were worked by bucket-line dredges and one by open-cut and treatment plant), 3 were copper mines, 4 were zinc-lead mines, and 1 was a zinc-copper mine; 3 produced over 1 type of ore. The 3 leading mines contributed 46 percent of the total gold produced in the United States in 1951, and the entire 25 supplied 77 percent.

TABLE 4.—Mine production of recoverable gold in the United States, 1942–46 (average) and 1947–51, by districts that produced 10,000 fine ounces or more during any year (1947–51), in fine ounces [1]

District or region	State	1942–46 (average)	1947	1948	1949	1950	1951
Lawrence County	South Dakota	201,253	407,192	377,836	464,650	567,996	458,040
West Mountain (Bingham)	Utah	274,620	384,414	332,588	286,155	428,313	407,196
Grass Valley—Nevada City	California	(2)	68,383	94,398	(2)	(2)	(2)
American River (Folsom)	do	55,126	102,121	104,196	98,435	91,260	86,867
Robinson	Nevada	54,270	39,490	37,453	38,703	49,878	60,055
Yuba River	California	(2)	(2)	(2)	(2)	(2)	(2)
Chelan County	Washington	37,972	12,071	41,826	(2)	(2)	46,458
Upper San Miguel	Colorado	20,924	38,155	38,188	35,217	52,567	34,030
Ajo	Arizona	35,413	30,477	38,647	38,455	37,632	33,805
Cripple Creek	Colorado	51,322	58,158	53,569	13,460	5,779	27,699
Warren (Bisbee)	Arizona	35,136	20,131	19,083	11,837	13,695	25,338
Big Bug	do	7,755	9,720	11,058	14,035	19,328	19,724
Yellow Pine	Idaho	6,311	31,006	27,158	53,576	48,472	19,605
Republic (Eureka)	Washington	20,805	22,590	28,196	23,751	24,929	(2)
California (Leadville)	Colorado	19,374	(2)	(2)	(2)	(2)	(2)
Park City Region	Utah	17,684	17,052	19,087	19,443	24,125	18,476
Round Mountain	Nevada	(2)	6			(2)	(2)
Bullion	do	6,680	17,058	16,676	16,791	20,405	(2)
Mother Lode	California	28,079	9,020	(2)	21,948	24,513	(2)
Summit Valley (Butte)	Montana	14,209	19,777	19,163	15,742	23,092	15,674
Oroville (Palermo)	California	19,306	22,589	20,800	22,701	(2)	(2)
Fairplay	Colorado	(2)	(2)	8,489	(2)	(2)	(2)
Pioneer (Superior)	Arizona	7,833	9,339	10,054	12,839	14,392	12,207
Battle Mountain	Nevada	6,255	(2)	7,982	(2)	(2)	(2)
Alleghany	California	(2)	7,779	(2)	(2)	14,314	10,776
Animas	Colorado	20,898	18,496	13,428	10,658	12,874	9,407
Verde (Jerome)	Arizona	14,380	6,931	11,374	10,790	9,421	7,325
Boise Basin	Idaho	4,962	7,894	11,732	4,789	4,942	5,009
Tintic	Utah	18,008	15,385	11,007	5,133	3,277	4,982
Cosumnes River	California	(2)	10,691	13,956	(2)	(2)	(2)
Merced River (Snelling)	do	(2)	(2)	(2)	(2)	(2)	4,768
Scott River	do	(2)	(2)	(2)	(2)	12,289	3,919
Tuolumne River (La Grange)	do	(2)	(2)	(2)	(2)	(2)	(2)
Comstock	Nevada	9,630	5,028	11,591	18,540	9,691	267
Klamath River	California	(2)	11,295	5,033	2,584	1,181	154
Potosi	Nevada	(2)			(2)	(2)	
Sheepeater	Montana	5,095	10,140	6,498			

[1] Exclusive of Alaska.
[2] Figure withheld to avoid disclosure of individual company operations.

TABLE 5.—Mine production of recoverable silver in the United States, 1942–46 (average) and 1947–51, by districts and regions that produced 200,000 fine ounces or more during any year (1947–51), in fine ounces

District or region	State	1942–46 (average)	1947	1948	1949	1950	1951
Coeur d'Alene Region	Idaho	8,944,163	9,234,906	10,598,338	9,146,146	15,056,131	13,639,808
Summit Valley (Butte)	Montana	5,583,651	5,251,095	6,099,790	5,635,101	6,121,264	5,950,647
West Mountain (Bingham)	Utah	4,226,800	4,816,611	4,694,674	4,316,378	4,963,586	4,923,249
Warren (Bisbee)	Arizona	1,594,241	1,522,558	1,432,172	1,166,210	1,079,311	1,292,719
Park City Region	Utah	1,621,313	1,352,748	1,703,864	1,061,902	952,632	1,131,360
Tintic	do	1,278,111	1,076,726	1,123,460	914,150	924,722	944,818
Big Bug	Arizona	289,845	386,452	425,079	581,351	701,973	636,812
Upper San Miguel	Colorado	265,096	392,540	526,742	579,498	730,860	621,257
Copper Mountain (Morenci)	Arizona	250,612	540,232	605,153	606,111	754,591	612,336
Pioneer (Superior)	do	416,609	314,126	308,448	401,202	529,186	581,952
Coso (Darwin)	California	378,159	1,093,709	393,761	352,482	600,440	570,595
Warm Springs	Idaho	570,519	427,242	266,226	468,302	502,973	506,363
Ajo	Arizona	392,697	353,789	455,411	471,134	473,020	437,675
Animas	Colorado	316,912	362,888	417,887	539,402	564,321	415,876
Pioche	Nevada	418,780	426,229	684,321	708,216	608,710	415,622
Red Cliff	Colorado	162,421	233,351	416,032	216,580	669,461	412,788
Verde (Jerome)	Arizona	810,342	367,778	408,669	509,828	456,254	408,891
California (Leadville)	Colorado	373,380	(1)	(1)	(1)	(1)	272,352
Creede	do	548,520	317,712	297,926	263,867	345,247	236,652
Central	New Mexico	(1)	167,538	(1)	(1)	(1)	236,484
Resting Springs	California	(1)	(1)	(1)	(1)	(1)	(1)
Ash Peak	Arizona	94,048	71,284	135,356	147,958	227,342	193,419
Rush Valley	Utah	(1)	(1)	(1)	(1)	95,324	189,110
Bayhorse	Idaho	191,965	204,264	166,246	87,130	157,031	178,410
Harshaw	Arizona	194,942	168,800	210,533	140,011	147,258	152,366
Pima (Sierritas, Papago, Twin Buttes)	do	93,338	143,653	162,224	252,334	182,540	145,941
Yellow Pine	Idaho	102,805	255,043	236,031	92,439	137,073	141,044
Sand Springs	Nevada	(1)		164,413	174,718	200,217	111,529
Virginia City	Montana	69,329	96,515	225,784	84,918	66,267	32,427
Comstock	Nevada	104,318	68,621	176,882	233,705	108,944	3,512
Ten Mile	Colorado	52,371	106,481	271,944	254,294	68,289	811

[1] Figure withheld to avoid disclosure of individual company operations.

TABLE 6.—Twenty-five leading gold-producing mines in the United States in 1951, in order of output

Rank	Mine	District	State	Operator	Source of gold
1	Homestake	Whitewood	South Dakota	Homestake Mining Co	Gold ore.
2	Utah Copper	West Mountain (Bingham)	Utah	Kennecott Copper Corp	Copper ore.
3	Fairbanks Unit	Fairbanks	Alaska	U. S. Smelting, Refining & Mining Co	Dredge.
4	Natomas	American River (Folsom)	California	Natomas Co	Do.
5	Brunswick-Idaho-Maryland	Grass Valley-Nevada City	do	Idaho Maryland Mines Corp	Gold ore.
6	Yuba Unit	Yuba River	do	Yuba Consolidated Gold Fields	Dredge.
7	Nome Unit	Nome	Alaska	U. S. Smelting, Refining & Mining Co	Do.
8	Empire Star group	Grass Valley-Nevada City	California	Empire Star Mines, Ltd	Gold ore.
9	Ruth Pit	Robinson	Nevada	Kennecott Copper Corp	Copper ore.
10	New Cornelia	Ajo	Arizona	Phelps Dodge Corp	Do.
11	Gold King	Wenatchee River	Washington	Lovitt Mining Co	Gold ore.
12	Copper Queen	Warren (Bisbee)	Arizona	Phelps Dodge Corp	Copper, zinc-lead ores.
13	Holden Group	Chelan Lake	Washington	Howe Sound Co	Zinc-copper ore.
14	Iron King	Big Bug	Arizona	Shattuck Denn Mining Corp	Zinc-lead ore.
15	Yellow Pine	Yellow Pine	Idaho	Bradley Mining Co	Gold ore.
16	Knob Hill	Republic	Washington	Knob Hill Mines, Inc	Do.
17	Treasury Tunnel-Black Bear	Upper San Miguel	Colorado	Idarado Mining Co	Zinc-lead-copper ore.
18	Round Mountain	Round Mountain	Nevada	Round Mountain Gold Dredging Co	Placer.
19	Goldacres	Bullion	do	London Extension Mining Co	Gold ore.
20	Portland, Dakota, Clinton	Portland, Bald Mountain	South Dakota	Bald Mountain Mining Co	Do.
21	Resurrection Group	California	Colorado	Resurrection Mining Co	Zinc-lead ore.
22	Smuggler Union, etc	Upper San Miguel	do	Telluride Mines, Inc	Do.
23	United States and Lark	West Mountain (Bingham)	Utah	U. S. Smelting, Refining & Mining Co	Gold-silver, lead, silver, zinc-lead ores.
24	Park Galena and Mayflower	Park City	do	New Park Mining Co	Zinc-lead ore.
25	Old Eureka	Mother Lode	California	Central Eureka Mining Co	Gold ore.

TABLE 7.—Twenty-five leading silver-producing mines in the United States in 1951, in order of output

Rank	Mine	District	State	Operator	Source of silver
1	Butte Hill mines and dumps	Summit Valley (Butte)	Montana	Anaconda Copper Mining Co	Copper, zinc-lead ores.
2	Sunshine	Evolution	Idaho	Sunshine Mining Co	Silver ore.
3	Utah Copper	West Mountain (Bingham)	Utah	Kennecott Copper Corp	Copper ore.
4	Polaris	Evolution	Idaho	Polaris Mining Co	Silver ore.
5	Silver Summit	do	do	Silver Summit Mining Co	Do.
6	Bunker Hill & Sullivan	Yreka	do	Bunker Hill & Sullivan Mining & Concentrating Co.	Zinc-lead ore.
7	United States and Lark	West Mountain (Bingham)	Utah	U. S. Smelting, Refining & Mining Co	Gold-silver, lead, silver, zinc-lead ores.
8	Copper Queen	Warren (Bisbee)	Arizona	Phelps Dodge Corp	Copper, zinc-lead ores.
9	St. Germaine, Purim	Evolution	Idaho	Silver Dollar Mining Co	Silver ore.
10	Iron King	Big Bug	Arizona	Shattuck Denn Mining Corp	Zinc-lead ore.
11	Morenci	Copper Mountain (Morenci)	do	Phelps Dodge Corp	Copper ore.
12	Magma	Pioneer (Superior)	do	Magma Copper Co	Copper, zinc-copper ores.
13	Darwin group	Coso	California	Anaconda Copper Mining Co	Zinc-lead, lead ores.
14	Chief No. 1	Tintic	Utah	Chief Consolidated Mining Co	Zinc-lead, silver ore.
15	Triumph, North Star	Warm Springs	Idaho	Triumph Mining Co	Lead, zinc-lead ores, silver, zinc-lead tailings.
16	Treasury Tunnel-Black Bear	Upper San Miguel	Colorado	Idarado Mining Co	Zinc-lead-copper ores.
17	Page	Yreka	Idaho	Federal Mining & Smelting Co	Zinc-lead ore.
18	New Cornelia	Ajo	Arizona	Phelps Dodge Corp	Copper ore.
19	Eagle mine group	Red Cliff	Colorado	New Jersey Zinc Co	Gold-silver, zinc ore.
20	United Verde	Verde (Jerome)	Arizona	Phelps Dodge Corp	Copper, zinc-copper ores.
21	Silver Syndicate	Evolution	Idaho	Silver Syndicate Mining Co	Silver ore.
22	Ploche group	Ploche	Nevada	Combined Metals Reduction Co	Zinc-lead ore.
23	Park Galena and Mayflower	Park City	Utah	New Park Mining Co	Do.
24	Silver King	do	do	Silver King Coalition Mines Co	Zinc-lead, lead ores.
25	Shenandoah Dives, etc	Animas	Colorado	Shenandoah-Dives Mining Co	Gold-silver ore.

TABLE 8.—Mine production of recoverable gold in the United States, 1941–51, with production of maximum year, and cumulative production from earliest record to end of 1951, by States, in fine ounces

	Maximum production [1]		Production by years											Total production from earliest record to end of 1951
	Year	Quantity	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	
Western States and Alaska:														
Alaska	1906	1,066,030	695,467	487,621	99,583	49,296	68,117	226,781	279,988	248,395	229,416	289,272	239,637	27,370,136
Arizona	1937	332,694	315,392	253,651	171,810	112,162	77,223	79,024	95,860	109,487	108,993	118,313	116,093	11,416,905
California	1852	3,932,631	1,408,793	847,997	148,328	117,373	147,938	356,824	431,415	421,473	417,231	412,118	339,732	103,903,188
Colorado	1900	1,391,364	380,029	268,627	137,558	111,455	100,935	142,613	168,279	154,802	102,618	130,390	116,503	39,730,535
Idaho	1871	212,850	149,816	95,020	30,808	25,008	17,780	42,975	64,982	58,454	77,829	79,652	45,064	8,166,730
Montana	1865	870,750	246,475	146,892	59,586	50,021	44,597	70,507	90,124	73,091	52,724	51,764	30,502	17,350,326
Nevada	1910	913,265	366,403	295,112	144,442	119,056	92,265	90,680	89,063	111,532	130,399	178,447	121,036	26,147,478
New Mexico	1915	70,681	27,845	11,961	5,563	6,918	5,604	4,009	3,146	3,414	3,249	3,414	3,959	2,200,017
Oregon	1940	113,402	96,565	46,233	1,097	1,369	4,467	17,598	18,979	14,611	16,226	11,058	7,927	5,760,353
South Dakota	1939	618,536	600,637	522,098	106,444	11,621	55,948	312,247	407,194	377,850	464,650	567,996	458,101	23,322,092
Texas	1929	1,279	306	236	4			9	45	57	40	49	32	8,513
Utah	1950	457,551	356,501	391,544	390,470	344,223	279,979	178,533	421,662	368,422	314,058	457,551	432,216	12,636,887
Washington	1950	92,117	84,176	75,396	65,244	47,277	57,860	51,168	34,965	70,075	71,994	92,117	67,405	2,515,226
Wyoming	1869	7,498	478	23		20	2	105	1,486	115	389		9	80,040
Total			4,728,883	3,442,411	1,360,937	995,799	952,715	1,573,073	2,107,188	2,011,778	1,989,816	2,392,141	1,978,216	280,608,426
West Central States: Missouri	1900	33												33
States east of the Mississippi:														
Alabama	1936	4,726	30	1			5	1						49,495
Georgia	1882	12,094	311	30	12	5		21	76	19	18		3	870,663
Indiana	[2]	[2]												[3]
Maryland	1937	1,040										20	1	6,123
Michigan	1890	4,354												33,297
North Carolina	1887	10,884	3,244	4,077	131	21					13			1,164,601
Pennsylvania	1942	2,499	2,422	2,499	2,218	2,115	1,588	1,150	1,518	2,200	1,645	1,764	2,179	[4] 34,590
South Carolina	1941	15,508	15,508	7,824	147									318,801
Tennessee	1930	696	227	159	303	222	148	95	303	156	171	160	108	21,863
Vermont	1946	165			17	100	104	165	100	104	120	146	156	[5] 1,045
Virginia	1938	2,943	240	109	50	132	12							167,558
Total			21,982	14,699	2,878	2,595	1,857	1,432	1,997	2,479	1,967	2,090	2,447	2,668,036
Grand total			4,750,865	3,457,110	1,363,815	998,394	954,572	1,574,505	2,109,185	2,014,257	1,991,783	2,394,231	1,980,663	283,276,495

[1] For Central and Eastern States figures are peaks since 1880, except Pennsylvania and Vermont, for which the figures are peaks since 1905. For Alaska, Nevada, and Oregon figures are likewise peaks since 1880 only. For earliest year of record for other States, see respective State charters in this volume.
[2] Figure not available.
[3] Small, figure not available.
[4] 1908–51 only.
[5] 1905–51 only.

TABLE 9.—Mine production of recoverable silver in the United States, 1941–51, with production of maximum year, and cumulative production from earliest record to end of 1951, by States, in fine ounces

	Maximum production [1]		Production by years											Total production from earliest record to end of 1951
	Year	Quantity	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	
Western States and Alaska:														
Alaska	1916	1,379,171	191,522	119,704	42,788	13,362	9,983	41,793	66,150	67,341	36,056	52,638	32,870	20,045,353
Arizona	1937	9,422,552	7,498,260	7,064,467	5,713,889	4,394,039	3,558,216	3,268,765	4,569,084	4,837,740	4,970,736	5,325,441	5,120,985	317,511,400
California	1921	3,629,223	2,154,188	1,450,440	609,075	778,936	986,798	1,342,651	1,597,442	724,771	783,880	1,071,917	1,145,219	113,523,317
Colorado	1893	25,838,600	7,301,697	3,096,211	2,664,142	2,248,830	2,226,780	2,240,151	2,557,653	3,011,011	2,894,886	3,492,278	2,787,882	745,170,388
Idaho	1937	19,587,766	16,672,410	14,644,890	11,700,180	9,931,614	8,142,667	6,491,104	10,345,779	11,448,875	10,049,257	16,095,019	14,753,023	583,177,365
Montana	1892	19,038,800	12,386,925	11,188,118	8,450,370	7,093,215	5,942,070	3,273,140	6,326,190	6,930,716	6,327,025	6,590,747	6,393,768	781,718,269
Nevada	1913	16,090,083	5,830,238	3,723,435	1,620,280	1,259,636	1,043,380	1,250,651	1,377,579	1,790,020	1,800,209	1,537,217	981,669	597,090,406
New Mexico	1885	2,343,800	1,328,317	676,170	463,583	535,275	465,127	338,000	515,833	537,674	380,855	338,581	443,267	69,970,941
Oregon	1941	276,158	276,158	87,376	10,523	20,243	10,461	6,927	30,379	13,596	12,195	13,565	6,218	5,301,265
South Dakota	1900	536,200	176,771	186,937	35,886	5,445	26,564	86,901	111,684	94,693	109,383	142,065	139,590	10,285,424
Texas	1938	1,433,008	1,096,027	672,781	10,284	5,355	23,265	42,922	20,547	3,065	2,691	2,454	1,381	33,298,501
Utah	1925	21,276,689	11,395,485	10,574,955	9,479,340	7,593,075	6,106,545	4,118,453	7,780,032	8,045,329	6,724,880	7,083,808	7,310,665	756,117,233
Washington	1902	721,450	402,030	369,038	370,440	321,608	281,444	264,453	293,736	375,831	357,853	363,656	334,948	14,555,897
Wyoming	1901	21,400	94	52		3	31	26	95	11	21		2	74,821
Total			66,704,122	53,854,574	41,170,780	34,200,636	28,823,331	22,765,937	35,592,183	37,880,673	34,449,927	42,109,386	39,451,487	4,047,840,580
West Central States: Missouri	1938	292,000	169,027	69,106	111,285	92,243	94,822	69,401	93,600	114,187	123,413	236,273	184,424	4,913,894
States east of the Mississippi:														
Alabama	1936	869	3				1							5,239
Georgia	1904	1,500	38	7					13	3				10,963
Illinois	1924	8,891	8,138	104	2,153	2,437	2,198	2,302	1,790	4,047	3,128	2,001	3,465	151,773
Maryland	1917	1,092												2,595
Michigan	1916	716,640	60,796	61,674	48,479	54,218	21,863		3,089					10,256,112
New York	1951	47,568	37,734	40,012	38,004	25,238	14,271	15,786	22,409	18,788	18,378	32,628	47,568	528,893
North Carolina	1906	30,769	7,439	8,259	7,169	1,461								357,223
Pennsylvania	1942	15,501	15,016	15,501	13,095	13,545	10,434	7,887	9,863	13,731	10,827	10,563	13,575	240,113
South Carolina	1940	8,047	6,525	5,064	135									35,325
Tennessee	1920	110,719	39,161	34,671	52,058	45,907	35,391	18,016	79,147	39,692	41,833	39,958	24,960	3,263,940
Vermont	1951	41,300			2,721	18,862	20,586	35,275	21,469	24,910	27,446	28,205	41,300	[2] 247,382
Virginia	1944	18,993	135	1,793	14,947	18,993	1,300							79,389
Total			174,985	167,085	178,761	180,661	106,044	79,266	137,780	101,171	101,612	113,355	130,868	15,178,947
Grand total			67,048,134	54,090,765	41,460,826	34,473,540	29,024,197	22,914,604	35,823,563	38,096,031	34,674,952	42,459,014	39,766,779	4,067,933,421

[1] States east of the Mississippi figures are peaks since 1896, except New York and Pennsylvania, which are peaks since 1905. The Illinois figure is the peak since 1907. Alaska, California, Nevada, and Oregon are peaks since 1880. For earliest year of record for other States, see respective State chapters in this volume.

[2] Includes a small quantity for New Hampshire.

Only 5 of the 25 leading silver-producing mines depended exclusively on silver ore; ores valuable chiefly for copper, lead, zinc, and gold supplied most of the silver production. The nine leading mines each producing over 1,000,000 ounces of silver in 1951 contributed 57 percent of the United States total. The entire 25 mines supplied 76 percent of the United States output. As several operators worked more than one of the leading silver mines as well as some smaller mines, the output of silver by companies was substantially more concentrated than that by mines.

ORE PRODUCTION, CLASSIFICATION, METAL YIELD, AND METHODS OF RECOVERY

Tables 10 to 15 give details of classes of ore, metal yield in fine ounces of gold and silver to the ton, and gold and silver output by classes of ore and by methods of recovery, embracing all ores that yielded gold and silver in the United States in 1951. These tables were compiled from the individual State chapters in this volume, in which more detailed data are presented.

The classification originally adopted in 1905 on the basis of smelter terminology, smelter settlement contracts, and metal recovery has been used continuously in succeeding years, except for modifications necessitated by the improvement in metallurgy and the lowering of the grade of complex ores treated. The copper ores include those smelting ores that contain 2.5 percent dry assay or more of copper

TABLE 10.—Ore, old tailings, etc., yielding gold and silver, produced in the United States and average recoverable content, in fine ounces, of gold and silver per ton in 1951 [1]

State	Gold ore			Gold-silver ore			Silver ore		
	Short tons	Average ounces per ton		Short tons	Average ounces per ton		Short tons	Average ounces per ton	
		Gold	Silver		Gold	Silver		Gold	Silver
Western States and Alaska:									
Alaska	13,870	0.069	0.013						
Arizona	3,486	.327	1.021	44,166	0.010	0.152	27,567	0.028	8.809
California	288,117	.501	.194	1,647	.524	9.748	8,388	.022	3.972
Colorado	115,496	.251	.061	258,929	.047	2.511	12,751	.030	17.103
Idaho	638,475	.045	.281	219	1.219	19.680	280,892	.002	34.843
Montana	59,403	.197	1.034	4,962	.101	3.370	20,505	.036	6.286
Nevada	214,676	.112	.043	12,700	.121	10.089	3,636	.030	10.403
New Mexico	1,500	.235	.050	1,723	.151	6.192	20	.050	24.150
Oregon	818	.671	4.132	150	.040	.833			
South Dakota	1,166,356	.393	.119						
Texas									
Utah	638	.149	1.276	43,688	.065	3.060	138,381	.023	4.600
Washington	103,351	.446	1.679				3		7.333
Wyoming	10	.400	.200						
Total	2,606,196	.286	.243	368,184	.052	2.625	492,143	.012	22.522
States east of the Mississippi	6	.667							
Total	2,606,202	.286	.243	368,184	.052	2.625	492,143	.012	22.522

For footnotes, see end of table.

TABLE 10.—Ore, old tailings, etc., yielding gold and silver, produced in the United States and average recoverable content, in fine ounces, of gold and silver per ton in 1951 [1]—Continued

State	Copper ore			Lead ore			Lead-copper ore		
	Short tons	Average ounces per ton		Short tons	Average ounces per ton		Short tons	Average ounces per ton	
		Gold	Silver		Gold	Silver		Gold	Silver
Western States and Alaska:									
Alaska									
Arizona	42,791,111	0.002	0.072	5,963	0.060	3.603	2	------	4.500
California	[2] 1,789	[3] .315	[3] 5.935	57,618	.071	6.287	55	------	13.273
Colorado	659	.042	14.555	34,564	.055	5.388			
Idaho	29,942	.005	2.684	129,409	.005	3.321	41,133	------	1.527
Montana	1,169,143	.002	1.329	22,823	.027	3.253	9	0.222	49.222
Nevada	6,630,768	.009	.025	14,343	.055	6.814			
New Mexico	8,055,796	------	.014	40,268	.001	.302			
Oregon	87	.023	.368						
South Dakota				24	.375	19.542			
Texas									
Utah	30,454,456	.013	.104	29,381	.039	8.485	36	.028	9.056
Washington	17,064	.080	.139	14,684	------	3.028			
Wyoming									
Total	89,150,815	.006	.092	349,077	.028	4.239	41,235	------	1.559
States east of the Mississippi	1,374,973	------	.048	23	------				
Total	90,525,788	.006	.091	349,100	.028	4.239	41,235	------	1.559

State	Zinc ore			Zinc-lead, zinc-copper, and zinc-lead-copper ores			Total ore		
	Short tons	Average ounces per ton		Short tons	Average ounces per ton		Short tons	Average ounces per ton	
		Gold	Silver		Gold	Silver		Gold	Silver
Western States and Alaska:									
Alaska							13,870	0.069	0.013
Arizona	8,859	0.002	0.644	939,199	0.032	1.865	43,820,353	.003	.117
California	40,556	.035	4.387	95,981	.005	4.960	[2] 494,151	[3] .308	[3] 2.292
Colorado	322,198	.006	.671	833,869	.069	1.798	1,578,466	.065	1.765
Idaho	66,707	------	.524	2,068,014	.001	2.016	3,254,791	.010	4.531
Montana	24,282	.006	1.426	2,664,748	.005	1.698	3,965,875	.007	1.612
Nevada	[4] 9,729	[4] .002	[4] 1.630	297,881	.014	1.714	7,183,733	.013	.135
New Mexico	548,943	.001	.417	45,098	.006	1.714	8,693,348	------	.051
Oregon				440	.468	2.086	1,495	.510	2.980
South Dakota							1,166,380	.393	.120
Texas				750	.043	1.841	750	.043	1.841
Utah	16,837	.003	.414	673,420	.050	4.606	31,356,837	.014	.233
Washington	2,688	------	.050	1,166,705	.017	.098	1,304,495	.052	.257
Wyoming							10	.400	.200
Total	1,040,799	.004	.693	8,786,105	.018	1.847	102,834,554	.014	.383
States east of the Mississippi	2,442,740	------		993,721	------	.051	[5] 4,811,463	([5])	[5] .024
Total	3,483,539	.001	.207	9,779,826	.016	1.664	107,646,017	.014	.367

[1] Missouri excluded.
[2] Includes copper precipitates and old slag.
[3] Includes old slag and tungsten ore.
[4] Includes 5,892 tons of ore and contained recoverable metal from the former Metals Reserve Company stockpile at Jean, Nev.
[5] Excludes magnetite-pyrite-chalcopyrite ore and gold and silver therefrom.

(or less than this percentage if no other metal is present); or those ores concentrated chiefly for their copper content. The lead ores are those that contain 5 percent dry assay or more of lead (minimum lead-smelting charge requires 7.5 to 8.5 percent wet assay), irrespective of precious-metal content, and ores that carry any grade of lead exclusively. Zinc smelting ores (chiefly oxides) had ranged from 16 to 45 percent zinc; but, with the development of slag fuming, which permits some oxidized ore in the charge, and with high zinc prices, the minimum has declined to as low as 5 percent recoverable zinc. Zinc concentrating ores include any grade of zinc ore that makes marketable zinc concentrate, irrespective of precious-metal content. The mixed ores are combinations of those enumerated.

Gold, gold-silver, and silver ores containing too little copper, lead, or zinc to be classified as copper, lead, zinc, or mixed base-metal ores are called "dry" ores, regardless of the ratio of concentration, except low-grade ore milled chiefly for its copper content and having very little or no precious-metal content (chiefly the "porphyry coppers") and ores from which separate products of lead concentrates and zinc concentrates are made. The crude ore into the mill in these two exceptional instances thus takes its name from its products—a name that is also justified by the mineralogical content and final recovery of metals. The "dry ores" thus are ores, chiefly siliceous, valuable for their gold and silver content and, in some instances, their fluxing properties, regardless of method of treatment. Dry gold ores are those that by inspection are overwhelmingly of gold content; a similar qualification applies to silver ores; decision as to "gold-silver" ore is made on a basis of value, using the rule that the bimetal classification is not used unless the metal of lower value equals or exceeds one-quarter of the combined value of the gold and silver.

The lead, zinc, and zinc-lead ores in most districts in the States east of the Rocky Mountains carry no appreciable quantity of gold or silver; such ores are excluded from this report unless otherwise indicated.

TABLE 11.—Mine production of gold and silver in the United States,[1] 1942–46 (average) and 1947–51, by percent from sources and in total fine ounces

	Placers	Dry ore	Copper ore	Lead ore	Zinc ore	Zinc-lead, zinc-copper, lead-copper, and zinc-lead-copper ores	Total fine ounces
GOLD							
1942–46 (average)	24.8	41.4	26.3	0.7	0.3	6.5	1,669,679
1947	32.2	38.5	23.8	.5	.4	4.6	2,109,185
1948	29.8	39.5	22.4	.5	.2	7.6	2,014,257
1949	26.8	44.8	19.8	.6	.2	7.8	1,991,783
1950	25.5	43.1	23.1	.7	.1	7.5	2,394,231
1951	24.8	38.9	27.5	.5	.2	8.1	1,980,663
SILVER							
1942–46 (average)	0.2	27.2	30.5	7.4	1.6	33.1	36,392,786
1947	.2	25.7	23.1	8.0	2.1	40.9	35,823,563
1948	.2	26.6	20.7	5.9	1.5	45.1	38,096,031
1949	.2	23.5	20.0	7.8	1.5	47.0	34,674,952
1950	.2	32.8	19.6	5.1	1.0	41.3	42,459,014
1951	.2	31.9	20.8	4.2	1.8	41.1	39,766,779

[1] Includes Alaska.

TABLE 12.—Mine production of gold and silver in the United States in 1951, by State and source, in fine ounces of recoverable metal

State	Placers	Dry ore	Copper ore	Lead ore	Lead-copper ore	Zinc ore	Zinc-lead, zinc-copper, and zinc-lead-copper ores	Total
GOLD								
Alaska	238,527	1,074		36				239,637
Arizona	156	2,352	83,525	356		15	29,689	116,093
California	187,624	145,495	[1] 564	4,103		1,428	518	339,732
Colorado	13,593	41,711	28	1,904		1,983	57,284	116,503
Georgia		3						3
Idaho	11,850	29,617	149	616	10	1	2,821	45,064
Maryland		1						1
Montana	1,074	12,924	2,904	613	2	155	12,830	30,502
Nevada	30,509	25,779	59,863	788		[2] 24	4,073	121,036
New Mexico	4	613	2,324	48		680	290	3,959
Oregon	7,164	555	2				206	7,927
Pennsylvania			[3] 2,179					2,179
South Dakota	6	458,086		9				458,101
Tennessee			108					108
Texas							32	32
Utah		6,122	391,400	1,142	1	47	33,504	432,216
Vermont			156					156
Washington	13	46,045	1,361				19,986	67,405
Wyoming	5	4						9
Total	490,525	770,381	544,563	9,615	13	4,333	161,233	1,980,663
SILVER								
Alaska	30,848	239		1,783				32,870
Arizona	11	253,121	3,088,738	21,482	9	5,705	1,751,919	5,120,985
California	12,462	105,193	[1] 10,617	362,221	730	177,908	476,088	1,145,219
Colorado	2,295	874,220	9,592	186,221		216,041	1,499,513	2,787,882
Idaho	4,835	9,971,051	80,372	429,731	62,795	34,948	4,169,291	14,753,023
Illinois							3,465	3,465
Missouri				[4] 184,424	(4)			184,424
Montana	137	207,037	1,553,724	74,246	443	34,624	4,523,557	6,393,768
Nevada	14,017	175,168	168,242	97,733		[2] 15,861	510,648	981,669
New Mexico		11,226	113,509	12,157		229,087	77,288	443,267
New York							47,568	47,568
Oregon	1,763	3,505	32				918	6,218
Pennsylvania			[3] 13,575					13,575
South Dakota		139,121		469				139,590
Tennessee			24,960					24,960
Texas							1,381	1,381
Utah		771,117	3,181,269	249,308	326	6,971	3,101,674	7,310,665
Vermont			41,300					41,300
Washington	2	173,527	2,365	44,462		135	114,457	334,948
Wyoming		2						2
Total	66,370	12,684,527	8,288,295	1,664,237	64,303	721,280	16,277,767	39,766,779

[1] Includes metal recovered from old slag and tungsten ore.
[2] Includes recoverable metal contained in 5,892 tons of ore from the former Metals Reserve Company stockpile at Jean, Nev.
[3] From magnetite-pyrite-chalcopyrite ore.
[4] A little silver recovered from lead-copper ore from one mine included with that from lead ore.

TABLE 13.—Gold and silver produced in the United States from ore and old tailings, in 1951, by State and method of recovery, in terms of recoverable metals [1]

State	Total ore, old tailings, etc. treated (short tons)	Ore and old tailings to mills						Crude ore to smelters		
		Short tons	Recoverable in bullion		Concentrates smelted and recoverable metal			Short tons	Gold (fine ounces)	Silver (fine ounces)
			Gold (fine ounces)	Silver (fine ounces)	Concentrates (short tons)	Gold (fine ounces)	Silver (fine ounces)			
Western States and Alaska:										
Alaska	[2] 13,870	[2] 13,870	717	101	100	393	1,921			
Arizona	[3] 40,123,940	39,491,121	329	115	1,410,713	92,546	3,703,891	632,819	23,062	1,416,968
California	494,151	452,217	142,547	66,048	33,309	6,219	737,470	41,934	3,342	329,239
Colorado	1,578,466	1,546,801	36,775	11,727	187,047	62,368	2,415,903	31,665	3,767	357,957
Idaho	3,254,791	3,172,257	5,693	2,804	289,886	26,392	14,527,391	82,534	1,129	217,993
Montana	3,965,875	3,856,554	825	42	515,710	21,747	6,089,719	109,321	6,856	303,870
Nevada	7,183,733	7,087,315	22,395	121,695	255,953	65,466	650,369	96,418	2,666	195,588
New Mexico	8,693,348	[4] 8,557,153	341	58	343,024	2,305	361,833	136,195	1,309	81,376
Oregon	1,495	1,143	54	10	76	471	3,498	352	238	947
South Dakota	1,166,380	1,166,356	458,086	139,121				24	9	469
Texas	750							750	32	1,381
Utah	[5] 31,356,837	31,134,299			1,028,548	424,704	6,253,396	[5] 222,538	7,512	1,057,269
Washington	1,304,495	1,248,019	2,668	27,211	65,571	38,208	272,117	56,476	26,516	35,618
Wyoming	10							10	9	2
Total	99,138,141	97,727,105	670,430	368,932	4,129,937	740,819	35,017,508	1,411,036	76,447	3,998,677
States east of the Mississippi	[6] 4,811,463	[6] 4,811,231	4		621,490	2,443	130,868	232		
Total	103,949,604	102,538,336	670,434	368,932	4,751,427	743,262	35,148,376	1,411,268	76,447	3,998,677

[1] Missouri excluded.
[2] Excludes weight of ore from which 68 tons of concentrate was produced containing 151 ounces of recoverable gold and 1,847 ounces of recoverable silver.
[3] Excludes 3,696,413 tons of ore leached from which no gold or silver was recovered.
[4] Includes 30,000 tons of newly mined ore treated in a heap-leaching plant.
[5] Includes 4,881 tons of old slag and 1,447 tons of furnace cleanings smelted and fumed.
[6] Excludes magnetite-pyrite-chalcopyrite ore from Pennsylvania.

TABLE 14.—Gold and silver produced at amalgamation and cyanidation mills in the United States and percentage of gold and silver recoverable from all sources, 1942–46 (average) and 1947–51 [1]

Year	Bullion and precipitates recoverable (fine ounces)				Percent of gold and silver from all sources							
	Amalgamation		Cyanidation		Amalgamation		Cyanidation		Smelting [2]		Placers	
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
1942–46 (average)	245,962	54,730	247,313	764,208	14.7	0.2	14.8	2.2	45.7	97.4	24.8	0.2
1947	378,578	80,756	272,039	273,646	17.9	.2	12.9	.8	37.0	98.8	32.2	.2
1948	378,590	104,598	278,237	481,406	18.8	.3	13.8	1.3	37.6	98.2	29.8	.2
1949	450,618	119,443	290,938	555,859	22.6	.3	14.6	1.6	36.0	97.9	26.8	.2
1950	547,118	153,806	300,783	449,699	22.9	.4	12.6	1.0	39.0	98.4	25.5	.2
1951	445,466	93,958	224,968	274,974	22.5	.2	11.3	.7	41.4	98.9	24.8	.2

[1] Includes Alaska. Illinois, Michigan, and Missouri excluded, 1942–46; Missouri excluded, 1947–51.
[2] Both crude ores and concentrates.

TABLE 15.—Gold and silver produced at amalgamation and cyanidation mills in the United States in 1951, by States

State	Amalgamation		Cyanidation		Percent of gold and silver from all sources in State			
	Bullion recoverable (fine ounces)		Bullion and precipitates recoverable (fine ounces)		Amalgamation		Cyanidation	
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
Western States and Alaska:								
Alaska	648	91	69	10	0.27	0.28	0.03	0.03
Arizona	329	115	-------	-------	.28	(1)	-------	-------
California	97,579	16,802	44,968	49,246	28.72	1.47	13.24	4.30
Colorado	21,790	9,778	14,985	1,949	18.70	.35	12.86	.07
Idaho	3,503	2,667	2,190	137	7.77	.02	4.86	(1)
Montana	825	42	-------	-------	2.70	(1)	-------	-------
Nevada	2,806	1,707	19,589	119,988	2.32	.17	16.18	12.22
New Mexico	326	58	15	-------	8.23	.01	.38	-------
Oregon	54	10	-------	-------	.68	.16	-------	-------
South Dakota	317,593	62,685	140,493	76,436	69.33	44.91	30.67	54.76
Washington	9	3	2,659	27,208	.01	(1)	3.94	8.12
Wyoming	-------	-------	-------	-------	-------	-------	-------	-------
Total	445,462	93,958	224,968	274,974	22.52	.24	11.37	.70
States east of the Mississippi	4	-------	-------	-------	.16	-------	-------	-------
Grand total	445,466	93,958	224,968	274,974	22.49	.24	11.36	.69

[1] Less than 0.01 percent.

PLACERS

Approximately 25 percent of the gold produced in 1951 was derived from placer mines. Of the 490,525 ounces of placer gold, 404,305 ounces (82 percent) was recovered by bucket-line dredges. This dredge output was nearly fourfold greater than that of 1944, the wartime low, but was far below the alltime high of 904,149 ounces established in 1940.

The quantity of gold recovered by bucket-line dredges from the inception of the industry as a commercial factor in 1896 to the end of 1951 is recorded as 22,223,306 ounces, originating by States as follows: California, 13,186,045 ounces; Alaska, 6,293,660 (including the production from single-dipper dredges and some gold by hydraulicking); Montana, 785,419; Idaho, 694,841; and other States, 1,263,341.

The second most important source of placer gold was nonfloating washing plants, with mechanical earth-moving equipment for gravel delivery. Production by this method has been generally upward since 1944. Production by dragline dredging dropped sharply but remained in third place in 1951. Production by hydraulicking regained fourth place in 1951 over production by small-scale hand methods.

TABLE 16.—Gold production at placer mines in the United States, 1947–51,[1] by class of mine and method of recovery

Class and method	Mines producing	Washing plants (dredges)	Material treated (cubic yards)	Gold recoverable		
				Fine ounces	Value	Average value per cubic yard
Surface placers:						
Gravel mechanically handled:						
Bucket-line dredges:						
1947	60	79	120,362,326	514,931	$18,022,585	$0.150
1948	57	78	120,062,532	475,228	16,632,980	.139
1949	52	74	110,897,581	425,863	14,905,205	.134
1950	43	63	108,250,189	492,939	17,252,865	.159
1951	36	56	93,214,943	404,305	14,150,675	.152
Dragline dredges:						
1947	71	65	10,325,994	55,448	1,940,680	.188
1948	42	41	5,224,260	31,446	1,100,610	.211
1949	35	31	4,583,055	22,789	797,615	.174
1950	23	21	4,623,474	21,032	736,120	.159
1951	25	23	2,342,647	8,820	308,700	.132
Suction dredges:						
1947	12	10	79,590	588	20,580	.259
1948	8	9	84,200	473	16,555	.197
1949	12	13	278,765	1,418	49,630	.178
1950	17	14	263,800	1,422	49,770	.189
1951	13	9	180,500	717	25,095	.139
Nonfloating washing plants:						
1947	137	136	4,281,440	57,356	2,007,460	.469
1948	153	152	5,985,070	65,856	2,304,960	.385
1949	183	183	4,995,465	70,974	2,484,090	.497
1950	185	183	8,510,139	85,932	3,007,620	.353
1951	117	115	7,049,566	69,592	2,435,720	.346
Gravel hydraulically handled:						
1947	167	----------	2,838,440	38,722	1,355,270	.477
1948	137	----------	1,708,650	16,976	594,160	.348
1949	81	----------	779,800	7,107	248,745	.319
1950	88	----------	639,585	4,342	151,970	.238
1951	51	----------	257,800	3,460	121,100	.470
Small-scale hand methods:						
Wet:						
1947	284	----------	783,852	11,122	389,270	.497
1948	275	----------	296,776	9,800	343,000	1.156
1949	279	----------	248,076	4,234	148,190	.597
1950	250	----------	261,562	4,856	169,960	.650
1951	148	----------	99,804	3,106	108,710	1.089
Dry:						
1947	19	----------	2,800	161	5,635	2.013
1948	10	----------	3,900	170	5,950	1.526
1949	13	----------	2,870	144	5,040	1.756
1950	7	----------	2,200	88	3,080	1.400
1951	4	----------	550	27	945	1.718
Underground placers (drift):						
1947	28	----------	7,248	517	18,095	2.497
1948	42	----------	20,105	551	19,285	.959
1949	26	----------	3,717	206	7,210	1.940
1950	34	----------	12,790	802	28,070	2.195
1951	19	----------	4,275	498	17,430	4.077
Grand total placers:						
1947	778	----------	138,681,690	678,845	23,759,575	.171
1948	724	----------	133,385,493	600,500	21,017,500	.158
1949	[2] 680	----------	121,789,329	532,735	18,645,725	.153
1950	647	----------	122,563,739	611,413	21,399,455	.175
1951	413	----------	103,150,085	490,525	17,168,375	.166

[1] Includes Alaska.
[2] A mine using more than 1 method of recovery is counted but once in arriving at total for all methods.

Alaska produced 49 percent of the United States placer gold in 1951, California 38, and Nevada 6. Other important producers, in order of output, were Colorado, Idaho, Oregon, and Montana. Alaska led in production by bucket-line dredging, nonfloating washing plants, hydraulicking, and underground placer mining and California by dragline dredging, suction dredging, and small-scale hand methods.

Table 16 shows the placer gold produced in the United States, classified by mining methods, in 1947–51.

Additional information on placer mining may be found in the State reviews of this volume.

REFINERY PRODUCTION

Table 17 contains official estimates of production of gold and silver in the United States, made by the Bureau of the Mint, based upon arrivals at United States mints and assay offices and at privately owned refineries. The mints and assay offices determine the State source of all newly mined unrefined material when deposits are received. The State source of material received by privately owned refineries is determined from information submitted by them and by intervening smelters, mills, etc., involved in the reduction processes.

TABLE 17.—Gold and silver refined in the United States, 1947–51, and approximate distribution by source (State), in 1951, in fine ounces

[U. S. Bureau of the Mint]

State or Territory	Gold	Silver
1947	2,165,318	38,587,069
1948	2,025,480	39,228,468
1949	1,921,949	34,944,554
1950	2,288,708	42,308,739
1951:		
Alaska	208,176	30,180
Arizona	109,889	5,041,872
California	347,154	963,861
Colorado	108,120	2,969,998
Idaho	56,245	15,955,727
Illinois		3,000
Michigan		274
Missouri		172,661
Montana	32,228	6,414,438
Nevada	121,976	1,032,922
New Mexico	4,144	410,028
New York		25,350
Oregon	8,687	9,443
Pennsylvania	2,155	13,374
South Dakota	462,685	141,456
Tennessee	79	19,039
Texas	40	1,400
Utah	362,031	6,292,248
Vermont	156	43,475
Washington	70,941	366,505
Wyoming	20	6
Total	1,894,726	39,907,257

CONSUMPTION AND USES IN INDUSTRY AND THE ARTS

Monetary use has claimed by far the largest part of the gold and silver output through the years, but this use to a large extent takes the form of stockpiling in Government and private hoards that can be made available to industry and the arts without smelter or refinery preparation. In contrast, the gold and silver that enter industry and

the arts are consumed much as are other metals, any return as secondary metal requiring the usual channels of collection, smelting, and refining. The consumption of gold and silver in the arts antedates written history, but industrial use of these two metals is a comparatively recent development.

TABLE 18.—Gold and silver produced in the United States, 1792–1951 [1]

Period	Gold		Silver	
	Fine ounces	Value [2]	Fine ounces	Value [3]
1792–1847	1,187,170	$24,537,000	309,500	$404,500
1848–73	60,021,278	1,240,750,000	146,218,600	193,631,500
1874–1951	225,062,723	5,474,735,080	3,960,565,930	2,989,995,398
Total	286,271,171	6,740,022,080	4,107,094,030	3,184,031,398

[1] Includes Alaska. From Report of the Director of the Mint. The estimates for 1792–1873 are by R. W. Raymond, Commissioner of Mining Statistics, Treasury Department, and since then, by the Director of the Mint.
[2] Gold valued in 1934 and thereafter at $35 per fine ounce.
[3] Silver valued in 1934 and thereafter at Government's average buying price for domestic product.

Gold.—The arts require a much larger quantity of gold than does industry, but the metal's corrosion resistance and other properties have resulted in some industrial demand. Consumption in the arts increased rapidly during the war. A high marriage rate and widespread prosperity have increased the sale of jewelry, watches, and many luxury items made of gold. Comparison of 1951 gold figures with those for 1950 shows an 3-percent decrease in the return from industrial use, a 22-percent decrease in issue for industrial use, and a 29-percent decrease in net consumption. The net absorption by industry and the arts exceeded the total new gold produced from domestic mines during 1951 slightly.

TABLE 19.—Net industrial [1] consumption of gold and silver in the United States 1942–46 (average) and 1947–51

[U. S. Bureau of the Mint]

Year	Gold (dollars)			Silver (fine ounces)		
	Issued for industrial use	Returned from industrial use	Net industrial consumption	Issued for industrial use	Returned from industrial use	Net industrial consumption
1942–46 (average)	127,041,429	28,327,873	98,713,556	155,625,825	45,066,086	110,559,739
1947	98,129,578	49,229,578	48,900,000	126,366,359	27,866,359	98,500,000
1948	90,128,764	45,142,764	44,986,000	129,186,173	23,897,173	105,289,000
1949	148,975,571	40,133,100	108,842,471	110,660,459	22,660,459	88,000,000
1950	134,587,773	36,742,020	97,845,753	155,257,340	45,257,340	110,000,000
1951	105,012,094	35,535,115	69,476,979	151,650,905	46,650,905	105,000,000

[1] Including the arts.

Silver.—The 1951 net consumption of silver in the arts and industry continued at a high level, although it declined about 5 percent below that of 1950.

Widespread prosperity and a high marriage rate sustained postwar demand for sterling and plated silverware, jewelry, watchcases, church articles, pens, pencils, and other items largely in the luxury

class. Consumption was large in photography, particularly for motion pictures. The industrial uses of silver had grown greatly during the war and continued to absorb much silver thereafter, although on a reduced scale.

MONETARY STOCKS

Gold holdings of the United States declined $11 million from $22,706 million on December 31, 1950, to $22,695 million on December 31, 1951, according to the Federal Reserve Bulletin. The low for 1951 was reached in June, when reserves had declined to $21,756 million, corresponding to a decrease of $950 million from January; however, the outflow of gold from the United States reversed itself sharply in July, with the result that the net decline in 1951 was slight. Total world reserves are not positively known, inasmuch as data are not available for some countries, including Germany, Japan, Australia, and the Soviet Union. However, the Federal Reserve Board estimates that world monetary reserves of gold on December 31, 1951, totaled $35,950 million, exclusive of holdings of the Soviet Union.

During the war the United States reserves of gold decreased by more than $2,500 million, but the flow of gold reversed in 1946, and the country's reserves rose steadily in the 3 years following, with a net gain of about $4,400 million, to set a new record high in the latter part of 1949. Largely as a consequence of credits extended under the Marshall Plan, gold moved regularly from the United States during nearly 2 years following September 1949 until the end of June 1951, with an overall decline in reserves in this period of about $2,800 million.

Silver holdings of the United States Treasury decreased 18 million fine ounces during 1951 to 1,965 million ounces. The holdings do not include 410,553,011 ounces released under lend-lease agreements that provide for the return of this silver.

Demand by governments for silver for coinage rose from 42 million ounces in 1950 to approximately 89 million ounces in 1951. Of this quantity, the United States consumed 44,440,000 ounces, Saudi Arabia 26,000,000, Western Germany 9,900,000, Mexico 4,500,000, and Canada 3,800,000.

PRICES

Since January 1934 the price of gold at the United States Mint has been $35 per fine troy ounce. The Treasury buying price for silver domestically mined after July 1, 1939, was fixed at $0.711+ per ounce on July 6, 1939; on July 31, 1946, the President approved an act (Public Law 579, 79th Cong.) which provided that the seigniorage to be deducted for silver mined after July 1, 1946, and delivered to the Treasury be reduced from 45 percent to 30 percent. The effect was to raise the price of domestically mined silver to 90.50505 cents an ounce; there has been no price change since.

The average price of pound-sterling exchange in New York (buying rates for cable transfers, as certified by the Federal Reserve Bank of New York) was: January 1948–August 1949, $4.03; September 1949, $3.44; and October 1949–December 1951, $2.80). The London price of silver, per ounce, 0.999 fine, as reported by the Director of

the Mint, opened in 1948 at 45d., a level maintained past midyear, when after a short upward movement it fell to 42.5d. by the year end. Changes in 1949 were of little significance until devaluation of the pound in September, following which the price rose to 64d., where it remained the rest of the year. Prices in 1951 ranged from a low of 70d. to a high of 78½d. (equivalent, in United States currency, to $0.81687 and $0.91606). The New York price, per ounce, 0.999 fine, opened in 1951 at $0.8000 but rose to $0.9016 early in January, based on actual transactions at $0.9041 (the approximate equivalent of the Treasury buying price of $0.9050+ per fine ounce for domestic production). This price resulted from the necessity of selling some Treasury silver to satisfy trade requirements. The price declined to $0.8775 early in June but soon returned to the $0.9016 level. Early in October it broke sharply to $0.8475 but quickly rose to $0.8800 and remained at this price to the end of the year.

FOREIGN TRADE [1]

The excess of gold imports over exports that prevailed from 1946 through 1949 was replaced in 1950 by an excess of exports over imports, and this situation continued through June 1951, after which imports again began to exceed exports. Excess exports of gold plus consumption in the arts and industries exceeded the domestic production. As has been normal for many years, imports of silver exceeded exports by a wide margin.

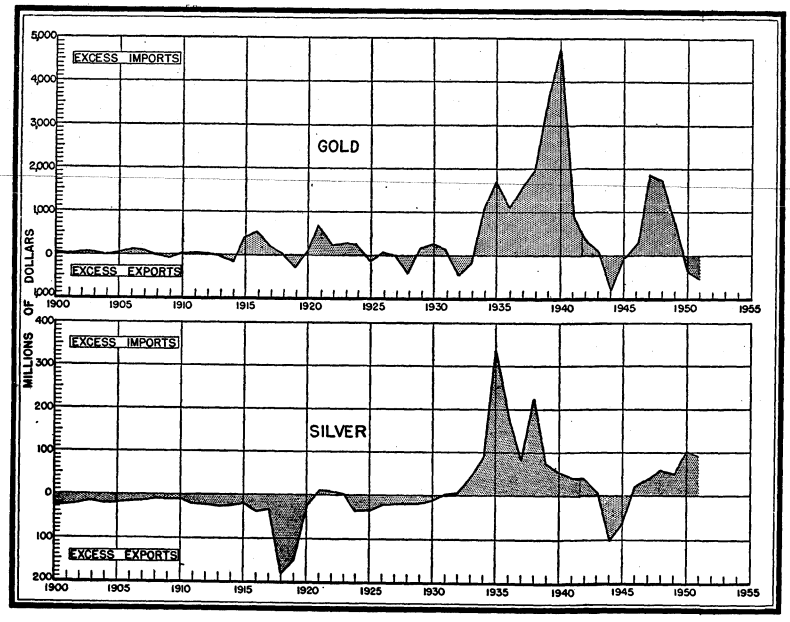

FIGURE 3.—Net imports or exports of gold and silver, 1900–51.

[1] Figures on imports and exports compiled by M. B. Price and E. D. Page, of the Bureau of Mines, from records of the U. S. Department of Commerce.

TABLE 20.—Value of gold and silver imported into and exported from the United States, 1947–51

[U. S. Department of Commerce]

	Imports	Exports	Excess of imports over exports [1]
Gold:			
1947	$2,079,588,406	$213,240,800	$1,866,347,606
1948	1,981,175,178	300,771,144	1,680,404,034
1949	771,390,261	84,935,678	686,454,583
1950	162,748,661	534,035,794	−371,287,133
1951	81,258,502	630,381,566	−549,123,064
Silver:			
1947	68,140,343	30,648,742	37,491,601
1948	70,884,513	12,400,060	58,484,453
1949	73,535,694	23,281,043	50,254,651
1950	110,035,107	6,201,874	103,833,233
1951	103,468,510	8,590,185	94,878,325

[1] Excess of exports over imports indicated by minus sign.

TABLE 21.—Gold imported into the United States in 1951, by country of origin

[U. S. Department of Commerce]

Country of origin	Ore and base bullion		Bullion, refined		Foreign coin (value)
	Troy ounces	Value	Troy ounces	Value	
Australia	12,776	$445,492			
Belgium-Luxembourg	1,929	67,346			
Bolivia	556	19,324			
Brazil	442	15,449			
British Guiana	10,899	400,262			
British Western Pacific Islands	68,459	2,378,332			
Canada	144,196	5,036,722	100,755	$3,526,881	
Chile	33,085	1,156,955			
Colombia	389	13,453			
Costa Rica	1	34			
Cuba	835	29,168			
Dominican Republic	411	14,338			
Ecuador	6,505	227,432			
El Salvador	22,946	802,879			
France	687	23,985			
Germany	344	12,040			
Guatemala	7	238			
Honduras	17,338	606,811			
Italy	661	23,159			$1,000
Japan			4,829	169,000	
Liberia	2,410	83,991			
Malta, Gozo, and Cyprus	2,003	69,930			
Mexico	104,821	3,650,125			
Netherlands Antilles	3	105			
Nicaragua	101,335	3,540,537			
Northern Rhodesia	315	11,031			
Panama	2,725	95,208			
Peru	15,727	548,840			
Philippines	145,261	5,080,692	13,650	477,722	
Portugal	16,993	594,755			
Saudi Arabia	2,586	90,510			
Southern Rhodesia	1,154	40,390			
Spain			300,135	10,504,729	3,345
Switzerland	38	1,325			
Trinidad and Tobago	1	35			
Union of South Africa	606	21,083	1,173,684	41,078,967	
United Kingdom	2,129	76,254			1,796
Venezuela	405	14,136			
Yugoslavia	8,649	302.696			
Total	729,627	25,495,062	1,593,053	55,757,299	6,141

TABLE 22.—Gold exported from the United States in 1951, by country of destination [1]

[U. S. Department of Commerce]

Country of destination	Troy ounces	Value	Country of destination	Troy ounces	Value
Bahamas	8	$379	India	3,151	$110,341
Belgium-Luxembourg	1,060	41,029	Indonesia		[3] 3,481,904
Bolivia	20	992	Iran	16,985	613,677
Brazil	3,317	158,089	Jamaica	11	434
Canada	12,081,015	422,837,066	Kuwait	182,649	7,081,327
Ceylon	15	591	Lebanon	135,570	4,768,365
Chile	1,281	49,558	Mexico	647,368	22,658,703
Colombia	246	11,611	Netherlands	11,572	450,037
Costa Rica	220	9,285	Netherlands Antilles	1,941	68,988
Cuba	2,300	84,002	Nicaragua	15	655
Dominican Republic	761	33,483	Panama	1,501	55,613
Ecuador	50	2,198	Peru	429,013	15,015,987
Egypt	2,181,368	76,352,967	Philippines	55,148	2,371,662
El Salvador	12,177	427,500	Portugal	[4] 90,547	[4] 3,223,625
Finland	8,024	280,848	Portuguese Asia	306	10,720
France	9,421	358,292	Saudi Arabia	15	[5] 824,854
Germany	51,765	1,834,358	Switzerland	5,180	231,496
Greece		[2] 8,225,456	Syria	120,002	[6] 6,253,495
Guatemala	131	6,078	Tangier	2,320	95,977
Haiti	453	18,190	United Kingdom	5,523	220,583
Honduras	70	3,421	Uruguay	1,439,320	50,419,995
Hong Kong	29	1,780	Venezuela	47,239	1,681,932
Iceland	115	4,023			
			Total	17,549,222	630,381,566

[1] Bullion, refined, unless otherwise indicated.
[2] Foreign coin.
[3] United States coin, valued at $2,710,692, and foreign coin, valued at $771,212.
[4] Includes 17,669 ounces in ore and base bullion valued at $625,058.
[5] Includes foreign coin valued at $824,008.
[6] Includes foreign coin valued at $2,053,405.

TABLE 23.—Silver imported into the United States in 1951, by country of origin

[U. S. Department of Commerce]

Country of origin	Ore and base bullion		Bullion, refined		United States coin (value)	Foreign coin (value)
	Troy ounces	Value	Troy ounces	Value		
Australia	993,687	$845,737				
Austria						$173
Bahamas					$1,650	
Belgium-Luxembourg	639,142	562,464	286,990	$257,995		753
Bolivia	4,802,930	4,057,252				
Brazil	7,523	5,975				
British Western Pacific Islands	16,085	12,738				
Canada	2,801,144	2,351,196	19,440,205	17,111,313	441,812	846
Canal Zone					97,651	
Chile	672,143	579,927				
China			53,519	41,779		1,593,560
Colombia	21,718	19,225				
Costa Rica	582	501				
Cuba	172,318	151,844			292,650	21,000,000
Denmark			79,926	67,621		
Dominican Republic					6,400	
Ecuador	29,869	25,828				
Egypt					294	
El Salvador	362,406	296,375				
France	579,230	522,191	75,635	66,815	7,390	
Germany	16,597	14,510			22,880	156
Guatemala	131,797	107,203				
Honduras	3,366,847	2,926,392			4,532,200	
Ireland					425	
Italy	3,676	2,801				
Jamaica					200	1,210
Japan			214,232	193,559		
Lebanon	109,418	97,422	64,284	55,646		32,599
Malta, Gozo, and Cyprus	18,579	16,721				
Mexico	5,494,913	4,710,128	17,918,605	15,587,299	37,500	
Netherlands	411,857	368,792	3,781,177	3,381,651	8,499	8
Nicaragua	141,764	117,870				
Northern Rhodesia	83,415	69,344				
Panama	4,340	3,832				
Peru	4,256,641	3,583,520	5,843,667	5,168,309		359,826
Philippines	317,339	271,482				
Poland-Danzig					1,060	
Portugal	58,248	51,493				
Saudi Arabia	11,758	9,406				
Southern Rhodesia	1,340	1,169				
Spain						4,160,942
Switzerland	453,182	400,849			2,770	191,085
Trinidad and Tobago	61	55				
Union of South Africa	236,442	207,544				
United Kingdom	1,053,297	913,923	2,064,417	1,818,781	45,486	939
Venezuela	275,969	219,960	2,168,169	1,930,225	14,700	
Yugoslavia	1,474,311	1,262,646				143,538
Total	29,020,568	24,788,315	51,990,826	45,680,993	5,513,567	27,485,635

TABLE 24.—Silver exported from the United States in 1951, by country of destination

[U. S. Department of Commerce]

Country of destination	Ore and base bullion		Bullion, refined		United States coin (value)	Foreign coin (value)
	Troy ounces	Value	Troy ounces	Value		
Austria			14,733	$12,228		
Bahamas					$1,000	
Belgium-Luxembourg			390,084	353,651		
Bermuda					2,300	
Brazil			143,358	129,899		
Canada			3,197,203	2,736,811	2,000	$795,622
Canal Zone						200
Cuba			135	114		140
Dominican Republic						250,000
France			32,150	26,242		
Germany			1,079,477	920,147		
Haiti					12,000	
Hong Kong						300
Italy			155,450	136,853		
Liberia					380,000	
Mexico						1,616,096
Netherlands			188,832	149,592		
Norway			173	138		
Philippines			121	109		
Portugal	65	$58	138	119		
Saudi Arabia					1,500	
Switzerland			222,092	190,995		
Union of South Africa			600,028	542,186	1,070	
United Kingdom			357,730	317,853		
Uruguay			6,660	6,000		
Venezuela			5,561	4,962		
Total	65	58	6,393,925	5,527,899	399,870	2,662,358

TECHNOLOGY

During 1949 and 1950 studies were made at the Rare and Precious Metals Experiment Station of the Bureau of Mines, Reno, Nev., to determine simple treatment methods employing the least possible equipment to produce satisfactory results on marginal ores and in small-scale operations. Tests were made on oxide ores and on sulfide ores that contain gold and silver and in some instances base metals. The methods of treatment investigated included gravity concentration, amalgamation, flotation, and cyanidation. No attempts were made during these studies to develop new methods for low-grade or refractory ores if simple treatment was not satisfactory.[2]

Research was continued along two lines: First, investigation of repeated reuse of activated carbon in the carbon-cyanidation process, which permits a simplified treatment of ore pulps that are difficult to settle or from which it is difficult to produce clarified pregnant solution. This process eliminates considerable plant equipment, and gold is recovered in an easily handled form.

The second line of research was the continued investigation of possible improvement of the cyanide process in regard to accelerating the solution of gold and silver, the increase of recovery, or both. A large number of addition reagents were tested, including many new organic materials. Some slight improvements were obtained, but the investigation was being continued in the hope of important achievements.

WORLD REVIEW

World output of gold rose slightly in 1951, continuing the movement that has prevailed since 1946, but the 1951 total was well below the annual quantities produced before World War II. World silver output was the same in 1951 as in 1950. Substantial declines in the United States and Mexico were offset by increases in Canada, Peru, West Germany, and South-West Africa and other countries.

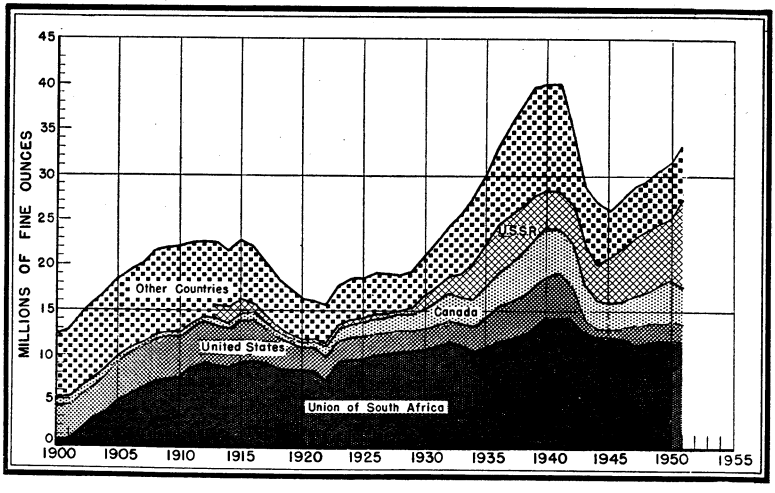

FIGURE 4.—World production of gold, 1900–51.

[2] Engel, A. L., Simple Treatment Methods for Oxide Gold and Silver Ores: Bureau of Mines Rept. of Investigations 4758, 1951, 14 pp. Simple Treatment Methods for Sulfide Gold and Silver Ores: Bureau of Mines Rept. of Investigations 4790, 1951, 17 pp.

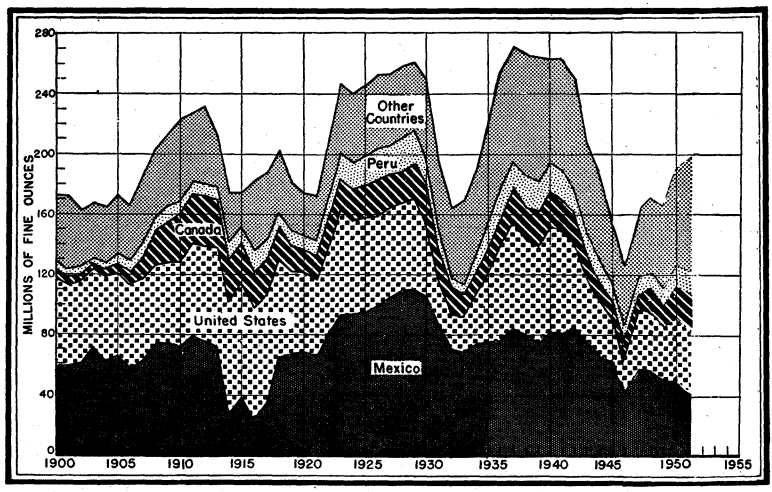

FIGURE 5.—World production of silver, 1900–51.

TABLE 25.—World production of gold, 1947–51, by countries, in fine ounces [1]

[Compiled by Pauline Roberts and Berenice B. Mitchell]

Country [1]	1947	1948	1949	1950	1951
North America:					
United States (including Alaska) [2]	2,165,318	2,025,480	1,921,949	2,288,708	1,894,726
Canada	3,070,221	3,529,608	4,123,518	[3] 4,441,227	4,328,931
Newfoundland	11,032				
Central America and West Indies:					
Costa Rica [4]	1,988	1,096	284	115	1
Cuba	364	334	[4] 5,692	[4] 6,915	[4] 835
Dominican Republic [4]	16	29	993	475	411
Guatemala [4]	35	16	5	397	7
Honduras	12,037	13,633	25,832	36,545	31,216
Nicaragua (exports)	213,454	222,627	219,139	229,206	251,160
Panama		1,000	[5] 9,657	1,118	2,897
Salvador (exports)	10,755	20,778	27,091	29,053	27,097
Mexico	464,739	367,612	405,550	408,122	394,007
Total	5,950,000	6,182,200	6,739,700	[3] 7,441,900	6,931,300
South America:					
Argentina	[6] 8,000	[6] 8,000	[6] 8,000	(7)	(7)
Bolivia	20,108	6,687	33,533	[3] [6] 7,700	(7)
Brazil (estimate)	167,000	156,900	183,500	[3] 195,500	200,000
British Guiana	21,111	16,518	19,368	11,800	13,485
Chile	168,855	164,258	179,144	[3] 190,172	173,646
Colombia	383,027	335,260	359,474	379,412	430,723
Ecuador	57,250	79,207	99,241	91,946	[6] 10,000
French Guiana	14,918	13,625	14,265	12,249	12,056
Peru	116,016	111,162	137,959	[3] 147,958	141,711
Surinam	4,134	4,177	3,794	4,546	6,494
Venezuela	21,830	49,730	61,378	34,462	2,861
Total	982,000	946,000	1,100,000	[3] 1,082,000	1,007,000
Europe:					
Czechoslovakia	2,090	(7)	(7)	(7)	(7)
Finland	11,285	11,317	14,587	9,465	18,721
France	42,407	47,519	47,294	63,015	45,976
Hungary	1,993	(7)	(7)	(7)	(7)
Italy	11,253	18,422	10,385	10,674	12,089
Portugal	15,754	11,799	10,385	15,465	[6] 14,000
Rumania	74,686	90,000	112,528	(7)	(7)
Spain	2,714	11,375	30,318	13,217	12,777
Sweden	75,586	71,889	80,280	78,866	80,000
U. S. S. R. (estimate) [8]	7,000,000	7,000,000	7,000,000	[3] 8,000,000	9,500,000
Total (estimate)	7,200,000	7,300,000	7,400,000	[3] 8,400,000	9,900,000

For footnotes, see end of table.

TABLE 25.—World production of gold, 1947–51, by countries, in fine ounces [1]—Continued

Country [1]	1947	1948	1949	1950	1951
Asia:					
Burma	[3] 67	230	158	150	([7])
China	107,535	88,200	[6] 60,000	[3] 108,000	[6] 100,000
India	171,704	[3] 180,430	[3] 164,203	196,848	226,475
Indonesia [6]	16,000	32,000	[3] 35,000	42,000	([7])
Japan	55,029	69,060	84,492	[3] 135,033	177,086
Korea:					
North	322,000	([7])	([7])	([7])	([7])
Republic of	2,494	3,466	3,419	5,144	1,000
Malaya	5,312	10,212	13,617	18,436	17,018
Philippines	64,441	209,225	287,844	333,991	393,602
Sarawak	389	599	1,523	1,440	931
Saudi Arabia	52,000	74,000	66,835	66,202	73,104
Taiwan (Formosa)	8,387	17,668	16,607	18,232	30,500
U. S. S. R.	([8])	([8])	([8])	([8])	([8])
Total	805,000	791,000	[3] 790,000	[3] 950,000	1,100,000
Africa:					
Angola	360	443	319	201	61
Bechuanaland	7,381	1,507	256	261	([7])
Belgian Congo [9]	301,445	299,774	333,853	339,415	352,308
Egypt	2,090	3,853	7,045	[3] 10,724	16,232
Eritrea	3,674	2,242	2,243	1,042	([7])
Ethiopia	[5] 27,382	41,595	45,102	[6] 43,200	[6] 33,000
French Cameroon	11,510	10,706	8,938	7,170	5,422
French Equatorial Africa	64,044	63,723	57,260	54,996	52,849
French Guinea	7,395	88,029	([7])	([7])	([7])
French Morocco	1,029	804	643	119	2,069
French West Africa	5,564	20,512	46,381	96,452	([7])
Gold Coast	558,011	672,388	676,934	[3] 689,441	699,000
Kenya	21,959	23,429	20,072	22,945	19,765
Liberia	16,987	13,797	14,656	11,025	9,822
Madagascar	1,511	2,095	1,663	1,935	1,951
Mozambique	5,427	4,734	2,468	997	861
Nigeria	2,203	2,899	2,515	2,238	1,566
Northern Rhodesia	[10] 779	[10] 1,180	[10] 1,186	[10] 1,432	101
Sierra Leone	2,400	2,193	[3] 2,272	[3] 3,778	([7])
Southern Rhodesia	522,735	514,440	528,180	511,163	486,907
South-West Africa	34	455	32	32	([7])
Sudan	3,725	3,579	4,114	3,503	1,495
Swaziland	5,637	3,110	2,841	1,794	322
Tanganyika (exports)	47,317	57,557	68,989	65,127	65,224
Uganda (exports)	1,366	1,158	650	[3] 509	223
Union of South Africa	11,200,281	11,584,849	11,705,048	11,663,713	11,516,450
Total	12,822,000	13,421,000	13,614,000	[3] 13,533,000	13,370,000
Oceania:					
Australia:					
Commonwealth	937,654	885,507	889,057	[3] 868,567	886,170
New Guinea	59,202	86,556	93,045	[3] 80,099	94,085
Papua	550	163	450	788	248
Fiji	94,353	93,059	104,036	103,421	93,635
New Zealand	112,260	93,903	84,874	76,527	75,115
Total	[3] 1,204,019	[3] 1,159,188	[3] 1,171,462	[3] 1,129,402	1,149,253
World total (estimate)	[3] 29,000,000	29,800,000	30,800,000	[3] 32,500,000	33,500,000

[1] Figures used derived in part from American Bureau of Metal Statistics. For some countries accurate figures are not possible to obtain owing to clandestine trade in gold. Data not available for Austria, Bulgaria, Germany, Thailand, and Yugoslavia; estimates included in the total. In addition, production in Cyprus, and Indochina was negligible.
[2] Refinery production. Excludes production of the Philippines.
[3] Revised figure.
[4] Imports into United States.
[5] Exports.
[6] Estimate.
[7] Data not available; estimate included in total.
[8] Output from U. S. S. R. in Asia included with U. S. S. R. in Europe.
[9] Includes Ruanda-Urundi.
[10] Included is yield from Nkana mine refinery slimes accumulated during the war: 547 ounces in 1947, 999 in 1948, 972 in 1949, and 1,296 in 1950.

TABLE 26.—World production of silver, 1947–51, by countries, in fine ounces [1]

[Compiled by Pauline Roberts and Berenice B. Mitchell]

Country [1]	1947	1948	1949	1950	1951
North America:					
United States	38,587,069	39,228,468	34,944,554	42,308,739	39,907,257
Canada	12,504,018	16,109,982	17,641,493	[2] 23,221,431	24,244,949
Newfoundland	956,052				
Central America and West Indies:					
Costa Rica [3]	1,470	3,029	720	215	582
Cuba	146,932	185,216	[3] 157,411	[3] 221,779	[3] 172,318
Guatemala	(4)	(4)	81,502	339,360	309,857
Honduras	2,413,399	3,170,871	3,431,614	[2] 3,514,556	3,182,254
Nicaragua	[5] 213,417	[3] 216,802	[3] 191,082	[3] 133,282	[3] 141,764
Panama	(4)	400	(4)	1,940	5,788
Salvador	[5] 265,104	[5] 216,342	280,309	462,973	352,102
Mexico	58,843,863	57,519,703	49,454,882	49,141,445	43,797,734
Total	113,931,000	[2] 116,651,000	106,184,000	[2] 119,346,000	112,115,000
South America:					
Argentina	[6] 2,435,400	[6] 1,201,900	1,249,421	1,150,000	1,253,879
Bolivia (exports)	6,233,354	7,562,208	6,634,627	6,566,950	7,172,220
Brazil	20,293	23,095	21,041	[2] 21,155	20,315
Chile	747,055	861,961	799,685	[2] 746,765	983,491
Colombia	110,352	109,188	106,590	115,711	130,028
Ecuador	134,100	205,800	[2] 264,300	[2] 273,200	33,600
Peru	10,782,995	9,288,777	10,627,717	[2] 13,367,807	14,856,536
Total	20,464,000	19,253,000	[2] 19,703,000	[2] 22,242,000	24,450,000
Europe:					
Austria		(4)	12,890	18,901	(4)
Czechoslovakia [6]	1,400,000	1,600,000	(4)	(4)	(4)
Finland	188,821	167,615	171,150	115,939	157,275
France	474,320	494,414	570,888	549,669	546,550
Germany, West	(4)	[7] 867,459	1,601,782	1,637,116	4,138,990
Greece	33,000	32,000			64,300
Italy	443,680	595,432	793,545	[2] 850,998	821,529
Norway	228,270	215,410	170,399	[2] 167,184	160,754
Portugal	7,395	35,366	31,958	60,709	55,798
Rumania	481,264	(4)	(4)	(4)	(4)
Spain	638,192	339,396	514,283	[2] 823,831	735,911
Sweden	1,088,656	1,137,943	1,140,708	1,291,656	(4)
United Kingdom	23,522	[2] 15,942	13,996	18,153	(4)
Yugoslavia	(4)	(4)	(4)	2,200,000	3,000,000
Total (estimate)	15,000,000	18,000,000	27,000,000	[2] 34,000,000	37,000,000
Asia:					
Burma	[2] [6] 100,000	[2] [6] 300,000	[6] 100,000		
China	1,747	(4)	160,000	320,000	320,000
India	12,422	12,797	11,275	15,676	17,180
Japan	1,792,050	2,185,672	2,887,265	[2] 3,964,572	4,607,713
Korea:					
North	[6] 128,600	(4)	(4)	(4)	(4)
Republic of	38,689	38,505	18,932	(4)	(4)
Philippines	54,940	150,760	218,419	216,034	274,602
Saudi Arabia	49,805	67,819	81,295	124,287	109,912
Taiwan (Formosa)	1,856	7,042	4,836	[2] [6] 3,200	[6] 3,200
Total (estimate)	2,200,000	[2] 2,800,000	[2] 3,500,000	[2] 4,700,000	5,400,000
Africa:					
Algeria	24,435	29,739	32,000	32,000	(4)
Bechuanaland	1,086	233	23	24	(4)
Belgian Congo	4,057,295	3,805,715	4,549,330	4,459,951	3,795,266
French Morocco	356,712	487,598	491,906	482,261	(4)
Gold Coast (exports)	41,250	45,553	[2] 40,051	43,317	52,542
Kenya	3,859	3,184	2,279	2,586	2,150
Mozambique	712	616	244	71	(4)
Nigeria	2,130	4,270	484	325	200
Northern Rhodesia	[8] 73,277	[8] 145,865	[8] 134,920	[8] 173,304	
Southern Rhodesia	91,900	81,404	84,495	85,549	79,731
South-West Africa	[6] 390,000	323,647	642,500	843,737	1,030,066
Swaziland	211	124	120	60	18
Tanganyika (exports)	20,794	25,010	27,631	31,014	35,697
Tunisia	53,852	16,011	[2] 67,517	73,947	61,119
Uganda (exports)	87	56	42		
Union of South Africa	1,147,694	1,170,951	1,159,375	1,119,135	1,162,588
Total	6,266,000	6,140,000	[2] 7,233,000	7,400,000	9,000,000

For footnotes, see end of table.

TABLE 26.—World production of silver, 1947–51, by countries in fine ounces [1]—Continued

Country [1]	1947	1948	1949	1950	1951
Oceania:					
Australia:					
Commonwealth	9, 527, 140	10, 057, 519	9, 849, 213	10, 677, 456	10, 436, 324
New Guinea [9]	35, 421	31, 739	31, 786	30, 399	(4)
Fiji	33, 237	29, 187	29, 755	37, 736	24, 869
New Zealand	221, 984	232, 563	232, 599	199, 701	133, 291
Total	9, 818, 000	10, 351, 000	10, 143, 000	10, 945, 000	10, 625, 000
World total (estimate)	167, 700, 000	[2] 173, 200, 000	[2] 173, 800, 000	[2] 198, 600, 000	198, 600, 000

[1] Silver is also produced in Bulgaria, Cyprus, Hong Kong, Hungary, Malaya, Indonesia, Poland, Sarawak, Sierra Leone, Turkey, and U. S. S. R.; production data are not available, but estimates are included in total.
[2] Revised figure.
[3] Imports into the United States. Scrap is included in this figure in many instances, most notably in the case of Cuba.
[4] Data not available; estimate included in total.
[5] Exports.
[6] Estimate.
[7] American and British zones only.
[8] Recovered from an accumulation of refinery slimes.
[9] Fiscal year ended May 31 of year following that stated.

Australia.—Gold production in Australia in 1951 was 886,170 ounces, a 2-percent increase over that of the preceding year. The reaction of Australia to the announcement of September 1951 of the International Monetary Fund on gold disposal was to permit the entire current Australian output of gold to be sold in the "free market," provided such sales were made with payment in United States dollars. Silver production in Australia declined from 10,677,456 ounces in 1950 to 10,436,324 in 1951.

Canada.—Although gold production dropped 3 percent from 1950 to 4,328,931 ounces, gold once again was the leading mineral in Canada in output value in 1951. Ranking third among the gold-producing countries of the world, Canada was exceeded in output by only South Africa and (probably) the U. S. S. R. A feature of the gold-mining industry in Canada in 1951 was the decision of the Canadian Government to allow, with some restrictions, sale of the current production of gold in the "free market." Properties receiving subsidy (most of the straight gold mines) under the Emergency Gold Mining Assistance Act forfeited rights to such aid if they elected to dispose of their output on the open market. However, several companies chose this course and were reported to have sold considerable gold at $39.30 to $39.55 per ounce, apparently for export to the European market.

The gold outputs of the provinces or territories in 1950 and 1951 were as follows, in fine troy ounces:

Province or Territory:	*1950*	*1951*
Alberta	152	97
British Columbia	290, 490	252, 015
Manitoba	191, 725	162, 257
Newfoundland	9, 254	8, 070
Northwest Territories	200, 663	210, 451
Nova Scotia	65	17
Ontario	2, 481, 110	2, 445, 902
Quebec	1, 094, 645	1, 061, 113
Saskatchewan	79, 784	113, 967
Yukon	93, 339	75, 042
Total	4, 441, 227	4, 328, 931

Of the 1951 output of gold, 84 percent was obtained by straight gold-lode mining, 13 percent as a byproduct of base-metal mining, and 3 percent by placer-gold mining.

Continuing an uptrend that started in 1948, silver production in Canada in 1951 rose 4 percent to 24,244,949 ounces; a large portion of the output was byproduct silver from base-metal ores. Canada ranked third in silver production in the world, exceeded by Mexico and the United States.

Colombia.—Gold production in Colombia in 1951 was 430,723 ounces, equivalent to a 14-percent increase above the 1950 figure. The gold production thus continued an uptrend that began in 1949 after a steady decline that started in 1941. About three-fourths of the 1951 output was obtained from placer mining and one-fourth from gold-lode mines. The silver production increased 12 percent to 130,028 ounces. The entire silver yield of Colombia was recovered as a byproduct of gold mining.

Honduras.—Honduras was the leading silver producer of the Central American countries and ranked sixth among the countries of the Western Hemisphere. The principal mines were the San Juancito and El Mochito of the New York & Honduras Rosario Mining Co. According to Mineral Trade Notes[3] the San Juancito produced 2,145,602 ounces of silver and 15,283 ounces of gold in 1951, and El Mochito 1,027,602 ounces of silver and 700 ounces of gold. Smaller producers also contributed some gold and silver. The Compania Minera Agua Fria ceased mining and milling operations on October 31, 1951. Honduras exported 3,309,680 ounces of silver and 33,578 ounces of gold in 1951.

Mexico.—Although silver production in 1951 dropped sharply to 43,797,734 ounces, Mexico maintained its position as the leading silver-producing country of the world. Gold production declined 3 percent from 1950 to 394,007 ounces.

Silver exports were high, but mostly in the form of currency minted in Mexico. Shipments were made to Saudi Arabia, West Germany, and Italy.

Republic of the Philippines.—Gold mining in the Philippines continued to recover from the dislocations caused by World War II, and gold production rose 18 percent over 1950 to 393,602 ounces in 1951. The alltime high of the Philippines was 1,144,332 ounces in 1941, produced by some 54 properties. Eleven mines were in active production in 1951 compared with 9 in 1950; rehabilitation from damage suffered during the war was almost completed in 2 additional properties. Gold producers in the Philippines were benefited by regulations that permitted them to sell up to 75 percent of their respective outputs in the domestic "free market," where it was reported the prevailing prices averaged well over $50 per ounce during 1951.[4]

Union of South Africa.—Both the quantity of ore milled and the quantity of gold produced in the Union of South Africa in 1951 were approximately 1 percent below those of the preceding year; the average yield of gold per ton of ore was slightly less. The average working cost per ton of ore was up 7 percent, but the overall average

[3] Bureau of Mines, Mineral Trade Notes: June 1952, vol. 34, No. 6, p. 12.
[4] Mining World, vol. 14, No. 5, Apr. 15, 1952, p. 119.

revenue per ton was sustained by sale of some of the output of gold at premium prices on the free market.

Progress was made in the development of the new gold field in the Orange Free State about 150 miles south-southwest of Johannesburg. Investigations since 1937 have shown that gold-bearing conglomerate beds or "reefs," generally similar to those mined in the Rand, underlie an area about 30 miles long and 10 miles wide; it was estimated that the new field had a production potential of 8 million ounces of gold annually. The field was divided into 13 separate holdings, on which 25 shafts had been or were being sunk. Two properties reached the production stage in 1951, and 4 more were expected to go into production in 1952.

TABLE 27.—Salient statistics of gold mining in the Union of South Africa, 1947–51

[Transvaal Chamber of Mines]

	1947	1948	1949	1950	1951
Ore milled (tons)	53,712,300	55,285,700	56,881,550	59,515,200	58,645,800
Gold recovered (fine ounces)	11,197,638	11,574,871	11,708,013	11,663,713	11,516,450
Gold recovered (dwt. per ton)	3.982	4.012	3.942	3.759	3.756
Working revenue	£92,740,023	£96,179,355	£110,617,476	£139,491,029	£137,494,860
Working revenue per ton	34s. 7d.	34s. 9d.	38s. 11d.	46s. 11d.	46s. 11d.
Working cost	£71,309,136	£72,383,938	£76,667,643	£87,956,643	£93,494,860
Working cost per ton of ore	26s. 7d.	26s. 2d.	27s. 0d.	29s. 7d.	31s. 10d.
Working cost per ounce of metal	133s. 4d.	130s. 7d.	136s. 9d.	157s. 3d.	169s. 6d.
Working profit	£21,430,887	£23,790,417	£33,949,793	£51,534,386	£44,157,054
Working profit per ton	8s. 0d.	8s. 7d.	11s. 11d.	17s. 4d.	15s. 1d.
Dividends	£11,845,035	£13,419,443	£17,394,046	£24,699,544	£22,787,806

Graphite

By Frank D. Lamb and E. V. Blankenbaker

GENERAL SUMMARY

EARLY in 1951 there was a critical shortage of flake graphite in the United States, caused by an increase in world demand for Madagascar graphite, Government purchasing, and lack of consumer stocks, depleted during previous years when the supply was short. During the year consumers could obtain enough graphite for current needs, as production in Madagascar reached an alltime high, increasing from 14,013 metric tons in 1950 to 18,340 in 1951.

Production of domestic natural graphite in 1951 increased 40 percent over 1950. The total value of domestic graphite shipments in 1951 increased 80 percent over 1950 to $771,434, partly as a result of a 21-percent increase in the quantity shipped but mainly because of a 48-percent increase in the average unit value of shipments in 1951 compared with 1950. Domestic graphite mines were still in an unfavorable position with respect to long-range competition from foreign sources because of their lower grade, higher costs, and the preference of consumers for foreign material. However, domestic producers had little difficulty in selling their limited current production.

The prices paid to foreign sources by consumers in the United States increased steadily during the year, and the ceiling prices established by the Government in July resulted in narrowing the margin between cost of production and selling price for processors. However, in August the Government exempted crude natural graphite and graphite concentrates from price controls and in December removed controls from foundry facings. Minimum quantity figures on consumption of natural graphite increased 83.5 percent over 1950.

TABLE 1.—Salient statistics of the graphite industry in the United States, 1950–51

	1950		1951	
	Short tons	Value	Short tons	Value
Natural graphite:				
Production	5,102	(1)	7,135	(1)
Sales	5,605	$427,908	6,808	$771,434
Consumption [2]	20,878	3,010,761	38,318	5,083,527
Imports:				
Crystalline flake	6,130	725,172	10,227	1,412,787
Lump, chip, or dust	100	7,514	336	29,096
Amorphous (natural)	37,255	1,335,142	43,830	1,561,494
Artificial	184	12,518	90	7,420
Total imports	43,669	2,080,346	54,483	3,010,797
Exports:				
Crystalline flake, lump, or chip	111	28,320	213	56,345
Amorphous (natural)	656	86,457	612	75,964
Other natural graphite	630	58,923	679	63,639
Total exports	1,397	173,700	1,504	195,948

[1] Figure not available.
[2] Minimum quantities; coverage incomplete but identical in 1950–51.

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PRODUCTION AND SALES

Production and sales of domestic natural graphite in 1951 were substantially greater than in 1950. The combined total of crystalline and amorphous graphite produced from domestic mines in 1951 was 7,135 short tons compared to 5,102 tons in 1950. Shipments were 6,808 short tons valued at $771,434 compared with 5,605 tons valued at $427,908 in 1950. The manufacture of artificial graphite was continued at Niagara Falls, N. Y., by the Acheson Graphite Division of the National Carbon Co., Inc., 30 East 42d St., New York 17, N. Y. Statistics on production and consumption of artificial graphite are collected by the Bureau of Mines, but the figures cannot be disclosed because there is only one producer.

There were three domestic producers of natural graphite in the United States in 1951, in Alabama, Texas, and Rhode Island. The small number of producers does not permit publication of separate statistics on natural crystalline and amorphous graphite However, table 2 shows combined figures for 1946 through 1951.

TABLE 2.—Production and shipments of natural graphite in the United States, 1946–51

Year	Production (short tons)	Shipments		Year	Production (short tons)	Shipments	
		Short tons	Value			Short tons	Value
1946	5,575	4,844	$252,596	1949	6,102	5,213	$475,264
1947	4,387	5,207	221,260	1950	5,102	5,605	427,908
1948	9,949	9,871	450,759	1951	7,135	6,808	771,434

CONSUMPTION

In 1950 and early in 1951 there was a shortage of flake graphite in the United States, and consumers experienced great difficulty in obtaining crucible-grade graphite from Madagascar. However, during 1951 production in Madagascar increased, enabling consumers to obtain enough graphite for all their current needs.

Although coverage of the graphite-consumption canvass is incomplete, the totals obtained indicate at least the minimum quantities of graphite used in making various products. Domestic consumption of natural graphite reported for 1951 is shown in table 3.

TABLE 3.—Consumption of natural graphite in the United States in 1951, by uses [1]

Use	Short tons	Value	Use	Short tons	Value
Foundry facings	16,112	$1,336,633	Packings	844	$320,307
Lubricants	5,579	650,825	Retorts	696	175,887
Crucibles	3,273	730,864	Paints	330	28,330
Batteries	3,189	173,121	Bearings	84	39,739
Pencils	2,276	572,934	Other [2]	4,469	758,740
Stoppers, sleeves, and nozzles	1,466	296,147	Total	38,318	5,083,527

[1] Minimum quantities; coverage incomplete.
[2] Includes brake lining, carbon brushes, electrodes, etc.

PRICES

Quotations for graphite continued to increase during 1951 on certain grades, and at the year end the trade-journal listings were as follows: Per pound, carlots, f. o. b. shipping point: Crystalline flake, natural; 85–88 percent carbon, crucible grade, 13 cents; 96 percent carbon, special and dry usage, 22 cents; 94 percent carbon, normal and wire drawing, 19 cents; 98 percent carbon, special for brushes, etc., 26½ cents.

Amorphous, natural, for foundry facings, etc., up to 85 percent carbon, 10 cents.

Madagascar, c. i. f. New York, "standard grades, 85–87 percent carbon," $250 per short ton; special mesh $300–$325; special grade, 99 percent carbon, $725.

Amorphous graphite, Mexican, f. o. b. point of shipment (Mexico), per metric ton, $9–$16, depending on grade.

As the prices paid to foreign sources by consumers increased, the ceiling prices established by the Government on July 26, 1951, resulted in a narrowing of the margin between cost of production and selling price for consumers. However, on August 10, 1951, the Government exempted natural graphite, either as crude ore or concentrates, from price controls and in December removed foundry facings from price controls.

FOREIGN TRADE [1]

Imports of crystalline flake graphite increased sharply in 1951. Imports of this type of graphite amounted to 10,227 short tons valued at $1,412,787—an increase of 67 percent in quantity and 95 percent in value from the 1950 figures. Natural amorphous graphite imports also increased in 1951 over 1950, resulting in a substantial increase in the total imports of all types of graphite as shown in table 4.

[1] Figures on imports and exports compiled by M. B. Price and E. D. Page, of the Bureau of Mines, from records of the U. S. Department of Commerce.

TABLE 4.—Graphite (natural and artificial) imported for consumption in the United States, 1947–51

[U. S. Department of Commerce]

	Crystalline				Amorphous				Total	
	Flake		Lump, chip, or dust		Natural		Artificial			
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1947	2,730	$255,556	198	$16,325	40,703	$1,236,734	28	$2,660	43,659	$1,511,275
1948	3,496	429,557	554	83,226	48,150	1,529,312	117	4,153	52,317	2,046,248
1949	2,228	277,368	235	27,313	29,298	954,388	44	1,398	31,805	1,260,467
1950										
Canada	420	58,329			2,589	222,410	184	12,518	3,193	293,257
Ceylon			84	4,709	5,998	621,537			6,082	626,246
France	51	19,705							51	19,705
Germany	39	5,500	11	1,558					50	7,058
India					(1)	125			(1)	125
Japan			3	624					3	624
Madagascar	5,620	641,638							5,620	641,638
Mexico					28,601	482,027			28,601	482,027
Norway					7	672			7	672
United Kingdom			2	623	60	8,371			62	8,994
Total	6,130	725,172	100	7,514	37,255	1,335,142	184	12,518	43,669	2,080,346
1951										
Canada	172	57,626			1,069	96,445	74	6,806	1,315	160,877
Ceylon			280	24,841	5,496	716,896			5,776	741,737
British East Africa					28	1,254			28	1,254
France	100	41,878	(1)	309					100	42,187
Germany	419	71,496			55	7,704	16	614	490	79,814
India	(1)	24							(1)	24
Madagascar	9,536	1,241,763	56	3,946	173	18,718			9,765	1,264,427
Mexico					35,337	582,257			35,337	582,257
Mozambique					167	10,938			167	10,938
Norway					1,447	114,654			1,447	114,654
United Kingdom					58	12,628			58	12,628
Total	10,227	1,412,787	336	29,096	43,830	1,561,494	90	7,420	54,483	3,010,797

[1] Less than 0.5 ton.

The United States tariff rates on graphite, effective January 1, 1948, were still in force during 1951. They were: Amorphous, natural and artificial, 5 percent ad valorem; crystalline flake, 15 percent ad valorem, with a specific minimum of 0.4125 cent per pound and a specific maximum of 0.825 cent per pound; crucible flake and dust and other crystalline lump and chip, 7½ percent ad valorem.

Exports of natural graphite, 1947–51, were: 1947, 1,546 tons, $171,607; 1948, 1,047 tons, $127,931; 1949, 1,352 tons, $158,694; 1950, 1,397 tons, $173,700; 1951, 1,504 tons, $195,948.

TABLE 5.—Graphite exported from the United States, 1950–51, by country of destination

[U. S. Department of Commerce]

Country	Amorphous		Crystalline flake, lump, or chip		Natural, n. e. s.	
	Short tons	Value	Short tons	Value	Short tons	Value
1950						
Austria	11	$1,794			(1)	$281
Belgium-Luxembourg	4	506				
Brazil	35	7,931	2	$235		
Canada	175	10,066	15	5,728	569	45,850
Chile	2	400	15	2,670		
Colombia			(1)	115		
Cuba	4	434	29	4,549	26	3,884
Czechoslovakia	27	4,482				
Denmark	7	1,470	(1)	111	11	4,760
Dominican Republic			2	396		
France	22	3,122				
Germany	30	3,947				
Guatemala			1	308		
Hong Kong	16	1,732				
Indonesia	2	704				
Israel			(1)	221		
Italy	11	1,916	2	325		
Mexico	5	1,813	24	7,633	6	670
Netherlands	3	349	(1)	159		
Netherlands Antilles			(1)	200		
Norway	10	3,096				
Pakistan			3	2,010		
Peru	1	161	(1)	295		
Philippines	46	6,375	13	2,035	4	666
Southern Rhodesia	15	2,400				
Sweden	56	8,655				
Switzerland	8	1,101				
Union of South Africa	120	18,315				
United Kingdom	46	6,688			11	2,240
Uruguay					1	252
Venezuela			5	1,330	2	320
Total	656	86,457	111	28,320	630	58,923
1951						
Australia			90	9,800		
Austria	1	187	1	278		
Belgium-Luxembourg	4	694				
Bolivia	1	226	1	144		
Brazil	5	2,173			1	140
Canada	238	20,734	18	6,600	575	46,406
Chile	8	1,600	4	1,542	5	1,290
Colombia	4	518	8	2,345		
Cuba	18	2,174	32	8,709	77	9,602
Denmark	23	3,982				
Dominican Republic			1	156		
El Salvador			(1)	126		
France	40	5,759				
Germany	32	4,136				
Guatemala			(1)	125		
India	23	3,813	21	9,767		
Israel and Palestine			1	364	1	547
Italy	11	1,990				
Japan	17	2,022				
Mexico	17	2,328	24	9,468	15	4,663
Netherlands			(1)	244		
Peru	2	387	2	961		
Philippines	64	9,355	6	1,898	3	631
Sweden	29	4,547				
Taiwan			1	1,458		
United Kingdom	73	9,003	(1)	525		
Uruguay			1	692		
Venezuela	2	336	2	1,143	2	360
Total	612	75,964	213	56,345	679	63,639

[1] Less than 0.5 ton.

WORLD REVIEW

Available statistics on the world production of graphite for 1945–51 are shown in table 6. Comparable figures for 1915-39 were published in Minerals Yearbook, Review of 1940 (p. 1414), and for 1938–46 in Minerals Yearbook, 1946 (p. 1287).

TABLE 6.—World production of natural graphite, 1945–51, by countries, in metric tons [1]

[Compiled by Helen L. Hunt]

Country [1]	1945	1946	1947	1948	1949	1950	1951
Argentina	333	250	(2)	(2)	(2)	(2)	(2)
Australia	114	353	308	235	126	[3] 147	129
Austria	[3] 3,722	[3] 246	3,845	11,300	14,093	14,685	18,227
Brazil	[3] 479	[3] 660	[3] 7,011	[3] 8,124	[3] 556	(2)	(2)
Canada	1,733	1,792	2,175	2,303	1,948	[3] 3,253	1,467
Ceylon (exports)	7,946	8,212	9,150	14,221	12,437	13,030	12,824
China	[4] 10,000				(2)	(2)	(2)
Czechoslovakia	10,973	5,108	7,000	15,000	(2)	(2)	(2)
Egypt	152			50			
Finland			401				
French Morocco	262	640	400	284	72	[3] 74	131
Germany, West	(2)	3,800	4,930	5,757	5,097	[3] 6,563	(2)
India	1,316	1,653	1,255	1,675	988	1,611	1,066
Italy	2,276	[3] 10,519	[3] 4,545	[3] 7,251	[3] 4,639	3,855	4,486
Japan	[3] 6,132	7,416	10,584	9,132	[3] 5,664	3,804	4,716
Kenya	3						
Korea	32,407	6,204	[5] 10,000	[6] 15,454	[6] 40,671	(2)	(2)
Madagascar	9,185	6,315	5,170	[3] 7,684	[3] 9,141	[3] 14,013	18,340
Malaya	[5] 163						
Mexico	23,634	21,949	27,984	35,261	23,812	24,626	32,286
Mozambique		200	126	90	110		240
Norway	1,115	661	2,481	1,083	[3] 2,257	[3] 2,465	2,500
Southern Rhodesia	6						
South-West Africa	1,318	1,193	1,639	1,627	2,264	1,380	2,626
Spain	128	320	309	241	256	[3] 310	284
Spanish Morocco	100	[5] 120	[5] 150	25	15	3	
Sweden	[3] 216			64	109	(2)	(2)
Union of South Africa	196	278	221	172	107	244	328
United States (amorphous and crystalline)	4,434	5,058	3,980	9,026	5,536	4,628	6,473
Uruguay			50				
Total (estimate) [1]	[3] 120,000	[3] 83,000	[3] 104,000	[3] 147,000	[3] 150,000	[3] 135,000	160,000

[1] In addition to countries listed, graphite was produced in French Equatorial Africa, Indochina, Peru, and U. S. S. R., but production data were not available. Estimates for these countries were not included in total.
[2] Data not available; estimate by author of chapter included in total.
[3] Revised figure.
[4] Estimated Japanese imports from Manchuria.
[5] Estimate.
[6] Republic of Korea only.

After reaching a production of 15,311 metric tons in 1940, output of graphite in Madagascar slumped during and after World War II. In 1950 production reached 14,013 metric tons and rose to a record 18,340 metric tons in 1951. This unprecedented increase in output made it possible to meet the requirements of industry, both in the United States and other countries, and also to make substantial shipments on United States Government contracts, which had fallen far in arrears. The increased production was attributed to modernization by mining companies, which received equipment from the United States, and to higher prices received for graphite.

Exports of graphite from Ceylon were 12,824 metric tons in 1951, of which the United States received 5,240 metric tons or approximately 41 percent. This was not adequate to take care of all the needs of industry in the United States and fulfill the requirements of the United States Government. Especially difficult to obtain were the higher grades of Ceylon amorphous lump graphite containing 97 percent carbon or better.

Mexican amorphous graphite was in good supply, although railroad-car shortages, labor difficulties, and lack of priority ratings to obtain operating supplies were said to have hindered industry efforts to maintain steady receipts of this supply.

Gypsum

By Oliver S. North and Nan C. Jensen

GENERAL SUMMARY

THE YEAR 1951 again witnessed high production of gypsum and gypsum products and the setting of some new industry records. A greater available productive capacity than in past years, along with other favorable factors, enabled the industry to meet the demand for its many products with a minimum of delay.

Although new nonfarm housing starts were about 300,000 fewer in 1951 than 1950, public construction and private industrial building were both higher. This condition, combined with a backlog of requirements for many housing units started in 1950 but uncompleted at the end of that year, resulted in the maintenance of sales of gypsum building products at approximately the 1950 levels.

Although the quantity of crude gypsum mined in the United States and the tonnage of crude imported both increased in 1951 over 1950, most use-classification gains were made by the major uncalcined products—agricultural gypsum and portland-cement retarder. The quantity of calcined gypsum produced was slightly higher in 1951; the quantity used in wallboard and laminated board more than accounted for the entire increase. The tonnages of calcined gypsum used in both plasters and lath declined.

TABLE 1.—Salient statistics of gypsum in the United States, 1947–51

	1947	1948	1949	1950	1951
Active establishments [1]	93	95	88	87	85
Crude gypsum: [2]					
Mined—short tons	6,208,216	7,254,535	6,608,118	8,192,625	8,665,534
Imported—do	2,157,049	2,859,209	2,593,329	[3] 3,219,299	3,448,077
Apparent supply—do	8,365,265	10,113,744	9,201,447	[3] 11,411,924	12.113,611
Calcined gypsum produced:					
Short tons	5,010,918	6,243,392	5,767,163	7,341,024	7,454,916
Value	$38,726,405	$48,144,806	$45,455,419	$60,479,573	$65,761,032
Gypsum products sold: [4]					
Uncalcined uses:					
Short tons	1,950,181	2,226,026	1,989,893	2,218,286	2,530,379
Value	$7,012,106	$7,927,266	$7,127,497	$7,911,988	$9,413,098
Industrial uses:					
Short tons	207,226	219,472	211,635	266,192	288,713
Value	$3,430,022	$3,731,489	$3,562,017	$4,530,159	$5,467,803
Building uses:					
Value	$117,973,351	$165,175,523	$148,056,853	$193,734,651	$222,166,148
Total value	$128,415,479	$176,834,278	$158,746,367	$206,176,798	$237,047,049
Gypsum and gypsum products:					
Imported for consumption	$2,523,936	$3,114,762	$2,851,289	[3] $3,584,152	$3,825,040
Exported	$1,599,578	$1,317,042	$1,936,148	$1,046,458	$1,584,488

[1] Each mine, plant, or combination mine and plant is counted as 1 establishment.
[2] Excludes byproduct gypsum.
[3] Revised figure.
[4] Made from domestic, imported, and byproduct crude gypsum.

At the end of 1951 the immediate outlook for the gypsum industry was somewhat uncertain. Although it appeared likely that the peak of home building had been passed, public and industrial construction promised to continue at a high rate in 1952. The backlog of orders for most gypsum building products had been largely filled, and at least a temporary tapering off in the output of those materials was in prospect. On the other hand, there seemed no reason that the sales of both cement retarder and agricultural gypsum should not at least reach their 1951 volumes.

DOMESTIC PRODUCTION

Crude.—The output of crude gypsum from mines in the United States reached a record high of 8,665,500 short tons in 1951—a 6-percent increase over the 1950 figure, which was the previous record. Increased quantities were mined in California, Iowa, Michigan, Nevada, Texas, and the Arizona-Arkansas-Kansas-Louisiana-New Mexico group, compared with 1950. A total of 55 mines reported

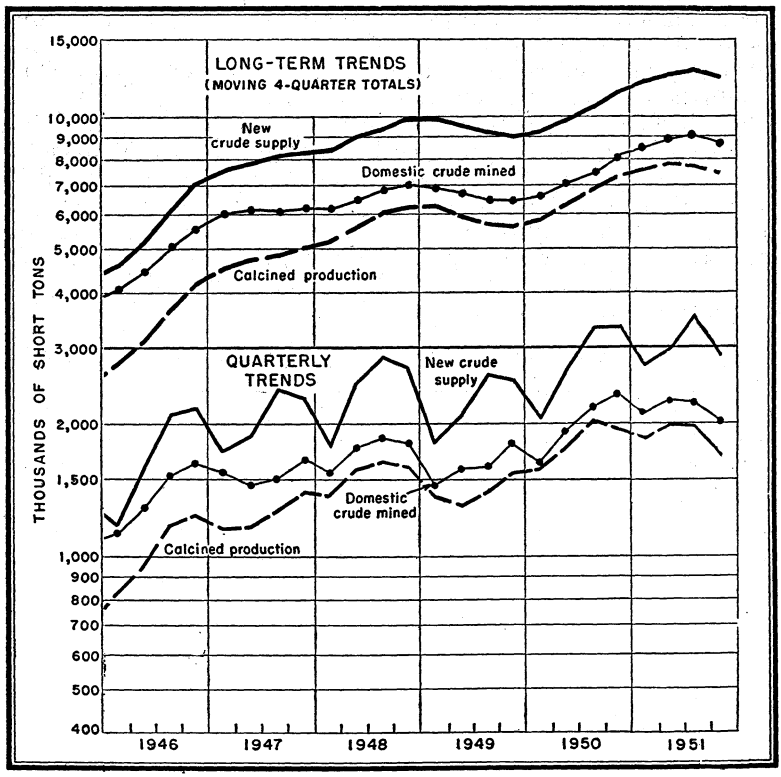

FIGURE 1.—Trends of new crude supply, domestic crude mined, and production of calcined gypsum, 1946–51, by quarters.

TABLE 2.—Crude gypsum mined in the United States, 1949–51, by States [1]

State	Active mines			1949		1950		1951	
	1949	1950	1951	Short tons	Value	Short tons	Value	Short tons	Value
California	13	11	10	753,581	$1,852,452	962,373	$2,462,604	1,092,883	$2,602,758
Iowa	5	5	5	858,464	2,188,002	981,647	2,507,651	1,127,705	2,881,150
Michigan	4	4	4	1,264,511	3,470,294	1,474,210	4,090,777	1,566,276	4,402,725
Nevada	5	4	5	495,229	1,347,666	604,604	1,614,107	643,637	1,811,757
New York	6	6	5	916,117	2,805,154	1,280,100	3,876,176	1,259,484	4,010,766
Texas	5	5	5	843,292	2,178,569	1,076,251	2,771,812	1,136,824	2,987,890
Other:									
Arizona	3	2	1						
Arkansas	1	1	1						
Kansas	2	2	2	234,575	515,577	333,228	706,451	392,863	717,133
Louisiana	----	1	1						
New Mexico	1	----	----						
Colorado	2	4	3						
Idaho	----	----	1						
Montana	2	2	2	180,794	565,336	197,443	594,844	173,341	559,191
Washington	----	1	1						
Wyoming	3	1	1						
Ohio	2	2	2						
Oklahoma	2	2	2	1,061,555	3,395,503	1,282,769	4,110,146	1,272,521	4,050,731
Utah	3	3	3						
Virginia	1	1	1						
Total	60	57	55	6,608,118	18,318,553	8,192,625	22,734,568	8,665,534	24,024,101

[1] Production of some States is not shown separately, in order not to disclose individual company operations.

output in 1951; of these, 39 were open-pit operations, 13 were underground mines, and 3 were combination pit-underground mines.

Calcined.—Fifty plants, with 225 pieces of calcining equipment, produced 7,454,900 short tons of calcined gypsum in 1951. This output established a new record, 2 percent above the previous record year, 1950. Production of calcined gypsum, the form in which most gypsum is utilized, is considered the most accurate overall yardstick of the industry, as it includes both domestic and imported raw material.

TABLE 3.—Calcined gypsum produced in the United States, 1950–51, by districts

District	1950		1951	
	Short tons	Value	Short tons	Value
New Hampshire, Massachusetts, and Connecticut	260,721	$2,343,843	269,595	$2,527,020
Eastern New York, New Jersey, Pennsylvania, Georgia, and Florida	1,359,269	12,069,598	1,384,516	13,335,707
Ohio, Virginia, Indiana, and Maryland	1,095,613	10,073,719	1,106,338	11,296,735
Western New York	848,865	5,616,168	820,416	6,159,060
Michigan	683,726	5,402,066	671,178	5,560,711
Iowa	631,919	4,574,214	766,370	6,028,271
Kansas and Oklahoma	361,984	3,131,925	425,378	3,302,367
Texas	752,615	5,566,132	793,562	6,509,550
Colorado, Montana, and Utah	299,178	3,227,565	277,258	2,766,854
California, Nevada, and Arizona [1]	1,047,134	8,474,343	940,305	8,274,757
Total	7,341,024	60,479,573	7,454,916	65,761,032

[1] No production from Arizona in 1951.

TABLE 4.—Active calcining plants and equipment in the United States, 1949–51, by States

State	1949			1950			1951		
	Calcining plants	Equipment		Calcining plants	Equipment		Calcining plants	Equipment	
		Kettles	Other calciners [1]		Kettles	Other calciners [1]		Kettles	Other calciners [1]
California	4	10	7	5	10	8	5	11	8
Iowa	5	18	4	5	22	4	5	24	4
Michigan	4	20	1	4	20	1	4	20	1
New York	7	22	6	7	22	6	7	22	6
Texas	4	29	1	4	30	1	4	31	1
Other States [2]	27	74	24	26	74	23	25	74	23
Total	51	173	43	51	178	43	50	182	43

[1] Includes rotary and beehive kilns, grinding-calcining units, and hydrocal cylinders.
[2] Comprises calcining plants in 1949–51 as follows: 1 each in Arizona (none in 1951), Connecticut, Florida, Georgia, Indiana, Maryland, Massachusetts, New Hampshire, New Jersey, New Mexico (none in 1950–51), Oklahoma, and Pennsylvania; 2 each in Colorado, Kansas, Montana, Nevada, Ohio, and Virginia; 3 in Utah.

Mine and Calcining-Plant Developments.—National Gypsum Co., Buffalo, N. Y., announced plans for a major expansion of its Medicine Lodge, Kans., plant. Two calcining kettles were to be added to the present facilities, and new and improved equipment at the mine was expected to double the output of crude rock. The present plant, formerly owned by Best Bros., has been in operation for half a century. It produces Keene's cement, dental plaster, plaster of Paris, paper filler, etc.[1]

Northwest Gypsum Co. was reported in midsummer to have officially placed in operation its open-pit mine near Weiser, Idaho, and its mill at Huntington, Oreg., which was said to have a rated capacity of 500 tons of crushed material per day. Initial production of gypsum fertilizer was planned, with production of cement retarder and other products to begin later.[2] However, the company produced only a small, experimental quantity of agricultural gypsum by the end of 1951.

Certain-teed Products Corp. purchased the plant facilities and about 500 acres of gypsum deposits from Union Gypsum Co., Phoenix, Ariz. The acquisition increased to seven the number of Certain-teed Products Corp. plants now in operation.[3]

Columbia Gypsum Products, Inc., Velox, Wash., was reported to be producing agricultural gypsum, using crude rock from deposits near Windermere, British Columbia, Canada. The company planned construction of a calcining plant, to have a daily capacity of 10 tons of hardwall plaster.[4]

Laucks Chemical Co., Seattle, Wash., reported plans to increase the output of its Okanogan County, Wash., gypsum mine to between 4,500 and 5,000 tons in 1951.[5]

[1] Rock Products, vol. 54, No. 3, March 1951, p. 67.
[2] Pit and Quarry, vol. 44, No. 1, July 1951, p. 65.
[3] Engineering and Mining Journal, vol. 152, No. 2, February 1951, p. 132.
[4] Pit and Quarry, vol. 43, No. 8, February 1951, p. 51.
[5] Rock Products, vol. 54, No. 7, July 1951, p. 88.

CONSUMPTION AND USES

Total expenditures in the United States for new construction amounted to $29.9 billion in 1951 compared with $27.9 billion in 1950. This increase reflected higher average construction costs, since the estimated physical volume of work accomplished was down slightly from 1950 record levels. A total of about 1,090,000 new nonfarm dwelling units were placed under construction in 1951. This was the second-best home-building year in history, although it was some 300,000 units below the 1950 figure.

Consumption of gypsum building products increased in 1951, even though housing starts declined, principally because the market was bolstered by a carryover demand from unfinished 1950 building units. Increased public construction and private industrial building also helped maintain demand for gypsum products at a high level. The gypsum industry, with greater available capacity than at any time in the past, apparently encountered no serious difficulties in meeting the continued high demand for its various products.

The total building uses of gypsum products, in dollar value, were 15 percent above 1950 and 50 percent above 1949.

Gypsum-Products Plant Developments.—Kaiser Gypsum, a division of Henry J. Kaiser Co., Oakland, Calif., acquired property near Seattle, Wash., on which it planned to build a gypsum calcining and

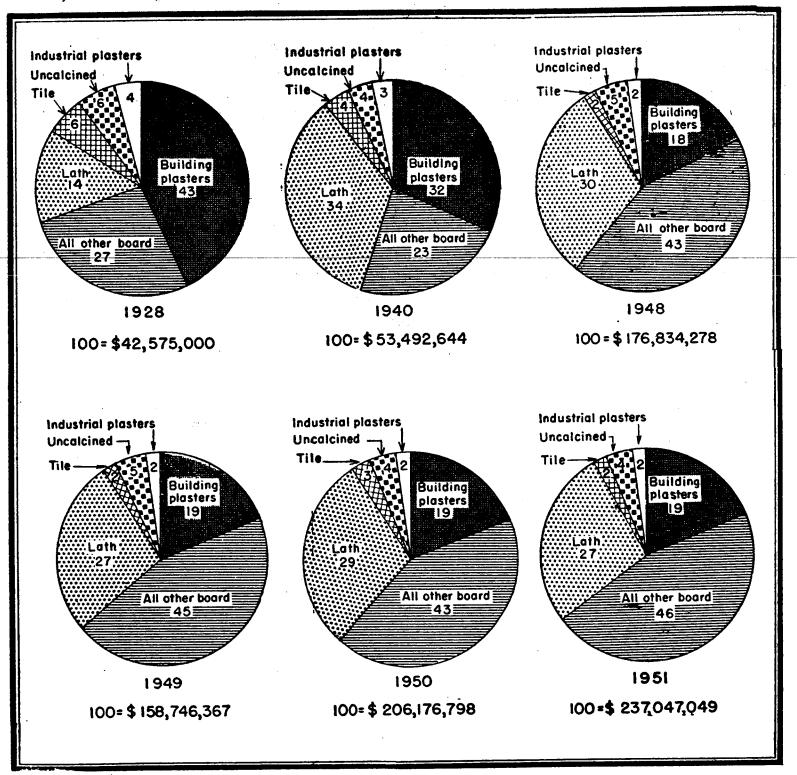

FIGURE 2.—Percentage distribution of total sales value, f. o. b. plant, of gypsum products in 1928, 1940, and 1948–51, by groups of products.

products plant. The project called for construction of the facilities needed to manufacture 100 million square feet of board annually, in addition to lath, sheathing, plaster, agricultural gypsum, and cement retarder. Raw gypsum would be obtained from deposits on San Marcos Island, off Lower California, Mexico. Kaiser Gypsum also operated gypsum plants at Long Beach and Redwood City, Calif.[6]

The expansion of National Gypsum Co. facilities at Medicine Lodge, Kans., included construction of a board plant over 800 feet long, to have a monthly capacity of 6 to 8 million square feet of lath and wallboard.[7] This action was a part of the company's broad expansion and improvement plans, which also included improvements and additions to its Fort Dodge, Iowa, operation, and building of a paper mill at Pryor, Okla.[8] However, work on the paper mill, which was to have been located on the site of the old Oklahoma Ordnance Works, was halted because the tense international situation created the possibility of reactivation of the ordnance works.[9] The company was later reported to be negotiating for the purchase of a different tract near Pryor on which to build the mill.[10]

Certain-teed Products Corp., Ardmore, Pa., reported plans for constructing a paper mill at Pryor, Okla., to manufacture paper for use at the company gypsum-board plants. The new mill would be operated by the Coronado Manufacturing Co., wholly owned sub-

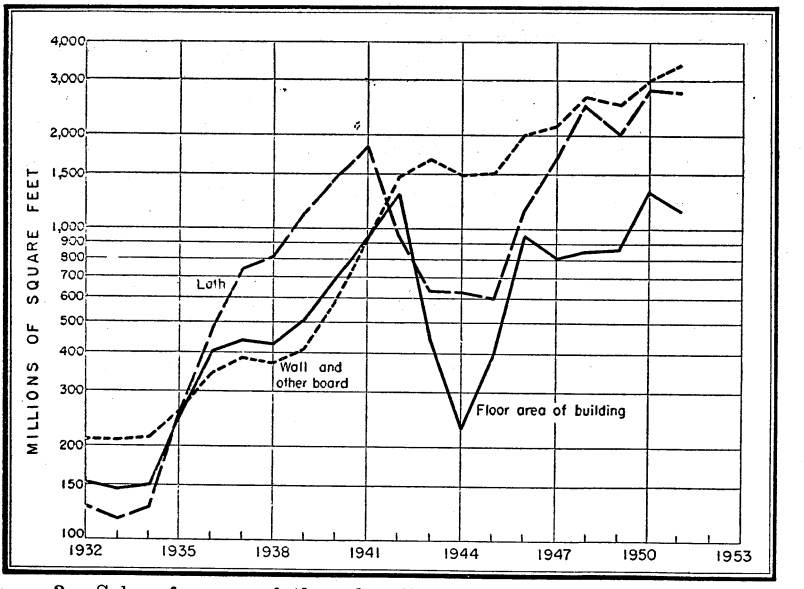

FIGURE 3.—Sales of gypsum lath and wallboard and other board (includes wallboard, laminated board in terms of component board, and sheathing), compared with Dodge Corp. figures on combined floor area of residential and nonresidential building, 1932–51.

[6] Chemical and Engineering News, vol. 29, No. 33, Aug. 13, 1951, p. 3226.
Rock Products, vol. 54, No. 9, September 1951, p. 57.
Pit and Quarry, vol. 44, No. 3, September 1951, p. 63.
[7] Rock Products, vol. 54, No. 3, March 1951, p. 67.
Pit and Quarry, vol. 44, No. 4, October 1951, p. 61.
[8] Pit and quarry, vol. 43, No. 7, January 1951, p. 73.
[9] Chemical and Engineering News, vol. 29, No. 4, Jan. 22, 1951, p. 294.
[10] Rock Products, vol. 54, No. 4, April, 1951 p. 105.

sidiary.[11] An article described in detail the mining, calcining, and wallboard-manufacturing operations at the Fort Dodge, Iowa, plant of Certain-teed Products Corp.[12]

American Gypsum Co. announced plans for erecting facilities to produce Keene's cement and gypsum board at its plant near Green River, Utah. The crude gypsum would be mined from a deposit 10 miles west of Green River.[13]

TABLE 5.—Gypsum products (made from domestic, imported, and byproduct crude gypsum) sold or used in the United States, 1950–51, by uses

Use	1950			1951			Percent of change in—	
	Short tons	Value		Short tons	Value		Tonnage	Average value
		Total	Average		Total	Average		
Uncalcined:								
Portland-cement retarder	1,720,936	$5,552,952	$3.23	1,808,766	$6,291,190	$3.48	+5	+8
Agricultural gypsum	465,359	1,990,507	4.28	687,620	2,741,158	3.99	+48	−7
Other uses [1]	31,991	368,529	11.52	33,993	380,750	11.20	+6	−3
Total uncalcined uses	2,218,286	7,911,988	3.57	2,530,379	9,413,098	3.72	+14	+4
Industrial:								
Plate-glass and terra-cotta plasters	63,727	683,791	10.73	63,371	813,020	12.83	−1	+20
Pottery plasters	49,748	810,561	16.29	48,365	882,987	18.26	−3	+12
Orthopedic and dental plasters	10,758	356,929	33.18	11,297	397,476	35.18	+5	+6
Other industrial uses [2]	141,959	2,678,878	18.87	165,680	3,374,320	20.37	+17	+8
Total industrial uses	266,192	4,530,159	17.02	288,713	5,467,803	18.94	+8	+11
Building:								
Cementitious:								
Plasters:								
Base-coat	2,334,656	28,246,739	12.10	2,170,299	30,166,130	13.90	−7	+15
Sanded	125,948	1,579,263	12.54	124,504	2,149,533	17.26	−1	+38
To mixing plants	16,073	163,411	10.17	16,345	189,698	11.61	+2	+14
Gaging and molding	219,417	3,261,444	14.86	208,422	3,310,641	15.88	−5	+7
Prepared finishes	19,659	1,044,512	53.13	18,323	1,030,955	56.27	−7	+6
Other [3]	168,065	4,025,662	23.95	246,124	5,456,166	22.17	+46	−7
Keene's cement	57,797	1,255,458	21.72	54,031	1,227,768	22.72	−7	+5
Total cementitious	2,941,615	39,576,489	13.45	2,838,048	43,530,891	15.34	−4	+14
Prefabricated:								
Lath	2,131,466	60,621,179	[4] 21.70	2,113,804	64,551,960	[4] 23.42	[5] −1	+8
Wallboard and laminated board	2,551,653	84,693,753	[6] 29.16	2,842,537	105,128,204	[6] 32.39	[5] +12	+11
Sheathing board	121,327	3,850,763	[4] 33.84	122,907	4,240,084	[4] 36.49	[5] +2	+8
Tile	257,536	4,992,467	[7] 75.26	218,603	4,715,009	[7] 77.79	[5] −16	+3
Total prefabricated	5,061,982	154,158,162	30.45	5,297,851	178,635,257	33.72	+5	+11
Total building uses		193,734,651			222,166,148			
Grand total value		206,176,798			237,047,049			

[1] Includes uncalcined gypsum sold for use as filler and rock dust, in brewer's fixe, in color manufacture, and for unspecified uses.
[2] Includes statuary, industrial casting and molding plasters, dead-burned filler, granite polishing, and miscellaneous uses.
[3] Includes insulating and roof-deck, joint filler, patching and painter's plaster, and unclassified building plasters.
[4] Average value per M square feet.
[5] Percent of change in square footage.
[6] Average value per M square feet of wallboard only.
[7] Average value per M square feet of partition tile only.

[11] Pit and Quarry, vol. 43, No. 12, June 1951, p. 53.
[12] Trauffer, W. E., Certain-teed Products: Pit and Quarry, vol. 43, No. 8, February 1951, pp. 67–70, 77.
[13] Pit and Quarry, vol. 43, No. 12, June 1951, p. 60.

TABLE 6.—Gypsum board and tile sold or used in the United States, 1947–51, by types

Year	Lath			Wallboard		
	M square feet	Value		M square feet	Value	
		Total	Average [1]		Total	Average [1]
1947	1,703,818	$32,241,998	$18.92	2,046,216	$53,122,413	$25.96
1948	2,504,733	53,596,957	21.40	[2] 2,531,865	[2] 72,071,432	[3] 28.40
1949	2,015,638	43,060,474	21.36	[2] 2,439,121	[2] 68,493,078	[3] 28.03
1950	2,793,620	60,621,179	21.70	[2] 2,901,947	[2] 84,693,753	[3] 29.16
1951	2,756,278	64,551,960	23.42	[2] 3,243,676	[2] 105,128,204	[3] 32.39

Year	Sheathing			Laminated board			Tile [4]		
	M square feet	Value		M square feet [5]	Value		M square feet	Value	
		Total	Average [1]		Total	Average [1]		Total	Average [6]
1947	106,482	$3,534,686	$33.20	1,741	$202,683	$116.42	26,769	$2,775,676	$67.37
1948	129,632	4,431,544	34.19	(2)	(2)	(7)	27,181	3,091,547	72.40
1949	97,037	3,267,935	33.68	(2)	(2)	(7)	28,518	3,286,264	73.17
1950	113,785	3,850,763	33.84	(2)	(2)	(7)	45,032	4,992,467	75.26
1951	116,204	4,240,084	36.49	(2)	(2)	(7)	37,862	4,715,009	77.79

[1] Per M square feet, f. o. b. producing plant.
[2] Laminated board included with wallboard.
[3] Average value per M square feet of wallboard.
[4] Includes partition, roof, floor, soffit, shoe, and all other gypsum tiles and planks.
[5] Area of component board and not of finished product.
[6] Per M square feet, f. o. b. producing plant, of partition tile only.
[7] Figure withheld to avoid disclosure of individual company operations.

PRICES

According to reports from producers, the average value of crude gypsum mined was $2.77 per short ton, compared with $2.78 in 1950 and $2.77 in 1949. Among uncalcined uses, the unit value of cement retarder increased from $3.23 to $3.48 per ton, while that of agricultural gypsum declined from $4.28 to $3.99. The average values of the industrial plasters showed gains of approximately $2 per ton each. The value of miscellaneous cementitious plaster declined, while Keene's cement and all other building plasters, especially ready-sanded plaster, increased in average value. All of the prefabricated gypsum products increased in average value.

FOREIGN TRADE [14]

Imports of crude gypsum into the United States increased to 3,448,077 short tons, 90 percent of which was imported from Canada and represented about one-fourth of the total apparent domestic supply. Marked tonnage increases were noted from Jamaica and Mexico. Imports from the latter country have more than doubled in the last 3 years. A small tonnage of crude gypsum was shipped from the Dominican Republic into the United States.

[14] Figures on imports and exports compiled by M. B. Price and E. D. Page, of the Bureau of Mines, from records of the U. S. Department of Commerce.

TABLE 7.—Gypsum and gypsum products imported for consumption in the United States, 1947–51

[U. S. Department of Commerce]

Year	Crude (including anhydrite)		Ground		Calcined		Keene's cement		Alabaster manufactures [1] (value)	Other manufactures, n. e. s. (value)	Total value
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value			
1947	2,157,049	$2,269,583	477	$13,228	130	$3,793	(2)	$27	$204,954	$32,351	$2,523,936
1948	2,859,209	2,977,809	404	13,960	11	610	12	728	83,245	38,410	3,114,762
1949	2,593,329	2,693,824	613	14,209	209	8,036	------	-------	55,569	79,651	2,851,289
1950	[3]3,219,299	[3]3,276,707	716	15,787	237	7,900	1	173	61,444	222,141	[3]3,584,152
1951	3,448,077	3,546,895	576	16,929	301	12,308	3	441	97,858	150,609	3,825,040

[1] Includes imports of jet manufactures, which are believed to be negligible.
[2] Less than 0.5 ton.
[3] Revised figure.

TABLE 8.—Crude gypsum (including anhydrite) imported for consumption in the United States, 1949–51, by countries

[U. S. Department of Commerce]

Country	1949		1950		1951	
	Short tons	Value	Short tons	Value	Short tons	Value
Canada	2,428,417	$2,468,124	[1]2,979,131	[1]$3,035,546	3,105,220	$3,173,749
China	3	667	2	449	1	160
Dominican Republic	16,070	78,709	----------	----------	6,685	23,874
Italy	----------	----------	1	34	----------	----------
Jamaica	----------	----------	[1]9,296	[1]27,275	22,563	65,471
Mexico	148,839	146,324	230,869	213,403	313,608	283,641
Total	2,593,329	2,693,824	[1]3,219,299	[1]3,276,707	3,448,077	3,546,895

[1] Revised figure.

TABLE 9.—Gypsum and gypsum products exported from the United States, 1947–51

[U. S. Department of Commerce]

Year	Crude, crushed, or calcined		Plasterboard, wallboard, and tile		Other manufactures, n. e. s. (value)	Total value
	Short tons	Value	Square feet	Value		
1947	33,208	$622,034	19,417,487	$645,448	$332,096	$1,599,578
1948	10,797	259,728	16,506,127	615,845	441,469	1,317,042
1949 [1]	17,567	423,478	53,313,138	1,336,269	176,401	1,936,148
1950 [1]	23,678	524,926	13,618,353	428,549	92,983	1,046,458
1951 [1]	25,045	608,940	25,556,712	848,777	126,771	1,584,488

[1] Owing to changes in items included in each classification, data are not strictly comparable with earlier years.

TECHNOLOGY

English scientists made a thorough study of the dehydration of gypsum and reported results in a series of four articles, as follows: I, A Study of the Thermal Decomposition of Gypsum by the Absorption of Oxygen and Nitrogen at 183°; II, A Study of the Thermal Dehydration of Gypsum by Means of Adsorption of Carbon Tetrachloride Vapor at 25°; III, Dehydration and Rehydration of Gypsum by Adsorption Methods; and IV, Heat of Immersion, Heat of Hydration, Specific Gravity, Sedimentation Volume, and Bulk Density of the Dehydration Products.[15]

A sulfate solubility test for dehydrated gypsum in portland cement was described. The test involves preparation of an aqueous extract of the cement, determination of the SO_3, Na_2O, and K_2O, and, as later modified, the CaO concentrations, and comparison of these values with the curve of Hansen and Pressler.[16]

The feasibility of producing ammonium sulfate commercially from gypsum and ammonium carbonate has attracted interest, both in the United States and abroad. A summary of plant developments and a brief description of the process now in use appeared in a trade press article.[17]

A recently issued patent described a new process by which sulfuric acid and cement can be produced from gypsum. Phosphate rock may be added for conversion into a superphosphate by the acid formed. The cement obtained is claimed to be of good quality and in sufficient quantity to offset the cost of the acid.[18]

WORLD REVIEW

Canada.—A booklet issued recently by the Canadian Department of Technical Surveys, Mines Branch, Ottawa, describes investigations into the beneficiation of Canadian gypsum. The booklet is designated as Memorandum Series 111, November 1950. The publication deals with a number of tests on low-grade gypsum, which constitutes the greater part of the raw material now available from economically workable deposits in central and western areas. Economic considerations have prevented development of gypsum deposits in many sections of Canada.[19]

The occurrences and geology of the gypsum deposits of southwestern Newfoundland were described at considerable length in an article. Reserves of gypsum and gypsum-anhydrite in this area are large.[20]

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[15] Gregg, S. J., and Willing, E. G. J., Dehydration of Gypsum: Jour. Chem. Soc., (London), I, September 1951, pp. 2373–2377; II, September 1951, pp. 2378–2380; III, November 1951, pp. 2916–2920; IV, November 1951, pp. 2921–2924.

[16] Gilliland, J. L., Identification of Dehydrated Gypsum in Portland Cement: Am. Concrete Inst. Jour., vol. 22, No. 10, June 1951, pp. 809–820.

[17] Chemical Week, Gypsum, Not Sulfur: Vol. 69, No. 15, Oct. 13, 1951, p. 33.

[18] Rock Products, vol. 54, No. 2, February 1951, p. 77.

[19] Rock Products, vol. 54, No. 6, June 1951, p. 153.
Bureau of Mines, Mineral Trade Notes: Vol. 32, No. 3, March 1951, p. 42.

[20] Baird, D. M., Gypsum Deposits of Southwestern Newfoundland: Canadian Min. and Met. Bull. 467 (Montreal), March 1951, pp. 155–164.

Cyprus.—In 1950, Cyprus' exports of gypsum reached record levels, with 62,558 long tons (53,094 tons raw and 9,464 tons of plaster of Paris) sent abroad compared with 23,979 tons in 1949, the previous peak year. The Hellenic Mining Co. new subsidiary, the Gypsum & Plasterboard Co., exported 50,094 tons of raw gypsum in 1950. The company was scheduled to place in operation in 1951 a modern stucco and plasterboard plant.[21]

Dominican Republic.—Considerable impetus was given to the Government-operated salt and gypsum industry in the Barahona area with the announcement that the Government would promote expansion of this industry. The Government Agricultural and Industrial Credit Bank floated a special bond issue to provide capital to liquidate pending accounts and to purchase modern mining equipment. Under study was a proposed railway to join the mining area with the port of Barahona, a distance of about 25 miles.[22]

Germany, West.—In the first 6 months of 1951 output of gypsum totaled 343,446 metric tons, of which 39,256 tons was exported, chiefly to the Scandinavian countries. Both production and exports were higher than in the first half of 1950.[23]

India.—Production of gypsum in India in 1950 was 202,118 long tons, of which 169,420 tons was mined in Rajasthan, particularly in the States of Bikaner and Jodhpur. The largest synthetic fertilizer factory in Asia, at Sindri, Bihar State, began production in October 1951. After a few months breaking-in period, it was expected to produce about 1,000 tons of ammonium sulfate a day, using the gypsum-ammonium nitrate process. It was claimed that this added capacity would make India self-sufficient in synthetic fertilizers. To meet the demand of this plant for crude gypsum, mining operations in Bikaner would be greatly expanded under the direction of local Government officials.[24]

United Kingdom.—An article in the trade press described the operation of the gypsum and alabaster industry in Staffordshire. The Fauld mine near Totbury produced gypsum, anhydrite, and alabaster. The formation being mined varied widely in quality from place to place, so selective mining was practiced, and careful grade control was maintained over the material taken. The alabaster works manufactured such articles as ash trays, book ends, vases, clock cases, lamp standards, etc., from large blocks, which sometimes weigh as much as 4 tons each, of high-grade alabaster. The manufacturing technique is described in detail.[25]

[21] Bureau of Mines, Mineral Trade Notes: Vol. 33, No. 2, August 1951, p. 30.
[22] Bureau of Mines, Mineral Trade Notes: Vol. 33, No. 1, July 1951, p. 34.
[23] Bureau of Mines, Mineral Trade Notes: Vol. 33, No. 3, September 1951, p. 40.
[24] Bureau of Mines, Mineral Trade Notes: Vol. 33, No. 6, December 1951, pp. 41–43.
[25] Bray, A., Gypsum and Alabaster in Staffordshire: Mine and Quarry Eng. (London), vol. 17, No. 10, October 1951, pp. 329–333.

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TABLE 10.—World production of gypsum, 1946–51, by countries, in metric tons [1]

[Compiled by Helen L. Hunt]

Country [1]	1946	1947	1948	1949	1950	1951
Algeria	28,600	38,345	33,258	31,881	46,097	82.000
Anglo-Egyptian Sudan	3,063	350	3,045	1,496	----------	183
Australia [2]	168,138	218,893	280,852	315,302	340,151	370,195
Austria	24,012	15,096	26,376	36,189	(3)	(3)
Belgian Congo	----------	----------	----------	----------	[4] 7,190	[4] 7,973
Brazil	(3)	(3)	(3)	50,857	[4] 51,000	(3)
Bulgaria [4]	5,000	5,000	5,000	5,000	5,000	(3)
Canada	1,838,895	2,362,365	3,164,211	2,854,999	[2] 3,429,332	3,563,745
Ceylon	33	69	170	[2] 187	----------	309
Chile	92,400	[2] 83,928	[2] 31,440	[2] 60,304	65,509	(3)
China	(3)	50,000	[4] 55,000	(3)	[4] 60,000	(3)
Colombia	(3)	17,372	4,200	[4] 2,760	1,930	(3)
Cuba [4]	14,300	14,900	16,500	13,880	15,500	30,000
Cyprus (exports)	15,464	7,844	19,500	25,788	65,485	23,171
Dominican Republic	[5] 10,974	13,393	7,304	18,157	----------	21,238
Ecuador	----------	----------	410	486	[4] 441	(3)
Egypt	78,316	72,337	95,243	6,909	(3)	112,056
Finland	(3)	(3)	1,711	(3)	(3)	(3)
France	1,746,375	2,229,940	2,254,181	2,143,163	2,100.000	[4] 2,000,000
French Morocco	15,135	17,285	30.136	[2] 36,130	(3)	(3)
Germany, West [6]	163,800	150,700	316,600	515,300	[2] 756,842	814,945
Greece	5,150	850	580	730	820	950
India	77,643	51,381	[2] 80,215	142,190	205,362	193,276
Iran [7]	(3)	(3)	(3)	[4] 378,000	[4] 378,000	(3)
Iraq	(3)	(3)	(3)	(3)	250,000	(3)
Ireland	37,894	36,415	62,693	67,268	82,668	[4] 100,000
Israel-Jordan	14,512	(3)	(3)	(3)	23,623	[8] 1,700
Italy	236,104	298,224	(3)	(3)	(3)	(3)
Jamaica	----------	----------	7,112	12,193	23,369	(3)
Japan	49,763	61,555	113,754	117,123	114,505	200,640
Kenya	508	659	1,016	181	610	83
New Caledonia	6,750	2,705	779	17,119	15.200	15,777
Pakistan	(3)	16,121	6,361	[2] 15,896	[2] 16,927	22,791
Peru	43,391	41,330	46,716	37,419	31,917	16,927
Philippines	----------	----------	818	2,710	2,883	399
Poland	9,787	14,917	14,183	26,361	32,824	(3)
Portugal	27,680	33,868	42,842	43,060	(3)	(3)
Spain	[9] 1,098,013	1,337,662	[9] 1,423,728	1,293,552	2,251,831	1,821.676
Switzerland	68,000	165,000	[4] 165,000	[4] 80,000	[4] 80,000	120,000
Syria [10]	1,200	4,500	[4] 1,000	1,400	2,000	8,170
Thailand (Siam)	87	71	200	154	336	79
Tunisia	8,985	17,650	19,130	22,066	(3)	(3)
Union of South Africa (sales and exports)	66,228	80,166	[2] 83,936	88,232	103,707	124,979
United Kingdom:						
Great Britain	1,715,060	1,773,733	[2] 2,120,700	2,144,272	2,241,711	[4] 2,200,000
Northern Ireland	----------	----------	----------	----------	(3)	173
United States	5,106,877	5,631,969	6,581,169	5,994,752	7,432,186	7,861,199
Venezuela [11]	973	3,451	2,406	3,042	2.050	(3)
Total (estimate) [1]	[2] 14,400,000	[2] 16,500,000	[2] 19,400,000	[2] 18,800,000	[2] 22,700,000	24,500.000

[1] In addition to the countries listed, gypsum is produced in Angola, Argentina, Ethiopia, Mexico, Rumania, U. S. S. R., and Yugoslavia, but production data are not available. Estimates for these countries are included in the total.

[2] Revised figure.

[3] Data not available; estimate by senior author of chapter included in total.

[4] Estimate.

[5] Exports.

[6] Crude production estimates based on the following calcined figures: 1946, 136,500 tons; 1947, 125,600; 1948, 263,822; 1949, 429,400; 1950, 630,702 (revised); 1951, 679,121.

[7] Fiscal year ended March 20 of year following that stated.

[8] Israel only.

[9] Includes Spanish Moroccan production: 1946, 1,219 tons; 1948, 1,829.

[10] Some pure, some 80 percent gypsum and 20 percent limestone.

[11] Production in Government quarries only; beginning 1951 no longer under Government control.

Helium

By H. S. Kennedy and P. V. Mullins

GENERAL SUMMARY

BUREAU of Mines helium-production plants in the southwestern part of the United States are the sole sources of commercial quantities of helium. The plants are situated at Amarillo, Tex.; Exell, Tex. (near Amarillo); Otis, Kans.; and Shiprock, New Mex.

Helium is produced by extraction from certain helium-bearing natural gases, which, in typical cases, contain about 1 to 2 percent helium. Production operations are conducted pursuant to the Helium Act approved September 1, 1937 (50 Stat. 885, 50 U. S. C. secs. 161, 163–166); and current regulations thereunder, approved December 3, 1949 (30 CFR 1).

In 1951 helium production totaled 112.0 million cubic feet compared with 81.4 million in 1950. About 70 percent of the helium produced is consumed by Federal agencies, principally by the Navy for use in antisubmarine patrol blimps. The balance of the helium produced is consumed by commercial companies, chiefly for use as the inert shielding medium for inert-arc welding. Helium may be purchased from many compressed-gas distributors in virtually all parts of the United States.

Field headquarters for the Bureau's helium production activities are maintained at Amarillo.

RESERVES

A discussion of helium-bearing natural-gas reserves in Minerals Yearbook for 1950 indicated that approximately 5 billion cubic feet of helium was available to the Bureau's helium plants at that time. Subsequent studies in the Channing area of the Texas Panhandle field, which serves the Exell Helium Plant, have increased the estimate of helium available from that source by more than 5 billion cubic feet, making a total of over 10 billion cubic feet available to the Bureau's plants at the end of 1951. Gas suitable for helium production also was available in other areas.

PRODUCTION

Table 1 gives helium-production statistics for Government plants from 1921–51, inclusive.

The Bureau's Exell plant, largest of the four plants, had been operated almost continuously since 1943 and produced a major portion of the helium required in the 1943–51 period. In 1951 the Exell plant produced about 60 percent of helium requirements. The balance was produced at the Otis and Amarillo plants. Helium production in 1951 was about 40 percent greater than in 1950 and about 100 percent greater than in 1949.

TABLE 1.—Helium production in the United States, 1921–51

Year	Plant	Cubic feet
1921—January 1929 [1]	Fort Worth, Tex., plant	46,088,787
1929 (April) [1]—1941	Amarillo, Tex., plant	131,614,437
1942	do	33,252,582
1943	All plants	116,307,437
1944	do	126,933,130
1945	do	94,733,744
1946	Amarillo and Exell, Tex., plants	58,236,385
1947	Exell, Tex., plant	70,297,700
1948	do	63,143,513
1949	do	55,165,482
1950	Amarillo and Exell, Tex., plants	81,394,416
1951	Amarillo, Exell, Tex., and Otis, Kans., plants.	112,047,244
Total 1921–51		[2]989,214,857

[1] No helium was produced at Government helium plants in February or March 1929. The Fort Worth helium plant was shut down Jan. 10, 1929, and the Amarillo helium plant was not put into operation until April.

[2] Includes 88,272,100 cubic feet extracted at the Exell plant and injected into the Government-owned Cliffside gas reservoir, for conservation, in calendar years 1945–49 and 1951 (none stored in 1950).

The Exell and Amarillo plants, situated 30 miles apart, are connected by a pipeline that traverses the Government-owned Cliffside gas field, source of helium-bearing gas for the Amarillo plant. The pipeline permits transportation of helium between the plants and injection and storage in the Cliffside field of any helium produced at Exell and not needed to meet demand. In 1951, 4,908,300 cubic feet of helium was injected and stored in this manner.

The Navajo (Shiprock) plant was maintained in standby status throughout 1951.

SHIPMENTS

Helium production is geared to and virtually equal to shipments (demand), as there is only limited aboveground storage for helium at the production plants.

Helium is shipped at 1,800 to 2,400 pounds pressure in special railroad tank cars, automotive trailers, and standard compressed-gas cylinders. Cylinder shipments are made exclusively from the Amarillo plant because of its convenient location to motor freight facilities which handle most cylinder shipments.

The rapidly increasing demand for helium caused a corresponding increase in use of all types of shipping containers and threat of a definite shortage of them.

CONSUMPTION AND USES

Helium continues to find its greatest use as a buoyant gas for blimps and balloons employed by military agencies, commercial advertising companies, the Weather Bureau, and others. A close second, and rapidly increasing use is to provide the inert shielding medium in shielded-arc welding of aluminum, magnesium, stainless steel, Monel, copper, and other metals. Helium is being used also to provide the essential inert atmosphere required in producing and fabricating less common, but increasingly important metals, such as titanium and zirconium.

The increasing use and importance of all of the aforementioned metals, especially in the national defense program, accounts for much of the increase in helium demand.

Helium is used for a variety of other purposes. It is finding wide use by Federal and non-Federal agencies in research and experimental work in atomic energy, guided missiles, physical and chemical properties of materials at low temperature, and many other fields of investigation. Oil and gas companies obtain desired reservoir data by using helium as a tracer in natural gas injected for pressure maintenance and recycling purposes. Medical uses of helium-oxygen mixtures to relieve suffering from asthma and other respiratory ailments and as a component of anesthetics to reduce explosion hazards in operating rooms are common and generally well known.

PRICES

Federal agencies requisition helium from the Bureau of Mines at a price that represents their proportionate shares of the expenses incident to the administration, operation, and maintenance of the Government's helium plants and properties. In 1951 this price was about $12.50 per 1,000 cubic feet, f. o. b. production plants. The price of helium to non-Federal purchasers, at a helium plant selected by the Bureau, was $13.50 per 1,000 cubic feet, as established by regulations approved in December 1949. An additional charge of $2.00 per 1,000 cubic feet was made when helium was delivered in standard cylinders.

FOREIGN TRADE

Helium is not produced commercially outside the United States. It can be exported from the United States only upon application to the Secretary of State and upon receipt of a license authorizing exportation.

TECHNOLOGY

The Bureau of Mines conducts a small research program on helium production and utilization at laboratories in Amarillo, Tex.

Research in 1951 was directed primarily at solution of processing and operating problems arising from rapidly increasing helium demand, especially for high-purity Grade A helium, which is now required or preferred for almost all uses. Research was continued also on helium utilization, chiefly with regard to shielded-arc welding and assistance to industry in helium tracer projects to obtain data on oil and gas reservoirs.

Research-staff members are available for consultation on helium-utilization and gas-processing features of mutual interest to those in other industries.

Iron Ore

By Jachin M. Forbes

GENERAL SUMMARY

THE LARGEST output of iron ore in history was recorded in the United States for 1951. Mines were called upon to supply unprecedented tonnages and were able to do so as a result of extraordinary efforts supported by good labor-management relations during most of the year. Transportation facilities for ore from the Lake Superior district were taxed to capacity but failed to establish a new high seasonal ore movement via the Great Lakes owing in part to bad weather at the end of the season. Supplementary tonnages amounting to about 6 million tons were transported all-rail direct from mines in the Lake Superior district to lower Lake furnaces.

The strong demand for iron ore, which was related to rearmament and steel-expansion programs, stimulated widespread interest in undeveloped and idle iron-ore deposits. A number of new mines were being developed during 1951 as well as old mines expanded or reopened. Stockpiles of hitherto unsalable ore were subjected to concentration and increased the supply of usable ore, and numerous intermittent producers of brown ore from small deposits enjoyed a good year. The tax benefits authorized by the Internal Revenue Act of 1950 encouraged several large mining companies to plan construction of additional mills for an expanded production of beneficiated iron ore, including 10.5 million tons annual capacity of taconite concentrates.

Foreign trade was highlighted by initial receipts of ore from two major developments that are expected to be important in the prospective supply pattern of the United States. The Iron Mines Co. of Venezuela, a subsidiary of Bethlehem Steel Co., announced the arrival of the first shipload of Venezuelan ore from the Pao mine in April, and the Liberia Mining Co. also began shipments during 1951. Development proceeded apace toward early production from other new sources in Quebec-Labrador and Venezuela.

The St. Lawrence Seaway, which would greatly facilitate movement of iron ore from the Quebec-Labrador deposits, was again discussed extensively before Congress in 1951. New urgency was indicated as a result of the need for Canadian ore. However, delaying tactics used by opponents of this project continued to be effective. Canadian authorities announced that if the United States was not prepared to complete the Seaway as a joint effort, plans would proceed for an all-Canadian project.

Salient Statistics.—Usable iron ore produced from domestic mines totaled 115.9 million gross tons in 1951. An additional half million tons of byproduct ore obtained from treating pyrites brought the total to 116.5 million tons, 19 percent higher than 1950 and 10 percent higher than 1942, the highest year of previous record. Each of the producing districts increased production above 1950, with the Lake Superior district providing the greatest increase in quantity and Western States the greatest percentage increase. Nearly three-fourths of production was of direct-shipping grade, and the remainder was concentrated or sintered. Although the quantity of beneficiated ore increased substantially in continuation of the trend apparent for many years, the percentage of production that was treated dropped as a result of a larger increase in direct-shipping ore. Concentrated- or

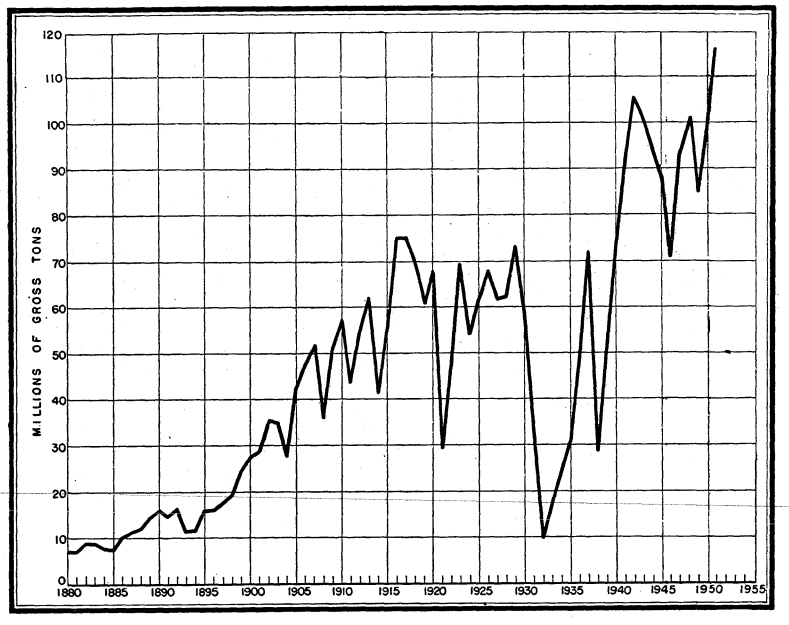

FIGURE 1.—Production of iron ore in the United States, 1880–1951.

sintered-ore production is limited by mill capacity and necessarily increases slowly, while the output of open-pit direct ore fluctuates in quick response to demand. The bulk of all production was of the hematite variety (Fe_2O_3) with only 10 percent of the usable product as magnetite (Fe_3O_4) and 3 percent brown ore ($Fe_2O_3 \cdot XH_2O$). No carbonate or siderite ($FeCO_3$) was produced separately, although East Texas brown ore includes some carbonate not differentiated statistically.

Shipments of iron ore did not differ substantially in quantity from production and increased a similar percentage above those of 1950. Reported value at the mines, on the other hand, increased 30 percent owing to higher prices as well as the larger tonnage. Average value per ton increased $0.47 to $5.46 in 1951.

Imports of iron ore increased again in 1951, with substantial assistance from new sources. One-third of the 23-percent increase over 1950 imports came from Venezuela, and one-fourth was attributable to increased receipts from Sweden. Nevertheless, Chile continued to be the leading supplier with 27 percent of the total. Exported iron ore went to Canada and Japan with only small lots to other destinations. Canada is normally a large user of United States ore; in turn, a substantial tonnage of Canadian ore is used in United States furnaces. In 1951 the export market again included Japan. The ore supplying this trade came from mines in California, Nevada, and Utah.

Consumption of iron ore was virtually all in iron and steel furnaces or sintering plants which merely treated the ore before consumption with untreated ores. The total reached a new high of 114.8 million tons including approximately one-half million tons for nonmetallurgical use. Thus, the supply of iron ore in 1951 exceeded requirements, and furnace stocks were greatly improved over the precarious position obtaining at the beginning of the year.

TABLE 1.—Salient statistics of iron ore in the United States, 1948–51

	1948	1949	1950	1951
Iron ore (usable; [1] less than 5 percent Mn):				
Production by districts:				
Lake Superior gross tons	82,630,430	68,494,123	79,627,294	93,946,990
Southeastern do	8,365,390	7,601,822	7,507,508	8,587,408
Northeastern do	4,422,971	3,863,833	4,474,834	5,180,959
Western do	5,104,703	4,441,671	5,860,755	8,181,465
Undistributed (byproduct ore) do	479,998	535,998	574,969	[2] 607,850
Total do	101,003,492	84,937,447	98,045,360	116,504,672
Production by types of product:				
Direct gross tons	76,882,338	63,970,016	70,309,322	85,281,923
Concentrates do	19,055,357	16,412,639	22,810,818	25,708,840
Sinter do	4,585,799	4,018,794	4,350,251	4,945,278
Byproduct material (pyrites cinder and sinter) gross tons	479,998	535,998	574,969	568,631
Total do	101,003,492	84,937,447	98,045,360	116,504,672
Production by types of ore:				
Hematite gross tons	90,686,138	76,262,577	87,156,235	101,530,954
Brown ore do	2,176,149	1,545,595	2,615,402	3,014,761
Magnetite do	7,661,207	6,593,277	7,698,754	11,390,326
Byproduct material (pyrites cinder and sinter) gross tons	479,998	535,998	574,969	568,631
Total gross tons	101,003,492	84,937,447	98,045,360	116,504,672
Shipments do	100,821,714	84,687,275	97,764,410	116,230,052
Value	$394,460,751	$381,515,831	$487,990,404	$634,728,583
Average value per ton at mine	$3.91	$4.50	$4.99	$5.46
Stocks at mines Dec. 31 gross tons	6,284,773	5,333,660	5,725,569	5,599,466
Imports [3] do	6,091,677	7,391,291	[4] 8,281,237	10,145,415
Value [3]	$27,271,681	$36,707,534	[4] $43,968,426	$59,627,587
Exports gross tons	3,080,666	2,424,775	[4] 2,550,738	4,295,938
Value	$13,744,979	$14,653,817	[4] $15,716,509	$30,622,063
Consumption gross tons	100,498,557	89,218,498	106,610,273	114,837,112
Manganiferous iron ore (5 to 35 percent Mn):				
Shipments gross tons	1,196,933	962,853	971,069	1,092,825
Value	[5]	$4,040,155	$4,609,432	$5,385,986

[1] Direct-shipping ore, washed ore, concentrates, sinter, and byproduct pyrites cinder and sinter.
[2] Includes 39,219 tons of iron ore from Puerto Rico.
[3] Excludes pyrites cinders.
[4] Revised figure.
[5] Figure withheld to avoid disclosure of individual company operations.

PRODUCTION AND SHIPMENTS

The output of crude iron ore, including ore to be beneficiated as well as direct-shipping grades, reached a new alltime high of 152.1 million gross tons in 1951. Of this total, 67.1 million tons or 44 percent was processed to obtain 25.7 million tons of concentrate and 4.9 million tons of sinter (an additional 18.4 million tons of sinter was produced at custom plants and consuming furnaces from iron-ore concentrates, fines, flue dust, mill scale, and other iron-bearing materials). Beneficiation at the mines included log washing, various gravity methods, magnetic separation, and agglomeration, principally by sintering. Direct-ore production totaled 85 million tons, some of which was crushed and sized before shipment. Byproduct cinder and sinter, a high-iron content residue from pyrites used in the

TABLE 2.—Crude iron ore mined in the United States, 1950–51, by State and variety, in gross tons

[Exclusive of ore containing 5 percent or more manganese]

State	Number of mines	Hematite	Brown ore	Magnetite	Total	Rank
1950						
Alabama	[1] 37	6,599,287	4,286,200		10,885,487	3
Arkansas	1			23,000	23,000	15
California	2	[2] 830,731		[2] 714	831,445	11
Georgia	[1] 11	213	999,000		999,213	10
Michigan	37	12,691,101			12,691,101	2
Minnesota	130	81,503,383	478,985	186,000	82,168,368	1
Missouri	3	569,634	17,500		587,134	12
Nevada	1			5,465	5,465	17
New Jersey	4			1,090,826	1,090,826	9
New Mexico	1			14,284	14,284	16
New York	7	(3)		[3] 6,722,422	6,722,422	4
Pennsylvania	1			1,762,540	1,762,540	7
Texas	3		2,599,723		2,599,723	6
Utah	5			[2] 3,139,926	3,139,926	5
Virginia	1		25,000		25,000	14
Wisconsin	2	1,701,638			1,701,638	8
Wyoming	1	491,906			491,906	13
Total	247	[3] 104,387,893	8,406,408	[3] 12,945,177	125,739,478	
Percent of total		83.0	6.7	10.3	100.0	
1951						
Alabama	[1] 44	7,444,467	5,064,950		12,509,417	3
Arkansas	2			6,047	6,047	19
California	2			[2] 1,198,847	1,198,847	10
Georgia	[1] 12		1,783,520		1,783,520	8
Michigan	39	13,918,614			13,918,614	2
Minnesota	146	98,824,060	641,846	703,953	100,169,859	1
Missouri	[1] 6	518,221	85,400		603,621	13
Nevada	5	258,205		73,122	331,327	14
New Jersey	4			1,166,495	1,166,495	11
New Mexico	3			32,210	32,210	17
New York	7	(3)		[3] 7,741,434	7,741,434	4
Pennsylvania	1			1,878,743	1,878,743	7
Tennessee	3	2,000	177,000		179,000	15
Texas	4		3,447,275		3,447,275	6
Utah	6			[2] 4,726,159	4,726,159	5
Virginia	1		7,753		7,753	18
Wisconsin	2	1,757,234			1,757,234	9
Wyoming	1	616,949			616,949	12
Puerto Rico	1			39,219	39,219	16
Total	289	[3] 123,339,750	11,207,744	[3] 17,566,229	152,113,723	
Percent of total		81.1	7.4	11.5	100.0	

[1] Excludes an undetermined number of small pits. Output of these pits included in tonnage given.
[2] Semialtered magnetite containing varying proportions of hematite.
[3] Small tonnage of hematite for nonmetallurgical use included with magnetite to avoid disclosure of individual company operations.

manufacture of sulfuric acid, accounted for 568,631 tons, part of which was sintered. In all, 116.5 million gross tons of usable iron ore, including byproduct ore and a small tonnage from Puerto Rico, was produced at domestic mines and mills in 1951. The total was 19 percent greater than 1950, as was the corresponding shipments total of 116.2 million tons.

The number of active mines increased appreciably during 1951, chiefly as a result of intermittent small operations of marginal character. However, the increase included several new mines of substantial size operated by established companies. Of the 289 mines recorded, 46 produced over 1 million tons of crude ore each. Minnesota, Michigan, and Alabama continued to produce the largest quantities, with 68, 12, and 7 percent, respectively, of the 115,936,041 tons of mine output. The Lake Superior district (Michigan, Minnesota, and Wisconsin) produced 93,946,990 tons or 81 percent of the total. Compared with 1950, this proportion was 0.7 percent lower, and consistent with the slightly smaller tonnage increase—18 percent for the district as compared with the 19 percent for the United States. Southeastern States (Alabama, Georgia, Tennessee, and Virginia) produced 8,587,408 tons or 7.4 percent of the total as compared with 7.7 percent in 1950; the tonnage increase was 14 percent. Northeastern States (New Jersey, New York, and Pennsylvania) produced 5,180,959 tons—4.5 percent of the total and 16 percent above the 1950 production. Western States achieved the largest percentage increase in 1951; the 8,181,465 tons of output was 40 percent greater than in 1950 and represented 7.1 percent of total usable ore production, as compared with 6.0 percent last year.

TABLE 3.—Crude iron ore mined in the United States, 1950–51, by State and mining method, in gross tons

[Exclusive of ore containing 5 percent or more manganese]

State	1950			1951		
	Open pit	Underground	Total	Open pit	Underground	Total
Alabama	4,534,737	6,350,750	10,885,487	5,423,623	7,085,794	12,509,417
Arkansas		23,000	23,000		6,047	6,047
California	831,445		831,445	1,198,847		1,198,847
Georgia	999,000	213	999,213	1,783,520		1,783,520
Michigan	846,986	11,844,115	12,691,101	1,085,662	12,832,952	13,918,614
Minnesota	78,363,335	3,805,033	82,168,368	96,431,377	3,738,482	100,169,859
Missouri	586,665	469	587,134	506,161	97,460	603,621
Nevada	5,465		5,465	331,327		331,327
New Jersey		1,090,826	1,090,826		1,166,495	1,166,495
New Mexico	14,284		14,284	32,210		32,210
New York	4,261,761	2,460,661	6,722,422	4,310,190	3,431,244	7,741,434
Pennsylvania	659,514	1,103,026	1,762,540	659,537	1,219,206	1,878,743
Tennessee				179,000		179,000
Texas	2,599,723		2,599,723	3,447,275		3,447,275
Utah	3,139,926		3,139,926	4,726,159		4,726,159
Virginia	25,000		25,000	7,753		7,753
Wisconsin		1,701,638	1,701,638		1,757,234	1,757,234
Wyoming		491,906	491,906		616,949	616,949
Puerto Rico				39,219		39,219
Total	96,867,841	28,871,637	125,739,478	120,161,860	31,951,863	152,113,723
Percent of total	77.0	23.0	100.0	79.0	21.0	100.0

TABLE 4.—Crude iron ore shipped from mines in the United States, 1950–51, by State and disposition, in gross tons

[Exclusive of ore containing 5 percent or more manganese]

State	1950			1951		
	Direct to consumers	To beneficiation plants	Total	Direct to consumers	To beneficiation plants	Total
Alabama	5,392,939	5,590,540	10,983,479	6,200,469	6,303,185	12,503,654
Arkansas		23,000	23,000	47	6,000	6,047
California	849,489		849,489	1,182,799		1,182,799
Georgia	213	999,000	999,213		1,783,520	1,783,520
Michigan	12,821,344		12,821,344	13,533,359	292,975	13,826,334
Minnesota	45,760,242	36,334,262	82,094,504	56,394,129	43,972,058	100,366,187
Missouri	19,169	567,965	587,134	2,500	601,011	603,511
Nevada	5,465		5,465	299,010		299,010
New Jersey	138,451	987,940	1,126,391	193,143	989,544	1,182,687
New Mexico	14,284		14,284	32,210		32,210
New York	126,488	6,591,792	6,718,280	112,686	7,633,037	7,745,723
Pennsylvania		1,750,115	1,750,115		1,876,904	1,876,904
Tennessee					179,000	179,000
Texas		2,599,723	2,599,723		3,447,275	3,447,275
Utah	3,111,167		3,111,167	4,637,239		4,637,239
Virginia		25,000	25,000	7,248		7,248
Wisconsin	1,701,619		1,701,619	1,745,120		1,745,120
Wyoming	491,906		491,906	616,949		616,949
Puerto Rico				39,219		39,219
Total	70,432,776	55,469,337	125,902,113	84,996,127	67,084,509	152,080,636
Percent of total	56.0	44.0	100.0	55.9	44.1	100.0

TABLE 5.—Iron ore mined in the United States, 1950–51, by mining district and variety, in gross tons

[Exclusive of ore containing 5 percent or more manganese]

Variety of ore	Lake Superior district	Southeastern States	Northeastern States	Western States	Total
1950					
Crude ore:					
Hematite	95,896,122	6,599,500	[1]	1,892,271	[1] 104,387,893
Brown ore	[2] 478,985	5,310,200		2,617,223	8,406,408
Magnetite	[3] 186,000		[1] 9,575,788	3,183,389	[1] 12,945,177
Total	96,561,107	11,909,700	9,575,788	7,692,883	125,739,478
Usable iron ore:					
Hematite	79,229,737	6,427,223	[1]	1,499,275	[1] 87,156,235
Brown ore	[2] 335,470	1,080,285		1,199,647	2,615,402
Magnetite	62,087		[1] 4,474,834	3,161,833	[1] 7,698,754
Total	79,627,294	7,507,508	4,474,834	5,860,755	97,470,391
1951					
Crude ore:					
Hematite	114,499,908	7,446,467	[1]	1,393,375	[1] 123,339,750
Brown ore	[2] 641,846	7,033,223		3,532,675	11,207,744
Magnetite	703,953		[1] 10,786,672	6,036,385	[1] [4] 17,566,229
Total	115,845,707	14,479,690	10,786,672	10,962,435	[4] 152,113,723
Usable iron ore:					
Hematite	93,356,118	7,144,625	[1]	1,030,211	[1] 101,530,954
Brown ore	[2] 452,405	1,442,783		1,119,573	3,014,761
Magnetite	138,467		[1] 5,180,959	6,031,681	[1] [4] 11,390,326
Total	93,946,990	8,587,408	5,180,959	8,181,465	[4] 115,936,041

[1] Small tonnage of hematite included with magnetite to avoid disclosure of individual company operations.
[2] Produced in Fillmore County; not in the true Lake Superior district.
[3] Approximate.
[4] Total includes 39,219 tons mined in Puerto Rico.

TABLE 6.—Iron ore produced in the United States, 1950–51, by State and type of product, in gross tons

[Exclusive of ore containing 5 percent or more manganese]

State	1950					1951				
	Direct shipping ore	Sinter [1]	Concentrates	Total	Iron content natural (percent)	Direct shipping ore	Sinter [1]	Concentrates	Total	Iron content natural (percent)
Mined ore:										
Alabama	5,297,655	1,127,717	874,372	7,299,744	37.42	6,194,253	949,902	1,041,838	8,185,993	37.48
Arkansas			1,444	1,444	48.00	47		1,296	1,343	54.36
California	831,445			831,445	54.15	1,198,847			1,198,847	53.35
Georgia	213		202,214	202,427	37.98			357,754	357,754	39.57
Michigan	12,691,101			12,691,101	51.28	13,625,639		78,262	13,703,901	54.13
Minnesota	45,851,046	253,452	19,130,057	65,234,555	49.37	56,444,522	194,971	21,846,362	78,485,855	50.53
Missouri	19,169		174,969	194,138	55.92	2,610		169,966	172,576	51.27
Nevada	5,465			5,465	64.59	331,327			331,327	56.19
New Jersey	138,110		448,237	586,347	62.16	193,417		465,328	658,745	62.60
New Mexico	14,284			14,284	53.20	32,210			32,210	53.15
New York	127,364	2,309,780	335,005	2,772,149	62.35	111,737	2,951,834	240,814	3,304,385	62.12
Pennsylvania		637,663	478,675	1,116,338	57.60		756,578	461,251	1,217,829	58.56
Tennessee								35,908	35,908	39.02
Texas		21,639	1,160,508	1,182,147	40.89		91,993	1,010,061	1,102,054	46.46
Utah	3,139,926			3,139,926	54.41	4,726,159			4,726,159	55.60
Virginia			5,337	5,337	32.00	7,753			7,753	33.54
Wisconsin	1,701,638			1,701,638	52.90	1,757,234			1,757,234	52.58
Wyoming	491,906			491,906	45.70	616,949			616,949	48.30
Puerto Rico						39,219			39,219	58.00
Total mined ore	70,309,322	4,350,251	22,810,818	97,470,391	49.40	85,281,923	4,945,278	25,708,840	115,936,041	50.71
Byproduct ore:[2]										
Colorado										
Michigan										
Delaware										
Tennessee		574,969		574,969	65.75		568,631		568,631	66.17
Virginia										
Grand total	70,309,322	4,925,220	22,810,818	98,045,360	49.49	85,281,923	5,513,909	25,708,840	116,504,672	50.79

[1] Exclusive of sinter produced at consuming plants.
[2] Cinder and sinter obtained from pyrites treated in, but not necessarily mined in, States indicated.

TABLE 7.—Iron ore produced in the United States, 1950–51, by State and variety, in gross tons

[Exclusive of ore containing 5 percent or more manganese]

State	1950				1951			
	Hematite	Brown ore	Magnetite	Total	Hematite	Brown ore	Magnetite	Total
Alabama	6,427,010	872,734		7,299,744	7,144,155	1,041,838		8,185,993
Arkansas			1,444	1,444			1,343	1,343
California	830,731		714	831,445			1,198,847	1,198,847
Georgia	213	202,214		202,427		357,754		357,754
Michigan	12,691,101			12,691,101	13,703,901			13,703,901
Minnesota	64,836,998	335,470	62,087	65,234,555	77,894,983	452,405	138,467	78,485,855
Missouri	176,638	17,500		194,138	155,057	17,519		172,576
Nevada			5,465	5,465	258,205		73,122	331,327
New Jersey			586,347	586,347			658,745	658,745
New Mexico			14,284	14,284			32,210	32,210
New York	(1)		[1]2,772,149	2,772,149	(1)		[1]3,304,385	3,304,385
Pennsylvania			1,116,338	1,116,338			1,217,829	1,217,829
Tennessee					470	35,438		35,908
Texas		1,182,147		1,182,147		1,102,054		1,102,054
Utah			3,139,926	3,139,926			4,726,159	4,726,159
Virginia		5,337		5,337		7,753		7,753
Wisconsin	1,701,638			1,701,638	1,757,234			1,757,234
Wyoming	491,906			491,906	616,949			616,949
Puerto Rico							39,219	39,219
Total	[1]87,156,235	2,615,402	[1]7,698,754	97,470,391	[1]101,530,954	3,014,761	[1]11,390,326	115,936,041
Byproduct ore:[2]								
Colorado								
Michigan								
Delaware								568,631
Tennessee				574,969				
Virginia								
Grand total	[1]87,156,235	2,615,402	[1]7,698,754	98,045,360	[1]101,530,954	3,014,761	[1]11,390,326	116,504,672

[1] Small tonnage of hematite included with magnetite to avoid disclosure of individual company operations.
[2] Cinder and sinter obtained from pyrites treated in, but not necessarily mined in, States indicated.

TABLE 8.—Shipments of iron ore in the United States in 1951, by State and use, in gross tons

[Exclusive of ore containing 5 percent or more manganese]

State	Iron and steel			Cement	Paint	Miscellaneous	Total	
	Direct shipping ore	Sinter [1]	Concentrates				Gross tons	Value
Mined ore:								
Alabama	6,200,161	950,026	1,031,242			308	8,181,737	$34,799,951
Arkansas	47		1,296				1,343	(2)
California	1,169,060			10,000		3,739	1,182,799	(2)
Georgia			357,754				357,754	1,339,248
Michigan	13,500,706		78,262		32,653		13,611,621	81,765,748
Minnesota	56,394,129	194,971	21,575,427				78,164,527	411,468,895
Missouri	2,500		169,966				172,466	(2)
Nevada	298,563					447	299,010	898,306
New Jersey	193,143		454,555	9,967	74	191	657,930	7,810,776
New Mexico	29,305			2,905			32,210	(2)
New York	112,686	2,914,350	500,068	3,900	(3)	[3]118,527	3,649,531	39,819,368
Pennsylvania		756,461	458,572				1,215,033	(2)
Tennessee			35,908				35,908	142,447
Texas		91,769	960,788		574		1,053,131	(2)
Utah	4,630,843			6,396			4,637,239	10,141,653
Virginia					7,248		7,248	(2)
Wisconsin	1,745,120						1,745,120	(2)
Wyoming	616,949						616,949	(2)
Puerto Rico	39,219						39,219	225,509
Undistributed [2]								41,650,747
Total	84,932,431	4,907,577	25,623,838	33,168	40,549	123,212	115,660,775	630,062,648
Byproduct ore: [4]								
Colorado								
Delaware								
Michigan		569,277					569,277	4,665,935
Tennessee								
Virginia								
Grand total	84,932,431	5,476,854	25,623,838	33,168	40,549	123,212	116,230,052	634,728,583

[1] Exclusive of sinter produced at consuming plants.
[2] Values that may not be shown separately are combined as "Undistributed."
[3] Small tonnage used as earth pigments included with miscellaneous.
[4] Cinder and sinter obtained from pyrites treated in, but not necessarily mined in, States indicated.

PRINCIPAL MINES

The domestic iron mines producing over 500,000 gross tons of crude ore each in 1951 are listed in table 9. The order of listing is based on the tonnage of material mined before treatment and without respect to iron content; thus mines producing low-grade material that is subsequently processed to eliminate a large percentage of gangue material are considered comparable in size to mines producing similar tonnages of direct-shipping ore. In the Lake Superior district a number of mines producing from continuous ore bodies have been consolidated into single operations as small pits have grown into large excavations. These are now identified by group, and account for the disappearance from the list of some large producers in past years.

Forty-six mines reported an output exceeding 1 million tons each in 1951 and together supplied 64 percent of total crude-ore production. Two mines listed in this group in 1950 reduced output below the million-ton level and were replaced by 10 mines listed below that level in 1950. Of the 46 mines, 31 were in Minnesota, 4 each in Alabama and New York, 2 in Utah, and 1 each in California, Michigan, Pennsylvania, Texas, and Wisconsin; 37 were open-pit mines, 6 under-

ground, and 3 combined operations. In 1950, 38 million-ton mines produced 59 percent of the total crude-ore output.

Forty-three mines, producing 500,000 to 1,000,000 tons each, supplied 19 percent of crude ore produced in 1951. Of these, 23 were in Minnesota, 11 in Michigan, 4 in Alabama, and 1 each in Missouri, New Jersey, Utah, Wisconsin, and Wyoming. Eighty-three percent of all crude iron ore mined in the United States during 1951 came from the 89 mines listed in table 9.

TABLE 9.—Iron-ore mines in the United States in 1951, by size of crude output

Name of mine	State	Nearest town	Range or district	Mining method	Production (gross tons)	
					Crude ore	Usable ore
Sherman	Minnesota	Fraser	Mesabi	Open pit	8,556,115	8,556,115
Rouchleau	do	Virginia	do	do	6,189,313	6,153,931
Hull Rust	do	Hibbing	do	do	5,937,572	5,787,727
Mountain Iron	do	Mountain Iron.	do	do	4,298,392	3,820,002
Mahoning	do	Hibbing	do	do	3,454,738	3,454,738
Monroe	do	Chisholm	do	do	3,262,183	3,255,592
Benson	New York	Star Lake	Adirondack	do	2,852,285	1,031,102
Lone Star	Texas	Daingerfield	East Texas	do	2,816,275	656,319
Gross Marble	Minnesota	Marble	Mesabi	do	2,651,924	1,307,541
Walker	do	Coleraine	do	do	2,473,847	1,362,440
Spruce	do	Eveleth	do	Combined	2,444,166	2,444,166
Hill-Trumbull	do	Marble	do	Open pit	2,259,480	805,557
Wenonah	Alabama	Bessemer	Birmingham	Underground	2,162,187	2,076,641
Gilbert	Minnesota	Gilbert	Mesabi	Open pit	2,079,830	2,004,399
Canton	do	Biwabik	do	do	1,972,614	1,972,614
Canisteo	do	Coleraine	do	do	1,947,694	924,036
Cornwall-Lebanon	Pennsylvania	Lebanon	Cornwall	Combined	1,878,743	1,217,829
Holman Cliffs	Minnesota	Taconite	Mesabi	Open pit	1,768,519	931,513
Buckeye	do	Coleraine	do	do	1,711,977	797,797
Iron Mountain	Utah	Cedar City	Iron Mountain.	do	1,707,721	1,707,721
Excelsior	do	do	do	do	1,674,838	1,674,838
Mather	Michigan	Ishpeming	Marquette	Underground	1,635,256	1,635,256
Patrick	Minnesota	Nashwauk	Mesabi	Open pit	1,518,499	533,264
Galbraith	do	do	do	do	1,497,649	744,125
Embarrass	do	Biwabik	do	do	1,480,112	1,480,112
New Bed Harmony & Old Bed.	New York	Mineville	Adirondack	Underground	1,480,105	973,498
Ishkooda	Alabama	Bessemer	Birmingham	do	1,466,581	1,408,556
Halobe	Minnesota	Nashwauk	Mesabi	Open pit	1,410,320	366,772
South Agnew	do	Hibbing	do	do	1,410,061	1,269,399
Hawkins	do	Nashwauk	do	do	1,389,634	666,848
Chateaugay	New York	Lyon Mountain.	Adirondack	Combined	1,386,600	381,406
Muscoda	Alabama	Bessemer	Birmingham	Underground	1,332,057	1,279,354
MacIntyre	New York	Tahawus	Adirondack	Open pit	1,330,730	716,878
Bray	Minnesota	Keewatin	Mesabi	do	1,287,066	946,966
Argonne	do	Nashwauk	do	do	1,264,730	634,266
Hill Annex	do	Calumet	do	do	1,257,209	699,843
Blackburn	Alabama	Russellville	Birmingham	do	1,200,000	248,352
Arcturus	Minnesota	Marble	Mesabi	do	1,184,694	517,013
Eagle Mountain	California	Desert Center.	Eagle Mountain.	do	1,183,247	1,183,247
Susquehanna	Minnesota	Hibbing	Mesabi	do	1,178,762	999,267
Danube	do	Bovey	do	do	1,159,458	758,208
Duncan	do	Hibbing	do	do	1,137,463	874,053
Olson	do	Nashwauk	do	do	1,135,523	454,453
Montreal	Wisconsin	Montreal	Gogebic	Underground	1,119,703	1,119,703
Longyear	Minnesota	Hibbing	Mesabi	Open pit	1,083,798	974,694
Mary Ellen	do	Biwabik	do	do	1,009,089	464,820
Pyne	Alabama	Bessemer	Birmingham	Underground	988,647	988,647
Mesabi Chief	Minnesota	Keewatin	Mesabi	Open pit	976,317	585,711
Scranton	do	Hibbing	do	do	950,840	950,840
Adkins	Alabama	Woodstock	Birmingham	do	950,000	190,511
Blowout	Utah	Cedar City	Iron Mountain.	do	914,446	914,446
Auburn Group	Minnesota	Virginia	Mesabi	do	914,208	914,208
Russellville No. 14	Alabama	Russellville	Birmingham	do	900,000	177,918
Pioneer	Minnesota	Ely	Vermilion	Underground	868,767	868,767
Fayal	do	Eveleth	Mesabi	Combined	811,786	811,786

TABLE 9.—Iron-ore mines in the United States in 1951, by size of crude output—Continued

Name of mine	State	Nearest town	Range or district	Mining method	Production (gross tons)	
					Crude ore	Usable ore
Buck Unit	Michigan	Iron River	Menominee	Underground	752,865	752,865
Bennett	Minnesota	Keewatin	Mesabi	Combined	713,645	619,857
Maas	Michigan	Negaunee	Marquette	Underground	712,474	712,474
Portsmouth	Minnesota	Crosby	Cuyuna	Open pit	708,537	516,652
Columbia	do	Virginia	Mesabi	do	707,029	683,615
Taconite Plant	do	Aurora	do	do	703,953	138,467
Webb	do	Hibbing	do	do	703,892	615,567
Cliffs Shaft	Michigan	Ishpeming	Marquette	Underground	700,346	700,346
Grant	Minnesota	Buhl	Mesabi	Open pit	684,041	483,380
Warner [1]	Alabama	Russellville	Birmingham	do	675,000	135,673
Prindle	Minnesota	Virginia	Mesabi	do	661,620	281,668
Spring Valley	do	Ostrander	Southern Minn. Mesabi	do	641,846	452,405
South Longyear	do	Hibbing	Mesabi	do	641,318	518,842
Cary	Wisconsin	Hurley	Gogebic	Underground	637,531	637,531
Athens	Michigan	Negaunee	Marquette	do	630,804	630,804
Newport	do	Ironwood	Gogebic	do	624,835	624,835
North Harrison	Minnesota	Nashwauk	Mesabi	Open pit	620,235	167,791
Sunrise	Wyoming	Sunrise	Wyoming	Underground	616,949	616,949
Hiawatha	Michigan	Iron River	Menominee	do	602,531	602,531
Wauseca	do	do	do	do	596,113	596,113
Geneva	do	Ironwood	Gogebic	do	592,659	592,659
Anvil-Palms-Kewee-naw.	do	Bessemer	do	do	588,288	588,288
Godfrey	Minnesota	Chisholm	Mesabi	do	576,999	576,999
Biwabik	do	Biwabik	do	Open pit	552,882	248,490
Charleson concentrator.	do	Virginia	do	do	544,212	198,971
Kevin	do	Cooley	do	do	543,973	164,635
Section 18	do	Hibbing	do	do	540,957	468,994
Homer-Minckler [2]	Michigan	Iron River	Menominee	Underground	540,690	540,690
Sherwood	do	do	do	do	537,421	537,421
Wyoming	Minnesota	Missabe Mtn Twp	Mesabi	Open pit	529,943	529,943
Iron Mountain	Missouri	Iron Mountain.	Iron Mountain.	Combined	515,611	152,447
Scrub Oaks	New Jersey	Dover	N. J. and SE, N. Y.	Underground	513,026	201,607
Feigh	Minnesota	Ironton	Cuyuna	Open pit	508,992	437,467
Zenith	do	Ely	Vermilion	Underground	506,284	506,284
Output of 89 mines producing more than 500,000 tons of crude ore each					125,841,271	95,909,065
Output of 12 mines producing 400,000 to 500,000 tons of crude ore each					5,281,240	4,028,772
Output of 15 mines producing 300,000 to 400,000 tons of crude ore each					5,258,567	4,133,419
Output of 35 mines producing 200,000 to 300,000 tons of crude ore each					8,763,762	6,999,132
Output of 32 mines producing 100,000 to 200,000 tons of crude ore each					4,506,682	3,152,895
Output of 20 mines producing 50,000 to 100,000 tons of crude ore each					1,499,619	1,067,797
Output of 86 mines producing under 50,000 tons of crude ore each					962,582	644,961
Grand total United States (289 mines)					152,113,723	115,936,041

[1] Shown as Warner-Auxford in 1950.
[2] Shown as Homer-Minckler-Cardiff in 1950.

SINTER

United States production of sinter for consumption in iron and steel furnaces during 1951 increased 21 percent above the 18,740,217 tons in 1950, reflecting new capacity installed during 1950 and 1951. Iron-bearing materials consumed in the manufacture of sinter included 16,795,596 tons of iron ore, 5,110 tons of manganiferous ore, 8,784,589 tons of flue dust, 457,277 tons of mill cinder and roll scale, and 640,340 tons of pyrites cinder. Included in the above figures but not identified were at least 20,000 tons of aniline sludge. The total, 26,682,912 tons, resulted in a conversion yield of 85 percent, 4 percent less than in 1950.

Sintering plants at mines in 5 States produced 4,945,278 tons (22 percent of the total), and plants at blast furnaces and custom mills in 14 States produced 17,697,754 tons (78 percent).

TABLE 10.—Production and consumption of sinter in the United States in 1951, by States, in gross tons

State	Sinter produced	Sinter consumed	
		In blast furnaces	In steel furnaces
Alabama	1,430,441	1,670,198	87,590
California	1,817,258	1,825,713	
Colorado			
Utah	62,122		
Delaware	1,001,291	991,831	107,184
Illinois	1,814,624	1,409,377	427,874
Indiana	475,661	794,861	45,827
Maryland			
Kentucky			
Tennessee			
West Virginia	547,298	556,659	
Michigan	194,971		
Minnesota	4,655,538	1,818,090	137,671
New York	3,658,102	4,135,550	338,946
Ohio	6,893,733	7,698,597	374,019
Pennsylvania	91,993	91,656	
Texas			
Total	22,643,032	20,992,532	1,519,111

REVIEW OF LAKE SUPERIOR DISTRICT

Production and Shipments.—Responding to extraordinary demand, mines and mills in Michigan, Minnesota, and Wisconsin produced 93,946,990 gross tons of usable iron ore (containing less than 5 percent manganese) in 1951, establishing a new record high and exceeding the previous high of 1942 by 3 percent. The Mesabi range alone produced 73,574,908 tons (63 percent of all domestic usable ore) and an equal percentage of all direct-shipping grades. The 6 ranges together supplied all of the Lake Superior production, with the exception of 452,405 tons of brown ore from mines in Fillmore County, Minn., which is not considered part of the true Lake Superior district. Deducting brown ore from the States' total above, the Lake Superior district produced 93,494,585 tons, or 80 percent of the total usable output. In addition, 1,007,611 tons of ore containing (natural) 5 percent or more manganese was produced, principally from the Cuyuna range. Including both Fillmore County and manganiferous production, the entire district output was 94,954,601 tons. The corresponding shipments total was 94,485,801 tons, of which 93,069,033 tons was iron ore from the 6 ranges, 452,235 tons was brown ore from Fillmore County, and 964,533 tons was manganiferous ore.

Railroad weights of iron and manganiferous ores shipped from United States mines in the Lake Superior district, as reported by the Lake Superior Iron Ore Association, totaled 94,488,009 tons, of which 86,952,792 tons was transshipped via the Great Lakes water route and 7,535,217 tons went to furnaces via all-rail. Of the all-rail shipments, about 6,000,000 tons went to furnaces normally supplied by the water route. This was an emergency measure of proportions that may never again be equaled.

Iron ore from Canadian mines in the Lake Superior region is not included in the above figures. Shipments from these mines in 1951 totaled 2,510,934 gross tons—1,184,210 tons from the Helen mine in the Michipicoten district and 1,326,724 tons from Steep Rock mines in the Atikokan district. This ore, also, normally moves over the Great Lakes; however, in 1951 a total of 383,581 tons moved all-rail to consuming centers.

The 266 vessels of the Great Lakes ore-carrier fleet had a trip capacity of 2,861,230 gross tons on May 15, 1951.[1] By November 2, new ships had joined the fleet; 6 more vessels were scheduled to be in service by May 1952.[2] Thus it was apparent that the transportation bottleneck for Lake Superior iron ore was about to be broken.

The 1951 navigation season began at Escanaba, Mich., on April 6 with departure of the steamer, *Joseph Sellwood*. Upper Lake ports opened within a week, Marquette, Mich., on April 9 and Duluth, Two Harbors, and Superior, Minn., on April 11. Unlike the previous spring, when ice and weather conditions seriously hampered early vessel movements, the 1951 season began with heavy shipments totaling 6,121,856 tons from United States ports in April compared with only 348,804 tons in April 1950. Weather did not seriously affect ore movements until November, when early cold waves struck the upper Lake area, slowing loading and causing some ships to remain in the harbor for a break in the blizzard. The effect was to reduce November shipments by water 1,261,100 tons below the previous November. However, stocks of ore at lower Lake furnaces were much improved compared with 1950, and the urgency had been dissipated by near-record water shipments, supplemented by all-rail shipments.

TABLE 11.—Iron ore produced in the Lake Superior district, 1854–1951, by ranges, in gross tons

[Exclusive after 1905 of ore containing 5 percent or more manganese]

Year	Marquette	Menominee	Gogebic	Vermilion	Mesabi	Cuyuna	Total
1854–1944	229, 773, 915	205, 736, 670	242, 702, 380	75, 704, 578	1, 376, 030, 818	32, 807, 310	2, 162, 755, 671
1945	4, 664, 816	4, 140, 239	4, 395, 653	1, 481, 007	58, 355, 320	1, 784, 010	74, 821, 045
1946	3, 455, 961	2, 662, 308	3, 633, 078	1, 232, 008	46, 678, 679	1, 380. 120	59, 042, 154
1947	5, 070, 631	3, 741, 217	5, 227, 005	1, 471, 879	58, 772. 404	2, 100, 846	76, 383, 982
1948	4, 830, 341	4. 259, 378	5, 504, 971	1, 580, 497	64, 071, 983	2, 030, 281	82, 277. 451
1949	4, 392, 732	3, 483, 375	4, 756, 474	1, 381, 327	52, 551, 346	1, 826, 711	68, 391, 965
1950	5, 085, 500	4, 068, 458	5, 238, 781	1, 580, 217	60, 838, 025	2, 480, 843	79, 291, 824
1951	5, 617. 935	4, 864, 831	4, 978, 369	1, 806, 818	73, 574, 908	2, 651, 724	93, 494, 585
Total	262, 891, 831	232, 956, 476	276, 436, 711	86, 238, 331	1, 790, 873, 483	47, 061, 845	2, 696, 458, 677

Technologic Trends.—Emphasis in the Lake Superior district during 1951 was on expanded total output; however, within the demand for greater tonnage was an urgent need for increased mill capacity to process crude ores. The first large steps toward producing commercial quantities of taconite concentrates were made, and widespread attention was given to more efficient means of treating the so-called wash ores. Variations of the heavy-medium process gained increased acceptance for ores of suitable character, and hydraulic applications were devised for some types of fine-grained ores. Flota-

[1] Wade, H. H., Mining Directory of Minnesota 1951: Univ. of Minnesota, Mines Exp. Sta, Bull., vol. 54, No. 21, May 1, 1951, p. 239.
[2] Wade, H. H., Mining Directory of Minnesota 1952: Univ. of Minnesota, Mines Exp. Sta., Bull., vol. 55, No. 19, May 1, 1952, p. 244.

tion was under consideration for commercial-scale production, and plans were being made to sinter large quantities of Mesabi soft ore.

Mining methods in use on the Menominee range were described in an article which included an informative table.[3] Of 17 mines listed, 15 were underground, 11 used sublevel stopes, 1 used a combination of sublevel and shrinkage stopes, 1 used shrinkage stopes, and 2 were under development. The table also listed shaft depths, number of men employed, methods of tramming, crushing, stockpiling, and shiploading, pumping capacity, skip size, and distance between levels.

Analyses.—Table 12 shows average analyses of all ore shipped from the Lake Superior district iron ranges, 1946–51. The gradual decline in average quality was apparent again in 1951; iron content was down 0.13 percent from 1950, with slight increases in silica and moisture.

Reserves.—Taxable and State-owned reserves of iron ore in Michigan and Minnesota are given in tables 13 and 14. It will be noted that Michigan reserves have increased, while Minnesota reserves have declined, except for 1950. This is partly explained by the fact that the bulk of Michigan's reserves is underground while Minnesota has a preponderance of ore in surface deposits. Underground development to prove reserves is more expensive and the tonnages are not amenable to visual estimates, however conservative. In either case, it should be remembered that taxable reserves do not represent the total tonnage that may be expected to become available.

TABLE 12.—Average analyses of total tonnages (bill-of-lading weights) of all grades of iron ore from all ranges of Lake Superior district, 1947–51

[Lake Superior Iron Ore Association]

Year	Gross tons	Content (natural), percent				
		Iron	Phosphorus	Silica	Manganese	Moisture
1947	77,210,278	50.91	0.093	9.09	0.75	11.28
1948	82,655,757	50.49	.093	9.30	.76	11.35
1949	68,531,664	50.39	.096	9.72	.78	11.12
1950	79,150,079	50.38	.092	9.85	.77	11.11
1951	93,549,414	50.25	.090	9.87	.77	11.22

TABLE 13.—Iron-ore reserves in Michigan, Jan. 1, 1948–52, in gross tons

[Michigan Department of Conservation]

Range	1948	1949	1950	1951	1952
Gogebic	31,937,142	30,511,502	29,098,914	33,466,792	34,162,005
Marquette	66,636,928	67,101,475	65,109,601	68,323,382	65,119,690
Menominee	51,462,819	55,913,371	55,594,843	60,136,726	62,940,226
Total Michigan	150,036,889	153,526,348	149,803,358	161,926,900	162,221,921

[3] Pearson, P. D. and Jamar, W. W., New Mining Methods Tested by Menominee Range Ore Producers: Trans. Am. Inst. Min. and Met. Eng., Min. Eng., vol. 3, No. 4, April 1951, pp. 337–346.

TABLE 14.—Unmined iron-ore reserves in Minnesota, May 1, 1947–51, in gross tons

[Minnesota Department of Taxation]

	1947	1948	1949	1950	1951
Mesabi	922, 401, 348	915, 220, 248	900, 959, 665	912, 226, 039	893, 007, 833
Vermilion	10, 699, 576	10, 435, 800	12, 196, 016	12, 498, 639	11, 660, 302
Cuyuna	55, 756, 200	38, 040, 129	37, 308, 274	42, 977, 068	41, 415, 581
Total Lake Superior district (taxable)	988, 857, 124	963, 696, 177	950, 463, 955	967, 701, 746	946, 083, 716
Fillmore County	186, 700	394, 248	547, 744	582, 820	908, 996
Morrison County				88, 286	44, 300
State ore (not taxable)	11, 600, 524	3, 515, 084	2, 435, 729	2, 642, 853	2, 643, 033
Total Minnesota	1, 000, 644, 348	967, 605, 509	953, 447, 428	971, 015, 705	949, 680, 045

MINING BY STATES

Alabama.—As the largest iron-ore-producing State outside the Lake Superior district, Alabama supplied 7 percent of all usable output in 1951. Production was 12 percent above 1950 but 8 percent below the record high of 1942.

Eighty-seven percent (7,107,376 tons) of the State production was red hematite from 10 major mines in Jefferson County. A small tonnage of soft red ore was also produced. Brown-ore concentrates, principally from mines in the Russellville area of Franklin County, totaled 1,041,838 tons or 13 percent of the State output. Virtually all of the red ore was produced from mines owned and operated by the local steel companies and merchant pig-iron producers. Brown ore was produced from numerous small surface operations; however, in the Russellville area, Sloss-Sheffield Steel & Iron Div., United States Pipe & Foundry Corp., Shook & Fletcher Supply Co., and the Schroeder Co. are major suppliers.

Alabama red ores are partly self-fluxing, with a low iron content, and brown-ore concentrates plus high-grade ore from the Lake Superior region and foreign sources are used for blending purposes to enrich the blast-furnace charge. Thus, Alabama consumed 9,859,720 tons of iron ore, 20 percent more than was produced in the State.

Arkansas.—The Magnet Iron Co., Little Rock, Ark., shipped magnetite selectively mined near Butterfield in Hot Spring County. In addition, a small lot of magnetite was shipped from Lawrence County.

California.—Kaiser Steel Corp. shipped mixed hematite and magnetite from the Eagle Mountain mine in Riverside County to its furnaces at Fontana, and 15,600 tons was shipped from the Bessemer mine in San Bernardino County for export to Japan.

Georgia.—Producers of brown-ore concentrates in Georgia increased output 77 percent over 1950 as a result of a relatively firm market. A laboratory set up during the year at Cartersville permitted ore analyses before shipment for some operators and reduced the risk of losses due to shipments failing to meet specifications. Most of the usable ore produced came from the vicinity of Cartersville in Bartow County and Cedartown in Polk County.

Michigan and Minnesota.—*See* Review of the Lake Superior District.

Missouri.—The Ozark Ore Co., a subsidiary of The M. A. Hanna Co., operated the Iron Mountain mine in St. Francois County as a combined open-pit-underground producer in 1951. The mine is converting to underground methods, and 94,850 of the total 515,611 tons of crude ore supplied by the mine came from the new shaft. Gravity methods are used to concentrate the crude ore to a usable product. During the year many showings of brown ore in Missouri were considered for commercial possibilities, and at least five companies shipped ore from various localities.

Nevada.—The iron ore export market to Japan stimulated the opening of several deposits in Nevada during 1951. Small shipments had been made for several years from a Union Pacific property of particularly high grade in Pershing County. However, a relatively firm market caused interest in other showings nearby, including the Segerstrom-Heiser deposit operated by the Dodge Construction Co. and the Buena Vista deposit operated by the Mineral Materials Co. The Phelps-Stokes deposit in Nye County was supplying a small tonnage of iron ore for nonmetallurgical use by the Standard Slag Co. and later expanded production to include exports. In Eureka County, Simplot Iron Mines Inc. developed the Modarelli deposit and exported a substantial tonnage in 1951.

New Jersey.—Established iron mines in Morris and Warren Counties increased 1951 production of magnetite lump ore and concentrates 12 percent above 1950. No shipments were reported from the Ringwood mine in Passaic County. However, a small tonnage was hoisted for test runs in the rehabilitation of the concentrating mill. The Peters and Cannon mines and the concentration mill which comprise the Ringwood properties were purchased from the Government by Ringwood Iron Mines, Inc.

New Mexico.—The Hanover-Bessemer mine in Grant County continued production of magnetite in 1951 and was joined by two small producers in Lincoln County.

New York.—Adirondack magnetite lump ore and concentrates were produced from four localities in 1951. Republic Steel Corp. produced from the Fisher Hill mine and the New Bed-Harmony-Old Bed shafts at Mineville in the Port Henry area, Essex County, and the combination open-pit underground Chateaugay mine at Lyon Mountain, Clinton County. National Lead Co. produced coproducts of iron-ore concentrates and ilmenite from the titaniferous ore body at Tahawus, Essex County. Jones & Laughlin Ore Co. produced concentrates and sinter from the Benson open pit near Star Lake in St. Lawrence County; and the Clifton mine, also in St. Lawrence County, operated by the Hanna Coal & Ore Corp., produced sintered magnetite concentrates. This mine was scheduled for abandonment owing to exhaustion of the ore body. The Clinton Metallic Paint Co. continued to produce hematite for use as pigment from mines in Oneida County.

Pennsylvania.—The Bethlehem Steel Co. Cornwall mines and Lebanon concentrator increased production of concentrates, sinter, and pellets 9 percent over 1950, notwithstanding the fact that Cornwall is one of the oldest iron-ore producers in the United States. Rarely during recent years in the United States has a new iron-ore deposit been discovered. Usually, known occurrences are investigated for commercial possibilities. However, modern geophysical exploration revealed a magnetic anomaly of large proportions near Morgantown, Pa., which was later proved by diamond core drilling to be a commercial-grade iron-ore body. The ore was located at a depth of 1,500 to 3,000 feet below the surface, and plans were announced to sink 2 shafts immediately. During the development of the mine, which is expected to require 2 to 3 years, a beneficiating plant will be constructed to produce concentrates of 60 percent-plus iron content.[4] Consumers of iron ore in Pennsylvania are expected to use large quantities of imported ores in the future, most of which will come through the ports of Philadelphia and Baltimore. Present facilities for handling these materials are inadequate, and ore-unloading docks were being constructed in Philadelphia by the Pennsylvania Railroad.[5] In Baltimore, Md., the new unloading dock of the Baltimore & Ohio Railroad was completed and put into service.

Tennessee.—Several small lots of brown ore were shipped from Tennessee deposits in 1951, with prospects for increased output in 1952.

Texas.—Brown-ore deposits in east Texas supplied a slightly smaller tonnage of usable ore than in 1950. This material contains some carbonate, not differentiated in production statistics, which requires calcining after concentration by hydraulic methods. Production for metallurgical use was by the Lone Star Steel Co. and the Sheffield Steel Corp. a subsidiary of Armco Steel Corp.

Utah.—Established producers in Iron County again increased production, which in 1951 exceeded the previous year by over 1.5 million tons, or 51 percent. The Desert Mound mine of the Columbia-Geneva Steel Division, United States Steel Corp., produced 422,000 tons of the increase, which, along with increases at other mines near Cedar City accounted for much of the 2-million-ton increase attributed to Western States.

Virginia.—The American Pigment Corp. continued to produce iron oxides for use as a pigment in making paint.

Wisconsin.—*See* Review of the Lake Superior District.

Wyoming.—The Sunrise mine in Platte County increased output 25 percent over 1950. This ore, classified as direct-shipping grade, undergoes partial treatment after shipment to the Pueblo plant of the Colorado Fuel & Iron Corp.

[4] Engineering and Mining Journal, vol. 152, No. 4, April 1951, p. 125.
[5] American Metal Market, vol. 58, No. 155, Aug. 14, 1951, pp. 1–3.

TABLE 15.—Iron ore mined in the United States in 1951, by State and by county, in gross tons

[Exclusive of ore containing 5 percent or more manganese]

State and county	Active mines	Crude ore	Usable ore
Alabama:			
Bibb	1	950,000	190,511
Blount	1	170,000	34,448
Calhoun	7	579,000	122,037
Cherokee	9	314,449	62,864
Etowah	1	573	573
Franklin	7	3,037,300	629,704
Jefferson	12	7,438,893	7,138,581
Marshall	1	11,000	2,218
St. Clair	1	4,202	4,202
Talladega	4	4,000	855
Total	[1] 44	12,509,417	8,185,993
Arkansas:			
Hot Spring	1	6,047	1,343
Lawrence	1		
Total	2	6,047	1,343
California:			
Riverside	1	1,183,247	1,183,247
San Bernardino	1	15,600	15,600
Total	2	1,198,847	1,198,847
Georgia:			
Bartow	7	1,200,220	240,223
Polk	4	583,300	117,531
Walker	1		
Total	[1] 12	1,783,520	357,754
Michigan:			
Dickinson	2	80,565	80,565
Gogebic	9	3,314,389	3,099,676
Iron	14	4,905,725	4,905,725
Marquette	14	5,617,935	5,617,935
Total	39	13,918,614	13,703,901
Minnesota:			
Crow Wing	16	3,406,543	2,651,724
Fillmore	1	641,846	452,405
Itasca	34	29,907,078	14,502,196
St. Louis	95	66,214,392	60,879,530
Total	146	100,169,859	78,485,855
Missouri:			
Butler	2	46,610	11,556
Crawford	1		
St. Francois	1	557,011	161,020
Wayne	2		
Total	[1] 6	603,621	172,576
Nevada:			
Churchill	1	309,030	309,030
Eureka	1		
Nye	1		
Pershing	2	22,297	22,297
Total	5	331,327	331,327
New Jersey:			
Morris	3	1,166,495	658,745
Warren	1		
Total	4	1,166,495	658,745
New Mexico:			
Grant	1	32,210	32,210
Lincoln	2		
Total	3	32,210	32,210
New York:			
Clinton	1	4,628,499	2,101,712
Essex	3		
Oneida	1		
St. Lawrence	2	3,112,935	1,202,673
Total	7	7,741,434	3,304,385
Pennsylvania:			
Lebanon	1	1,878,743	1,217,829
Tennessee:			
Bradley	1	179,000	35,908
Monroe	2		
Total	3	179,000	35,908
Texas:			
Cass	2	3,447,275	1,102,054
Cherokee	1		
Morris	1		
Total	4	3,447,275	1,102,054
Utah: Iron	6	4,726,159	4,726,159
Virginia: Pulaski	1	7,753	7,753
Wisconsin: Iron	2	1,757,234	1,757,234
Wyoming: Platte	1	616,949	616,949
Puerto Rico	1	39,219	39,219
Grand total	289	152,113,723	115,936,041

[1] Excludes undetermined number of small pits. Estimated output of these mines included in tonnage given.

CONSUMPTION

Consumers of iron ore reported the use of 114.8 million gross tons during 1951, a new record high consumption total that exceeded the previous record (1950) by 8 percent. Blast furnaces used 80 percent of the total, steel furnaces 5, sintering plants 14, and ferroalloy furnaces, cement plants, and pigment and other uses less than 1 percent. The increasing proportion of iron ore going through the sintering

process before final consumption in both iron and steel furnaces is of particular interest. Additional information on this phase of the industry is given in the Sinter section of this chapter. Iron-ore consumption by State and use is shown in table 16.

TABLE 16.—Consumption of iron ore in the United States in 1951, by State and use, in gross tons

[Exclusive of ore containing 5 percent or more manganese]

State	Metallurgical uses				Miscellaneous uses			Total [1]
	Iron blast furnaces	Steel furnaces	Sintering plants	Ferro-alloy furnaces	Cement	Paint	Other	
Alabama	7,549,939	53,021	1,286,218		67,290		308	8,956,776
California	2,785,857	416,495	1,928,312		39,242	(2)	3,739	5,173,645
Colorado								
Utah					(2)			
Illinois	10,409,854	436,195	363,944		435	(2)		11,210,428
Indiana	11,926,942	614,745	910,630	1,342	543			13,454,202
Kentucky	1,084,200	63,836						1,148,036
Maryland	7,366,385	756,583	408,242		(2)	(2)		8,531,210
Massachusetts								
Michigan								
Minnesota	1,125,375	111,896	194,971					1,432,242
New Jersey						(2)	(2)	(2)
New York	5,136,122	383,387	4,269,118	95,519	(2)	(2)	(2)	9,884,146
Ohio	17,303,202	902,212	2,913,687	315,450	4,220	(2)		21,438,771
Pennsylvania	23,362,498	1,718,073	4,394,824	2,132	(2)	47,616		29,525,143
Tennessee	190,040				13,728			203,768
Texas	1,143,648	13,645	125,650		27,609			1,310,552
Virginia					(2)	(2)		(2)
West Virginia	2,264,746	15,571			(2)			2,280,317
Undistributed [3]				10,417	95,537	65,269	116,653	287,876
Total	91,648,808	5,485,659	16,795,596	424,860	248,604	112,885	120,700	114,837,112

[1] State totals include only tonnages shown. Other tonnages included with "Undistributed."
[2] Included with "Undistributed."
[3] Includes States indicated by footnote 2 plus the following: For cement, Arkansas, Arizona, Florida, Idaho, Iowa, Kansas, Missouri, Montana, Oklahoma, Oregon, South Dakota, and Washington; for paint, Georgia, North Dakota, and Wisconsin; and a small tonnage from Nevada as ship ballast and in making refractories.

STOCKS

Mine stocks of usable iron ore on hand December 31, 1951, are shown in table 17. Minnesota, Michigan, and New York mines held the bulk of this ore—44, 35, and 10 percent, respectively, of the total. Including Wisconsin, the Lake Superior district held 82 percent of all mine stocks. Consuming plants reported 40,952,788 gross tons of iron ore on hand at the end of 1951, including 648,527 tons of sinter. Any iron-ore balance calculated from domestic shipments, imports, exports, consumption, and stock changes should consider also stocks of ore at Lake Erie ports (see below) and a reasonable allowance for ore in transit. Additional difficulties involved in obtaining a balance concern recycled materials such as flue dust, mill cinder, and roll scale blended with iron-ore concentrates and fines in the manufacture of sinter.

Stocks at Lake Erie Ports.—Iron ore on Lake Erie docks January 1, 1952, totaled 6,395,884 tons. A month earlier, near the close of the Lake navigation season, these stocks were 6,841,157 tons, according to reports of the Lake Superior Iron Ore Association. During the 4 months December 1, 1951–April 1, 1952, the total was reduced

TABLE 17.—Stocks of usable iron ore at mines, Dec. 31, 1950–51, by States, in gross tons

State	1950	1951	State	1950	1951
Alabama	54,609	44,389	Pennsylvania	5,357	8,153
California	91,346	107,394	Texas	54,132	103,055
Michigan	1,876,036	1,985,840	Utah	60,459	149,379
Minnesota	2,324,731	2,445,286	Virginia	576	1,081
Missouri		110	Wisconsin	124,886	137,000
Nevada		32,317			
New Jersey		815	Total	5,725,569	5,599,466
New York	1,133,437	584,647			

3,471,872 tons to 3,369,285 tons. It should be noted that some furnaces using Lake Superior ores received substantial tonnage via all-rail from Lake Superior mines during this period.

PRICES [6]

The average value per gross ton of iron ore f. o. b. mines and mills was $5.46 in 1951 compared with $4.99 in 1950, and $4.50 in 1949. Table 18 gives the average value at mines of the different types of product and varieties of ore for each of the producing States, except where there are fewer than three shippers of a certain class of ore in a State and where permission has not been given to publish the value. These data are taken directly from statements of producers and probably represent the commercial selling prices only approximately. In general, the delivered cost is given less transportation costs to the consuming plant. In the Lake Superior district the mine value is the Lake Erie price less freight from mines to lower Lake ports. This value appears to be applied also to ore that is not sold on the open market.

Prices of Lake Superior Iron Ore.—Lake Erie base prices for Lake Superior iron ores were effective December 2, 1950, for the 1951 season. An increase of $0.60 per ton over 1950 was accorded for each ore classification which were quoted for 1951 as follows: Old Range Bessemer, $8.70; Old Range non-Bessemer, $8.55; Mesabi Bessemer, $8.45; Mesabi non-Bessemer, $8.30; and High-Phosphorus, $8.30.[7] These prices were for ore delivered at lower Lake ports and based on 51.5 percent iron content (natural) for all grades. Bessemer grades carry 0.045 percent (max.) phosphorus (dry), and High-Phosphorus grades exceed 0.18 percent phosphorus (dry). Premiums and penalties are applied for variations in analyses and physical structure.

Freight Rates.—Transportation charges on iron ore were increased effective August 28, 1951, with interim increases from April 4, 1951, by I. C. C. ex parte 175 of August 27, 1951. The interim changes did not affect rates from upper Lake ranges to lower Lake ports but afforded increases ranging between $0.05 and $0.11 per ton for rail rates to consuming centers from lower Lake ports. Comparing 1950 rates from the Mesabi range to Pittsburgh with 1951 rates after the I. C. C. order, rail rates to upper Lake ports increased $0.063 to $1.113; vessel rates increased $0.012 to $1.662; and rail rates to Pitts-

[6] For an explanation of the factors affecting the price of iron ore, *see* Minerals Yearbook, 1948, p. 647.
[7] Wade, H. H., Mining Directory of Minnesota, 1952: Univ. of Minnesota, Mines Exp. Sta. Bull., vol. 55, No. 19, May 1, 1952, p. 245.

TABLE 18.—Average value per gross ton of iron ore at mines in the United States, 1950–51

[Exclusive of ore containing 5 percent or more manganese]

State	1950							1951						
	Direct			Concentrates				Direct			Concentrates			
	Hematite	Brown ore	Magnetite	Hematite	Brown ore	Magnetite	Sinter	Hematite	Brown ore	Magnetite	Hematite	Brown ore	Magnetite	Sinter
Mined ore:														
Alabama	$3.88	-----	-----	-----	$3.11	-----	(1)	$4.08	-----	-----	-----	$3.29	-----	(1)
Georgia	(1)	-----	-----	-----	3.34	-----	-----	-----	-----	-----	-----	3.74	-----	-----
Michigan	5.64	-----	-----	-----	-----	-----	-----	6.01	-----	-----	$5.10	-----	-----	-----
Minnesota	4.72	-----	-----	$5.09	(1)	(1)	(1)	5.19	-----	-----	5.44	(1)	(1)	(1)
New Jersey	-----	-----	(1)	-----	-----	$9.32	-----	-----	-----	(1)	-----	-----	$11.86	-----
New York	-----	-----	(1)	(1)	-----	7.50	$10.04	-----	-----	(1)	(1)	-----	7.02	$11.71
Pennsylvania	-----	-----	-----	-----	-----	(1)	(1)	-----	-----	-----	-----	-----	(1)	(1)
Utah	-----	-----	$1.85	-----	-----	-----	-----	-----	-----	$2.19	-----	-----	-----	-----
Other States [2]	4.44	$3.50	3.19	7.92	3.09	3.23	(1)	4.91	$11.04	6.52	8.44	5.51	3.64	(1)
Average, all States	4.82	3.50	2.47	5.12	3.42	8.54	8.52	5.23	11.04	3.54	5.46	4.44	9.37	10.47
Byproduct ore: [3]														
Colorado	-----	-----	-----	-----	-----	-----	-----							
Michigan	-----	-----	-----	-----	-----	-----	-----							
Delaware														8.20
Tennessee	-----	-----	-----	-----	-----	-----	7.55	-----	-----	-----	-----	-----	-----	
Virginia														

[1] Included with average for all States.
[2] Includes Arkansas, California, Missouri, Nevada, New Mexico, Tennessee, Texas, Virginia, Wisconsin, Wyoming, and Puerto Rico.
[3] Cinder and sinter obtained from pyrites treated in, but not necessarily mined in, States indicated.

burgh increased $0.1134 to $2.0034. The overall increase totaled $0.1884 per ton, bringing transportation charges to $4.7784. By adding $0.1434 Federal transportation tax and $5.137 average value for Mesabi direct-shipping ore at the mines, the Pittsburgh value for the bulk of Lake Superior ore was calculated at $10.06 per gross ton. The considerable tonnage of ore moved all-rail from Lake Superior mines to lower Lakes consuming centers during 1951 was affected by increases for the interim period, April 4, to August 28 and afterwards. Rates from the Mesabi range to Pittsburgh were $5.63 per ton to April 4, 1951, $5.72 April 4 through August 27, and $5.9678 after August 27, 1951. The difference in rates for ore over the water route after August 27, 1951, as compared with all-rail rates equaled $1.1894 per ton.

Additional details on rates between points and component charges were published.[8]

FOREIGN TRADE [9]

The origin, tonnage, and value of iron ore imported and exported, 1949–51, are shown in tables 19 and 20. Imports increased 23 percent over 1950 and continued the trend toward greater use in the United States of foreign iron ores. Although initial shipments of 635,416 tons were received from Bethlehem Steel's El Pao mine in Venezuela, the increase does not reflect the upsurge expected in imported ore

[8] Lake Superior Iron Ore Assoc., Revised Freight Rate Table: Cleveland, May 28, 1951, and Sept. 1, 1951.
[9] Figures on imports and exports compiled by M. B. Price and E. D. Page, of the Bureau of Mines, from records of the U. S. Department of Commerce.

when shipments begin from the Quebec-Labrador and Cerro Bolivar developments. Chile maintained its position as leading foreign supplier, with 27 percent of total receipts in 1951. Sweden was a close second, with 25 percent, followed by Canada, 20 percent; and Brazil, 10 percent. Of 12 other sources (together supplying the remaining 18 percent), Venezuela exceeded one-half million tons and Algeria approached that level, leaving 10 of the 16 sources supplying less than 8 percent of all receipts. Exports were highlighted by Japan's return to the market for United States iron ore. The 954,842

TABLE 19.—Iron ore imported for consumption in the United States, 1949–51, by countries, in gross tons [1]

[U. S. Department of Commerce]

Country	1949		1950		1951	
	Gross tons	Value	Gross tons	Value	Gross tons	Value
Algeria	415,501	$2,349,746	494,342	$2,917,910	446,273	$2,919,490
Argentina	20	24,809				
Brazil	351,134	2,281,797	[2] 701,329	[2] 4,732,136	1,037,828	8,963,341
British West Africa	59,548	395,034	192,669	1,615,728	255,817	1,586,940
Canada	1,615,803	10,742,201	[2] 1,852,508	[2] 12,728,135	1,968,466	14,435,644
Chile	2,627,007	6,891,016	[2] 2,606,557	[2] 6,821,829	2,767,207	8,587,746
Cuba	11,589	24,763	29,000	61,770	4,502	65,410
Egypt	7,500	88,650				
France			500	1,550		
Iran	1,500	90,000	3,000	180,000	1,500	60,000
Liberia	30	105	(3)	51	110,123	552,694
Mexico	169,823	284,557	190,958	475,299	169,563	506,482
Netherlands	7,114	64,026				
Philippines	5,250	51,816	3,600	36,000		
Spain	9,200	78,658			74,306	599,350
Spanish Africa			39,680	[2] 250,717	8,750	62,335
Sweden	2,027,155	12,893,385	[2] 2,047,250	[2] 13,511,874	2,520,993	16,914,666
Tunisia	82,815	424,076	119,093	608,377	134,775	528,617
Venezuela					635,416	3,780,692
Union of South Africa					9,450	35,343
United Kingdom	302	22,895	751	27,050	446	28,837
Total	7,391,291	36,707,534	[2] 8,281,237	[2] 43,968,426	10,145,415	59,627,587

[1] In addition 7,588 tons of pyrites cinder valued at $27,601 were imported in 1949; 15,735 tons ($58,260) in 1950; and 8,675 tons ($34,758) in 1951; all from Canada.
[2] Revised figure.
[3] Less than 0.5 ton.

TABLE 20.—Iron ore exported from the United States, 1949–51, by country of destination, in gross tons

[U. S. Department of Commerce]

Destination	1949		1950		1951	
	Gross tons	Value	Gross tons	Value	Gross tons	Value
Australia	12	$3,109	7	$2,748	4	$1,439
Brazil					4	326
Canada	2,168,763	12,312,318	[1] 2,550,712	[1] 15,709,693	3,340,171	21,734,997
Canal Zone	9	200			4	138
Gold Coast			1	463		
Japan	251,791	2,293,560			954,842	8,871,222
Mexico					46	127
Netherlands	75	5,804				
Norway	75	788			854	11,129
Philippines	4,047	36,806	7	639	4	485
United Kingdom	3	1,232	11	2,966	9	2,200
Total	2,424,775	14,653,817	[1] 2,550,738	[1] 15,716,509	4,295,938	30,622,063

[1] Revised figure.

tons shipped to Japan and a 31-percent increase over 1950 in iron ore to Canada accounted for virtually all of the 68-percent increase in exports. Seven other countries received 925 tons in total.

BENEFICIATION

Shipments of beneficiated iron ore increased 15 percent over 1950. However, owing to a larger increase in direct shipments, the proportion of treated ore dropped to 26.5 percent compared with 27.5 percent in 1950. Table 21 shows tonnages of beneficiated iron ore, total shipments, and proportion of beneficiated ore since 1925.

Plans of the Erie Mining Co., Reserve Mining Co., and Oliver Iron Mining Div., United States Steel Corp., for the construction of taconite-beneficiation facilities proceeded during 1951. Reserve Mining Co. highlighted the taconite-development program with the announcement of a decision to construct a commercial plant of 2.5 million tons annual capacity for finished product. Mining and crushing facilities will be at Babbitt, Minn., with a new railroad 47 miles to Beaver Bay where the concentrating plant and ore-loading docks will be constructed.[10] Three contracting companies have combined and contracted to build the project managed by Oglebay, Norton & Co. for Reserve Mining Co. Plans included provisions to enlarge the plant as required to 10 million tons annual capacity. Ultimate cost of the initial phase was expected to exceed $75 million.[11] Oliver began its development program in 1950 with the construction of an agglomerating plant at Virginia, Minn. On May 17, 1951, ground was broken for the construction of a 500,000-ton taconite-beneficiation pilot plant at Mountain Iron, Minn. This company's program is long range and comprehensive, including research on various phases of taconite production, as well as treatment of high-grade fine ores and presently treated ores.[12] Erie Mining Co. continued to operate its pilot plant for concentrating and agglomerating taconite at Aurora, Minn., while preparing plans for the construction of commercial-scale facilities.

Michigan low-grade iron deposits, comparable in some respects to Mesabi taconite, were scheduled for increasing attention. Cleveland-Cliffs Iron Co. and Ford Motor Co. announced plans to construct a plant on the Marquette range at Humboldt, Mich., capable of producing 200,000 tons of concentrate annually. The product will be sintered at Detroit initially, but plans included possible agglomeration before shipment when proved feasible.[13] Of particular interest is the fact that Michigan low-grade ores are nonmagnetic, requiring entirely different beneficiating methods than magnetic taconite. Flotation will be used at Humboldt and for the first time in an iron-ore operation larger than laboratory scale. Results of the operation will carry substantial significance relative to the possibility of using flotation methods on other fine-size nonmagnetic ores.

Eastern magnetite produced in New Jersey and New York carries a nonmagnetic component, termed "martite," disseminated with the magnetite. In some deposits it constitutes a substantial percentage

[10] Engineering and Mining Journal, vol. 152, No. 11, November 1951, pp. 102–103.
[11] Mining World, vol. 13, No. 12, November 1951, p. 74.
[12] Mining World, vol. 13, No. 8, July 1951, p. 74.
[13] American Metal Market, vol. 58, No. 223, November 22, 1951, p. 1.

of the ore, which is lost if only magnetic methods are used. Wilfley tables have been used extensively; but to improve recovery, Jones & Laughlin Ore Co. was installing at its Benson Mine a production-scale bank of Humphrey spirals late in 1951.[14] These wet-gravity concentrators are operating successfully on fine-size material in Minnesota and Michigan.

Heavy-medium separators are finding new application in Alabama in the recovery of brown ores failing to respond to washing methods, and new variations in heavy-medium-type equipment have appeared in the Lake Superior district. In general, this type of treatment has proved most satisfactory for beneficiating ore in which the iron-bearing particles are free in sizes between ⅛ inch to 3 inches. Sizes smaller than ⅛ inch not responding to magnetic separation constitute a major beneficiation problem and are receiving attention from research efforts. Recent developments in heavy-medium methods were described.[15]

TABLE 21.—Beneficiated iron ore shipped from mines in the United States, 1925–29 (average) and 1930–51, in gross tons

[Exclusive of ore containing 5 percent or more manganese]

Year	Beneficiated	Total	Proportion of beneficiated to total (percent)	Year	Beneficiated	Total	Proportion of beneficiated to total (percent)
1925–29 (av.)	8,653,590	66,697,126	13.0	1941	19,376,120	93,053,994	20.8
1930	8,973,888	55,201,221	16.3	1942	23,104,945	105,313,653	21.9
1931	4,676,364	28,516,032	16.4	1943	20,117,685	98,817,470	20.4
1932	407,486	5,331,201	7.6	1944	20,303,422	94,544,635	21.5
1933	3,555,892	24,624,285	14.4	1945	19,586,782	87,580,942	22.4
1934	4,145,590	25,792,606	16.1	1946	15,588,763	69,494,052	22.4
1935	6,066,601	33,426,486	18.2	1947	21,407,760	92,670,188	23.1
1936	9,658,699	51,465,648	18.8	1948	23,629,265	100,274,965	23.6
1937	12,350,136	72,347,785	17.1	1949	20,658,232	84,174,399	24.5
1938	4,836,435	26,430,910	18.3	1950	26,717,928	97,150,704	27.5
1939	9,425,809	54,827,100	17.2	1951	30,664,648	115,660,775	26.5
1940	12,925,741	75,198,084	17.2				

EMPLOYMENT

The average number of workers employed at iron-ore-producing mines and mills in 1951 increased 9 percent over 1950, according to preliminary estimates. The total man-hours worked was estimated at 75,120,000, an increase of 14 percent, which compares with the 19-percent production increase. The indicated average output of usable ore per man-hour was 1.557 tons (115,936,041 tons of iron ore plus 1,007,611 tons of manganiferous iron ore divided by estimated man-hours) compared with 1.492 tons in 1950 and 1.378 in 1949.

The above data and table 22 include, in the Lake Superior district, manganiferous ore, which the trade considers a special grade of iron ore.

[14] Mining World, vol. 13, No. 11, October 1951, p. 49.
[15] Erck, L. J., Operating Factors and Recent Developments in the Heavy-Media Process: Min. Jour., vol. 236, No. 6028, March 2, 1951, pp. 199–202.

TABLE 22.—Employment at iron-ore mines and beneficiating plants, quantity and tenor of ore produced, and average output per man in 1950, by district and State [1]

District and State	Employment					Production									
		Time employed					Usable ore			Average per man (gross tons)					
				Man-hours				Iron contained		Crude ore		Usable ore			
	Average number of men employed	Average number of days	Total man shifts	Average per shift	Total	Crude ore (gross tons)	Gross tons	Gross tons	Percent natural	Per shift	Per hour	Per shift	Per hour	Iron contained Per shift	Iron contained Per hour
Lake Superior: [1]															
Michigan, Wisconsin	8,300	260	2,154,249	8.00	17,236,637	14,502,686	14,502,686	7,451,129	51.38	6.732	0.841	6.732	0.841	3.459	0.432
Minnesota	12,537	279	3,497,987	8.02	28,037,822	82,997,216	66,063,403	32,525,462	49.23	23.727	2.960	18.886	2.356	9.298	1.160
Total	20,837	271	5,652,236	8.01	45,274,459	97,499,902	80,566,089	39,976,591	49.62	17.250	2.154	14.254	1.780	7.073	.883
Southeastern States: [2]															
Alabama	5,330	240	1,279,989	8.10	10,370,038	10,885,487	7,299,744	2,731,335	37.42	8.504	1.050	5.703	.704	2.134	.263
Georgia	131	200	26,218	9.74	255,278	999,213	202,427	76,885	37.98	38.112	3.914	7.721	.793	2.933	.301
Total	5,461	239	1,306,207	8.13	10,625,316	11,884,700	7,502,171	2,808,220	37.43	9.099	1.119	5.743	.706	2.150	.264
Northeastern States:															
New Jersey	862	243	209,463	7.94	1,662,178	1,090,826	586,347	364,499	62.16	5.208	.656	2.799	.353	1.740	.219
New York, Pennsylvania	2,615	276	721,478	8.03	5,791,513	8,484,962	3,888,487	2,371,531	60.99	11.761	1.465	5.390	.671	3.287	.409
Total	3,477	268	930,941	8.01	7,453,691	9,575,788	4,474,834	2,736,030	61.14	10.286	1.285	4.807	.600	2.939	.367
Western States:															
California, Nevada	189	245	46,271	8.00	370,161	836,910	836,910	453,745	54.22	18.087	2.261	18.087	2.261	9.800	1.226
Arkansas, Missouri	184	252	46,339	8.00	370,784	610,134	195,582	109,246	55.86	13.167	1.646	4.221	.527	2.358	.295
New Mexico, Texas	344	251	86,235	8.00	689,878	2,614,007	1,196,431	490,996	41.04	30.313	3.789	13.874	1.734	5.694	.712
Wyoming, Utah	595	258	153.288	7.77	1,190,309	3,631,832	3,631,832	1,933,303	53.23	23.693	3.051	23.693	3.051	12.612	1.624
Total	1,312	253	332,133	7.89	2,621,132	7,692,883	5,860,755	2,987,290	50.97	23.162	2.935	17.646	2.236	8.994	1.140
Total 1950 [2]	31,087	264	8,221,517	8.02	65,974,598	126,678,273	98,409,186	48,509,839	49.29	15.408	1.920	11.970	1.492	5.900	.735

[1] Includes manganese-bearing ore from the Lake Superior district.
[2] Man-hour data for Virginia are not available and are therefore excluded from all totals; however, production data for Virginia (5,337 tons of usable ore) are included with total production.

WORLD REVIEW

World production of iron ore, 1946–51, by countries, is shown in table 24. The 1951 estimates indicate an increase over 1950 of 19 percent, much of which was attributable to the United States, but a general rise was apparent throughout the world.

CANADA

Much of the information in this section is from Preliminary Report on Mineral Production, 1951, of the Dominion Bureau of Statistics, Department of Trade and Commerce, Ottawa.

Iron-ore production and shipments rose from 3,271,000 metric tons in 1950 to 4,297,000 tons in 1951, an increase of 31 percent and a new all-time record high for Canada, but small when compared with the tonnages expected within the next decade.

British Columbia.—The Argonaut Mining Co. Ltd., a subsidiary of Utah Construction Co., together with an affiliated operation, produced and shipped to Japan 109,000 metric tons of iron-ore concentrates from deposits on Vancouver and Texada Islands.

Labrador-Quebec.—Development of major iron deposts continued in 1951. Progress was detailed in an address by W. H. Durrell, general manager of the Iron Ore Co. of Canada, in an address delivered before the Hamilton branch, Engineering Institute of Canada, January 19, 1952. Durrell emphasized that development was on schedule and that initial shipments could be expected "not later than the late summer of 1954." Describing the railroad under construction and its projected operation, he said:

> Loaded trains will consist of 115 cars, 14,000 trailing tons hauled by locomotives of 6,000 h. p. Tentative running times are 14 hours for loaded trains and 12 hours for empty trains. To handle 10,000,000 tons in the operating season we will be required to operate approximately seven trains in each direction per day. The operation will require 55 diesel units, 20 cabooses, 2,400 ore cars (95 tons), and for construction and future maintenance, in addition to the above, we require 175 ballast cars, 50 boarding cars, 20 air dump cars, 100 flat cars, 15 tank cars, and 20 box cars.

Newfoundland.—The Wabana iron mines produced 1,622,000 metric tons of iron ore in 1951 and completed mechanization of the operation. Reserves are large in this bedded deposit of fossiliferous hematite. However, the market is limited to works having facilities for smelting high-phosphorus ores.

Ontario.—Steep Rock iron mines in the Atikokan district produced 1,348,000 metric tons of iron ore in 1951. Development continued toward the objective of 100 million tons of delineated reserve and eventual annual production of 10 million tons. The more immediate objective was an output rate of 3 million tons by 1955 from Errington open-pit and underground mines and the Hogarth open-pit. Algoma Ore Properties, Ltd., produced and sintered an estimated 1,218,000 tons of iron ore from the Helen mine which, with the Atikokan output, totaled 2,566,000 tons for Ontario, an all-time record high, with an increase of 16 percent over 1950. At Marmora, Hastings County, Ontario, the Bethlehem Steel Co. was exploring magnetite deposits of the Adirondack type; and in the Michipicoten district near Algoma's Helen mine, the Jalore Mining Co. was drilling siderite deposits on property owned by Frobisher, Ltd.

OTHER COUNTRIES

Brazil.—The lumpy iron ore, which constitutes most of Brazil's iron-ore exports, is a top-grade product greatly in demand for consumption in open-hearth steel furnaces. It commands the highest prices, which limit to some extent the magnitude of exports to the United States as well as other countries. In 1951 Brazil produced 2,555,000 metric tons of iron ore, of which the United States received 1,054,000 tons. Not all of the production was of open-hearth grade, a substantial tonnage having been consumed in domestic blast furnaces.

Chile.—The Tofo mine operated by Bethlehem Chile Iron Mines Co. produced 3,252,000 metric tons of iron ore, of which 2,812,000 tons moved to the United States.

Liberia.—After several years of development work, including the construction of a railroad and dock facilities, the Liberia Mining Co. shipped its first boatload of open-hearth-grade iron ore to the United States in June 1951. From surface deposits at Bomi Hills, 45 miles from Liberia's capital and port, Monrovia, the company expects to export about 1 million tons annually. Total receipts of Liberian ore in the United States during 1951 were 111,890 metric tons.

Peru.—A potential source of iron ore for United States furnaces was planned for development by the Utah Construction Co. of San Francisco.[16] The contract signed between the Peruvian Government and Utah Construction Co. provided a 20-year mining concession with an agreement to supply about 300,000 tons per year to an electric furnace not yet installed at Chimbote, 300 miles north of Lima. The deposit is some 300 miles south of Lima but only 15 miles from the coast.

Sweden.—Iron-ore production increased 16 percent to 16,111,000 metric tons in Sweden during 1951. The United States received 2,561,000 tons, and the remainder went to domestic and European furnaces. The Kiruna, Malmberget, and Grangeburg deposits were discussed.[17]

Venezuela.—The Pao iron-ore deposit 30 miles from San Felix on the south bank of the Orinoco River began shipments in 1951 after 15 years of exploration and development. Operated by the Iron Mines Co. of Venezuela, El Pao will supply ore to Bethlehem Steel's furnaces and eventually supplant ore now coming from Chile. Although production began in 1950, the first boatload of ore arrived at Sparrows Point, Md., on Bethlehem's S. S. *Bethore*, March 22, 1951. Production totaled 1,270,000 metric tons in 1951, and receipts at Sparrows Point were 646,000 tons. This source is one of the important new deposits scheduled to supply the United States expanding requirements for iron ore.[18]

A larger Venezuelan deposit, Cerro Bolivar is under development by the United States Steel Corp. and is expected to begin shipments before 1955.[19]

[16] American Metal Market, vol. 59, No. 39, Feb. 27, 1951, pp. 1–3.
[17] Mining Journal (London) vol. 237, Nos. 6060 and 6061, Oct. 12 and Oct. 19, 1951.
[18] Mining Congress Journal, vol. 37, No. 4, April 1951, pp. 118–124.
[19] Lippert, T. W., Cerro Bolivar, Saga of an Iron-Ore Crisis Averted: Min. Eng., vol. 187, No. 2, February 1950, pp. 178–192.

TABLE 23.—World production of iron ore, 1946–51, by countries, in thousands of metric tons [1]

[Compiled by Pauline Roberts]

Country [1]	1946	1947	1948	1949	1950	1951
North America:						
Canada	1,406	1,741	1,213	3,334	[2] 3,271	4,297
Newfoundland	1,264	1,467	1,492			
Cuba		63	37	12	12	17
Mexico	275	332	333	363	420	460
United States	71,980	94,586	102,625	86,301	[2] 99,619	118,375
South America:						
Argentina	55	61	[3]	[3]	[3]	[3]
Brazil	518	927	[2] 1,572	[2] 1,888	[2] 2,057	2,555
Chile [4]	1,353	1,608	2,545	2,597	2,976	3,252
Venezuela					190	1,270
Europe:						
Austria	462	885	1,269	1,488	1,859	2,370
Belgium	40	58	[2] 89	42	46	79
Czechoslovakia	1,116	1,363	1,428	[5] 1,400	[5] 1,600	[3]
France [6]	16,232	18,719	23,061	31,424	[2] 29,983	35,264
Germany:						
East Germany [7]	236	283	[5] 250	[5] 250	[5] 328	[3]
West Germany [7]	3,904	4,463	7,276	9,112	10,882	12,923
Greece (exports)	13	41	47	22	41	56
Hungary	133	244	318	339	368	[3]
Italy	132	[2] 227	[2] 549	521	442	515
Luxembourg	2,247	1,992	3,399	4,137	3,845	5,625
Norway	60	128	199	[2] 275	[2] 304	353
Poland	395	504	659	699	790	[5] 850
Rumania	112	121	[5] 209	[5] 324	[5] 395	[5] 510
Spain	1,596	1,514	1,631	1,876	[2] 2,088	2,316
Sweden	6,867	[2] 8,894	[2] 13,286	[2] 13,729	13,927	16,111
Switzerland	18	45	75	70	55	86
U. S. S. R. [8]	[5] 21,000	[5] 24,000	[3]	[3]	[3]	[3]
United Kingdom: Great Britain [9]	12,368	11,269	13,299	13,612	[2] 13,143	14,882
Yugoslavia	399	739	879	835	[2] 826	581
Asia:						
China	[10] 15	[10] 19	[5] [10] 247	[5] 500	[5] 2,000	[5] 3,000
Hong Kong			1	59	169	161
India	2,446	2,539	2,321	2,854	[2] 3,005	3,714
Japan [11]	566	500	561	[2] 794	[2] 927	1,099
Korea, north	[5] 75	[5] 93	[5] 200	[3]	[3]	[3]
Malaya	[12]	1	1	9	507	851
Philippines			18	370	599	903
Portuguese India			8	151	131	436
Thailand					3	7
Turkey	112	149	192	211	234	226
U. S. S. R.	[3]	[3]	[3]	[3]	[3]	[3]
Africa:						
Algeria	1,671	1,558	1,872	2,538	2,573	2,815
French Morocco	125	[2] 154	[2] 301	357	319	533
Liberia						171
Northern Rhodesia	[12]	2	[12]	2		
Sierra Leone	741	854	968	[13] 1,001	1,185	[3]
Southern Rhodesia		[12]	30	51	57	58
Spanish Morocco	787	869	[2] 885	[2] 893	[2] 951	948
Tunisia	184	404	[2] 696	712	758	923
Union of South Africa	947	1,162	1,164	1,242	1,189	1,421
Oceania:						
Australia	1,849	2,181	2,077	1,484	2,403	2,468
New Caledonia					15	
New Zealand	8	6	5	4	4	3
Total (estimate)	154,000	187,000	217,000	220,000	[2] 247,000	293,000

[1] In addition to countries listed, Bulgaria, Egypt, Madagascar, Portugal, and South-West Africa report production of iron ore in past years, but quantity produced is believed insufficient to affect estimate of world total.
[2] Revised figure.
[3] Data not available; estimate by author of chapter included in total.
[4] Production of Tofo mines.
[5] Estimate.
[6] Including Moselle (Lorraine).
[7] Exclusive of manganiferous iron ore carrying 12 to 30 percent manganese.
[8] U. S. S. R. in Asia included with U. S. S. R. in Europe.
[9] Exclusive of bog ore, which is used mainly for purification of gas.
[10] Production of National Resources Commission only.
[11] Includes iron-sand production as follows: 1946, 10,472 tons; 1947, 3,772 tons; 1948, 2,588 tons; 1949, 33,120 tons (revised); 1950, 101,544 tons (revised); 1951, 213,924 tons.
[12] Less than 500 tons.
[13] Marketable ore only; washed fines are excluded.

Iron and Steel

By Norwood B. Melcher, Jachin M. Forbes and James C. O. Harris

GENERAL SUMMARY

PRODUCTION of steel in the United States in 1951 reached an all-time high of over 105 million net tons. For the first time in the history of this country, the production exceeded rated capacity on an annual basis. The percentage of capacity for 1951 was 100.9; the previous high was 98.1 percent in 1943. The major factors that contributed to this high production rate were the 4-percent capacity increase during the year, not reflected in the high operating rate; the decrease in charging and rebuild time for furnaces; improved refractories; the jet tapper; and the use of oxygen in the open-hearth bath.

Bethlehem Steel Corp. led all companies in net capacity increase in 1951, with an 800,000-ton gain after subtracting 240,000 tons of discontinued Bessemer capacity. United States Steel Corp. was second with a gain of 774,000 tons. Year-end plans called for a 120-million-ton capacity at all United States plants by the end of 1953. This would be an increase of about 20 million tons over December 31, 1950. United States Steel Corp. planned the greatest single capacity

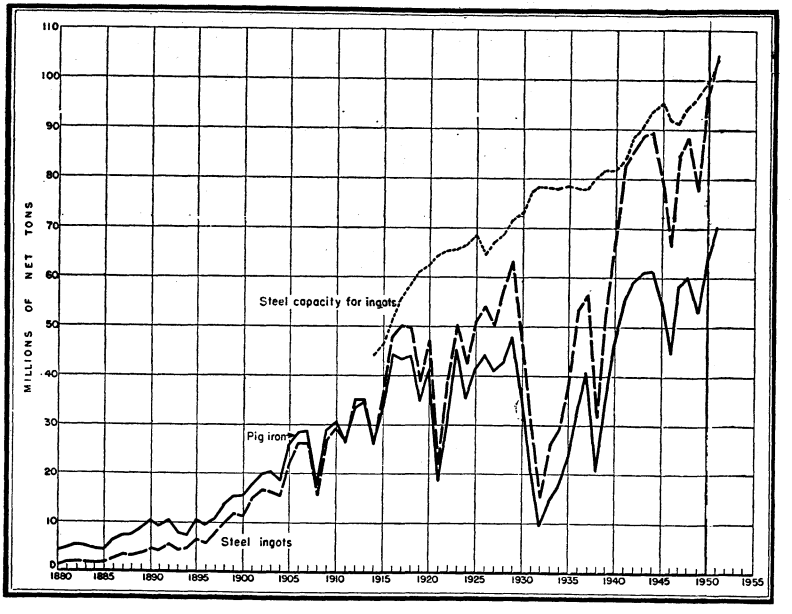

FIGURE 1.—Production of pig iron and steel ingots and steel capacity for ingots, in the United States, 1880–1951.

increase in 1952, with 1.8 million tons at its Morrisville, Pa., Fairless works; 500,000 tons at its Fairfield, Ala., works; and smaller increases at other plants.

Among the various industries receiving steel, the automotive industry showed the greatest change in receipts of steel. In 1951, during which passenger-car output dropped 20 percent (although truck production held its own), that industry received 16.7 percent (12,982,356 tons) of all steel shipments compared with 20.4 percent in 1950 and 19.4 percent in 1949. The rail-transportation industry, with freight-car loadings the greatest since 1948, increased its proportion of total shipments of steel received from 6.1 percent in 1950 to 7.4 percent in 1951. Ordnance and other military industries received 1.5 percent of the total shipments in 1951 compared with 0.3 percent in 1950, while the proportion received by the shipbuilding and marine-equipment industry more than doubled (1.1 percent compared with 0.5 percent in 1950).[1]

According to the records of the United States Department of Commerce, the total weight of semimanufactured and manufactured steel products exported exceeded the 1950 figure. Among such products, exports of steel ingots, blooms, billets, slabs, sheet bars, iron bars, concrete-reinforcing bars, iron and steel (uncoated), and wire nails more than doubled. Exports of welded galvanized pipes and tubes decreased considerably. Exports of all structural shapes combined increased, but those of fabricated structural shapes decreased somewhat.

TABLE 1.—Salient statistics of iron and steel in the United States, 1947–51, in net (short) tons

	1947	1948	1949	1950	1951
Pig iron:					
Production	58,327,231	60,073,140	53,323,142	64,499,983	70,277,938
Shipments	58,367,510	60,051,350	52,919,019	64,626,146	70,250,379
Imports	32,624	219,252	99,804	[1] 804,799	1,066,513
Exports	[1] 10,940	7,032	81,309	6,813	6,555
Steel: [2]					
Production of ingots and castings:					
Open-hearth:					
Basic	76,209,268	78,714,852	69,742,110	85,661,651	92,387,447
Acid	664,525	625,305	506,693	600,858	779,071
Bessemer	4,232,543	4,243,172	3,946,656	4,534,558	4,890,946
Crucible	18	5,057,141	3,782,717	6,039,008	7,142,384
Electric	3,787,717				
Total	84,894,071	88,640,470	77,978,176	96,836,075	105,199,848
Capacity, annual, as of Jan. 1	91,241,250	94,233,460	96,120,930	99,392,800	104,229,650
Percent of capacity	93.0	94.1	81.1	[1] 97.4	100.9
Production of alloy steel: [3]					
Stainless	519,933	617,378	455,093	832,309	933,730
Other than stainless	6,908,298	7,863,736	5,442,476	7,737,796	9,190,857
Total	7,428,231	8,481,114	5,897,569	8,570,105	10,124,587
Shipments of steel products:					
For domestic consumption	58,850,458	62,728,250	54,586,039	69,665,819	76,164,539
For export	4,206,692	3,244,888	3,517,971	2,566,473	2,764,411
Total	63,057,150	65,973,138	58,104,010	72,232,292	78,928,950

[1] Revised figure.
[2] American Iron and Steel Institute.
[3] Included in production of ingots and castings.

[1] Proportions are based on shipments for which consuming industry was reported; these shipments were somewhat less than those shown in table 1

According to data compiled by the Bureau of Labor Statistics each employee in the steel industry averaged 41.1 hours of work weekly compared with 39.9 in 1950 and 37.9 hours in 1949. Average hourly earnings per worker were $1.885 compared with $1.689 in 1950 and $1.703 in 1949. There was a gradual increase in employment during 1951, beginning with 559,000 in January and ending with 573,000 in December. The composite price of finished steel, as published by the Iron Age (4.131 cents per pound) remained the same throughout 1951, the last increase being in December 1950.

GOVERNMENT REGULATIONS

The first materials control order (the M order series of NPA) was M–1–Steel, issued October 12, 1950, by the National Production Authority. This order established the general rules for the acceptance and delivery of priority-rated orders received by the producers of the different types of steel, such as bars, pipe, plates, rail, and tin plate. It governed the distribution of steel, except in several special fields, until the Controlled Materials Plan regulations were issued in May and June 1951 to be effective for the third quarter 1951. M–1 was amended numerous times to take care of special programs, such as the freight-car program, and further to define the different steel products controlled by its provisions.

On November 8, 1950, NPA issued M–6 (later M–6A), Steel Distributors, which established the rules for the distribution of the various steel products to steel warehouses and also the distribution of these products by the steel warehouses. The regulation was needed to insure a steady flow of material to these warehouses, so that the small users who bought less than mill quantities could be assured of a continued supply through normal channels.

Owing to a serious shortage of steel scrap which developed in the latter part of 1950, NPA found it necessary on January 4, 1951, to issue M–20, Iron and Steel Scrap. This order, as originally issued, established a 60-day inventory limitation on steel scrap. Later, it was amended to permit the NPA to direct the shipment of scrap held by scrap dealers to selected users. The regulation also contained certain technical provisions, such as segregation of different types of scrap.

On March 7, 1951, NPA issued M–47 (later M–47–A and M–47–B), Use of Iron and Steel. This regulation limited the use of these materials in the consumers' durable goods field to a percentage of a base-period use.

With the advent of the Controlled Materials Plan in the second quarter of 1951, the distribution of steel, along with copper and aluminum, was made subject to its regulations. When in full operation, this plan called for filing applications for steel, both for production and construction, by all users except for certain small-user exemptions. Certain other orders were issued, such as M–80 and its schedules on Alloying Materials and Alloy Products, which affected the distribution, use, and inventories of steel. Another type of action should be mentioned. NPA from time to time issued production directives to the mills to produce certain quantities of certain items of steel in short supply and also required the mills to set aside certain percentages of their production for direct defense and AEC orders.

In addition to the orders described above, numerous orders were issued to take care of special problems with regard to use of steel in certain industries such as mining, petroleum, transportation, and power.

PRODUCTION AND SHIPMENTS OF PIG IRON

Domestic production of pig iron, exclusive of ferro-alloys, was 70.3 million net tons in 1951, 9 percent greater than in 1950 and 32 percent more than in 1949. Pig-iron production in 1951 consumed 97.3 million net tons of domestic iron and manganiferous ores and 6.5 million tons of foreign ores, with 62 percent coming from Chile and Sweden; about 0.5 million tons of iron ore was received from Venezuela, a new source for the United States. Blast furnaces consumed 23.5 million tons of sinter and 10.2 million tons of miscellaneous iron-bearing materials. In addition to the above raw materials, 1,997,054 tons of home scrap and 505,331 tons of flue dust were used.

Shipments of pig iron were 70.3 million tons in 1951, 9 percent over 1950 and 33 percent over 1949.

The figures in table 4 cover total shipments, which consist predominantly of molten pig iron transferred to steel furnaces on the site. Values for merchant pig iron are included. However, the average value per ton of pig iron is lower than market prices published in trade journals because handling charges, selling commissions, freight costs, and other related costs are not included. The term "shipped," as distinguished from "production," refers, in the case of on-site transfers, to departmental transfers, upon which value is placed for bookkeeping purposes rather than to actual sales, as in the case of merchant pig iron.

TABLE 2.—Pig iron produced and shipped in the United States, 1950–51, by States

State	Produced		Shipped from furnaces			
			1950		1951	
	1950 (net tons)	1951 (net tons)	Net tons	Value	Net tons	Value
Alabama	4,347,331	4,370,527	4,307,035	$167,984,326	4,384,286	$192,359,317
California	660,463	921,695	667,145	139,453,422	919,877	178,012,998
Colorado	2,572,895	2,866,062	2,577,127		2,881,411	
Texas						
Utah						
Illinois	6,035,333	6,575,674	6,038,572	258,242,109	6,592,721	306,764,003
Indiana	7,018,237	7,759,741	7,012,970	297,568,747	7,699,783	358,743,571
Kentucky	753,855	766,344	753,855	(1)	766,344	(1)
Maryland	3,525,694	3,658,335	3,525,475	(1)	3,657,171	(1)
Massachusetts	147,511	186,296	181,998	(1)	182,184	(1)
Michigan	2,189,696	2,207,665	2,157,298	(1)	2,163,862	(1)
Minnesota	639,774	697,101	652,267	(1)	696,228	(1)
New York	4,154,039	4,512,389	4,221,534	180,158,268	4,542,343	218,058,754
Ohio	12,510,703	13,710,153	12,521,354	530,707,544	13,725,969	626,822,217
Pennsylvania	18,239,608	20,211,510	18,300,347	788,496,589	20,205,913	951,282,026
Tennessee	1,704,844	1,834,446	1,709,169	(1)	1,832,287	(1)
West Virginia						
Undistributed [1]				406,790,469		452,066,935
Total	64,499,983	70,277,938	64,626,146	2,769,401,474	70,250,379	3,284,109,821

[1] Data that may not be shown separately because they would reveal individual company operations are combined as "Undistributed."

TABLE 3.—Foreign iron ore and manganiferous iron ore consumed in the manufacture of pig iron in the United States, 1950–51, by source of ore, in net tons

Source	1950	1951	Source	1950	1951
Africa	1,033,852	614,743	Mexico	246,976	185,536
Brazil	86,967	233,046	Sweden	1,006,029	1,067,691
Canada	1,025,718	910,639	Venezuela		451,692
Chile	3,207,715	2,977,266	Unclassified	28,163	39,239
Cuba		16,898			
India		2,095	Total	6,635,420	6,498,845

TABLE 4.—Pig iron shipped from blast furnaces in the United States, 1950–51, by grades [1]

Grade	1950			1951		
	Net tons	Value		Net tons	Value	
		Total	Average		Total	Average
Foundry	3,221,744	$134,068,514	$41.61	3,371,400	$154,735,170	$45.90
Basic	50,546,029	2,162,481,670	42.78	55,045,515	2,571,504,501	46.72
Bessemer	7,385,236	320,747,035	43.43	8,191,237	383,395,106	46.81
Low-phosphorus	304,259	14,655,875	48.17	327,570	17,756,536	54.21
Malleable	2,995,210	129,650,167	43.29	3,106,087	146,691,219	47.23
All other (not ferroalloys)	173,668	7,798,213	44.90	208,570	10,027,289	48.08
Total	64,626,146	2,769,401,474	42.85	70,250,379	3,284,109,821	46.75

[1] Includes pig iron transferred directly to steel furnaces at same site.

Metalliferous Materials Used.—The production of pig iron in 1951 required 127,285,286 net tons of iron ore, sinter, and manganiferous iron ore; 3,723,803 net tons of mill cinder and roll scale; 3,697,161 net tons of open-hearth and Bessemer slags; 2,681,466 tons of purchased scrap; and 113,825 tons of other materials—an average of 1.957 tons of metalliferous materials (exclusive of home scrap and flue dust) per ton of pig iron made.

Alabama furnaces used red hematite from the Birmingham district and brown ores from Alabama and Georgia, as well as hematite from Missouri and the Lake Superior region. Foreign iron ore from Africa, Brazil, and Sweden, and foreign manganese-bearing ores from Africa, Brazil, Cuba, and India were also used.

Most of the iron ore used at Sparrows Point, Md., was of foreign origin. The sources were Africa, Chile, Cuba, Sweden, and Venezuela; manganiferous ores were received from Africa.

Republic Steel Corp., at Troy, N. Y., received manganiferous ores from South Africa and iron ores from the Adirondack district.

Colorado Fuel and Iron Corp. (E. & G. Brooke Iron Division), Birdsboro, Pa., used iron ore and manganiferous ore from Africa and iron ore from New Jersey.

Texas blast furnaces used domestic ore from various sources and foreign ores from Mexico and Brazil. Manganiferous ores from Mexico and India were also used.

Utah furnaces used iron ore from Iron County, Utah, and manganiferous ore from Nevada and Utah.

Kaiser Steel Corp., Fontana, Calif., used iron ore from Eagle Mountain, Riverside County, Calif.

Pueblo, Colo., furnaces (Colorado Fuel & Iron Corp.) used iron ore from Wyoming and Utah and iron and manganiferous ores from New Mexico.

TABLE 5.—Number of blast furnaces (including ferroalloy blast furnaces) in the United States, December 31, 1950–51

[American Iron and Steel Institute]

State	Dec. 31, 1950			Dec. 31, 1951		
	In blast	Out of blast	Total	In blast	Out of blast	Total
Alabama	18	2	20	19	2	21
California	2		2	2		2
Colorado	4		4	3	1	4
Illinois	20	2	22	21	1	22
Indiana	20	2	22	21	1	22
Kentucky	3		3	3		3
Maryland	8		8	8		8
Massachusetts	1		1	1		1
Michigan	6		6	6		6
Minnesota	3		3	3		3
New York	16		16	16		16
Ohio	48	2	50	50		50
Pennsylvania	72	5	77	74	3	77
Tennessee	2	1	3	3		3
Texas	2	1	3	2	1	3
Utah	4	1	5	5		5
Virginia	1		1	1		1
West Virginia	4		4	4		4
Total	234	16	250	242	9	251

TABLE 6.—Iron ore and other metallic materials consumed and pig iron produced in the United States, 1950–51, by States, in net tons

State	Metalliferous materials consumed					Pig iron produced	Materials consumed per ton of pig iron made			
	Iron and manganiferous iron ores		Sinter	Miscellaneous [1]	Total		Ores	Sinter	Miscellaneous	Total
	Domestic	Foreign								
1950										
Alabama	7, 651, 627	182, 123	2, 026, 465	260, 744	10, 120, 959	4, 347, 331	1. 802	0. 466	0. 060	2. 328
California	585, 085	67	430, 825	116, 308	1, 132, 285	660, 463	.886	.652	.176	1. 714
Colorado, Texas, Utah	3, 533, 890	246, 909	1, 225, 479	129, 637	5, 135, 915	2, 572, 895	1. 470	.476	.050	1. 996
Illinois	10, 728, 534		856, 342	869, 773	12, 454, 649	6, 035, 333	1. 778	.142	.144	2. 064
Indiana	12, 403, 128	115, 089	1, 196, 887	619, 414	14, 334, 518	7, 018, 237	1. 784	.171	.088	2. 043
Kentucky	1, 235, 705		42, 618	195, 645	1, 473, 968	753, 855	1. 639	.057	.260	1. 956
Maryland	884, 156	4, 426, 850	566, 063	553, 937	6, 431, 006	3, 525, 694	1. 506	.161	.157	1. 824
Massachusetts	199, 924	48, 123		9, 753	257, 800	147, 511	1. 682		.066	1. 748
Michigan	3, 163, 027		476, 609	297, 771	3, 937, 407	2, 189, 696	1. 444	.218	.136	1. 798
Minnesota	1, 223, 753			98, 044	1, 321, 797	639, 774	1. 913		.153	2. 066
New York	6, 107, 720	43, 476	1, 266, 553	659, 366	8, 077, 115	4, 154, 039	1. 481	.305	.159	1. 945
Ohio	17, 727, 614	691, 157	3, 644, 476	2, 160, 182	24, 223, 429	12, 510, 703	1. 472	.291	.173	1. 936
Pennsylvania	23, 833, 548	746, 373	6, 926, 291	3, 397, 435	34, 903, 647	18, 239, 608	1. 348	.380	.186	1. 914
Tennessee, West Virginia	2, 322, 595	135, 253	107, 725	170, 217	2, 735, 790	1, 704, 844	1. 442	.063	.100	1. 605
Total	91, 600, 306	6, 635, 420	18, 766, 333	9, 538, 226	126, 540, 285	64, 499, 983	1. 523	.291	.148	1. 962
1951										
Alabama	8, 407, 299	55, 811	1, 870, 622	253, 467	10, 587, 199	4, 370, 527	1. 936	.428	.058	2. 422
California	862, 977		623, 836	121, 854	1, 608, 667	921, 695	.936	.677	.132	1. 745
Colorado, Texas, Utah	3, 474, 102	187, 631	1, 523, 618	136, 783	5, 322, 134	2, 866, 062	1. 278	.532	.048	1. 857
Illinois	11, 762, 281		1, 110, 851	997, 464	13, 870, 596	6, 575, 674	1. 789	.169	.152	2. 110
Indiana	13, 292, 905	106, 520	1, 578, 502	619, 489	15, 597, 416	7, 759, 741	1. 727	.203	.080	2. 010
Kentucky	1, 214, 304		96, 218	166, 054	1, 476, 576	766, 344	1. 585	.126	.217	1. 927
Maryland	550, 696	4, 582, 020	683, 878	596, 759	6, 413, 353	3, 658, 335	1. 403	.187	.163	1. 753
Massachusetts	181, 678	119, 400		20, 092	321, 170	186, 296	1. 616		.108	1. 724
Michigan	3, 076, 112	2, 852	623, 458	752, 211	4, 454, 633	2, 207, 665	1. 395	.282	.341	2. 018
Minnesota	1, 269, 460			143, 984	1, 413, 444	697, 101	1. 821		.207	2. 028
New York	5, 903, 809	33, 896	2, 036, 261	667, 870	8, 641, 836	4, 512, 389	1. 316	.451	.148	1. 915
Ohio	19, 043, 978	634, 432	4, 631, 816	2, 137, 676	26, 447, 902	13, 710, 153	1. 435	.338	.156	1. 929
Pennsylvania	25, 654, 976	607, 150	8, 622, 428	3, 443, 590	38, 328, 144	20, 211, 510	1. 299	.427	.170	1. 896
Tennessee, West Virginia	2, 580, 228	169, 133	110, 148	181, 783	3, 041, 292	1, 834, 446	1. 499	.060	.099	1. 658
Total	97, 274, 805	6, 498, 845	23, 511, 636	10, 239, 076	137, 524, 362	70, 277, 938	1. 477	.335	.146	1. 957

[1] Excludes recycled materials.

PRODUCTION OF STEEL [2]

Steel production rose to 105.2 million net tons in 1951, an increase of 9 percent over 1950 and 35 percent over 1949. Rated capacity as of January 1, 1951, was 5 percent over 1950 and 8 percent over 1949. The 4.4 million-net-ton-capacity increase during 1951 plus the many improvements in steelmaking practice put into effect by steel companies permitted production to exceed rated capacity for the first time.

In 1950 and 1951, about 89 percent of domestic steel was made in open-hearth furnaces compared with 90 percent in 1949. Seven percent of total steel production in 1951, 6 percent in 1950, and 5 percent in 1949 was in electric furnaces.

TABLE 7.—Steel capacity, production, and percent of operations in the United States, 1947–51, in net tons [1]

[American Iron and Steel Institute]

Year	Annual capacity as of Jan. 1	Production					
		Open-hearth	Bessemer	Crucible	Electric	Total	Percent of capacity
1947	91,241,250	76,873,793	4,232,543	18	3,787,717	84,894,071	93.0
1948	94,233,460	79,340,157	4,243,172	(2)	5,057,141	88,640,470	94.1
1949	96,120,930	70,248,803	3,946,656	(2)	3,782,717	77,978,176	81.1
1950	99,392,800	86,262,509	4,534,558	(2)	6,039,008	96,836,075	[3] 97.4
1951	104,229,650	93,166,518	4,890,946	(2)	7,142,384	105,199,848	100.9

[1] The figures include only that portion of the capacity and production of steel for castings used by foundries which were operated by companies producing steel ingots. Omitted portion is about 2 percent of total steel production.
[2] Included with "Electric."
[3] Revised figure.

TABLE 8.—Open-hearth steel ingots and castings manufactured in the United States, 1947–51, by States, in net tons [1]

[American Iron and Steel Institute]

State	1947	1948	1949	1950	1951
New England States	428,651	454,524	381,763	485,007	535,014
New York and New Jersey	4,213,369	4,277,040	4,020,711	4,820,177	5,271,387
Pennsylvania	22,911,984	23,648,314	19,759,983	24,610,259	26,977,599
Ohio	14,026,978	14,045,722	12,215,389	15,200,938	16,842,144
Indiana	10,128,496	10,453,975	9,099,413	11,055,043	11,888,961
Illinois	6,206,370	6,269,723	5,886,460	6,831,337	7,271,633
Other States	18,957,945	20,190,859	18,885,084	23,259,748	24,379,780
Total	76,873,793	79,340,157	70,248,803	86,262,509	93,166,518

[1] Includes only that portion of steel for castings produced in foundries operated by companies manufacturing steel ingots. *See* table 7.

Alloy Steel.—Alloy-steel output for 1951 was 10,125,000 net tons, the highest production for alloy steel since 1944. The production increase for 1951 was 18 percent over 1950 and 72 percent over 1949. Alloy production represented 10 percent of the total steel made in 1951, 9 percent in 1950, and 8 percent in 1949. Of the alloy steel produced in 1951, 65 percent was produced in basic open-hearth, 2 percent in the acid open-hearth, and 33 percent in electric furnaces.

[2] The data concerning steel production used by the Bureau of Mines are furnished by the American Iron and Steel Institute. The output from steel foundries that do not produce steel ingots is not included in the production data.

These figures reflected an increase in the proportions produced by electric furnaces (32 percent in 1950) and acid open-hearth furnaces (1 percent in 1950). Alloy-steel data include steels in which the minimum of the range specified in one or more of the elements named exceeds the following percentages: Manganese, 1.65 percent; silicon, 0.60 percent; copper, 0.60 percent; or aluminum, boron, chromium, cobalt, columbium, molybdenum, nickel, titanium, tungsten, vanadium, zirconium and other alloying elements, any added percent.

TABLE 9.—Bessemer-steel ingots and castings manufactured in the United States 1947–51, by States, in net tons [1]

[American Iron and Steel Institute]

State	1947	1948	1949	1950	1951
Ohio	1,981,428	1,936,873	1,760,006	2,000,294	2,208,456
Pennsylvania	1,345,412	1,355,934	1,174,866	1,293,746	1,345,297
Other States	905,703	950,365	1,011,784	1,240,518	1,337,193
Total	4,232,543	4,243,172	3,946,656	4,534,558	4,890,946

[1] Includes only that portion of steel for castings produced in foundries by companies manufacturing steel ingots. *See* table 7.

TABLE 10.—Steel electrically manufactured in the United States, 1946–51, in net tons [1]

[American Iron and Steel Institute]

Year	Ingots	Castings	Total	Year	Ingots	Castings	Total
1946	2,479,064	83,960	2,563,024	1949	3,687,077	95,640	3,782,717
1947	3,680,516	107,219	3,787,735	1950	5,927,509	111,499	6,039,008
1948	4,973,611	83,530	5,057,141	1951	7,043,366	99,018	7,142,384

[1] Includes a very small quantity of crucible steel. Includes only that portion of steel for castings produced in foundries operated by companies manufacturing steel ingots. *See* table 7.

TABLE 11.—Alloy-steel ingots and castings manufactured in the United States, 1947–51, by processes, in net tons [1]

[American Iron and Steel Institute]

Process	1947	1948	1949	1950	1951
Open-hearth:					
Basic	5,520,540	6,285,054	4,192,344	5,738,067	6,585,635
Acid	128,754	128,915	105,550	123,253	238,034
Crucible	1,778,937	2,067,145	1,599,675	2,708,785	3,300,918
Electric					
Total	7,428,231	8,481,114	5,897,569	8,570,105	10,124,587

[1] Includes only that portion of steel for castings produced in foundries operated by companies manufacturing steel ingots. *See* table 7.

Metalliferous Materials Used.—During 1951 steel furnaces used 3.8 million tons of domestic iron ore and 2.4 million tons of foreign ore; the latter originated in Africa, Brazil, Canada, Cuba, Sweden, and Venezuela. Also used was 1.7 million tons of sinter made from both foreign and domestic ores.

Scrap and pig iron used in steel furnaces in 1951 totaled 118.8 million net tons. The percentage of each used (48 and 52 percent, respectively) was the same as in 1950. The basic open hearth makes use of both charge and feed ores. Charge ore is added to furnish available oxygen to the charge before the heat is melted. The properties that are acceptable in charge ore or sinter vary with furnace size, hot-metal analysis, and amount of ore used. The sum of the acid compounds, SiO_2 plus Al_2O_3 plus TiO_2 should be under 8 percent. Up to about 8 percent natural moisture in the charge can be tolerated in most practices. With the present trend in industry to use higher sulfur fuels in the open hearth, the sulfur content of the ore should be below 0.05 percent.

Feed ore is used after a heat is melted to accelerate the oxidation of carbon during the refining period. The physical and chemical characteristics desired in charge and feed ore are very similar. Both ores should be hard and dense and free from fines. Mill cinder, sinter, and roll scale may be used in place of feed ore, but none is as effective for carbon removal as ore. Roll scale is sometimes used in conjunction with spar during the working of heats that are high in phosphorus. Owing to limited domestic supply of charge and feed ore, substantial amounts of these ores are now obtained from foreign sources (in 1951, about two-fifths of the total of such ores used in steel furnaces), mainly from South America and Africa.

TABLE 12.—Metalliferous materials consumed in steel furnaces in the United States, 1947–51, in net tons

	Iron ore		Sinter	Manganese ore		Pig iron	Ferro-alloys	Iron and steel scrap	
	Domestic	Foreign		Domestic	Foreign			Home	Purchased
1947	3,795,886	809,191	1,134,542	2,080	3,512	50,177,381	1,250,000	23,993,919	20,791,449
1948	3,808,155	1,064,513	1,114,032	2,698	4,159	52,177,785	1,300,000	24,689,529	22,890,571
1949	3,152,797	1,107,625	1,051,746	1,231	3,033	46,502,503	950,000	22,675,212	17,753,002
1950	3,495,862	1,799,089	1,310,471	2,877	1,335	56,269,610	1,320,000	27,353,503	23,738,078
1951	3,774,770	2,369,165	1,701,404	660	2,847	61,750,383	1,470,000	30,100,917	26,986,412

CONSUMPTION OF PIG IRON

Consumption of pig iron in 1951 increased 10 percent over 1950 and 34 percent over 1949. Of the total pig iron, 78 percent was consumed in 8 Middle Atlantic and East North Central States as shown in table 14. In 1951, 86 percent of the pig iron went to the steelmaking furnaces to be processed into steel; 4 percent was used to make direct castings and 10 percent to iron furnaces. These percentages were the same as in 1950.

There were plants using pig iron in 1950 in all 48 States and the District of Columbia; Pennsylvania, Ohio, and Indiana consumed 59 percent of the total.

TABLE 13.—Consumption of pig iron in the United States, 1948–51, by type of furnace

Type of furnace or equipment	1948		1949		1950		1951	
	Net tons	Percent of total	Net tons	Percent of total	Net tons	Percent of total	Net tons	Percent of total
Open-hearth	47,267,334	78.8	41,782,506	78.2	50,946,134	78.5	56,055,103	78.5
Bessemer	4,778,137	8.0	4,612,408	8.6	5,169,835	8.0	5,551,149	7.8
Electric	132,314	.2	107,589	.2	153,641	.2	144,131	.2
Cupola	5,280,957	8.8	4,764,003	8.9	6,059,188	9.3	6,559,800	9.2
Air Brackelsberg	368,003	.6	273,514	.5	334,613	.5	400,267	.5
Crucible	1,013	(1)	1,052	(1)	1,190	(1)	243	(1)
Puddling	14,979	(1)	3,880	(1)	3,168	(1)		
Direct castings	2,183,572	3.6	1,901,760	3.6	2,275,349	3.5	2,703,624	3.8
Miscellaneous	95	(1)	53	(1)				
Total	60,026,404	100.0	53,446,765	100.0	64,943,118	100.0	71,414,317	100.0

[1] Less than 0.05 percent.

TABLE 14.—Consumption of pig iron in the United States, 1947–51, by State and district

State and district	1947		1948		1949		1950		1951, net tons [1]
	Consumers	Net tons	Consumers	Net tons	Consumers	Net tons	Consumers	Net tons	
Connecticut	58	92,114	59	73,173	56	56,835	54	75,868	83,101
Maine	15	14,111	15	14,882	11	10,304	13	9,657	9,647
Massachusetts	98	199,258	100	219,453	95	174,401	101	218,931	231,897
New Hampshire	16	5,771	16	4,178	15	3,252	16	4,190	4,762
Rhode Island	12	31,036	11	23,520	11	32,217	15	41,223	57,792
Vermont	14	10,007	14	7,687	13	6,328	13	8,783	17,331
Total New England	213	352,297	215	342,893	201	283,337	212	358,652	404,530
New Jersey [2]	76	241,512	80	279,352	78	243,854	73	274,116	295,182
New York	172	2,966,882	174	2,948,785	170	2,652,854	163	3,060,001	3,416,408
Pennsylvania [2]	349	17,287,166	401	17,667,350	390	14,834,486	347	18,315,008	20,314,328
Total Middle Atlantic	597	20,495,560	655	20,895,487	638	17,731,194	583	21,649,125	24,025,918
Illinois [2]	208	4,782,722	216	4,809,697	209	4,498,693	204	5,465,752	5,948,201
Indiana	128	6,810,122	137	7,075,885	135	6,303,356	132	7,480,127	8,339,759
Michigan	167	2,462,871	167	2,718,956	169	2,689,505	171	3,687,724	3,605,019
Ohio [2]	299	11,674,075	327	11,633,581	319	10,134,409	283	11,667,857	13,230,964
Wisconsin	116	274,893	125	260,572	121	243,420	123	295,792	341,120
Total East North Central	918	26,004,683	972	26,498,691	953	23,869,383	913	28,597,252	31,465,063
Iowa	54	98,116	50	91,291	52	107,353	54	101,702	152,275
Kansas	22	14,041	25	24,410	24	16,624	21	16,887	10,395
Nebraska	11		11		11		10		
Minnesota	59	445,809	58	458,374	54	383,952	59	542,101	620,166
North Dakota	1		1		1		2		
South Dakota	1		1		1		2		
Missouri	51	80,926	51	87,654	49	63,524	45	86,939	103,115
Total West North Central	199	638,892	197	661,729	192	571,453	193	747,629	885,951
Delaware	7		7		7		6		
District of Columbia	1	2,599,039	3	2,994,431	2	3,058,103	1	3,666,178	3,871,880
Maryland [2]	19		23		21		18		
Florida	14	37,525	15	38,565	14	70,171	13	86,243	79,929
Georgia	49		51		50		49		
North Carolina	47	27,466	44	20,482	45	20,958	52	30,658	29,946
South Carolina	16	9,169	14	9,404	14	7,360	16	11,424	21,521
Virginia	54	1,449,362	51	1,670,691	49	1,662,263	49	1,952,608	1,929,435
West Virginia	25		26		23		22		
Total South Atlantic	232	4,122,561	234	4,733,573	225	4,818,855	226	5,747,111	5,932,711

For footnotes, see end of table.

TABLE 14.—Consumption of pig iron in the United States, 1947–51, by State and district—Continued

State and district	1947		1948		1949		1950		1951, net tons [1]
	Consumers	Net tons	Consumers	Net tons	Consumers	Net tons	Consumers	Net tons	
Alabama	69	3,356,612	74	3,500,614	72	3,152,311	79	3,777,495	3,902,199
Kentucky [2]	24	809,159	25	924,040	22	761,149	22	973,876	1,041,910
Mississippi	8		8		8		8		
Tennessee	53		53		50		51		
Total East South Central	154	4,165,771	160	4,424,654	152	3,913,460	160	4,751,371	4,944,109
Arkansas	4	5,766	4	7,025	3	6,015	5	7,280	13,981
Louisiana	11		12		12		11		
Oklahoma	9		9		11		15		578,593
Texas	37	120,091	38	230,947	37	198,318	45	356,724	
Total West South Central	61	125,857	63	237,972	63	204,333	76	364,004	592,574
Arizona	4	1,215	4	1,251	4	1,194	3	1,520	866
Nevada									
New Mexico									
Colorado	26	1,511,704	30	1,583,437	31	1,364,097	25	1,766,874	1,864,848
Utah									
Montana	5	3,041	4	320	4	305	3	207	276
Idaho			2	315	2	194	2	167	689
Wyoming			2	4	2	5	2	4	
Total Mountain	35	1,515,960	42	1,585,327	43	1,365,795	35	1,768,772	1,866,679
California [2]	116	635,164	111	625,229	108	673,613	105	937,740	1,271,574
Oregon	26	17,812	23	20,849	23	15,342	24	21,462	25,208
Washington	31		29		35		28		
Total Pacific	173	652,976	163	646,078	166	688,955	157	959,202	1,296,782
Undistributed [2]	7	216,198	------	----------	------	----------	------	----------	----------
Total United States	2,589	58,290,755	2,701	60,026,404	2,633	53,446,765	2,555	64,943,118	71,414,317

[1] Consumption for 1951 obtained from sample monthly canvasses; therefore, exact number of consumers by States not available.

[2] In 1947 some pig iron consumed in California, Illinois, Kentucky, Maryland, New Jersey, Ohio, and Pennsylvania—not separable—is included with "Undistributed."

PRICES

The average value of all grades of pig iron given in table 15 was compiled from producers' reports to the Bureau of Mines. The figures represent value f. o. b. blast furnaces and do not include the value of ferroalloys. The annual average value for all grades of pig iron at furnaces was $46.75 in 1951 compared with $42.85 in 1950.

The average monthly prices of foundry, Bessemer, and basic pig iron at Mahoning Valley furnaces and foundry pig at Birmingham furnaces, according to published market quotations, are summarized in table 16.

TABLE 15.—Average value of pig iron at blast furnaces in the United States, 1947–51, by States, per net ton

State	1947	1948	1949	1950	1951
Alabama	$28.12	$36.52	$35.79	$39.00	$43.87
California, Colorado, and Utah	30.50	40.93	42.92	44.52	48.50
Illinois	30.97	35.72	41.69	42.77	46.53
Indiana	30.57	37.86	41.26	42.43	46.59
New York	27.54	32.70	43.81	42.68	48.01
Ohio	30.87	37.98	40.92	42.38	45.67
Pennsylvania	30.23	36.68	43.04	43.09	47.08
Other States [1]	31.67	38.77	44.59	44.73	47.98
Average for United States	30.34	37.17	42.05	42.85	46.75

[1] Comprises Kentucky, Maryland, Massachusetts, Michigan, Minnesota, Tennessee, Texas, and West Virginia.

TABLE 16.—Average monthly prices of chief grades of pig iron in the United States, 1950–51, per net ton

[Metal Statistics, 1952]

Month	Foundry pig iron at Birmingham furnaces		Foundry pig iron at Valley furnaces		Bessemer pig iron at Valley furnaces		Basic pig iron at Valley furnaces	
	1950	1951	1950	1951	1950	1951	1950	1951
January	$35.16	$43.64	$41.52	$46.87	$41.96	$47.32	$41.07	$46.43
February	37.39	43.64	41.52	46.87	41.96	47.32	41.07	46.43
March	37.84	43.64	41.52	46.87	41.96	47.32	41.07	46.43
April	37.84	43.64	41.52	46.87	41.96	47.32	41.07	46.43
May	37.84	43.64	41.52	46.87	41.96	47.32	41.07	46.43
June	37.84	43.64	41.52	46.87	41.96	47.32	41.07	46.43
July	37.84	43.64	41.52	46.87	41.96	47.32	41.07	46.43
August	37.84	43.64	41.52	46.87	41.96	47.32	41.07	46.43
September	38.46	43.64	42.19	46.87	42.63	47.32	41.74	46.43
October	40.96	43.64	44.20	46.87	44.64	47.32	43.75	46.43
November	40.96	43.64	44.20	46.87	44.64	47.32	43.75	46.43
December	43.24	43.64	46.61	46.87	47.05	47.32	46.16	46.43
Average	38.60	43.64	42.45	46.87	42.89	47.32	42.00	46.43

TABLE 17.—Composite prices of finished steel in the United States, 1944–51, by months, in cents per pound

[Iron Age]

Month	1944	1945	1946	1947	1948	1949	1950	1951
January	2.396	2.412	2.464	2.877	3.193	3.720	3.837	4.131
February	2.396	2.427	2.555	2.884	3.125	3.719	3.837	4.131
March	2.396	2.432	2.719	2.884	3.241	3.715	3.837	4.131
April	2.396	2.433	2.719	2.884	3.241	3.709	3.837	4.131
May	2.396	2.436	2.719	2.884	3.214	3.706	3.837	4.131
June	2.396	2.464	2.719	2.884	3.211	3.705	3.837	4.131
July	2.396	2.464	2.719	2.914	3.293	3.705	3.837	4.131
August	2.396	2.464	2.719	3.193	3.720	3.705	3.837	4.131
September	2.396	2.464	2.719	3.193	3.720	3.705	3.837	4.131
October	2.396	2.464	2.719	3.193	3.720	3.705	3.837	4.131
November	2.396	2.464	2.719	3.193	3.720	3.705	3.837	4.131
December	2.396	2.464	2.747	3.193	3.720	3.756	4.131	4.131
Average	2.396	2.449	2.686	3.014	3.434	3.713	3.862	4.131

FOREIGN TRADE [3]

Imports and exports of steel both increased in 1951, while pig-iron exports decreased and imports increased. Imports of steel (manufactures and semimanufactures) rose from 1,099,000 tons (revised) in 1950 to 2,289,000 tons in 1951, and exports increased 14 percent. Pig-iron imports increased from 805,000 tons (revised) in 1950 to 1,067,000 in 1951, while exports decreased from 6,813 tons ($321,795) to 6,555 tons ($352,353).

Sixty-nine percent of the pig iron imported came from Austria, Canada, Germany, and the Netherlands, while Australia, Canada, and Mexico received 95 percent of the exported tonnage.

TABLE 18.—Pig iron imported for consumption in the United States, 1947–51, by countries, in net tons

[U. S. Department of Commerce]

Country	1947	1948	1949	1950	1951
North America:					
Canada	1,747	5,729	12,270	[1] 195,807	220,094
Mexico	1,004				
South America:					
Argentina		2			
Brazil		551			33,936
Chile				7,583	57,241
Europe:					
Austria	281	19,145	5,145	56,635	82,628
Belgium-Luxembourg		33,147	15,688	8,086	16,605
France		17,876	340	37,640	37,323
Germany		24,558	2,383	[1] 225,132	331,244
Italy		5,001			123
Netherlands	2,711	45,020	20,527	[1] 243,434	99,189
Norway	9,482	23,919	146	5,364	15,352
Poland-Danzig	7,466				
Spain					34,048
Sweden		1,301	436	14,798	43,822
Turkey					36,587
U. S. S. R.	1,357				
United Kingdom	8,576		193	2,816	3,957
Asia: India		16,101	23,077	7,168	34,158
Africa: Union of South Africa				336	20,206
Oceania: Australia		26,902	19,599		
Total: Net tons	32,624	219,252	99,804	[1] 804,799	1,066,513
Value	$1,738,812	$11,810,853	$4,591,779	[1] $26,237,334	$49,169,985

[1] Revised figure.

Steel bars, boiler and other iron and steel plate, and structural iron and steel were principal imports. Sheets (black and galvanized), tinplate and terneplate, casing and line pipe, structural shapes, and rails made up 60 percent of the exports.

[3] Figures on imports and exports compiled by M. B. Price and E. D. Page, of the Bureau of Mines, from records of the U. S. Department of Commerce.

TABLE 19.—Major iron and steel products imported for consumption in the United States, 1949–51

[U. S. Department of Commerce]

Products	1949		1950		1951	
	Net tons	Value	Net tons	Value	Net tons	Value
Semimanufactures:						
Steel bars:						
Concrete reinforcement bars	10,269	$1,254,076	60,421	$3,612,285	138,424	$14,805,112
Solid or hollow, n. e. s.	35,268	3,007,463	[1] 108,527	[1] 6,435,303	246,146	24,924,652
Hollow and hollow drill steel	92	21,438	799	196,267	1,311	332,056
Iron slabs, blooms, or other forms					5	765
Bar iron	353	80,200	387	58,826	695	108,286
Wire rods, nail rods, and flat rods up to 6 inches in width	5,732	27,926	[1] 112,354	[1] 7,341,986	122,009	12,094,127
Boiler and other plate iron and steel, n. e. s.	30,519	2,988,108	[1] 163,301	[1] 13,825,592	584,805	73,964,682
Steel ingots, blooms, and slabs	50,310	3,312,902	115,384	6,738,677	40,227	3,019,220
Billets, solid or hollow	2,002	165,969	[1] 67,089	[1] 4,200,255	99,401	8,470,562
Die blocks or blanks, shafting, etc.	660	61,626	12,211	780,128	1,142	274,858
Circular saw plates	2	1,016	16	13,860	35	25,260
Sheets of iron or steel, common or black and boiler or other plate iron or steel	3,572	396,433	27,301	2,579,819	71,542	10,266,848
Sheets and plates and steel, n. s. p. f.	9,266	865,110	[1] 33,101	[1] 2,806,693	37,096	4,545,612
Tinplate, terneplate, and taggers' tin	13,684	2,052,030	4,289	687,562	445	88,213
Total semimanufactures	161,729	14,234,297	[1] 705,180	[1] 49,277,253	1,343,283	152,920,253
Manufactures:						
Structural iron and steel	119,506	11,895,706	[1] 178,007	[1] 12,134,078	459,904	46,899,983
Rails for railways	944	76,459	[1] 7,169	318,545	11,026	561,766
Rail braces, bars, fishplates, or splice bars and tie plates	162	16,452	295	25,283	118	9,343
Pipes and tubes:						
Cast-iron pipe and fittings	256	39,823	1,215	119,756	6,932	733,645
Other pipes and tubes	5,459	1,154,349	40,495	4,724,099	239,578	39,740,011
Wire:						
Barbed	100	11,653	9,505	1,008,545	7,245	1,082,260
Round wire, n. e. s.	2,308	245,907	17,829	1,808,094	26,977	3,773,165
Telegraph, telephone, etc., except copper, covered with cotton jute, etc.	456	241,344	214	76,355	860	325,594
Flat wire and iron or steel strips	1,574	1,598,381	[1] 8,082	1,998,968	41,219	8,808,230
Rope and strand	891	380,756	2,305	[1] 718,828	4,339	1,423,250
Galvanized fencing wire and wire fencing	7	786	1,367	136,107	1,466	185,472
Hoop or band iron or steel, for baling	2,985	284,033	17,885	1,574,263	14,547	1,436,478
Hoop, band and strips, or scroll iron or steel, n. s. p. f.	5,647	511,081	[1] 41,548	[1] 2,683,009	71,646	7,443,613
Nails	2,384	429,188	67,524	7,189,462	56,419	7,795,986
Castings and forgings, n. e. s.	196	67,149	803	177,518	3,235	1,020,793
Total manufactures	142,875	16,953,067	[1] 394,243	[1] 34,692,910	945,511	121,239,589
Grand total	304,604	31,187,364	[1] 1,099,423	[1] 83,970,163	2,288,794	274,159,842

[1] Revised figure.

TABLE 20.—Major iron and steel products exported from the United States, 1949–51

[U. S. Department of Commerce]

Products	1949		1950		1951	
	Net tons	Value	Net tons	Value	Net tons	Value
Semimanufactures:						
Steel ingots, blooms, billets, slabs, and sheet bars	257,248	$21,546,322	61,612	$4,962,518	134,613	$12,010,195
Iron and steel bars and rods:						
Iron bars	1,470	322,745	1,006	164,924	2,941	499,453
Concrete reinforcement bars	107,902	10,386,873	18,589	1,820,988	44,426	4,820,793
Other steel bars	332,387	39,949,878	99,245	13,201,530	150,350	21,009,357
Wire rods	53,315	5,019,109	6,264	596,163	4,148	481,320

TABLE 20.—Major iron and steel products exported from the United States, 1949–51—Continued

Products	1949		1950		1951	
	Net tons	Value	Net tons	Value	Net tons	Value
Semimanufactures—Continued						
Iron and steel plates, sheets, skelp, and strips:						
Plates, including boiler plate, not fabricated	417,097	$41,542,588	112,225	$12,111,005	160,542	$19,322,830
Skelp iron and steel	117,369	8,467,977	116,581	8,720,436	107,878	8,946,310
Iron and steel sheets, galvanized	85,594	13,071,223	100,361	16,663,184	68,087	12,515,185
Steel sheets, black, ungalvanized	551,245	74,987,636	[1] 501,175	[1] 68,025,075	525,076	80,986,780
Iron sheets, black	22,650	2,638,541	17,046	2,086,764	14,050	1,773,745
Strip, hoop, band, and scroll iron and steel:						
Cold-rolled	57,376	12,591,131	43,289	10,553,658	52,625	13,903,833
Hot-rolled	82,376	9,224,040	49,592	5,598,381	60,589	7,899,601
Tinplate and terneplate	558,173	95,662,968	[1] 495,994	[1] 81,741,856	558,664	113,562,793
Total semimanufactures	2,644,202	335,411,031	[1] 1,622,979	[1] 226,246,482	1,883,989	297,732,195
Manufactures—steel-mill products:						
Structural iron and steel:						
Water, oil, gas, and other storage tanks complete and knocked-down material	106,003	19,037,149	39,147	8,441,499	33,304	8,796,908
Structural shapes:						
Not fabricated	302,700	25,680,402	153,570	13,800,340	232,035	22,466,923
Fabricated	152,894	36,483,622	110,348	27,957,015	77,136	23,535,603
Plates, fabricated, punched, or shaped	30,328	6,295,963	7,370	1,733,857	13,012	3,608,662
Metal lath	5,166	1,259,732	3,000	805,043	4,684	1,326,342
Frames, sashes, and sheet piling	22,501	3,793,458	12,264	1,934,753	13,182	2,136,551
Railway-track material:						
Rails for railways	236,990	19,416,144	137,391	10,105,145	105,599	8,755,167
Rail joints, splice bars, fishplates, and tie plates	22,680	3,100,755	23,649	2,791,794	33,779	4,411,717
Switches, frogs, and crossings	6,043	1,674,188	2,505	696,517	2,514	733,539
Railroad spikes	3,634	544,619	7,516	1,064,531	8,319	1,466,060
Railroad bolts, nuts, washers, and nut locks	1,994	508,375	1,600	371,125	1,673	463,363
Tubular products:						
Boiler tubes	47,168	9,798,567	15,541	3,760,427	18,616	5,629,942
Casing and line pipe	492,929	72,067,360	[1] 452,160	[1] 61,864,657	464,034	70,555,797
Seamless black pipe, and tubes, and other line and boiler, pipe and tubes, except casing	25,782	4,251,542	17,328	3,112,500	17,203	3,785,463
Welded black pipe and tubes	101,766	15,710,248	59,881	8,369,201	68,415	11,096,062
Welded galvanized pipe and tubes	98,536	17,826,791	64,990	10,683,312	44,005	8,736,989
Malleable-iron screwed pipe fittings	5,522	4,037,896	[1] 4,099	[1] 2,739,743	4,489	3,554,624
Cast-iron screwed pipe fittings	752	294,867	620	274,257	692	349,614
Cast-iron pressure pipe and fittings	47,828	5,669,993	21,179	2,538,927	38,371	4,557,082
Cast-iron soil pipe and fittings	10,165	1,809,149	5,802	1,014,642	10,712	2,083,057
Iron and steel pipe and fittings, n. e. s.	68,685	32,783,594	39,394	19,301,638	54,058	24,912,574
Wire and manufactures:						
Barbed wire	75,737	11,666,175	10,976	1,587,017	13,900	2,159,062
Galvanized wire	56,902	9,591,071	11,123	2,023,933	15,741	3,070,636
Iron and steel wire, uncoated	73,828	11,524,306	25,936	5,214,337	54,574	10,197,841
Wire rope and strand	12,915	5,286,181	11,632	4,650,253	18,040	8,200,077
Woven-wire fencing and screen cloth	20,615	7,008,457	8,774	[1] 3,205,089	12,933	4,910,328
All other	36,191	10,439,244	24,478	[1] 7,547,144	38,004	12,168,578
Nails and bolts, iron and steel, n. e. s.:						
Wire nails	25,910	4,187,757	3,097	554,609	8,737	1,534,790
All other nails, including tacks and staples	11,571	3,178,429	3,717	1,562,514	5,520	2,241,352
Bolts, machine screws, nuts, rivets, and washers, n. e. s	26,129	12,045,325	16,213	[1] 8,595,585	21,594	13,530,637
Castings and forgings:						
Horseshoes, mule shoes, and calks	418	90,463	340	62,588	568	107,699
Iron and steel, including car wheels, tires, and axles	135,926	22,580,115	87,491	14,630,082	110,869	20,195,167
Total manufactures	2,266,208	379,641,937	[1] 1,383,131	[1] 232,994,074	1,546,312	291,278,206
Advanced manufactures:						
House-heating boilers and radiators		736,209		784,595		1,709,679
Oil burners and parts		4,802,112		5,952,281		8,333,848
Tools (iron and steel chief value)		46,974,002		[1] 31,570,192		42,999,558
Total advanced manufactures		52,512,323		[1] 38,307,068		53,043,085

[1] Revised figure.

WORLD PRODUCTION

World production of steel and pig iron (including ferroalloys) increased 12 percent each in 1951 over 1950. These materials had increased 18 and 16 percent, respectively, in 1950 over 1949. In 1951, the United States was first and Russia second in both pig iron and steel production, West Germany attained third place in pig-iron output, and the United Kingdom was third in steel production.

Austria.—Pig-iron, crude-steel, and rolled-steel output attained alltime highs in 1951, with production at 270, 158 and 151 percent, respectively, of prewar (1937) levels. Compared with 1950, crude steel increased 9 percent while pig iron and rolled steel increased 19 percent each. At Voest, a third blast furnace was blown in during May 1951, and a new slabbing mill, a European Recovery Program project, began operation in August. This mill can produce 300,000 tons of slabs per year on a two-shift basis.[4]

Burma.—Burma was planning to construct a State-owned rolling mill, which was scheduled to melt and roll 5,000 tons of scrap iron and steel a year. An estimated 50,000 tons of scrap was available in the country.[5]

India.—India produced over 1.5 million tons of steel in 1951. Construction of a 500,000-ton steel plant in the State of Madhya Bharat was being reconsidered.

Mexico.—A $5 million expansion of the Altos Hornos steel mill at Monclova, Coah., was expected to get underway soon, increasing the finishing capacity of the plant from 115,000 to 185,000 tons annually.[6]

Philippines.—Orders for equipment for the country's first steel mill at the Marcelo plant in Manila, which will consist of three electric furnaces, a rolling mill and a fire-brick plant had been placed, and operation was expected to begin in 1952.

Output from full production reportedly was expected to reach 44,000 tons of steel ingots.[7]

Spain.—Total steel production in 1951 was 831,000 metric tons, a 3-percent increase over the 807,000 tons produced in 1950. During the last half of the year increased supplies of local scrap (though of poor quality) and increased imports of coke, combined with ample electric power, enabled the steel industry to reach a new postwar high. Sociedad Metalurgia Duro Felguera, La Felguera, Oviedo Province, started operating several Bessemer-type converters and a new electric furnace that raised the company capacity by 57,000 tons annually. It was the only steel company in Spain to show a sizable gain in steel production—about 30 percent. The scrap requirements of this company were expected to be reduced considerably by the newly installed duplex process.[8]

U. S. S. R.—The Soviet Union produced over 31 million metric tons of steel in 1951, exceeding the production of the United Kingdom and Germany combined. This put the Soviet Union well into second place in world steel production.

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[4] Bureau of Mines, Mineral Trade Notes: Vol. 34, No. 5, May 1952, pp. 12–15.
[5] Steel, vol. 128, Jan. 22, 1951, pp. 53–54.
[6] Engineering and Mining Journal, vol. 152, July 1951, p. 209.
[7] Mining World, Jan. 1951, vol. 13, p. 53.
[8] Bureau of Mines, Mineral Trade Notes: Vol. 35, No. 4, October 1952, pp. 13–14.

United Kingdom.—The British iron and steel industry went under Government control February 15, 1951. Steven Hardie was made chairman of the new organization, the Iron & Steel Corp., which is composed of 180 firms that cost the Government £230 million. He stated that the new capital plans for the industry involve spending £500 million during the next 5 years.

British steel production declined slightly in 1951 from the 1950 record high of 16,554,000 tons, while there was a slight increase in pig-iron production. The principal cause for the decreased steel production was the shortage of scrap and other raw materials. According to the British Iron and Steel Federation, steel production could have reached the original estimate of 16 million tons in 1951

TABLE 21.—World production of pig iron (including ferroalloys), 1947–51, by countries, in thousands of metric tons [1]

[Compiled by Pauline Roberts]

Country [1]	1947	1948	1949	1950	1951
Argentina	[2] 18	([3])	([3])	20	28
Australia	1,206	1,158	1,046	1,336	1,357
Austria	279	613	838	[4] 886	1,051
Belgium	2,817	3,929	3,749	[4] 3,695	4,847
Brazil	481	552	512	[4] 729	[2] 750
Canada	1,987	[4] 2,140	[4] 2,138	[4] 2,253	2,543
Chile	11	14	19	[4] 109	240
China [2]	136	147	317	1,022	1,300
Czechoslovakia	1,422	1,660	1,875	1,883	[2] 2,000
Denmark	23	31	39	51	33
Finland	71	90	101	63	102
France	4,893	6,630	[4] 8,409	[4] 7,838	8,839
Saar	653	1,134	1,582	[4] 1,684	2,364
Germany:					
East Germany	139	182	250	283	[2] 350
West Germany	2,512	4,662	[4] 7,659	9,480	10,880
Hungary	299	403	428	[2] 500	[2] 410
India	1,567	1,494	[4] 1,637	[4] 1,706	1,853
Italy	384	526	445	[4] 573	1,048
Japan	367	836	[4] 1,602	[4] 2,299	3,228
Korea: North	[2] 20	[2] 30	[2] 50	[2] 23	([3])
Luxembourg	1,818	2,626	2,372	2,499	3,157
Mexico [5]	236	270	356	249	211
Netherlands	288	442	434	454	525
Norway	165	215	[4] 234	[4] 227	241
Poland	867	[4] 1,208	[4] 1,365	[4] 1,488	[2] 1,479
Rumania	90	[2] [4] 191	[2] [4] 275	[2] [4] 335	([3])
Southern Rhodesia	----	17	[4] 28	[4] 34	10
Spain	517	537	634	680	679
Sweden	725	804	860	[4] 837	838
Switzerland	[2] 12	[2] 30	[2] 32	34	35
Thailand	----	----	----	8	9
Trieste	----	----	61	65	40
Turkey	99	[4] 102	[4] 116	116	155
Union of South Africa	630	651	708	733	805
U. S. S. R. [2]	11,200	14,100	16,700	19,500	22,500
United Kingdom	7,910	9,425	9,653	[4] 9,818	9,859
United States	54,559	56,214	49,775	[4] 60,210	65,805
Yugoslavia	[4] 171	172	191	[4] 212	250
Total (estimate)	100,000	113,000	116,000	[4] 134,000	150,000

[1] Pig iron is also produced in Belgian Congo, Indonesia, New Zealand, and the Philippines, but quantity produced is believed insufficient to affect estimate of world total.
[2] Estimate.
[3] Data not available; estimate by author of chapter included in total.
[4] Revised figure.
[5] Excluding ferroalloy production, for which data are not yet available, but estimate has been included in total.

TABLE 22.—World production of steel ingots and castings, 1947–51, by countries, in thousands of metric tons

[Compiled by Pauline Roberts]

Country	1947	1948	1949	1950	1951
Argentina [1]	150	170	180	200	250
Australia	[2] 1,321	[2] 1,176	[2] 1,149	[2] 1,448	1,457
Austria	357	648	835	947	1,028
Belgium	2,882	3,920	3,849	[2] 3,777	5,069
Brazil	387	483	605	[2] 779	[1] 830
Canada	2,673	2,903	2,894	3,070	3,236
Chile	31	30	32	[2] 56	190
China	[1 2] 50	[1 2] 30	[1] 100	[1 2] 680	[1] 1,000
Colombia [1]	5	10	10	10	10
Czechoslovakia	2,286	2,650	[2] 2,762	[1 2] 3,011	[1] 3,312
Denmark	58	72	76	123	164
Egypt [1]	10	10	10	10	10
Finland	81	109	114	105	138
France	5,733	7,266	[2] 9,152	8,652	9,828
Saar	708	1,228	1,757	[2] 1,898	2,603
Germany:					
East Germany	250	332	700	1,155	1,552
West Germany	3,767	6,784	9,156	12,121	13,506
Greece	10	[1] 17	[1] 23	[1] 26	(3)
Hungary	597	[2] 762	849	1,022	[1] 1,234
India	1,276	1,276	1,374	[2] 1,461	1,524
Ireland [1]	16	16	16	16	16
Italy	1,691	2,101	2,026	2,323	2,992
Trieste		24	29	39	56
Japan	[2] 952	1,714	3,111	[2] 4,838	6,502
Korea	[1] 50	[1] 40	[1] 40	(3)	(3)
Luxembourg	1,714	2,453	2,272	[2] 2,451	3,077
Mexico	322	269	345	[2] 333	[1] 430
Netherlands	[2] 196	[2] 334	[2] 428	490	552
Norway	65	[2] 71	[2] 74	[2] 81	86
Pakistan	(3)	(3)	(3)	5	6
Peru [1]	10	10	10	10	10
Poland	1,579	1,954	2,305	2,515	[1] 2,800
Rumania	183	[1] 340	[1] 459	[1] 558	646
Southern Rhodesia	6	8	18	22	28
Spain	[2] 608	[2] 673	[2] 684	[2] 807	831
Sweden	1,191	1,257	1,370	[2] 1,437	1,503
Switzerland	92	[2] 120	[2] 124	130	144
Thailand	(3)	(3)	(3)	5	6
Turkey	93	[2] 102	103	90	135
Union of South Africa	598	597	632	755	948
U. S. S. R. [1]	14,000	18,300	23,000	27,000	[1] 31,500
United Kingdom	12,929	15,115	15,803	16,555	15,889
United States [4]	77,014	80,413	70,740	87,848	95,435
Yugoslavia	311	367	399	[2] 428	434
Total	136,000	156,000	[2] 160,000	[2] 189,000	211,000

[1] Estimate.
[2] Revised figure.
[3] Data not available; estimate included in total.
[4] Data from American Iron and Steel Institute. Excludes production of castings by companies that do not produce steel ingots.

had the iron foundries not been allowed to use more scrap and pig iron in 1951 than they did in 1950. This diversion of scrap and pig iron caused a greater shortage of these materials at steel-making furnaces.[9]

[9] Mining World, April 1951, vol. 13, No. 4, p. 46.
State Department Dispatch 3375, Feb. 1, 1952, American Embassy, London, England, 5 pp.

Iron and Steel Scrap

By James E. Larkin

GENERAL SUMMARY

THE QUANTITY of ferrous materials (scrap and pig iron) consumed in 1951 was the largest in history, totaling 148.1 million short tons to exceed the previous record year (1950) by 11 percent. In 1951, 38.8 million short tons was home scrap, and 37.9 million tons was purchased scrap, each establishing a record year, making a total of 76.7 million tons, which represented 52 percent of the total charge. Home scrap was consumed in 1951 at an average monthly rate of 3,238,000 short tons; March (3,457,326 tons), was the largest month on record, and January, April, May, and October were also all greater than the previous record month of October 1950. Purchased-scrap consumption in 1951 was at a record monthly rate of 3,156,000 short tons. The record purchased-scrap consumption was also in March (3,472,697 short tons), and January, April, May, June, August, and October were all greater than the previous record month—October 1950. Purchased-scrap consumption for the year exceeded 1950 by 4.5 million short tons; 1948, the greatest peacetime year, by 5.3 million tons; and 1942, the highest wartime year, by 10.7 million tons. The large use of ferrous scrap resulted in a greater demand for pig iron; accordingly, a record year was established by the use of 71.4 million short tons. Consumption of pig iron in October (6,273,559 tons) was the greatest quantity used in any one month, and the total for the year exceeded the previous year by 6.5 million short tons, or 10 percent.

The proportions of scrap and pig iron used in steel furnaces in 1951—the same as in 1950—were 48 and 52 percent, respectively, compared with 47 and 53 percent in 1949. The charge of scrap and pig iron used in iron foundries, mainly cupola furnaces, comprised 65 percent scrap and 35 percent pig iron, the same as in 1950 and 1949.

The increased consumption of purchased iron and steel scrap reduced stocks of this material held by consumers to a level 20 percent lower on December 31 than at the beginning of the year—equivalent to a 31-day supply at the 1951 average daily consumption rate of 103,474 short tons. Stocks reached a high of 4,125,351 short tons for the year at the end of January but decreased steadily to a low of 2,941,465 short tons at the end of June. In order to alleviate the purchased-scrap shortage, which was caused by the mills expanding their production facilities to meet the requirements of an increased military program as well as domestic needs, the Government, through the National Production Authority, organized committees in industry to appoint representatives in their organizations to urge the collection of all dormant plant scrap and to identify machinery that was obsolete and could be scrapped. Federal Government agencies, including the

Navy and Army, Maritime Commission, and the Interior and Agriculture Departments, were called upon to urge their various installations, yards, mines, and experiment stations to turn in all possible scrap. Results of this combined effort on the part of the scrap iron and steel industries and Government agencies to bring out as much scrap as possible were evident by the end of October, when the stocks of purchased scrap held by consumers had advanced to more than a 30-day supply.

TABLE 1.—Salient statistics of ferrous scrap and pig iron in the United States, 1950–51

	1950 (short tons)	1951 (short tons)	Percent of change from 1950
Stocks, December 31: Ferrous scrap and pig iron at consumers' plants:			
Home scrap	1,469,463	1,198,556	−18
Purchased scrap	3,950,863	3,167,501	−20
Pig iron	1,800,137	1,750,986	−3
Total	7,220,463	6,117,043	−15
Consumption: Ferrous scrap and pig iron charged to—			
Steel furnaces: [1]			
Home scrap	27,353,503	30,100,917	+10
Purchased scrap	23,738,078	26,986,412	+14
Pig iron	56,269,610	61,750,383	+10
Total	107,361,191	118,837,712	+11
Iron furnaces: [2]			
Home scrap	8,116,435	8,707,235	+7
Purchased scrap	8,193,174	9,521,028	+16
Pig iron	8,673,508	9,663,934	+11
Total	24,983,117	27,892,197	+12
Miscellaneous uses [3] and ferro-alloy production:			
Home scrap	55,169	48,592	−12
Purchased scrap	1,444,916	1,363,915	−6
Total	1,500,085	1,412,507	−6
All uses:			
Home scrap	35,525,107	38,856,744	+9
Purchased scrap	33,376,168	37,871,355	+13
Total ferrous scrap	68,901,275	76,728,099	+11
Pig iron	64,943,118	71,414,317	+10
Grand total	133,844,393	148,142,416	+11
Imports of scrap (including tin plate scrap)	[4] 785,230	416,858	−47
Exports of scrap:			
Iron and steel	[4] 208,355	229,718	+10
Tin plate, circles, strips, cobbles, etc	[4] 8,609	15,622	+81
Average prices per gross ton:			
Scrap:			
No. 1 Heavy-Melting, Pittsburgh [5]	[4] $39.16	$44.21	+13
No. 1 Cast Cupola, Chicago [5]	[4] $47.85	$50.17	+5
For export	[4] $31.04	$41.52	+34
Pig iron, f. o. b. Valley furnaces: [5]			
Basic	[4] $47.03	$52.00	+11
No. 2 Foundry	[4] $47.55	$52.50	+10

[1] Includes open-hearth, Bessemer, and electric furnaces.
[2] Includes cupola, air, Brackelsberg, puddling (1950 only, none in 1951), crucible, and blast furnaces; also direct castings.
[3] Includes rerolling, reforging, copper precipitation, nonferrous, and chemical uses
[4] Revised figure.
[5] Iron Age.

GOVERNMENT REGULATIONS

Regardless of the above-mentioned efforts to bring out more scrap and build up consumers' inventories to a safe level, it was decided that some means of control over stocks and prices was necessary.

National Production Authority Regulation 1, effective September 18, 1950, had provided for a measure of control over inventories of commodities in short supply, including iron and steel scrap. However, this merely restricted commercial dealers to "a practicable minimum working inventory." Order M–20, on the other hand, effective January 4, 1951, amplified Regulation 1, with respect to iron and steel scrap, by prohibiting any regular dealer, broker, automobile wrecker, or producer of scrap from receiving in any 60-day period (except for certain normal seasonal operations) iron and steel scrap that would increase his inventory position beyond either a minimum practicable working inventory or beyond his average inventory position during the preceding 60-day period, whichever was the lesser. This order, in turn, was amended, effective January 29, 1951, to provide that NPA might (1) establish limitations on consumers' scrap inventories and (2) allocate scrap and specifically direct the manner and quantities in which deliveries were to be made. March was the first month of allocation of scrap from dealers to consumers. Special controls over automobile wreckers were established on December 11, when NPA issued Order M–92, requiring an inventory report from automobile wreckers by December 20, covering the number of motor vehicles, car units,[1] and poundage of loose scrap. The order put a ceiling on acceptance by automobile wreckers of delivery of motor vehicles and car units and required a quarterly turnover both of car units and of motor vehicles manufactured before 1946. It also required automobile wreckers to comply with National Production Authority allocation directives at any time.

Prices of iron and steel scrap were covered by the general price freeze imposed by the Office of Price Stabilization on January 26, 1951, and subsequently were brought under specific control by Ceiling Price Regulation 5 of February 5.

CONSUMPTION

The use of scrap and pig iron increased in every district[2] during 1951, the total being 11 percent greater than in 1950. There was a noticeably greater amount of scrap than pig iron used in the New England, West North Central, West South Central, and Pacific districts. These districts together used 11 percent of the total scrap consumed in 1951 and 4 percent of the pig iron, compared with 10 and 4 percent, respectively, in 1950. The average ratio of scrap to pig

[1] A car unit was defined as any motor vehicle, regardless of age, stripped of salvageable parts or 1,500 pounds of loose scrap, that is, detached nonsalvageable material resulting from dismantling operations.

[2] The geographical districts have been rearranged in this chapter to be the same as the geographical divisions used by the Bureau of the Census.

iron in these four districts combined was 2.6:1, whereas the United States average was 1.07:1. Owing in part to the type of operations in these four districts the scrap to pig-iron ratio varies somewhat from the United States ratio. The United States as a whole used 7 percent more scrap than pig iron in 1951 compared with 6 percent in 1950.

Open-hearth furnaces continued to be the largest consumers of ferrous scrap and pig iron, increasing their consumption over that of 1950 by 3.9 million tons of scrap and 5.1 million tons of pig iron. Open-hearth consumption took 62 percent of the total scrap in 1951 and 63 percent in 1950, comprised of 68 percent of the home scrap in 1951 (the same as in 1950) and 55 percent of the purchased scrap in 1951 (58 percent in 1950). Pig-iron consumption in open hearths accounted for 78 percent of the total pig iron consumed (the same as in 1950).

Cupola-furnace consumption in 1951 was as follows: Home scrap, 15 percent of the total home scrap consumed (the same as in 1950); purchased scrap, 17 percent (compared with 16 percent in 1950); pig iron, 9 percent (the same as for the 4 years preceding 1951).

Bessemer converters consumed 8 percent of the pig iron during 1951 (the same as in 1950), compared with 9 percent in 1949, and 0.4 percent of scrap (the same as for 1950 and 1949).

Electric furnaces consumed 12 percent of the total scrap (1 percent more than in 1950 and 3 percent more than in 1949) and 0.2 percent of the pig iron (unchanged from 1949–50).

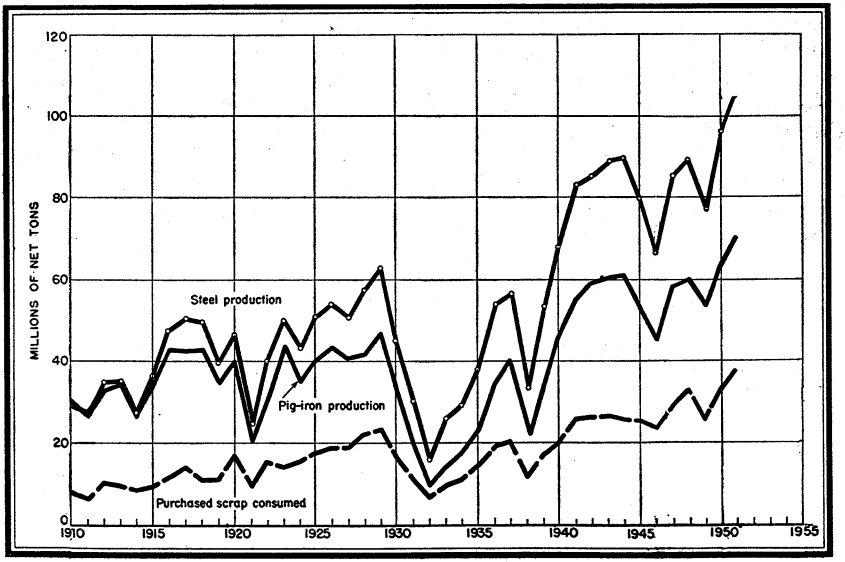

FIGURE 1.—Consumption of purchased scrap and output of pig iron and steel in the United States, 1910–51. Figures on consumption of purchased scrap for 1910–32 are from State of Minnesota vs. Oliver Iron Mining Co., et al., Exhibits, vol. 5, 1935, p. 328; those for 1933–34 are estimated by authors; and those for 1935–51 are based on Bureau of Mines records. Data on steel output are from the American Iron and Steel Institute.

TABLE 2.—Ferrous scrap and pig iron consumed in the United States and percent of total derived from home scrap, purchased scrap, and pig iron, 1950–51, by districts

District [1]	1950					1951				
	Total consumed (short tons)	Percent of total consumed				Total consumed (short tons)	Percent of total consumed			
		Scrap			Pig iron		Scrap			Pig iron
		Home	Purchased	Total			Home	Purchased	Total	
New England	1,327,623	31.5	41.5	73.0	27.0	1,584,510	31.8	42.7	74.5	25.5
Middle Atlantic [2]	42,006,832	25.2	23.3	48.5	51.5	47,075,594	25.9	23.0	48.9	51.1
East North Central [2]	60,655,932	27.9	25.0	52.9	47.1	66,266,770	26.7	25.8	52.5	47.5
West North Central	2,859,341	23.1	50.8	73.9	26.1	3,531,848	25.7	49.2	74.9	25.1
South Atlantic [2]	10,137,621	24.6	18.7	43.3	56.7	10,520,272	24.4	19.2	43.6	56.4
East South Central [2]	8,549,846	26.0	18.4	44.4	55.6	9,042,798	26.5	18.8	45.3	54.7
West South Central	1,367,470	25.3	48.1	73.4	26.6	1,894,015	24.6	44.1	68.7	31.3
Mountain	3,309,550	27.3	19.3	46.6	53.4	3,556,812	26.6	20.9	47.5	52.5
Pacific [2]	3,630,178	27.0	46.6	73.6	26.4	4,588,400	25.3	46.4	71.7	28.3
Undistributed [2]						81,397	(3)	100.0	100.0	
Total	133,844,393	26.6	24.9	51.5	48.5	148,142,416	26.2	25.6	51.8	48.2

[1] The geographical districts have been rearranged in the tables appearing in this chapter to be the same as the geographical divisions used by the Bureau of Census.
[2] In 1951 some scrap consumed in the Middle Atlantic, East North Central, South Atlantic, East South Central, and Pacific districts (not separable) is included with "Undistributed."
[3] Less than 0.05 percent.

TABLE 3.—Consumption of ferrous scrap and pig iron in the United States, 1950–51, by type of furnace, in short tons

Type of furnace or equipment	Scrap			Pig iron	Total scrap and pig iron
	Home	Purchased	Total		
1950					
Open-hearth	24,309,250	19,202,771	43,512,021	50,946,134	94,458,155
Bessemer	211,316	45,374	256,690	5,169,835	5,426,525
Electric	2,832,937	4,489,933	7,322,870	153,641	7,476,511
Cupola	5,335,513	5,385,463	10,720,976	6,059,188	16,780,164
Air [1]	756,077	439,188	1,195,265	334,613	1,529,878
Crucible	646	280	926	1,190	2,116
Puddling	31	2,346	2,377	3,168	5,545
Blast	2,024,168	2,365,897	4,390,065		4,390,065
Direct castings				2,275,349	2,275,349
Ferroalloy	12,454	343,004	355,458		355,458
Miscellaneous	42,715	1,101,912	1,144,627		1,144,627
Total	35,525,107	33,376,168	68,901,275	64,943,118	133,844,393
1951					
Open-hearth	26,610,109	20,805,677	47,415,786	56,055,103	103,470,889
Bessemer	253,782	45,973	299,755	5,551,149	5,850,904
Electric	3,237,026	6,134,762	9,371,788	144,131	9,515,919
Cupola	5,794,969	6,523,688	12,318,657	6,559,800	18,878,457
Air [1]	906,437	525,128	1,431,565	400,267	1,831,832
Crucible	94	78	172	243	415
Blast	2,005,735	2,472,134	4,477,869		4,477,869
Direct castings				2,703,624	2,703,624
Ferroalloy	13,547	401,402	414,949		414,949
Miscellaneous	35,045	962,513	997,558		997,558
Total	38,856,744	37,871,355	76,728,099	71,414,317	148,142,416

[1] Includes data for 2 Brackelsberg furnaces.

TABLE 4.—Proportion of home and purchased scrap and pig iron used in furnace charges in the United States, 1950–51, in percent

Type of furnace	1950				1951			
	Scrap			Pig iron	Scrap			Pig iron
	Home	Purchased	Total		Home	Purchased	Total	
Open-hearth	25.8	20.3	46.1	53.9	25.7	20.1	45.8	54.2
Bessemer	3.9	.8	4.7	95.3	4.3	.8	5.1	94.9
Electric	37.9	60.0	97.9	2.1	34.0	64.5	98.5	1.5
Cupola	31.8	32.1	63.9	36.1	30.7	34.6	65.3	34.7
Air [1]	49.4	28.7	78.1	21.9	49.5	28.6	78.1	21.9
Crucible	30.5	13.3	43.8	56.2	22.6	18.8	41.4	58.6
Puddling	.6	42.3	42.9	57.1				
Blast	46.1	53.9	100.0		44.8	55.2	100.0	

[1] Includes data for 2 Brackelsberg furnaces.

TABLE 5.—Consumption of ferrous scrap and pig iron in the United States in 1951, by type of consumer and type of furnace, in short tons

Type of consumer and type of furnace or equipment	Scrap			Pig iron	Total scrap and pig iron
	Home	Purchased	Total		
Manufacturers of steel ingots and castings: [1]					
Open-hearth	26,163,725	19,856,778	46,020,503	55,848,915	101,869,418
Bessemer	239,068	17,634	256,702	5,546,349	5,803,051
Electric	2,370,249	5,012,360	7,382,609	91,083	7,473,692
Cupola	205,082	121,069	326,151	669,304	995,455
Air	24,975	21,908	46,883	18,514	65,397
Crucible	16		16	8	24
Blast [2]	2,005,735	2,472,134	4,477,869		4,477,869
Direct castings				1,671,296	1,671,296
Miscellaneous	27,046	276,995	304,041		304,041
Total: 1951	31,035,896	27,778,878	58,814,774	63,845,469	122,660,243
1950	28,790,280	25,154,882	53,945,162	58,036,371	111,981,533
Manufacturers of steel castings: [3]					
Open-hearth	446,384	948,899	1,395,283	206,188	1,601,471
Bessemer	13,190	20,888	34,078	4,259	38,337
Electric	782,411	1,037,042	1,819,453	28,848	1,848,301
Cupola	308,964	627,865	936,829	235,525	1,172,354
Air [4]	199,065	134,728	333,793	80,311	414,104
Direct castings				149	149
Miscellaneous	697		697		697
Total: 1951	1,750,711	2,769,422	4,520,133	555,280	5,075,413
1950	1,175,941	1,868,230	3,044,171	436,201	3,480,372
Iron foundries and miscellaneous users:					
Bessemer	1,524	7,451	8,975	541	9,516
Electric	84,366	85,360	169,726	24,200	193,926
Cupola	5,280,923	5,774,754	11,055,677	5,654,971	16,710,648
Air	682,397	368,492	1,050,889	301,442	1,352,331
Crucible	78	78	156	235	391
Direct castings				1,032,179	1,032,179
Ferro-alloy	13,547	401,402	414,949		414,949
Miscellaneous	7,302	685,518	692,820		692,820
Total: 1951	6,070,137	7,323,055	13,393,192	7,013,568	20,406,760
1950	5,558,886	6,353,056	11,911,942	6,470,546	18,382,488

[1] Includes only those castings made by companies producing steel ingots.
[2] Includes consumption in blast furnaces by both integrated and nonintegrated mills.
[3] Excludes companies that produce both steel castings and steel ingots.
[4] Includes data for two Brackelsberg furnaces.

TABLE 6.—Consumption of ferrous scrap and pig iron in the United States, 1947–51, by districts

District and year	Scrap						Pig iron	
	Home		Purchased		Total			
	Short tons	Change from previous year (percent)	Short tons	Change from previous year (percent)	Short tons	Change from previous year (percent)	Short tons	Change from previous year (percent)
New England:								
1947	460,062	+17.2	561,545	+17.5	1,021,607	+17.4	352,297	+18.6
1948	442,821	−3.7	648,418	+15.5	1,091,239	+6.8	342,893	−2.7
1949	345,288	−22.0	420,160	−35.2	765,448	−29.9	283,337	−17.4
1950	417,689	+21.0	551,282	+31.2	968,971	+26.6	358,652	+26.6
1951	504,157	+20.7	675,823	+22.6	1,179,980	+21.8	404,530	+12.8
Middle Atlantic:								
1947 [1]	9,969,067	+21.6	8,448,241	+29.7	18,417,308	+25.2	20,495,560	+32.1
1948	10,416,428	+4.5	9,240,074	+9.4	19,656,502	+6.7	20,895,487	+2.0
1949	8,899,441	−14.6	7,147,852	−22.6	16,047,293	−18.4	17,731,194	−15.1
1950	10,585,951	+19.0	9,771,756	+36.7	20,357,707	+26.9	21,649,125	+22.1
1951 [2]	12,210,369	+15.3	10,839,307	+10.9	23,049,676	+13.2	24,025,918	+11.0
East North Central:								
1947 [1]	14,931,852	+19.6	12,950,672	+23.9	27,881,924	+21.6	26,004,683	+26.8
1948	15,048,785	+.8	14,486,835	+11.9	29,535,620	+5.9	26,498,691	+1.9
1949	13,821,486	−8.2	11,035,315	−23.8	24,856,801	−15.8	23,869,383	−9.9
1950	16,921,000	+22.4	15,137,680	+37.2	32,058,680	+29.0	28,597,252	+19.8
1951 [2]	17,693,909	+4.6	17,107,798	+13.0	34,801,707	+8.6	31,465,063	+10.0
West North Central:								
1947	621,708	+8.6	1,308,349	+23.3	1,930,057	+18.2	638,892	−3.1
1948	660,035	+6.2	1,404,212	+7.3	2,064,247	+7.0	661,729	+3.6
1949	576,147	−12.7	1,175,904	−16.3	1,752,051	−15.1	571,453	−13.6
1950	659,059	+14.4	1,452,653	+23.5	2,111,712	+20.5	747,629	+30.8
1951	908,344	+37.8	1,737,553	+19.6	2,645,897	+25.3	885,951	+18.5
South Atlantic:								
1947 [1]	1,910,449	+15.6	2,076,565	+20.3	3,987,014	+18.0	4,122,561	+20.2
1948	2,130,399	+11.5	2,078,125	+.1	4,208,524	+5.6	4,733,573	+14.8
1949	2,154,561	+1.1	1,704,767	−18.0	3,859,328	−8.3	4,818,855	+1.8
1950	2,491,182	+15.6	1,899,328	+11.4	4,390,510	+13.8	5,747,111	+19.3
1951 [2]	2,570,140	+3.2	2,017,421	+6.2	4,587,561	+4.5	5,932,711	+3.2
East South Central:								
1947 [1]	1,861,045	+15.5	1,160,825	+25.8	3,021,870	+19.3	4,165,771	+26.9
1948	1,964,069	+5.5	1,542,245	+32.9	3,506,314	+16.0	4,424,654	+6.2
1949	1,740,298	−11.4	1,184,021	−23.2	2,924,319	−16.6	3,913,460	−11.6
1950	2,221,577	+27.7	1,576,898	+33.2	3,798,475	+29.9	4,751,371	+21.4
1951 [2]	2,395,012	+7.8	1,703,677	+8.0	4,098,689	+7.9	4,944,109	+4.1
West South Central:								
1947	214,063	+54.0	532,740	+32.3	746,803	+37.9	125,857	+110.6
1948	233,904	+9.3	573,557	+7.7	807,461	+8.1	237,972	+89.1
1949	196,586	−16.0	488,576	−14.8	685,162	−15.1	204,333	−14.1
1950	345,371	+75.7	658,095	+34.7	1,003,466	+46.5	364,004	+78.1
1951	465,411	+34.8	836,030	+27.0	1,301,441	+29.7	592,574	+62.8
Mountain:								
1947	764,317	+54.0	498,052	+16.3	1,262,369	+36.6	1,515,960	+98.4
1948	753,167	−1.5	583,453	+17.1	1,336,620	+5.9	1,585,327	+4.6
1949	676,327	−10.2	548,626	−6.0	1,224,953	−8.4	1,365,795	−13.8
1950	903,368	+33.6	637,410	+16.2	1,540,778	+25.8	1,768,772	+29.5
1951	946,741	+4.8	743,392	+16.6	1,690,133	+9.7	1,866,679	+5.5
Pacific:								
1947 [1]	671,750	+14.3	1,724,540	+26.5	2,396,290	+22.8	652,976	+17.8
1948	770,035	+14.6	1,987,313	+15.2	2,757,348	+15.1	646,078	−1.1
1949	756,359	−1.8	1,466,509	−26.2	2,222,868	−19.4	688,955	+6.6
1950	979,910	+29.6	1,691,066	+15.3	2,670,976	+20.2	959,202	+39.2
1951 [2]	1,162,622	+18.6	2,128,996	+25.9	3,291,618	+23.2	1,296,782	+35.2
Undistributed:								
1947 [1]	174,629	-------	24,490	-------	199,119	-------	216,198	-------
1951 [2]	39	-------	81,358	-------	81,397	-------	-------	-------
United States:								
1947	31,578,942	+20.8	29,285,419	+25.4	60,864,361	+23.0	58,290,755	+29.3
1948	32,419,643	+2.7	32,544,232	+11.1	64,963,875	+6.7	60,026,404	+3.0
1949	29,166,493	−10.0	25,171,730	−22.7	54,338,223	−16.4	53,446,765	−11.0
1950	35,525,107	+21.8	33,376,168	+32.6	68,901,275	+26.8	64,943,118	+21.5
1951	38,856,744	+9.4	37,871,355	+13.5	76,728,099	+11.4	71,414,317	+10.0

[1] In 1947 some scrap and pig iron consumed in East North Central, East South Central, Middle Atlantic, Pacific, and South Atlantic districts—not separable—are included with "Undistributed."

[2] In 1951 some scrap consumed in East North Central, East South Central, Middle Atlantic, Pacific and South Atlantic districts—not separable—is included with "Undistributed."

CONSUMPTION BY DISTRICTS AND STATES

During 1951 iron and steel scrap and pig iron were used in all 48 States and the District of Columbia. The largest consuming districts were East North Central, Middle Atlantic, and South Atlantic. (*See* table 6). All districts increased over 1950 in total scrap and pig-iron consumption. The States having the largest consumption of scrap, with the percentage consumed, were: Pennsylvania 24, Ohio 18, Illinois 10, and Indiana 9.

Consumption for 1951 was obtained from sample monthly canvasses; therefore, exact number of active plants by States is not available.

TABLE 7.—Consumption of ferrous scrap and pig iron in the United States in 1951, by State and district

State and district	Scrap						Pig iron	
	Home		Purchased		Total			
	Short tons	Percent of total	Short tons	Percent of total	Short tons	Percent of total	Short tons	Percent of total
Connecticut	149,120	0.4	243,874	0.7	392,994	0.5	83,101	0.1
Maine	10,720	(1)	11,226	(1)	21,946	(1)	9,647	(1)
Massachusetts	259,243	.7	313,206	.8	572,449	.7	231,897	.4
New Hampshire	9,523	(1)	12,882	(1)	22,405	(1)	4,762	(1)
Rhode Island	54,333	.1	72,256	.2	126,589	.2	57,792	.1
Vermont	21,218	.1	22,379	.1	43,597	.1	17,331	(1)
Total New England	504,157	1.3	675,823	1.8	1,179,980	1.5	404,530	.6
New Jersey	273,418	.7	567,807	1.5	841,225	1.1	295,182	.4
New York [2]	1,783,928	4.6	1,935,093	5.1	3,719,021	4.8	3,416,408	4.8
Pennsylvania	10,153,023	26.1	8,336,407	22.0	18,489,430	24.1	20,314,328	28.5
Total Middle Atlantic	12,210,369	31.4	10,839,307	28.6	23,049,676	30.0	24,025,918	33.7
Illinois	3,431,327	8.8	3,869,852	10.2	7,301,179	9.5	5,948,201	8.3
Indiana	4,355,666	11.2	2,280,882	6.0	6,636,548	8.7	8,339,759	11.7
Michigan	2,511,812	6.5	3,515,648	9.3	6,027,460	7.9	3,605,019	5.1
Ohio [2]	6,808,322	17.5	6,952,548	18.4	13,760,870	17.9	13,230,964	18.5
Wisconsin	586,782	1.5	488,868	1.3	1,075,650	1.4	341,120	.5
Total East North Central	17,693,909	45.5	17,107,798	45.2	34,801,707	45.4	31,465,063	44.1
Iowa	264,089	.7	386,680	1.0	650,769	.9	152,275	.2
Kansas, Nebraska	31,428	.1	73,803	.2	105,231	.1	10,395	(1)
Minnesota, North Dakota, South Dakota	409,955	1.1	449,254	1.2	859,209	1.1	620,166	.9
Missouri	202,872	.5	827,816	2.2	1,030,688	1.4	103,115	.1
Total West North Central	908,344	2.4	1,737,553	4.6	2,645,897	3.5	885,951	1.2
Delaware, District of Columbia, Maryland	1,769,029	4.5	784,484	2.1	2,553,513	3.3	3,871,880	5.4
Florida, Georgia	70,384	.1	151,233	.4	221,617	.3	79,929	.1
North Carolina	25,915	.1	30,004	.1	55,919	.1	29,946	.1
South Carolina	19,762	.1	11,858	(1)	31,620	(1)	21,521	(1)
Virginia, West Virginia [2]	685,050	1.8	1,039,842	2.7	1,724,892	2.3	1,929,435	2.7
Total South Atlantic	2,570,140	6.6	2,017,421	5.3	4,587,561	6.0	5,932,711	8.3

For footnotes, see end of table.

TABLE 7.—Consumption of ferrous scrap and pig iron in the United States in 1951, by State and district—Continued

State and district	Scrap						Pig iron	
	Home		Purchased		Total			
	Short tons	Percent of total	Short tons	Percent of total	Short tons	Percent of total	Short tons	Percent of total
Alabama [2]	1,677,302	4.3	984,677	2.6	2,661,979	3.4	3,902,199	5.5
Kentucky, Mississippi, Tennessee	717,710	1.9	719,000	1.9	1,436,710	1.9	1,041,910	1.4
Total East South Central	2,395,012	6.2	1,703,677	4.5	4,098,689	5.3	4,944,109	6.9
Arkansas, Louisiana, Oklahoma	47,499	.1	125,158	.3	172,657	.2	13,981	(1)
Texas	417,912	1.1	710,872	1.9	1,128,784	1.5	578,593	.8
Total West South Central	465,411	1.2	836,030	2.2	1,301,441	1.7	592,574	.8
Arizona, Nevada, New Mexico	26,887	.1	65,329	.2	92,216	.1	866	(1)
Colorado, Utah	911,168	2.3	653,848	1.8	1,565,016	2.1	1,864,848	2.6
Montana	6,209	(1)	13,574	(1)	19,783	(1)	276	(1)
Idaho, Wyoming	2,477	(1)	10,641	(1)	13,118	(1)	689	(1)
Total Mountain	946,741	2.4	743,392	2.0	1,690,133	2.2	1,866,679	2.6
California	1,046,662	2.7	1,591,903	4.2	2,638,565	3.4	1,271,574	1.8
Oregon [2], Washington	115,960	.3	537,093	1.4	653,053	.9	25,208	(1)
Total Pacific	1,162,622	3.0	2,128,996	5.6	3,291,618	4.3	1,296,782	1.8
Undistributed [2]	39	(1)	81,358	.2	81,397	.1		
Total United States:								
1951	38,856,744	100.0	37,871,355	100.0	76,728,099	100.0	71,414,317	100.0
1950	35,525,107	100.0	33,376,168	100.0	68,901,275	100.0	64,943,118	100.0

[1] Less than 0.05 percent.
[2] Some scrap consumption in Alabama, New York, Ohio, Oregon, and West Virginia—not separable—is included with "Undistributed."

CONSUMPTION BY TYPE OF FURNACE

Open-Hearth Furnaces.—Ferrous scrap and pig-iron consumption in open-hearth furnaces in 1951 totaled 103.5 million short tons, an increase of 10 percent over 1950, and established a record high consumption of these materials by this type of furnace. The use of home scrap increased 9 percent over 1950 and was 2 percent greater than in 1944, the previous record year for the use of this material. Purchased scrap increased 8 percent, total scrap 9 percent, and pig iron 10 percent. The open-hearth furnace melt in 1951 consisted of 46 percent scrap and 54 percent pig iron (unchanged from 1950). Of the total scrap consumed, 44 percent was purchased (the same as in 1950) compared with 42 percent in 1949.

Pennsylvania continued to be the leading State in the use of scrap in the open hearth, followed by Ohio, Indiana and Illinois; this rank has remained unchanged since 1936.

TABLE 8.—Consumption of ferrous scrap and pig iron in open-hearth furnaces in the United States in 1951, by district and State, in short tons

District and State	Scrap			Pig iron	Total scrap and pig iron
	Home	Purchased	Total		
New England:					
Connecticut, Massachusetts, Rhode Island	142,327	330,257	472,584	132,368	604,952
Total: 1951	142,327	330,257	472,584	132,368	604,952
1950	120,542	240,162	360,704	117,267	477,971
Middle Atlantic:					
New Jersey, New York	1,441,658	1,227,068	2,668,726	3,119,596	5,788,322
Pennsylvania	7,819,945	5,699,267	13,519,212	16,813,900	30,333,112
Total: 1951	9,261,603	6,926,335	16,187,938	19,933,496	36,121,434
1950	8,064,751	6,422,944	14,487,695	17,953,543	32,441,238
East North Central:					
Illinois	2,135,076	1,784,961	3,920,037	4,359,903	8,279,940
Indiana	3,753,929	1,784,688	5,538,617	7,653,517	13,192,134
Michigan, Wisconsin	900,725	942,503	1,843,228	2,426,550	4,269,778
Ohio	4,816,946	4,129,659	8,946,605	9,666,435	18,613,040
Total: 1951	11,606,676	8,641,811	20,248,487	24,106,405	44,354,892
1950	10,849,430	7,923,112	18,772,542	21,474,239	40,246,781
West North Central:					
Minnesota, Missouri	325,469	812,135	1,137,604	605,852	1,743,456
Total: 1951	325,469	812,135	1,137,604	605,852	1,743,456
1950	310,483	745,423	1,055,906	530,449	1,586,355
South Atlantic:					
Delaware, Maryland	1,560,846	546,159	2,107,005	3,381,395	5,488,400
Georgia, West Virginia	529,979	890,317	1,420,296	1,451,820	2,872,116
Total: 1951	2,090,825	1,436,476	3,527,301	4,833,215	8,360,516
1950	1,917,819	1,381,649	3,299,468	4,730,414	8,029,882
East South Central:					
Alabama, Kentucky	1,373,955	529,640	1,903,595	3,363,738	5,267,333
Total: 1951	1,373,955	529,640	1,903,595	3,363,738	5,267,333
1950	1,318,783	605,161	1,923,944	3,441,843	5,365,787
West South Central:					
Oklahoma, Texas	207,925	467,335	675,260	311,769	987,029
Total: 1951	207,925	467,335	675,260	311,769	987,029
1950	215,251	470,129	685,380	291,123	976,503
Mountain:					
Colorado, Utah	849,248	513,306	1,362,554	1,660,574	3,023,128
Total: 1951	849,248	513,306	1,362,554	1,660,574	3,023,128
1950	827,252	432,405	1,259,657	1,599,016	2,858,673
Pacific:					
California, Washington	752,081	1,148,382	1,900,463	1,107,686	3,008,149
Total: 1951	752,081	1,148,382	1,900,463	1,107,686	3,008,149
1950	684,939	981,786	1,666,725	808,240	2,474,965
Total United States: 1951	26,610,109	20,805,677	47,415,786	56,055,103	103,470,889
1950	24,309,250	19,202,771	43,512,021	50,946,134	94,458,155

Bessemer Converters.—The 5.9 million short tons of ferrous raw materials used in Bessemer converters in 1951 represents an 8-percent increase over the 1950 use of these materials. The ratio of scrap to

total metal charge was 1:20 compared with 1:21 during 1950; of the scrap used, 85 percent was home scrap, slightly higher than the previous year.

Following the usual pattern, Pennsylvania was the principal consumer of converter scrap in 1951. Ohio was the largest consumer of pig iron in this type of furnace, using 44 percent of the total.

Although the use of ferrous raw materials, was greater in 1951 than 1950, it was less than in the years 1941 through 1944, with 1943 the record year for the consumption of these materials in Bessemer converters.

TABLE 9.—Consumption of ferrous scrap and pig iron in Bessemer converters in the United States in 1951, by district and State, in short tons

District and State	Scrap			Pig iron	Total scrap and pig iron
	Home	Purchased	Total		
New England and Middle Atlantic:					
Connecticut, New Jersey	2,686	3,032	5,718	928	6,646
Pennsylvania	97,086	19,199	116,285	1,614,049	1,730,334
Total: 1951	99,772	22,231	122,003	1,614,977	1,736,980
1950	84,137	17,505	101,642	1,522,382	1,624,024
East North Central and West North Central:					
Illinois, Indiana, Minnesota	2,840	4,323	7,163	365,973	373,136
	6,263	7,067	13,330	314,662	327,992
Ohio	102,122	32	102,154	2,442,798	2,544,952
Total: 1951	111,225	11,422	122,647	3,123,433	3,246,080
1950	91,404	13,896	105,300	2,913,864	3,019,164
South Atlantic:					
Delaware, Maryland, West Virginia	41,888	8,441	50,329	811,697	862,026
Total: 1951	41,888	8,441	50,329	811,697	862,026
1950	34,339	11,024	45,363	733,397	778,760
East South Central and West South Central:					
Alabama, Louisiana, Texas	878	3,758	4,636	1,036	5,672
Total: 1951	878	3,758	4,636	1,036	5,672
1950	1,368	2,696	4,064	156	4,220
Mountain and Pacific:					
Colorado, Washington	19	121	140	6	146
Total: 1951	19	121	140	6	146
1950	68	253	321	36	357
Total United States: 1951	253,782	45,973	299,755	5,551,149	5,850,904
1950	211,316	45,374	256,690	5,169,835	5,426,525

Electric Steel Furnaces.—The melt of ferrous scrap and pig iron used in electric furnaces in 1951 represented an all-time record for the use of these materials in this type of furnace. The melt totaled 9.5 million short tons, an increase of 27 percent over the 7.5 million tons used in 1950, the previous record year. Of the total scrap used, 6.1 million tons was purchased scrap, a new record for the use of this material in electric furnaces. Increases in the use of scrap occurred in all districts; pig iron decreased in the East North Central, West North Central, and Pacific districts.

TABLE 10.—Consumption of ferrous scrap and pig iron in electric steel furnaces in the United States in 1951, by district and State, in short tons

District and State	Scrap			Pig iron	Total scrap and pig iron
	Home	Purchased	Total		
New England:					
Connecticut, New Hampshire	8,784	10,265	19,049	446	19,495
Massachusetts	18,244	10,819	29,063	1,207	30,270
Total: 1951	27,028	21,084	48,112	1,653	49,765
1950	15,324	13,956	29,280	649	29,929
Middle Atlantic:					
New Jersey	18,903	24,056	42,959	4,958	47,917
New York	89,822	145,753	235,575	6,403	241,978
Pennsylvania	834,977	1,252,644	2,087,621	19,487	2,107,108
Total: 1951	943,702	1,422,453	2,366,155	30,848	2,397,003
1950	799,382	1,000,755	1,800,137	23,387	1,823,524
East North Central:					
Illinois	467,816	937,170	1,404,986	66,018	1,471,004
Indiana	46,157	78,254	124,411	1,122	125,533
Michigan	342,356	1,022,623	1,364,979	8,009	1,372,988
Ohio	810,232	1,396,361	2,206,593	16,520	2,223,113
Wisconsin	88,595	100,588	189,183	3,902	193,085
Total: 1951	1,755,156	3,534,996	5,290,152	95,571	5,385,723
1950	1,702,725	2,699,840	4,402,565	116,671	4,519,236
West North Central:					
Iowa, Kansas, Nebraska	27,448	38,208	65,656	385	66,041
Minnesota	6,855	10,395	17,250	157	17,407
Missouri	13,941	22,606	36,547	457	37,004
Total: 1951	48,244	71,209	119,453	999	120,452
1950	34,270	47,213	81,483	2,174	83,657
South Atlantic:					
Delaware, District of Columbia, Maryland	35,968	68,300	104,268	3,667	107,935
Florida, Georgia	7,152	3,892	11,044	76	11,120
North Carolina, Virginia, West Virginia	20,517	8,162	28,679	818	29,497
Total: 1951	63,637	80,354	143,991	4,561	148,552
1950	50,170	73,625	123,795	4,223	128,018
East South Central:					
Alabama	14,724	70,042	84,766	30	84,796
Kentucky	59,806	218,105	277,911	740	278,651
Tennessee	7,980	20,876	28,856	1,321	30,177
Total: 1951	82,510	309,023	391,533	2,091	393,624
1950	41,775	219,367	261,142	721	261,863
West South Central:					
Arkansas, Louisiana, Oklahoma	21,182	26,657	47,839	1,427	49,266
Texas	46,313	76,974	123,287	2,804	126,091
Total: 1951	67,495	103,631	171,126	4,231	175,357
1950	16,894	32,630	49,524	1,380	50,904
Mountain:					
Arizona, Colorado, Nevada, Utah	19,820	23,038	42,858	902	43,760
Total: 1951	19,820	23,038	42,858	902	43,760
1950	7,558	11,075	18,633	540	19,173
Pacific:					
California	179,988	317,727	497,715	2,650	500,365
Oregon	25,283	120,548	145,831	277	146,108
Washington	24,163	130,699	154,862	348	155,210
Total: 1951	229,434	568,974	798,408	3,275	801,683
1950	164,839	391,472	556,311	3,896	560,207
Total United States: 1951	3,237,026	6,134,762	9,371,788	144,131	9,515,919
1950	2,832,937	4,489,933	7,322,870	153,641	7,476,511

Cupolas.—Figures released by the Bureau of the Census, United States Department of Commerce, indicate that shipments of gray-iron castings in 1951 increased 9 percent over 1950. Accordingly, requirements for scrap and pig-iron cupola consumption increased in 1951, which resulted in a new record high being attained in the use of these materials in this type of furnace. These furnaces used 18.9 million short tons of scrap and pig iron, a 13-percent increase over the 16.8 million tons used in 1950, the previous record year. The use of home scrap increased 9 percent, purchased scrap 21 percent, total scrap 15 percent, and pig iron 8 percent.

Charges to cupolas consisted of 31 percent home scrap, 34 percent purchased scrap, and 35 percent pig iron compared with 32, 32, and 36 percent, respectively, in 1950.

Michigan continued to be the largest consumer of cupola scrap, followed in order by Ohio, Illinois, and Pennsylvania.

Air Furnaces.—Scrap and pig iron consumed in air furnaces (including 2 Brackelsbergs) in 1951 amounted to 1.8 million short tons (an increase of 20 percent over the 1.5 million tons melted in these furnaces in 1950). The use of home scrap, purchased scrap, and pig iron each increased by 20 percent over 1950. The total charge of iron and steel scrap and pig iron in air furnaces during 1951 was comprised of 49

TABLE 11.—Consumption in ferrous scrap and pig iron in cupola furnaces in the United States in 1951, by district and State, in short tons

District and State	Scrap			Pig iron	Total scrap and pig iron
	Home	Purchased	Total		
New England:					
Connecticut	69,019	56,351	125,370	68,171	193,541
Maine	10,720	11,226	21,946	9,647	31,593
Massachusetts	128,859	135,871	264,730	119,203	383,933
New Hampshire	3,189	11,457	14,646	2,520	17,166
Rhode Island	34,755	31,201	65,956	32,259	98,215
Vermont	21,218	22,379	43,597	17,331	60,928
Total: 1951	267,760	268,485	536,245	249,131	785,376
1950	231,561	258,013	489,574	220,542	710,116
Middle Atlantic:					
New Jersey	179,494	309,292	488,786	245,693	734,479
New York	230,683	233,145	463,828	235,701	699,529
Pennsylvania	471,480	557,848	1,029,328	579,621	1,608,949
Total: 1951	881,657	1,100,285	1,981,942	1,061,015	3,042,957
1950	737,085	925,908	1,662,993	968,502	2,631,495
East North Central:					
Illinois	595,949	510,134	1,106,083	403,622	1,509,705
Indiana	358,835	311,179	670,014	310,828	980,842
Michigan	1,152,316	1,191,744	2,344,060	1,131,283	3,475,343
Ohio	508,956	654,980	1,163,936	486,352	1,650,288
Wisconsin	423,032	324,983	748,015	298,368	1,046,283
Total: 1951	3,039,088	2,993,020	6,032,108	2,630,353	8,662,461
1950	3,084,159	2,565,114	5,649,273	2,865,752	8,515,025
West North Central:					
Iowa	234,133	190,232	424,365	148,751	573,116
Kansas	15,373	37,409	52,782	9,940	62,722
Nebraska	1,967	13,605	15,572	358	15,930
Minnesota, North Dakota, South Dakota	91,215	155,396	246,611	62,250	[308,861
Missouri	76,869	156,758	233,627	47,594	281,221
Total: 1951	419,557	553,400	972,957	268,893	1,241,850
1950	280,063	402,245	682,308	206,367	888,675

TABLE 11.—Consumption in ferrous scrap and pig iron in cupola furnaces in the United States in 1951, by district and State, in short tons—Continued

District and State	Scrap			Pig iron	Total scrap and pig iron
	Home	Purchased	Total		
South Atlantic:					
Maryland	44,078	48,500	92,578	67,593	160,171
Florida	1,247	3,114	4,361	1,700	6,061
Georgia	17,273	21,881	39,154	23,659	62,813
North Carolina	22,061	29,120	51,181	29,308	80,489
South Carolina	19,762	11,208	30,970	21,521	52,491
Virginia	67,501	142,135	209,636	80,710	290,346
West Virginia	7,976	22,233	30,209	47,592	77,801
Total: 1951	179,898	278,191	458,089	272,083	730,172
1950	164,913	242,735	407,648	228,757	636,405
East South Central:					
Alabama	395,222	438,191	833,413	1,182,082	2,015,495
Kentucky	95,885	58,087	153,972	194,114	348,086
Mississippi	144		144		144
Tennessee	159,831	148,769	308,600	201,457	510,057
Total: 1951	651,082	645,047	1,296,129	1,577,653	2,873,782
1950	606,177	497,996	1,104,173	1,308,754	2,412,927
West South Central:					
Arkansas	124	128	252	498	750
Louisiana	5,092	13,832	18,924	901	19,825
Oklahoma	16,283	20,777	37,060	10,464	47,524
Texas	97,018	177,095	274,113	260,270	534,383
Total: 1951	118,517	211,832	330,349	272,133	602,482
1950	54,344	118,042	172,386	68,319	240,705
Mountain:					
Arizona, New Mexico	16,288	25,966	42,254	560	42,814
Colorado	25,562	56,059	81,621	36,953	118,574
Utah	15,081	48,630	63,711	77,790	141,501
Idaho, Wyoming	2,138	9,129	11,267	689	11,956
Montana	6,209	4,827	11,036	276	11,312
Total: 1951	65,278	144,611	209,889	116,268	326,157
1950	50,307	127,535	177,842	93,290	271,132
Pacific:					
California	154,401	263,532	417,933	108,149	526,082
Oregon	8,801	27,003	35,804	2,470	38,274
Washington	8,930	38,282	47,212	1,652	48,864
Total: 1951	172,132	328,817	500,949	112,271	613,220
1950	126,904	247,875	374,779	98,905	473,684
Total, United States: 1951	5,794,969	6,523,688	12,318,657	6,559,800	18,878,457
1950	5,335,513	5,385,463	10,720,976	6,059,188	16,780,164

percent home scrap, 29 percent purchased scrap, and 22 percent pig iron (the same as in 1950).

Ohio led in the use of scrap in air furnaces, followed in order by Illinois and Pennsylvania. (*See* table 12).

Crucible and Puddling Furnaces.—Crucible furnaces used 172 short tons of scrap and 243 tons of pig iron in 1951 compared with 926 and 1,190 tons, respectively, in 1950. There was no tonnage of iron and steel scrap reported as being melted in puddling furnaces during 1951.

Blast Furnaces.—Materials other than scrap constitute by far the largest proportion of the blast-furnace charge and in 1951 consisted of 127,285,286 short tons of iron ore, sinter, and manganiferous ore; 3,723,803 tons of mill cinder and roll scale; 3,697,161 tons of open-hearth and Bessemer slag; and 113,825 tons of miscellaneous materials.

Total consumption of scrap in blast furnaces during 1951 was 4.5 million short tons, a 2 percent increase over 1950. The scrap charged

TABLE 12.—Consumption of ferrous scrap and pig iron in air furnaces [1] in the United States in 1951, by district and State, in short tons

District and State	Scrap			Pig iron	Total scrap and pig iron
	Home	Purchased	Total		
New England:					
Connecticut	30,668	13,240	43,908	11,700	55,506
Massachusetts, New Hampshire	17,483	5,798	23,281	9,357	32,638
Total: 1951	48,151	19,038	67,189	21,057	88,246
1950	42,701	14,304	57,005	19,594	76,599
Middle Atlantic:					
New Jersey	3,941	909	4,850	3,295	8,145
New York	48,244	21,489	69,733	27,381	97,114
Pennsylvania	125,820	76,898	202,718	66,892	269,610
Total: 1951	178,005	99,296	277,301	97,568	374,869
1950	131,765	78,243	210,008	73,775	283,783
East North Central:					
Illinois	151,853	85,867	237,720	67,277	304,997
Indiana	128,996	62,059	191,055	53,629	244,684
Michigan	68,302	51,846	120,148	20,899	141,047
Ohio	232,480	151,603	384,083	79,889	463,972
Wisconsin	51,981	27,578	79,559	31,248	110,807
Total: 1951	633,612	378,953	1,012,565	252,942	1,265,507
1950	545,579	329,002	874,581	218,416	1,092,997
West North Central:					
Iowa, Minnesota, Missouri	12,380	4,519	16,899	10,179	27,078
Total: 1951	12,380	4,519	16,899	10,179	27,078
1950	10,156	3,336	13,492	8,606	22,098
South Atlantic and West South Central:					
Delaware, North Carolina, West Virginia	14,234	8,459	22,693	11,002	33,695
Oklahoma, Texas	12,395	7,816	20,211	3,405	23,616
Total: 1951	26,629	16,275	42,904	14,407	57,311
1950	23,178	12,745	35,923	11,642	47,565
Mountain and Pacific:					
California, Colorado	7,660	7,047	14,707	4,114	18,821
Total: 1951	7,660	7,047	14,707	4,114	18,821
1950	2,698	1,558	4,256	2,580	6,836
Total United States: 1951	906,437	525,128	1,431,565	400,267	1,831,832
1950	756,077	439,188	1,195,265	334,613	1,529,878

[1] Includes 2 Brackelsberg furnaces, 1 each in Indiana and Ohio.

to blast furnaces was 45 percent home, 55 percent purchased, compared with 46 and 54 percent, respectively, in 1950 and 50 percent, respectively, in 1949. The proportion of scrap used to pig iron produced was 6.4 percent, comprised of 2.9 percent home scrap and 3.5 percent purchased scrap, compared with 6.8 percent in 1950. (*See* table 13).

USE OF SCRAP IN FERROALLOY PRODUCTION

The producers of ferroalloys (by other than blast furnaces) in 1951 consumed 414,949 short tons of scrap, a 17 percent increase over 1950. Of this total, 405 tons was used in the aluminothermic process and the balance in electric furnaces. Purchased scrap represented 97 percent of the quantity used and home scrap, 3 percent; in 1950 these percentages were 96 and 4, respectively. (*See* table 14).

TABLE 13.—Consumption of ferrous scrap in blast furnaces in the United States in 1951, by district and State, in short tons

District and State	Home	Purchased	Total
New England and Middle Atlantic:			
Massachusetts, New York	56,796	275,109	331,905
Pennsylvania	794,382	632,429	1,426,811
Total: 1951	851,178	907,538	1,758,716
1950	753,796	920,220	1,674,016
East North Central and West North Central:			
Illinois	77,101	315,088	392,189
Indiana	50,204	35,637	85,841
Michigan, Minnesota, Ohio	154,447	359,816	514,263
	337,540	535,968	873,508
Total: 1951	619,292	1,246,509	1,865,801
1950	643,226	1,163,997	1,807,223
South Atlantic and East South Central:			
Alabama	263,899	141,726	405,625
Kentucky, Maryland, Tennessee, Texas, West Virginia	260,140	175,719	435,859
Total: 1951	524,039	317,445	841,484
1950	611,173	277,725	888,898
Mountain and Pacific:			
California, Colorado, Utah	11,226	642	11,868
Total: 1951	11,226	642	11,868
1950	15,973	3,955	19,928
Total United States: 1951	2,005,735	2,472,134	4,477,869
1950	2,024,168	2,365,897	4,390,065

TABLE 14.—Consumption of ferrous scrap by ferroalloy producers in the United States in 1951, by district and State, in short tons

District and State	Home	Purchased	Total
Middle Atlantic:			
New York [1]	76	75,251	75,327
Pennsylvania	----------	1,412	1,412
Total: 1951	76	76,663	76,739
1950	20	80,986	81,006
East North Central and West North Central:			
Iowa, Ohio [1]	13,432	201,767	215,199
Total: 1951	13,432	201,767	215,199
1950	12,434	182,208	194,642
South Atlantic and East South Central:			
Alabama [1], Kentucky, South Carolina, Tennessee, West Virginia [1]	----------	35,698	35,698
Total: 1951	----------	35,698	35,698
1950	----------	72,947	72,947
Pacific:			
Oregon [1], Washington	----------	5,916	5,916
Total: 1951	----------	5,916	5,916
1950	----------	6,863	6,863
Undistributed: [1] 1951	39	81,358	81,397
Total United States: 1951	13,547	401,402	414,949
1950	12,454	343,004	355,458

[1] Some scrap consumption in Alabama, New York, Ohio, Oregon and West Virginia—not separable—is included with "Undistributed."

Nineteen ferroalloy plants used ferrous scrap in 1951. All of these plants operated electric furnaces. Two of this group employed both the electric and aluminothermic process.

Scrap used in blast furnaces in the manufacture of ferroalloys is included in this chapter with blast furnaces.

MISCELLANEOUS USES

Scrap consumed in 1951 for miscellaneous purposes, such as re-rolling, nonferrous metallurgy, and as a chemical agent, amounted to 1.3 percent of the total consumption. This was the first time in 7 years that it had not been almost 2 percent. The quantity so used—997,558 short tons—was a decrease of 13 percent from that used for these purposes in 1950. Of the quantity used, 96 percent was purchased scrap and 4 percent home scrap.

TABLE 15.—Consumption of ferrous scrap in miscellaneous uses in the United States in 1951, by district and State, in short tons

District and State	Home	Purchased	Total
New England:			
Connecticut, Massachusetts	500	16,657	17,157
Total: 1951	500	16,657	17,157
1950	681	14,799	15,480
Middle Atlantic:			
New Jersey	3,402	129,133	132,535
New York		78,926	78,926
Pennsylvania	9,317	96,710	106,027
Total: 1951	12,719	304,769	317,488
1950	21,619	332,697	354,316
East North Central:			
Illinois	692	232,309	233,001
Indiana	15,282	6,414	21,696
Michigan, Wisconsin	1,859	14,243	16,102
Ohio		63,042	63,042
Total: 1951	17,833	316,008	333,841
1950	16,005	435,178	451,183
West North Central:			
Minnesota	243	538	781
Missouri		79,025	79,025
Total: 1951	243	79,563	79,806
1950	19	79,697	79,716
South Atlantic:			
Delaware, North Carolina, Georgia	395	4,070	4,465
Virginia, West Virginia	442	53,148	53,590
Total: 1951	837	57,218	58,055
1950	1,228	66,610	67,838
East South Central and West South Central:			
Alabama, Texas	448	56,764	57,212
Total: 1951	448	56,764	57,212
1950	431	49,240	49,671
Mountain:			
Arizona, Nevada		32,114	32,114
Colorado, Idaho, Montana	1,123	10,576	11,699
Utah	1,233	19,338	20,571
Total: 1951	2,356	62,028	64,384
1950	2,262	64,845	67,107
Pacific:			
California	4	67,769	67,773
Washington	105	1,737	1,842
Total: 1951	109	69,506	69,615
1950	470	58,846	59,316
Total United States: 1951	35,045	962,513	997,558
1950	42,715	1,101,912	1,144,627

STOCKS

Complete iron-and steel-scrap stock figures covering 1951 year-end stocks are not available; producers (railroads and manufacturers) were not canvassed. Dealers, automobile wreckers, shipbreakers and consumers reporting to the Bureau of Mines had 5.5 million short tons of material on hand December 31, 1951, compared with 5.7 million tons at the end of 1950—a decrease of 261,519 tons or 5 percent.

Consumers' Stocks.—Consumers' stocks of home and purchased iron and steel scrap on December 31, 1951, totaled 4.4 million short tons—a decrease of 1.1 million tons or 19 percent from the beginning of the year. Stocks of home scrap (1.2 million tons) decreased 18 percent and purchased scrap (3.2 million tons) 20 percent. Stocks of pig iron on December 31, 1951, totaled 1,750,986 short tons—a decrease of 3 percent from the 1,800,137 tons on hand December 31, 1950.

Suppliers' Stocks.—Stocks of iron and steel scrap in the hands of a combined total of 1,989 dealers, automobile wreckers, and shipbreakers as reported to the Bureau of Mines totaled 1.1 million short tons on December 31, 1951.

TABLE 16.—Consumers' stocks of ferrous scrap and pig iron on hand in the United States on Dec. 31, 1950, and Dec. 31, 1951, by State and district, in short tons

State and district	Dec. 31, 1950				Dec. 31, 1951			
	Scrap			Pig Iron	Scrap			Pig Iron
	Home	Purchased	Total		Home	Purchased	Total	
Connecticut	4,604	19,634	24,238	16,239	4,745	17,736	22,481	9,951
Maine	322	2,067	2,389	4,172	110	3,344	3,454	2,363
Massachusetts	33,392	36,378	69,770	59,227	8,071	43,061	51,132	46,698
New Hampshire	321	3,322	3,643	756	267	2,540	2,807	264
Rhode Island	984	5,655	6,639	5,898	765	7,175	7,940	19,838
Vermont	159	6,745	6,904	2,135	85	8,365	8,450	2,033
Total New England	39,782	73,801	113,583	88,427	14,043	82,221	96,264	81,147
New Jersey	6,725	67,104	73,829	54,817	9,228	65,633	74,861	46,595
New York [1]	65,872	237,954	303,826	108,388	66,317	146,158	212,475	76,361
Pennsylvania	441,541	781,091	1,222,632	291,276	390,588	582,846	973,434	340,638
Total Middle Atlantic	514,138	1,086,149	1,600,287	454,481	466,133	794,637	1,260,770	463,594
Illinois	98,243	490,972	589,215	129,256	58,937	369,863	428,800	106,920
Indiana	186,030	257,151	443,181	81,349	48,427	230,693	279,120	139,956
Michigan	67,026	207,382	274,408	319,899	48,730	219,247	267,977	198,752
Ohio [1]	228,224	644,357	872,581	222,436	230,319	490,701	721,020	216,654
Wisconsin	11,744	82,546	94,290	41,149	31,199	71,568	102,767	32,866
Total East North Central	591,267	1,682,408	2,273,675	794,089	417,612	1,382,072	1,799,684	695,148
Iowa	2,309	49,296	51,605	22,749	7,951	48,241	56,192	24,104
Kansas, Nebraska	773	15,877	16,650	3,817	180	15,587	15,767	1,656
Minnesota, North Dakota, South Dakota	12,482	107,653	120,135	13,991	17,453	62,300	79,753	17,583
Missouri	3,222	115,282	118,504	17,003	3,168	73,540	76,708	18,844
Total West North Central	18,786	288,108	306,894	57,560	28,752	199,668	228,420	62,187

For footnote, see end of table.

TABLE 16.—Consumers' stocks of ferrous scrap and pig iron on hand in the United States on Dec. 31, 1950, and Dec. 31, 1951, by State and district, in short tons—Continued

State and district	Dec. 31, 1950				Dec. 31, 1951			
	Scrap			Pig Iron	Scrap			Pig Iron
	Home	Purchased	Total		Home	Purchased	Total	
Delaware, District of Columbia, Maryland	47,477	45,775	93,252	17,208	30,004	26,169	56,173	23,178
Florida, Georgia	925	10,491	11,416	4,768	1,104	13,496	14,600	7,295
North Carolina	536	1,913	2,449	2,903	1,138	2,706	3,844	5,340
South Carolina	135	5,351	5,486	2,536	82	4,929	5,011	2,012
Virginia, West Virginia [1]	9,961	103,393	113,354	13,484	11,156	84,500	95,656	51,152
Total South Atlantic	59,034	166,923	225,957	40,899	43,484	131,800	175,284	88,977
Alabama [1]	92,268	119,694	211,962	170,836	85,757	99,969	185,726	162,490
Kentucky, Mississippi, Tennessee	12,982	90,511	103,493	49,004	13,672	48,564	62,236	54,849
Total East South Central	105,250	210,205	315,455	219,840	99,429	148,533	247,962	217,339
Arkansas, Louisiana, Oklahoma	481	14,067	14,548	1,106	1,126	12,962	14,088	5,607
Texas	48,326	61,448	109,774	60,463	38,379	69,844	108,223	58,410
Total West South Central	48,807	75,515	124,322	61,569	39,505	82,806	122,311	64,017
Arizona, Nevada, New Mexico	2,697	5,107	7,804	99	7,167	7,012	14,179	282
Colorado, Utah	54,583	63,769	118,352	27,540	30,176	60,885	91,061	26,354
Montana	851	4,418	5,269	165	793	2,989	3,782	26
Idaho, Wyoming	251	3,329	3,580	149	15	5,202	5,217	454
Total Mountain	58,382	76,623	135,005	27,953	38,151	76,088	114,239	27,116
Alaska, Washington, Oregon [1]	2,953	78,008	80,961	6,797	1,634	65,273	66,907	2,556
California	31,064	213,123	244,187	48,522	49,802	189,156	238,958	48,905
Total Pacific	34,017	291,131	325,148	55,319	51,436	254,429	305,865	51,461
Undistributed [1]					11	15,247	15,258	
Total United States	1,469,463	3,950,863	5,420,326	1,800,137	1,198,556	3,167,501	4,366,057	1,750,986

[1] Some scrap stocks in Alabama, New York, Ohio, Oregon, and West Virginia—not separable—are included with "Undistributed."

PRICES

The price of No. 1 Heavy-Melting scrap at Pittsburgh as reported in the January 2, 1951, weekly issue of Iron Age was $46.13 compared with $29.75 per gross ton at the same time for the previous year and by the end of the month had advanced to $51.13 compared with $30.75 at the end of January 1950. This price prevailed until February 5, when it was rolled back to $44 per ton by the Office of Price Stabilization, a level $24 per ton over the ceiling placed on No. 1 Heavy-Melting and Cast scrap by the Office of Price Administration during World War II. Cast scrap on Jan. 2, 1951, was quoted at $67.75,

compared with $37.50 at the same time in 1950. At the same time that other prices of scrap were rolled back, a ceiling of $49 per gross ton was placed on cast-iron scrap.

The composite price of iron and steel scrap, as reported in the Iron Age Annual Review, was $46.15 per gross ton in January 1951, a new record high and an increase of $19.57 over the $26.58 per gross ton quoted at the same time for 1950. With price regulations effective in the early part of the year, the composite price of iron and steel scrap dropped to $43 in March; this price prevailed until October, when it decreased to $42.50 per gross ton for the 1 month, then declined to $42 for November and December 1951. The No. 1 Cast scrap composite price at Chicago was $63 per gross ton in January, an increase of $24.50 per ton over January 1950 but $11.30 below the peak price of $74.30 per gross ton in August 1948. No. 1 Heavy-Melting at Pittsburgh and Chicago was quoted in Iron Age Annual Review at a price of $47.13 and $44.63, respectively, in January 1951, high for the year, but decreased to a low of $43 and $41.50 per gross ton, respectively, in November and December. The prices set by the Office of Price Stabilization for No. 1 Heavy-Melting steel at Pittsburgh and Chicago, respectively, were $44 and $42.50 per gross ton.

FOREIGN TRADE [3]

Imports.—Imports of iron and steel scrap, including tin-plate scrap, totaled 416,858 short tons in 1951, a decrease of 47 percent from the 785,230 (revised) short tons imported in 1950, with the value amounting to $15,009,285 compared with $18,718,895 (revised) in 1950, a decrease of 20 percent. The decline in imports during 1951 was due in part to a decrease in scrap collections and the increased requirements in the countries that had been the principal suppliers during the past few years. Of the 1951 imports, 69,799 tons came from Canada, 63,912 from Germany, 43,870 from Cuba, 31,648 from Japan, 27,844 from France, and the remainder from other countries. There was 57,759 tons of tin-plate scrap imported in 1951, mostly from Canada, compared with 47,481 in 1950.

Exports.—Exports of ferrous scrap from the United States in 1951 were 245,340 short tons valued at $9,094,473, a 13-percent increase in tonnage over 1950 and a 51-percent increase in value. Imports exceeded exports by 171,518 short tons. The tonnage exported amounted to 7 percent of the 5-year prewar average (1935–39) of 3.3 million tons a year, the same percentage as in 1950. The 1951 exports included 15,622 tons of tin-plate scrap, tin-plate circles, strips, cobbles, and terneplate clippings and scrap valued at $2,279,258. The same materials in 1950 amounted to 8,609 (revised) tons valued at $758,972 (revised).

[3] Figures on imports and exports compiled by M. B. Price and E. D. Page, of the Bureau of Mines, from records of the U. S. Department of Commerce.

TABLE 17.—Ferrous scrap imported for consumption in the United States, 1947–51, by countries, in short tons

[U. S. Department of Commerce]

Country	1947	1948	1949	1950	1951
Algeria		481	548	15,401	22,863
Australia	3,451	18,168	12,469	16,635	12,512
Belgium-Luxembourg		7,614	5,731	[1] 39,527	1,676
Canada	32,864	34,547	71,199	87,981	69,799
Canal Zone	1,335	6,957	1,824	1,163	10,525
Cuba	22,687	33,026	10,337	21,242	43,870
Denmark		5,808	146	5,006	475
France		1,113	213	[1] 162,090	27,844
French Morocco		3,384	1,682	6,586	3,042
Germany		227,805	532,850	185,839	63,912
Hong Kong				8,915	
India		3,694	1,186	325	21,519
Iraq				7,466	
Italy	([2])	3,963	16		
Japan		65,856	209,519	113,436	31,648
Korea	896				8,516
Netherlands		9,863	200,486	70,001	19,402
Netherlands Antilles	5,468	5,411	2,128	3,609	4,328
New Zealand		664	1,634	175	7,477
Philippines	3	25,399	75,955	14,253	26,336
Switzerland				3	6,709
Union of South Africa	351	4,284	4,461	5,893	6,930
United Kingdom	1,238	1,251	3,257	8,529	6,225
Other countries	2,388	21,436	15,653	11,155	21,250
Total: Short tons	70,681	480,724	1,151,294	[1] 785,230	416,858
Value	$1,124,686	$12,180,222	$29,937,798	[1] $18,718,895	$15,009,285

[1] Revised figure.
[2] Less than 0.5 ton.

TABLE 18.—Ferrous scrap exported from the United States, 1947–51, by country of destination, in short tons

[U. S. Department of Commerce]

Destination	1947	1948	1949	1950	1951
Argentina	1,681	1,187	3,866	1,112	2,597
Brazil	392	602	12	3,225	1,018
British Malaya				863	2,487
Canada	119,223	168,119	[1] 162,631	[2] 81,000	89,632
Chile	5,401	48			6
China	3,645	434	33	[2] 230	
Colombia	206	4		217	
Egypt			315		
Hong Kong	1,941	1,131	1,558	2,547	14
India	72	850	808	160	797
Japan				1,605	3,105
Malta, Gozo, and Cyprus					1,000
Mexico	33,882	39,291	[1] 123,624	124,537	[1] 140,304
Netherlands	266			355	1,212
Norway		34	4,120		
Sweden	608	95			51
Turkey	120		503	95	420
Union of South Africa	477	58	25	236	709
United Kingdom	141		38		
Uruguay	203				230
Other countries	2,069	341	[1] 1,061	782	1,758
Total: Short tons	170,327	212,194	[1] 298,594	[2] 216,964	[1] 245,340
Value	$5,072,847	$7,156,105	[1] $7,342,886	[2] $6,013,719	[1] $9,094,473

[1] Includes rerolling rails as follows: 1949, Canada, 37 tons; Mexico, 1,095 tons; other countries, 74 tons; total, 1,206 tons ($50,086); 1951, Mexico, 9,813 tons ($358,146).
[2] Revised figure.

TABLE 19.—Ferrous scrap imported into and exported from the United States, 1947–51, by classes

[U. S. Department of Commerce]

Year	Imports			Exports				
	Iron and steel scrap	Tinplate scrap	Total	Iron and steel scrap	Tinplate scrap	Tinplate circles, strips, cobbles, etc.	Terneplate clippings and scrap	Total
	SHORT TONS							
1947	36,189	34,492	70,681	164,276	60	5,981	10	170,327
1948	434,710	46,014	480,724	208,246	--------	3,637	311	212,194
1949	1,105,343	45,951	1,151,294	[1] 294,960	--------	3,380	254	[1] 298,594
1950	[2] 737,749	47,481	[2] 785,230	[2] 208,355	629	[2] 7,819	161	[2] 216,964
1951	359,099	57,759	416,858	[1] 229,718	907	14,554	161	[1] 245,340
	VALUE							
1947	$668,590	$456,096	$1,124,686	$4,280,158	$54,396	$737,493	$800	$5,072,847
1948	11,149,265	1,030,957	12,180,222	6,738,977	--------	391,421	25,707	7,156,105
1949	28,890,519	1,047,279	29,937,798	[1] 6,947,516	--------	370,568	24,802	[1] 7,342,886
1950	[2] 17,834,543	884,352	[2] 18,718,895	[2] 5,254,747	39,237	[2] 697,755	21,980	[2] 6,013,719
1951	13,181,093	1,828,192	15,009,285	[1] 6,815,215	33,498	2,227,549	18,211	[1] 9,094,473

[1] Includes rerolling rails as follows: 1949, 1,206 tons valued at $50,086; 1951, 9,813 tons valued at $358,146.
[2] Revised figure.

WORLD REVIEW

Hong Kong.[4]—Chinese interests in Hong Kong scoured the ports of the world for second-hand ships which they broke up either as scrap or reprocessed steel for sale to the Chinese Communists. At the same time, these interests purchased large quantities of scrap abroad for delivery to China. China's demand was so keen that dealers paid very high prices for old hulks that would barely float. Purchases were made in such diverse regions as France, India, and New Zealand.

The cost of scrap iron in Hong Kong in February 1951 was about 400 Hong Kong dollars compared with 60 to 110 in 1948, depending on whether the ship was sunk or afloat.

Annual trade figures reflected the enormous increase in Hong Kong's exports of iron and steel. The value of these exports rose from 37.7 million Hong Kong dollars in 1949 to 124 million in 1950.

Most of the secondhand ships were broken up by Chinese companies in Hong Kong, where a certain amount of reprocessing was also done. Some of this scrap or reprocessed steel was devoted to Hong Kong's own needs, but it was estimated that at least 75 percent was being reexported to China. Companies in China were also busy breaking up ships. At least six tankers and freighters that had been laid up in Hong Kong waters since the war were towed to Whampoa (near Canton) for this purpose during December 1950 and January 1951. All this scrap and reprocessed steel was sent by railway from Canton to Chinese mills in the north.

[4] Metal Bulletin (London), Feb. 9, 1951, No. 3566, pp. 19–20.

Netherlands.[5]—Shortage of scrap in the Netherlands resulted in the shutting down of one of the five open-hearth furnaces at the Koninklijke Hoogovens en Stallfabrieken at Ymuiden. The company involved could not pay ruling prices for scrap because it was obliged to sell steel at or below a fixed ceiling price. Coke supplies also caused it some concern.

Sweden.[6]—The future supply of scrap was not expected to be quite as promising as that of Swedish iron ore. The importance of scrap as a raw material in the manufacture of steel has been steadily increasing. In June 1951 about a quarter of all the steel produced in Sweden was derived from scrap. The Swedish steelworks consumption of purchased scrap usually amounts to about 400,000 metric tons a year. Barely half of their requirements can usually be met out of domestic sources, while the rest (about 180,000 tons) has to be imported. During the early postwar years it was comparatively easy to procure scrap from abroad; but in recent years it has become increasingly difficult, and since the outbreak of the war in Korea there has been an ever-growing shortage of scrap. The principal supplier of scrap to Sweden after World War II was Western Germany. By 1951 the steel production in Western Germany increased and seriously limited German scrap exports. Sweden's imports of German scrap were estimated to amount in 1951 to not more than 125,000 tons.

United Kingdom.[7]—A sharp drop in collections of scrap iron and steel in Germany imperiled exports of scrap to the United Kingdom and to the United States. Talks took place between the United Kingdom and United States high commissioners and the German Federal Chancellor to arrive at some satisfactory solution to this situation. An agreement, signed in September 1951, was based upon a normal collection of 450,000 short tons of scrap per month. German industry was guaranteed the first 325,000 tons, with the United States and the United Kingdom assured of at least 62,000 tons each a month. However, the first month's collection after the agreement came to only 344,000 tons, leaving for export to the United States and the United Kingdom combined some 19,000 tons, as against shipments of 128,000 tons in the same month in 1950.

[5] Metal Bulletin (London), Mar. 6, 1951, No. 3573, p. 33.
[6] Svenska Handelsbanken, Index: Stockholm, June 1951, p. 58.
[7] Waste Trade Journal, vol. 92, No. 8, Nov. 17, 1951, p. 7.

Lead[1]

By O. M. Bishop and Edith E. den Hartog

GENERAL SUMMARY

THE LEAD INDUSTRY in 1951 was characterized by a marked decrease in imports, lessened mine output, and the greatest recovery of secondary lead on record. Although consumption was 4 percent less than in 1950, new supplies were inadequate, and lead was withdrawn from the stocks of consumers, producers, and Government to meet the demand. A ceiling price of 17.00 cents per pound, New York, was established January 26 on domestic lead, and selling prices were generally quoted at the ceiling until October 2 when the Office of Price Stabilization authorized an increase of 2 cents a pound. The increase became effective immediately and remained to the end of the year. Before October 2 domestic consumers could buy lead abroad at any price, but after that date regulations prevented the purchase of foreign lead at prices over the domestic ceiling price plus duty. Unable to sell all of the lead they produced outside of the United States, certain foreign producers were forced to lower their prices, and there was every indication that by early 1952 additional foreign supplies would be available at the ceiling price.

The total supply of 1,155,000 short tons of lead was composed of 388,000 tons of recoverable mine production, 518,000 tons of secondary lead, and imports (excluding scrap) equal to 249,000 tons, lead content. Consumption of lead, including that in pigments and chemicals, totaled 1,185,000 tons. Producers' stocks of refined primary lead declined from 28,894 tons at the beginning of the year to 18,518 tons on December 31, 1951, but antimonial lead stocks remained about the same. Consumers' stocks decreased 37,124 tons during the year to 102,760 tons.

The drop in mine output from 431,000 tons in 1950 to 388,000 tons in 1951 was attributed partly to shutdowns at most lead mines and mills in the Western States from August 23 to September 6. The decrease in producers' stocks was due partly to strikes at the Selby, Omaha, Perth Amboy, Herculaneum, and Bunker Hill plants and to a fire at the Tooele smelter which curtailed production. The decline in imports was attributed almost wholly to the higher prices paid in foreign markets and to the existence of a domestic tariff that added to the cost of foreign metal.

GOVERNMENT REGULATIONS

In 1951 the Government exercised limited controls over the lead industry owing to concern over possible shortages for defense requirements. Lead was brought under inventory control on February 16 through National Production Authority Order M–38. This order was

[1] This report deals primarily with the smelting, refining, and consuming phases of the industry. For details of mining operations, see various State chapters of this volume.

TABLE 1.—Salient statistics of the lead industry in the United States, 1942–46 (average) and 1947–51, in short tons

	1942–46 (average)	1947	1948	1949	1950	1951
Production of refined primary lead:						
From domestic ores and base bullion	383,640	381,109	339,413	404,449	418,809	342,644
From foreign ores and base bullion	72,959	59,901	67,281	72,889	89,505	75,049
Total	456,599	441,010	406,694	477,338	508,314	417,693
Recovery of secondary lead	350,467	511,970	500,071	412,183	482,275	518,110
Imports (general):						
Lead in pigs, bars, and old	237,638	175,538	276,013	289,889	[2] 461,827	187,989
Lead in base bullion	9,726	1,580	7,186	2,373	3,488	2,281
Lead in ores and matte	71,434	50,752	63,907	107,279	[2] 76,520	67,651
Exports of refined pig lead	4,294	1,523	411	969	2,735	1,281
Consumption of primary and secondary lead	1,056,544	1,172,000	1,133,895	957,674	1,237,981	1,184,793
Prices (cents per pound):						
New York:						
Average for period	6.82	14.67	18.04	15.36	13.30	17.49
Quotation at end of period	7.71	15.00	21.50	12.00	17.00	19.00
London average for period	5.42	15.27	17.16	16.95	13.29	20.25
Mine production of recoverable lead [1]	418,544	384,221	390,476	409,908	430,827	388,164
World smelter production of lead	1,461,800	1,455,000	[2] 1,505,000	[2] 1,709,000	[2] 1,870,000	1,821,000

[1] Includes Alaska.
[2] Revised figure.

amended on May 28 to set forth certain limitations on the acceptance of rated orders so as to provide for creation of a set-aside reserve of pig lead to meet emergency conditions and to establish limitations on the use of lead and lead products. Beginning June 1 the amended order restricted the use of lead to not more than 100 percent of the average monthly quantity used during the first 6 months of 1950 and prohibited its use for any new purposes. Order M–76, issued on July 26, placed the supply of soft pig lead produced by primary refiners under allocation control as of September 1 to assure equitable distribution. Effective November 1, imported pig lead was also placed under allocation control by Order M–76 as amended.

DOMESTIC PRODUCTION

Statistics on lead output may be prepared on a mine or smelter and refinery basis. Mine-production data, compiled on the basis of lead content in ores and concentrates, adjusted to account for average losses in smelting, are a better measure of domestic output from year to year and are most accurate for showing the geographic distribution of production. Pig-lead output, as reported by smelters and refiners, presents a more precise figure of actual lead recovery but indicates only in a general way the source of crude material treated. Smelter and refinery output generally differs from the mine figure owing to the lag between mine shipments and smelter treatment of ores and concentrates.

MINE PRODUCTION

Domestic mine output of recoverable lead declined 10 percent in 1951 compared with 1950 and was the lowest annual output since 1947. Production during the first half of the year was at a rate well above the 1,063-ton average daily output for the entire year. In July, August, and September production was considerably below the daily average

for the year, while output during the last quarter approximately equaled the average output per day for the year.

Production in 9 of the 16 States producing over 1,000 tons of recoverable lead in 1951 decreased from the 1950 output. Virginia's output was the lowest since the State's production was first recorded separately in 1939. In Arizona, Nevada, and Idaho mine production was the smallest since 1944, 1945, and 1946, respectively. On the other hand, Colorado produced more lead in 1951 than in any year since 1927, and Montana's output was the largest since 1940.

Of the total lead produced in the United States in 1951, 68 percent came from 25 properties. Missouri continued to rank first among the States in the production of lead, and the Southeastern Missouri district continued to be the largest producer of lead, supplying nearly 32 percent of the total domestic output. As in previous years, the St. Joseph Lead Co. produced the bulk of the district's output from its Bonne Terre, Desloge, Federal, and Leadwood mine groups in St. Francois County and, as a joint venture with the National Lead Co., the Mine La Motte property in Madison County. Each mine is equipped with a mill; the 5 have a combined daily capacity of about 28,800 tons of ore. In Madison County the National Lead Co. St. Louis Smelting & Refining Division, operated its Madison lead-copper mine and 1,200-ton flotation mill at Fredericktown throughout the year, except for a 7-week period in April and May when operations were stopped owing to a strike. The St. Joseph Lead Co. began construction of 2 new mills during the year, 1 at Hayden Creek and the other at Indian Creek. The Midwest Mining & Milling Co. acquired the Catherine and Fleming mine, formerly held by the Fredericktown Lead Co., and continued exploration and development work on the property.

Lead production in the Tri-State district declined 14 percent in 1951, chiefly because of the lower grade of ore mined. This decrease occurred despite substantially higher concentrate prices than in 1950 and a 14-percent increase in zinc production. The Eagle-Picher Co., Mining & Smelting Division, was by far the largest producer in the district and was followed by the American Zinc, Lead & Smelting Co., Nellie B. Division. Other large producers were the National Lead Co. St. Louis Smelting & Refining Division, Federal Mining & Smelting Co., and Bilharz Mining Co. In December 1951, 19 mine mills and 3 tailings mills were operating in the district compared to 16 mine mills and 4 tailings mills in 1950.

Mine production of recoverable lead in the combined Western States decreased 10 percent in 1951. During the year mines in these States accounted for nearly 60 percent of the total domestic output or about the same as in 1950.

Idaho continued to be the largest producer of lead in the Western States and second only to Missouri in the United States despite a 23-percent reduction in output in 1951. The decline resulted principally from a shortage of underground miners in late summer and early fall and a 2-week strike of mine, mill, and smelter workers in August and September. In 1951, 92 percent of Idaho's total lead came from the Coeur d'Alene region and most of the remainder from the Warm Springs and Bayhorse districts. The Bunker Hill & Sullivan mine at Kellogg was by far the largest producer. The 5 leading producing

mines—the Bunker Hill & Sullivan, Page, Star, Morning, and Triumph—contributed over 59 percent of the State total lead. Other important producers were the Sidney group, Dayrock, Tamarack, Constitution, Sunshine, and the Frisco group properties. Zinc-lead ore and old tailings from the Coeur d'Alene region yielded 78 percent of State output.

Utah increased its output of lead 13 percent in 1951, although the leading properties were idle for about 2 weeks because of strikes. The United States & Lark mine at Bingham was again the principal producer. Other important lead-producing mines were the Chief No. 1, Park Utah Consolidated, Silver King Coalition, New Park, Calumet, Butterfield, Chief Consolidated Tailings, Ophir, and Hidden Treasure. These 10 properties supplied about 96 percent of the State lead. Of the total output nearly 88 percent was recovered from zinc-lead ore and 6 percent from lead ore.

Lead production in Colorado in 1951 increased for the fifth consecutive year and was the largest since 1927. The larger producing mines, in order of rank, were the Resurrection group, Treasury Tunnel-Black Bear (Idarado) group, Eagle, Smuggler Union group, and Shenandoah-Dives group. Zinc-lead ore and zinc-lead-copper ores yielded 69 percent of State total lead, zinc ore 14 percent, gold and silver ores 9 percent, and lead ore 7 percent.

Montana lead production in 1951 increased 9 percent over the 1950 output and was the highest since 1940. Most of this gain was due to an increased tonnage of zinc-lead ore produced from the Butte Hill mines and dumps of the Anaconda Copper Mining Co. and to a substantial rise in production from the Mike Horse mine, which was operated all of 1951 in contrast to 6 months' operation in 1950. Other large producers were the Jack Waite mine and the Blacktail property. Anaconda company-owned and leased operations accounted for 78 percent of the State lead in 1951. Of the total lead output 89 percent was recovered from zinc-lead ore and 7 percent from lead ore.

Arizona's output of lead in 1951 dropped 34 percent below the 1950 total owing chiefly to a marked decrease in the production of zinc-lead ore from the Copper Queen mine at Bisbee, where zinc-lead ore reserves were nearly depleted. The St. Anthony property at Tiger was the leading lead producer in the State during the year; it was followed by the Iron King mine at Humboldt, San Xavier mine near Sahuarita, Flux group near Patagonia, Copper Queen mine at Bisbee, and Aravaipa group near Klondike. About 92 percent of the State total lead was obtained from zinc-lead ore and 5 percent from lead ore.

Mine production of lead in California in 1951 decreased 12 percent from the record output established in 1950. The Anaconda Copper Mining Co. Inyo County properties, the Darwin group, Coso district, and the Shoshone group, Resting Springs district again furnished the bulk of the State lead. Moderate quantities of lead were recovered from ore from the Coronado Copper & Zinc Co. Afterthought mine and from flue dust accumulated at the site of the abandoned Kennett Copper smelter, both in Shasta County. About 58 percent of the total output was derived from lead ore and 35 percent from zinc-lead ore.

Lead output in Washington in 1951 decreased nearly 23 percent from the record quantity produced in 1950, chiefly because of reduced output at the Grandview and Bonanza mines. The 4 largest mines—Pend Oreille, Grandview, Bonanza, and Deep Creek—supplied 98 percent of the State total lead during the year. Over 77 percent of the output was from zinc-lead ore and most of the remainder from lead ore.

Nevada lead output dropped 24 percent in 1951 compared with 1950. Of the State total, 66 percent was mined in the Pioche district, Lincoln County. The leading producers in order of output were the Pioche group and Ely Valley mine, Pioche district; San Rafael mine, Quartz Mountain district; Copper Canyon mine, Battle Mountain district; and Bristol mine, Jack Rabbit district. About 77 percent of the total lead output was recovered from zinc-lead and zinc-lead-copper ores and most of the remainder from lead ore.

Production of lead in New Mexico increased 41 percent in 1951. Such a large percentage gain was to be expected as output in 1950 was unusually low, because most of the mines that shut down when metal prices declined in 1949 remained idle several months in 1950. The largest producers were the Ground Hog and Bayard groups in the Central district and the Lynchburg mine in the Magdalena district. Zinc and zinc-lead ore yielded 80 percent of the State total lead and lead ore 18 percent in 1951.

TABLE 2.—Mine production of recoverable lead in the United States, 1942–46 (average) and 1947–51, by States, in short tons

State	1942–46 (average)	1947	1948	1949	1950	1951
Western States and Alaska:						
Alaska	157	264	329	51	149	21
Arizona	18,401	28,566	29,899	33,568	26,383	17,394
California	6,760	10,080	9,110	10,318	15,831	13,967
Colorado	16,998	18,696	25,143	26,853	27,007	30,336
Idaho	84,466	78,944	88,544	79,299	100,025	76,713
Montana	13,552	16,108	18,411	17,996	19,617	21,302
Nevada	6,044	7,161	9,777	10,626	9,408	7,148
New Mexico	6,031	6,383	7,653	4,652	4,150	5,846
Oregon	7	12	7	12	17	2
South Dakota	32	8	16	4	----	2
Texas	48	78	170	132	129	43
Utah	52,247	49,698	55,950	53,072	44,753	50,451
Washington	4,497	5,359	7,147	6,417	10,334	8,002
Wyoming	1	----	----	----	----	----
Total	209,241	221,357	252,156	243,000	257,803	231,227
West Central States:						
Arkansas	1	18	22	1	9	33
Kansas	8,368	7,285	8,386	9,772	9,487	8,947
Missouri	174,966	132,246	102,288	127,522	134,626	123,702
Oklahoma	16,569	14,289	16,918	19,858	20,724	16,575
Total	199,904	153,838	127,614	157,153	164,846	149,257
States east of the Mississippi River:						
Illinois	2,646	2,325	3,695	3,824	2,729	3,160
Kentucky	194	214	216	187	66	107
New York	1,674	1,496	1,231	1,317	1,484	1,500
Tennessee	123	22	----	257	113	14
Virginia	3,467	3,803	4,703	3,313	3,254	1,508
Wisconsin	1,295	1,166	861	857	532	1,391
Total	9,399	9,026	10,706	9,755	8,178	7,680
Grand total	418,544	384,221	390,476	409,908	430,827	388,164

Mines in States east of the Mississippi River produced 6 percent less lead in 1951 than in 1950. Decreased output was attributed to a 54-percent drop in production from Virginia, where the Austinville mine of the New Jersey Zinc Co. was idle from April to October 1 because of a strike. Lead is produced chiefly as a byproduct or co-product of zinc and fluorspar mining in these States.

Small quantities of lead were also recovered in 1951 from ores mined in Alaska, Oregon, South Dakota, Texas, and Arkansas.

TABLE 3.—Mine production of recoverable lead in the United States, by districts that produced 1,000 tons or more during any year, 1942–46 (average) and 1947–51, in short tons

District	State	1942–46 (average)	1947	1948	1949	1950	1951
Southeastern Missouri region.	Missouri	170,945	129,516	100,654	126,269	133,680	122,318
Coeur d'Alene region	Idaho	78,616	73,060	82,587	74,152	94,697	70,570
West Mountain (Bingham).	Utah	28,334	26,163	30,672	32,600	27,472	29,120
Tri-State (Joplin region)	Kansas, Southwestern Missouri, Oklahoma.	28,808	24,239	26,901	30,883	31,157	26,906
Summit Valley (Butte)	Montana	3,795	10,630	13,217	11,490	15,679	16,630
Park City region	Utah	12,050	10,987	12,670	8,583	7,538	11,719
Upper San Miguel	Colorado	1,919	2,559	3,804	5,285	7,780	8,008
Coso (Darwin)	California	3,747	6,551	6,078	4,928	8,479	7,191
California (Leadville)	Colorado	4,701	4,296	4,745	5,080	6,392	5,996
Tintic	Utah	6,585	6,166	5,970	6,676	6,520	5,553
Metaline	Washington	4,028	3,450	4,297	4,030	7,445	5,234
Pioche	Nevada	3,248	3,487	5,613	6,630	6,761	4,751
Red Cliff	Colorado	1,341	924	1,120	1,600	2,110	4,274
Old Hat	Arizona	3,822	4,603	5,406	6,788	5,980	4,238
Big Bug	do	1,496	2,323	2,676	3,330	4,357	4,035
Animas	Colorado	2,567	2,241	1,886	2,935	3,069	3,963
Central	New Mexico	3,957	3,450	3,740	2,479	2,315	3,133
Warm Springs	Idaho	2,949	1,879	1,304	2,339	2,648	3,086
Pima (Sierritas, Papago, Twin Buttes).	Arizona	1,479	2,909	3,917	4,232	2,996	2,834
Rush Valley and Smelter (Tooele County).	Utah	3,483	3,829	4,185	2,953	1,393	2,674
Kentucky-Southern Illinois.	Kentucky, Southern Illinois.	2,626	1,889	2,965	2,822	1,526	2,516
Pioneer (Rico)	Colorado	2,458	2,042	2,430	1,388	1,138	2,231
Upper Mississippi Valley	Iowa, Northern Illinois, Wisconsin.	1,508	1,816	1,807	2,046	1,801	1,923
Bossburg	Washington	133	1,010	1,394	2,011	2,640	1,768
Bayhorse	Idaho	1,410	2,039	1,880	1,073	1,679	1,732
Harshaw	Arizona	2,720	1,393	1,999	1,546	1,931	1,668
Warren (Bisbee)	do	5,062	13,422	11,253	13,865	7,790	1,606
Austinville	Virginia	3,252	3,803	4,703	3,313	3,254	1,508
St. Lawrence County	New York	1,674	1,496	1,231	1,317	1,484	1,497
Heddleston	Montana	2,580	2,087	1,946	2,335	930	1,398
Aravaipa	Arizona	226	794	1,142	1,271	1,498	1,294
Creede	Colorado	426	329	451	1,162	1,422	1,167
Sneffels	do	321	(1)	756	1,064	866	1,094
Magdalena	New Mexico	1,264	1,987	2,826	1,162	926	1,004
Northport (Aladdin)	Washington	134	508	1,426	342	237	937
Tomichi	Colorado	281	1,458	1,788	1,221	645	761
Ophir	Utah	780	790	791	1,089	948	712
Eureka	Colorado	93	630	1,107	578	323	569
Modoc	California	247	139	1,061	729	87	317
Smelter (Lewis and Clark County).	Montana	1,285	60	396	166	261	209
Alder Creek	Idaho	54	1,103	776	442	62	115
Ten Mile	Colorado	490	1,167	4,177	3,671	910	6
Eagle [2]	Montana	1,155	393	600	1,024	1,013	(1)
Battle Mountain	Nevada	65	39	234	1,290	564	
Resting Springs [2]	California	(1)	(1)	(1)	(1)	(1)	(1)

[1] Figure not shown in order to avoid disclosure of individual company operations.
[2] This district is not listed in order of 1951 output.

TABLE 4 —Twenty-five leading lead-producing mines in the United States in 1951, in order of output

Rank	Mine	District	State	Operator	Type of ore
1	Federal	Southeastern Missouri	Missouri	St. Joseph Lead Co	Lead.
2	United States and Lark	West Mountain (Bingham)	Utah	U. S. Smelting, Refining & Mining Co	Zinc-lead.
3	Bunker Hill & Sullivan	Yreka	Idaho	Bunker Hill & Sullivan Mining & Concentrating Co	Do.
4	Leadwood	Southeastern Missouri	Missouri	St. Joseph Lead Co	Lead.
5	Butte Hill mines and dumps	Summit Valley (Butte)	Montana	Anaconda Copper Mining Co	Zinc-lead.
6	Mine La Motte	Southeastern Missouri	Missouri	St. Joseph Lead Co	Lead.
7	Bonne Terre	do	do	do	Do.
8	Page	Yreka	Idaho	Federal Mining & Smelting Co	Zinc-lead.
9	Star	Hunter	do	Sullivan Mining Co	Do.
10	Darwin group	Coso	California	Anaconda Copper Mining Co	Lead.
11	Madison	Southeastern Missouri	Missouri	St. Louis Smelting & Refining Co	Lead-copper.
12	Shoshone group	Resting Springs	California	Anaconda Copper Mining Co	Lead.
13	Resurrection	Leadville	Colorado	Resurrection Mining Co	Zinc-lead.
14	Morning	Hunter	Idaho	Federal Mining & Smelting Co	Do.
15	Treasury Tunnel-Black Bear	Upper San Miguel	Colorado	Idarado Mining Co	Do.
16	Combined Metals group	Pioche	Nevada	Combined Metals Reduction Co	Do.
17	Chief and Eureka Hill	Tintic	Utah	Chief Consolidated Mining Co	Do.
18	Eagle	Red Cliff	Colorado	New Jersey Zinc Co	Zinc.
19	Park Utah Consolidated	Park City	Utah	Park Utah Consolidated Mines Co	Zinc-lead.
20	Mammoth-Collins	Old Hat	Arizona	St. Anthony Mining & Development Co	Do.
21	Desloge	Southeastern Missouri	Missouri	St. Joseph Lead Co	Lead.
22	Iron King	Big Bug	Arizona	Shattuck-Denn Mining Co	Zinc-lead.
23	Silver King	Park City	Utah	Silver King Coalition Mines Co	Do.
24	Smuggler Union	Upper San Miguel	Colorado	Telluride Mines, Inc	Do.
25	Park Galena and Mayflower	Park City	Utah	New Park Mining Co	Do.

The 25 leading lead-producing mines in the United States in 1951, listed in table 4, yielded 68 percent of the total domestic output; the 10 leading mines produced 51 percent and the 4 leading mines 36 percent.

Detailed information on the production of mines and mining districts in the United States may be found in the chapters of this volume dealing with the mine production of gold, silver, copper, lead, and zinc in the various States.

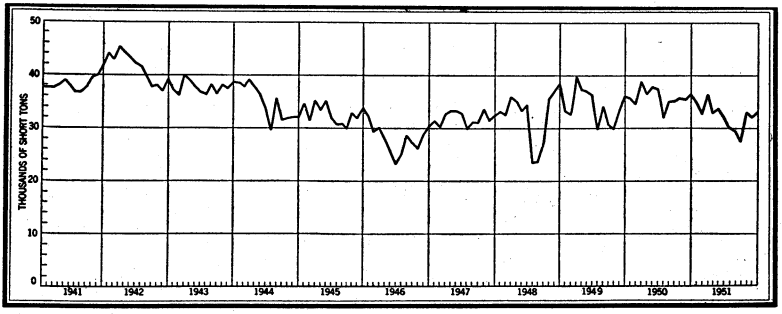

FIGURE 1.—Mine production of recoverable lead in the United States, 1941–51, by months.

TABLE 5.—Mine production of recoverable lead in the United States, 1950–51, by months, in short tons

Month	1950	1951	Month	1950	1951
January	35,684	35,102	August	35,020	29,487
February	34,716	32,864	September	35,087	27,494
March	38,960	36,474	October	35,730	33,058
April	36,432	32,972	November	35,419	32,060
May	37,906	33,537	December	36,397	32,928
June	37,439	32,148			
July	32,037	30,040	Total	430,827	388,164

SMELTER AND REFINERY PRODUCTION

Pig (refined) lead produced in the United States is derived from three principal sources—domestic mine production, imports of foreign ores and base bullion, and scrap materials (treated largely at secondary smelters)—and is recovered at primary refineries that treat ore, base bullion, and small quantities of scrap and at secondary plants that process scrap exclusively. Of the 13 primary lead plants in the United States, 6 combine smelting and refining operations, 5 produce only base bullion (containing approximately 98 percent lead plus gold and silver, and small quantities of other impurities recovered from the ores smelted), and 2 confine their activities to refining. Refined lead and antimonial or "hard" lead may be produced by both primary and secondary plants. Because of the large quantity of hard lead, such as battery scrap, melted at secondary smelters, the output from this type of operation is essentially antimonial lead. Statistics on the production of refined lead and alloys at secondary plants are given in the Secondary Lead section of this chapter.

Of the 13 primary smelters in operation in 1951, all but 2 consumed substantial quantities of primary materials in the form of ores and concentrates. During the year these 11 plants consumed 435,894 short tons (lead content) of this type of material, of which 18 percent was of foreign origin. In 1950, 511,433 tons (lead content) of ores and concentrates were consumed, 17 percent of which was foreign.

Active Lead Smelters and Refineries.—Primary lead smelters and refineries operating in the United States in 1951 were as follows:

California: Selby—Selby plant, American Smelting & Refining Co. (smelter and refinery).
Colorado: Leadville—Arkansas Valley plant, American Smelting & Refining Co. (smelter).
Idaho: Bradley—Bunker Hill Smelter, Bunker Hill & Sullivan Mining & Concentrating Co. (smelter and refinery).
Illinois: Alton—Federal plant, American Smelting & Refining Co. (smelter and refinery).
Indiana: East Chicago—U. S. S. Lead Refinery, Inc. (refinery).
Kansas: Galena—Galena plant, Eagle-Picher Co. (smelter and refinery).
Missouri: Herculaneum—Herculaneum plant, St. Joseph Lead Co. (smelter and refinery).
Montana: East Helena—East Helena plant, American Smelting & Refining Co. (smelter).
Nebraska: Omaha—Omaha plant, American Smelting & Refining Co. (refinery).
New Jersey: Barber—Perth Amboy plant, American Smelting & Refining Co. (smelter and refinery).
Texas: El Paso—El Paso plant, American Smelting & Refining Co. (smelter).
Utah:
Midvale—Midvale plant, United States Smelting, Refining & Mining Co. (smelter).
Tooele—Tooele plant, International Smelting & Refining Co. (smelter).

REFINED LEAD

Primary refineries in the United States produced 422,000 short tons of refined lead in 1951 or 18 percent less than the 1950 output of 514,000 tons.

Of the 418,000 of refined lead produced from primary sources during the year, domestic ores and base bullion were the source of 82 percent and imported ores and base bullion of 18 percent, the same proportions for domestic and foreign materials as in 1950. Table 7 gives the production of refined lead by source material and country of origin. Details of the sources of lead from domestic ores are given in the Mine Production section of this chapter.

TABLE 6.—Refined lead produced at primary refineries in the United States, 1947–51, by source material, in short tons

Source	1947	1948	1949	1950	1951
Refined lead:					
From domestic ores and base bullion	381,109	339,413	404,449	418,809	342,644
From foreign ores	59,838	60,829	71,413	86,241	71,984
From foreign base bullion	63	6,452	1,476	3,264	3,065
Total from primary sources	441,010	406,694	477,338	508,314	417,693
From scrap	15,662	4,952	23,230	5,455	3,893
Total refined lead	456,672	411,646	500,568	513,769	421,586
Average sales price per pound	$0.143	$0.179	$0.158	$0.135	$0.173
Total calculated value of primary refined lead [1]	$126,130,000	$145,600,000	$150,840,000	$137,245,000	$144,522,000

[1] Excludes value of refined lead produced from scrap at primary refineries.

TABLE 7.—Refined primary lead produced in the United States, 1947–51, by source material and country of origin, in short tons

Source	1947	1948	1949	1950	1951
Domestic ore and base bullion	381,109	339,413	404,449	418,809	342,644
Foreign ore:					
Australia	5,952	6,729	6,465	6,984	9,056
Canada	3,548	3,608	3,317	7,892	7,986
Europe		43	30		17
Mexico	5,523	4,427	8,477	5,992	3,620
South America	17,096	24,589	29,163	38,770	36,849
Other foreign	27,719	21,433	23,961	26,603	14,456
Total	59,838	60,829	71,413	86,241	71,984
Foreign base bullion:					
Australia		466	1,382	2,427	2,815
Mexico	30	5,637	36	435	27
South America	33	52	58	402	75
Other foreign		297			148
Total	63	6,452	1,476	3,264	3,065
Total foreign	59,901	67,281	72,889	89,505	75,049
Grand total	441,010	406,694	477,338	508,314	417,693

ANTIMONIAL LEAD

Antimonial lead output at primary refineries in 1951 rose 14 percent above the 1950 level but was well below the record high established in 1948. Production increased at 3 of the 5 primary plants producing the alloy. Distribution of antimonial lead production at primary refineries in 1947–51 by source material is shown in table 8, as is also the average antimony content.

Although antimonial lead is an important byproduct of the refining of base bullion, the quantity derived from this source is only a small part of total domestic output. The major production is recovered from the smelting of antimonial lead scrap at secondary smelters. Production data from lead-smelting plants treating scrap materials exclusively are summarized in the following section.

TABLE 8.—Antimonial lead produced at primary lead refineries in the United States, 1947–51

Year	Production (short tons)	Antimony content		Lead content by difference (short tons)			
		Short tons	Percent	From domestic ore	From foreign ore	From scrap	Total
1947	86,075	4,933	5.7	14,836	9,850	56,456	81,142
1948	100,764	5,760	5.7	29,561	15,918	49,525	95,004
1949	41,402	3,385	8.2	692	4,620	32,705	38,017
1950	57,959	4,504	7.8	10,728	4,344	38,383	53,455
1951	65,309	4,416	6.7	17,372	9,218	34,303	60,893

SECONDARY LEAD

Some scrap lead is treated at primary smelters, but the greater part is processed at a large number of plants that specialize in the treatment of secondary materials. Secondary lead is recovered in the form of refined lead, antimonial lead, and other alloys.

Secondary lead recovery in 1951 was the highest on record—7 percent above the 1950 figure—and exceeded the domestic mine output of recoverable lead for the sixth consecutive year. Data on recovery, by type of plant, in 1947-51 are shown in table 9. Detailed information on secondary lead appears in the Secondary Metals—Nonferrous chapter of this volume.

TABLE 9.—Secondary lead recovered in the United States, 1947–51, in short tons

	1947	1948	1949	1950	1951
As refined metal:					
At primary plants	15,662	4,952	23,230	5,455	3,893
At other plants	95,843	126,951	129,396	123,858	165,023
Total	111,505	131,903	152,626	129,313	168,916
In antimonial lead:					
At primary plants	56,456	49,525	32,705	38,383	34,303
At other plants	209,479	194,027	140,037	187,257	195,660
Total	265,935	243,552	172,742	225,640	229,963
In other alloys	134,530	124,616	86,815	127,322	119,231
Grand total:					
Short tons	511,970	500,071	412,183	482,275	518,110
Value	$146,423,420	$179,025,418	$130,249,828	$130,214,250	$179,266,060

LEAD PIGMENTS

The principal lead pigments are litharge, white lead, red lead, sublimed lead, leaded zinc oxide, and orange mineral. These products are manufactured for the most part from metal, but some ore and concentrates are converted directly into pigments. Details of the production of lead pigments are given in the Lead and Zinc Pigments and Zinc Salts chapter of this volume.

CONSUMPTION AND USES

Domestic lead consumption (including lead in lead ore consumed directly in the manufacture of lead pigments and salts) totaled 1,184,793 short tons in 1951. Of the total consumed, 749,590 tons was refined soft lead and 296,555 tons was contained in antimonial lead, 26,205 tons in unmelted white scrap, 45,784 tons in "percentage metals" (the alloy pig metals derived from the secondary lead industry), 24,303 tons in copper-base scrap, 29,538 tons in drosses and residues, and 12,818 tons recovered from ores in leaded zinc oxide. In 1951, 42 percent of all lead consumed was used in the manufacture of metal products (excluding storage batteries). Production of the 3 largest lead-consuming items—batteries, cable coverings, and tetraethyl fluid—took 54 percent of all lead consumed during the year. Batteries took 32 percent and cable covering and tetraethyl fluid each 11 percent.

TABLE 10.—Consumption of lead in the United States in 1950 and 1951, by product, in short tons

	1950	1951		1950	1951
Metal products:			Pigments:		
Ammunition	38,438	40,242	White lead	36,181	25,578
Bearing metals	38,241	35,410	Red lead and litharge	101,974	88,031
Brass and bronze	21,461	29,858	Pigment colors	13,464	12,796
Cable covering	131,989	131,863	Other [2]	14,768	13,099
Calking lead	53,450	46,544	Total pigments	166,387	139,504
Casting metals	19,295	22,497			
Collapsible tubes	13,386	13,657	Chemicals:		
Foil	3,941	2,881	Tetraethyl lead	113,846	128,407
Pipes, traps, and bends	41,361	33,095	Miscellaneous chemicals	11,680	6,949
Sheet lead	30,778	31,210	Total chemicals	125,526	135,356
Solder	94,606	82,465			
Terne metal	3,805	2,051	Miscellaneous uses:		
Type metal	24,776	28,236	Annealing	6,456	6,656
Total metal products	515,527	500,009	Galvanizing	2,426	2,173
			Lead plating	1,521	1,444
Storage batteries: [1]			Weights and ballast	6,870	7,913
Antimonial lead	212,464	199,838	Total miscellaneous uses	17,273	18,186
Lead oxides	185,945	175,546	Other, unclassified uses	14,859	16,354
Total storage batteries	398,409	375,384	Grand total	1,237,981	1,184,793

[1] Classified under "metal products" before 1950.
[2] Includes lead content of leaded zinc oxide production.

TABLE 11.—Consumption of lead in the United States 1950–51, by months, in short tons [1]

Month	1950	1951	Month	1950	1951
January	83,671	126,022	August	127,317	97,622
February	78,491	101,603	September	121,782	78,999
March	88,939	120,826	October	126,599	88,527
April	84,673	118,372	November	116,304	88,106
May	100,620	102,524	December	110,456	86,307
June	103,443	94,458			
July	95,686	81,427	Total	1,237,981	1,184,793

[1] Includes lead content of leaded zinc oxide production.

TABLE 12.—Consumption of lead in the United States in 1951, by class of product and type of material, in short tons

	Soft and antimonial lead	Scrap, percentage metal, drosses, etc.	Total
Metal products	383,108	116,901	500,009
Storage batteries [1]	368,361	7,023	375,384
Pigments	126,603	83	126,686
Chemicals	135,356		135,356
Miscellaneous	17,547	639	18,186
Unclassified	15,170	1,184	16,354
Total	1,046,145	125,830	[2] 1,171,975

[1] Formerly classified under metal products.
[2] Excludes 12,818 tons of lead contained in leaded zinc oxide.

STOCKS

Producers' Stocks.—Lead stocks, as reported by the American Bureau of Metal Statistics, are shown in table 13. Stocks of refined and antimonial lead include metal held by all primary refiners and by some of the refiners of secondary metal who produce soft lead. According to reports released by the American Bureau of Metal Statistics, monthly stocks of refined lead and antimonial lead in 1951 were, on the average, less than half of the tonnage held in comparable periods of 1950. Inventories totaled 25,339 tons on December 31, 1951, compared with year-end stocks of 35,619 tons in 1950.

TABLE 13.—Stocks of lead at smelters and refineries in the United States at end of year, 1947–51, in short tons

[American Bureau of Metal Statistics]

	1947	1948	1949	1950	1951
Refined pig lead	13,634	29,050	61,329	28,894	18,518
Antimonial lead	7,694	9,594	9,095	6,725	6,821
Total	21,328	38,644	70,424	35,619	25,339
Lead in base bullion—					
At smelters and refineries	7,652	9,697	16,364	11,993	11,315
In transit to refineries	5,447	4,101	3,696	4,959	3,909
In process at refineries	16,328	17,939	15,561	15,341	15,700
Total	29,427	31,737	35,621	32,293	30,924
Lead in ore and matte and in process at smelters	77,199	76,373	95,481	69,757	67,817
Grand total	127,954	146,754	201,526	137,669	124,080

The Bureau of Mines annual survey of primary smelters and refiners indicated stocks of 28,894 tons (lead content) of refined soft lead at plants on January 1, 1951, and 18,517 tons on December 31, 1951. Primary antimonial lead stocks at these same plants totaled 6,152 tons (lead content) at the beginning of 1951 and 6,367 tons at the end of the year. In terms of lead content, stocks of ore and concentrates at the operating primary smelters and refineries increased from 42,346 tons to 44,378 during the same period. The inventory of base bullion at refineries that receive base bullion as a raw material and at smelters that produce base bullion for shipment to refineries was 11,658 tons at the beginning of the year and 12,731 tons on December 31, 1951. Stocks of in-process base bullion or work lead at four combination smelter-refinery plants are not included in reports to the Bureau of Mines. No direct comparison can be made between these data and the figures of the American Bureau of Metal Statistics. Figures reported to the Bureau of Mines represent physical inventory at the plants, irrespective of ownership, and do not include material in process or in transit.

Consumers' Stocks.—Consumers' stocks of lead decreased 27 percent during 1951. The decline was consistent through the first 6 months, was reversed in July, and then continued the downward trend through the remainder of the year, dropping from 139,884 tons on January 1 to 102,760 on December 31. Stocks of antimonial lead gained 2 percent and percentage metals 9 percent, but stocks of refined soft lead dropped 35 percent, white-metal scrap 42 percent, copper-base scrap 8 percent, and drosses 46 percent.

TABLE 14.—Consumers' stocks of lead in the United States at end of year, 1948–51, by type of material, in short tons, lead content

Year	Refined soft lead	Antimonial lead	Unmelted white scrap	Percentage metals	Copper-base scrap	Drosses, residues, etc.	Total
1948	62,077	35,088	4,828	7,932	2,301	6,972	119,198
1949	64,542	16,837	2,957	5,405	2,087	5,439	97,267
1950 [1]	87,285	27,737	5,406	6,446	1,558	11,452	139,884
1951	56,731	28,221	3,140	7,054	1,429	6,185	102,760

[1] Revised figures.

PRICES

The two major markets for lead in the United States are New York and St. Louis. Much of the lead produced domestically is sold at prices normally based upon quotations in these markets. Since suspension of trading on the London Metal Exchange in September 1939 the London market has had no direct influence on New York quotations, and the differential between St. Louis and New York prices has remained 0.2 cent a pound, an amount approximating the freight charges between the two cities.

The price of lead was controlled by the Office of Price Stabilization during 1951. Ceiling prices were established for lead on January 26, 1951, at the highest price (for each seller) at which sales were made between December 19, 1950, and January 25, 1951. Thus a number of ceiling prices were established. The bulk of lead sales, however, were at 17.00 cents per pound, common lead, New York. The 17.00-cent price remained in effect until October 2, when the Office of Price Stabilization permitted a rise of 2 cents a pound. No further change in price occurred in 1951.

TABLE 15.—Average monthly and yearly quoted prices of lead at St Louis, New York, and London, 1949–51, in cents per pound [1]

Month	1949			1950			1951		
	St. Louis	New York	London [2]	St. Louis	New York	London [2]	St. Louis	New York	London [2]
January	21.32	21.50	22.10	11.80	12.00	12.11	16.80	17.00	17.00
February	21.32	21.50	22.10	11.80	12.00	12.11	16.80	17.00	17.00
March	18.73	18.91	22.10	10.76	10.96	11.06	16.80	17.00	17.00
April	14.99	15.16	19.28	10.43	10.63	10.57	16.80	17.00	20.00
May	13.57	13.72	17.98	11.52	11.72	11.61	16.80	17.00	20.00
June	11.85	12.00	15.45	11.61	11.81	11.84	16.80	17.00	20.00
July	13.39	13.56	14.59	11.46	11.66	11.58	16.80	17.00	21.45
August	14.80	15.01	15.56	12.73	12.93	12.84	16.80	17.00	22.49
September	14.85	15.05	15.51	15.60	15.80	15.70	16.80	17.00	22.49
October	13.23	13.42	13.79	15.84	16.04	16.00	18.72	18.92	21.87
November	12.33	12.52	12.79	16.80	17.00	17.00	18.80	19.00	21.88
December	11.80	12.00	12.12	16.80	17.00	17.00	18.80	19.00	21.84
Average	15.18	15.36	16.95	13.10	13.30	13.29	17.29	17.49	20.25

[1] St. Louis: Metal Statistics, 1952, p. 531. New York: Metal Statistics, 1952, p. 525. London: E&MJ Metal and Mineral Markets.

[2] Conversion of English quotations into American money based on average rates of exchange recorded by Federal Reserve Board.

The official London price of £136 per long ton of lead (equivalent to 17.00 cents per pound computed on the 280.00-cent per pound base), fixed by the Ministry of Supply on November 1, 1950, remained in effect until April 1, 1951, when the Ministry raised the price to £160 (20.00 cents). The price was increased again on July 14 to £180 (22.50 cents). On October 1 the official price was reduced to £175 (21.88 cents), at which level it remained for the balance of the year. (During the latter half of 1951 sterling exchange rates varied between 278.63 and 280.00 cents per pound, hence actual dollar prices were at times slightly less than the 21.88-cent equivalent shown).

FOREIGN TRADE [2]

Tariff.—There has been a tariff on lead for well over a century, ranging from a low of 15 percent ad valorem to a high of 3 cents a pound. The import duty set by the Tariff Act of 1930 on lead-bearing ores, flue dust, and mattes (lead content) was 1½ cents per pound and on lead bullion, pigs, bars, scrap lead, antimonial lead, type metal, babbitt metal, solder, and alloys not specifically provided for, 2½ cents per pound. In accordance with the Mexican Trade Agreement of January 30, 1943, these rates were reduced to ¾ cent and 1 1/16 cents per pound, respectively. In June 1948 these duties were suspended for 1 year by act of Congress. As the Congress took no action on a bill to extend the suspension beyond June 30, 1949, the expiration date of the original legislation, the import duties provided for in the Mexican Trade Agreement were reinstated automatically on July 1, 1949, and continued at those levels throughout 1950. Abrogation of the agreement, effective January 1, 1951, restored the full duties established by the Tariff Act of 1930. The Mexican Agreement was reaffirmed on June 6, 1951, reestablishing the 1 1/16-cent and ¾-cent duties on pig lead and lead in ores and concentrates, respectively.

Imports.—Total imports of lead declined to 258,000 tons in 1951 or less than half the record quantity of 542,000 tons imported in 1950. The drastic decline resulted from the reluctance of foreign producers to export lead to the United States, when the Free World market price for lead was considerably higher than the United States ceiling price. However, since foreign demand could not absorb the available foreign lead, stocks in the hands of producers accumulated until producers were compelled to reduce prices. By the end of the year Free World prices were essentially at the United States level.

Of total imports, 178,900 tons (69 percent) was as pigs and bars, 67,700 tons (26 percent) in ore and matte, 9,100 tons (4 percent) as reclaimed, scrap, etc., and 2,300 tons (1 percent) in base bullion. Canada supplied 32 percent of the pigs and bars, Mexico 21 percent, Yugoslavia 20 percent, Peru 18 percent, Australia 8 percent, and other countries 1 percent. Imports of ore and matte came principally from Peru, Bolivia, Africa, Canada, and Australia.

[2] Figures on imports and exports compiled by M. B. Price and E. D. Page, of the Bureau of Mines, from records of the U. S. Department of Commerce.

TABLE 16.—Total lead imported into the United States in ore, matte, base bullion, pigs, bars, and reclaimed, 1947–51, by countries, in short tons [1]

[U. S. Department of Commerce]

Country	1947	1948	1949	1950	1951 [2]
Ore and matte:					
Africa	5,616	10,142	31,373	19,713	10,673
Australia	7,054	9,017	8,983	[3] 9,792	7,423
Bolivia	6,234	20,369	24,098	[3] 13,336	15,989
Canada	14,833	8,288	10,326	[3] 9,452	7,427
Chile	3,048	3,430	3,395	[3] 2,605	1,945
El Salvador	1	250	333	417	286
Guatemala		23	2,827	325	3,169
Honduras		61	465	412	381
Mexico	3,065	2,702	8,388	2,846	2,517
Peru	10,477	8,548	14,970	16,010	16,946
Other countries	424	1,077	2,121	[3] 1,612	895
Total ore and matte	50,752	63,907	107,279	[3] 76,520	67,651
Base bullion:					
Australia			2,246	2,263	2,234
Guatemala				232	
Japan				921	
Korea	285	82			
Mexico	1,255	6,455	25		
Peru	40	619	102	72	47
Other countries		30			
Total base bullion	1,580	7,186	2,373	3,488	2,281
Pigs and bars:					
Africa	78	507	280		2,279
Australia	10,639	30,469	17,192	22,009	13,598
Belgium-Luxembourg		8,911	212	166	331
Burma		2,343	1,414		
Canada	59,079	53,978	56,432	107,673	56,959
Germany			8,333	8,643	738
Italy		21,349	3,419		
Japan			2,108	[3] 5,712	
Korea	1,659	39	51		
Mexico	85,783	98,460	126,398	220,767	36,863
Netherlands		1,826	219	484	
Peru	1,151	23,559	34,626	31,988	31,528
Spain		1,653		440	
Yugoslavia	1,120	2,889	23,436	43,855	36,310
Other countries	4	1,133	1,120	51	301
Total pigs and bars	159,513	247,116	275,240	[3] 441,788	178,907
Reclaimed, scrap, etc.:					
Africa	478	344	479		
Australia	1,111	3,690	2,971	1,061	2,175
Belgium-Luxembourg		986	329	13	
Canada	8,070	11,687	1,856	1,317	1,698
Canal Zone	202	447	384	319	228
Chile	62				84
France		(4)	289		88
Germany			663	290	
Italy	69	2,304	346		
Jamaica	31	1	89	51	252
Japan	5,336		2,765	[3] 14,769	441
Malta, Gozo, Cyprus	78	155			
Mexico		1,644	845	934	2,089
Netherlands		2,460	599	4	18
Panama	41	223	92	80	234
Philippines	433	2,341	1,144	99	114
Yugoslavia		652			
Venezuela		2	8	106	668
Other countries	114	1,961	1,790	996	993
Total reclaimed, scrap, etc	16,025	28,897	14,649	[3] 20,039	9,082
Grand total	227,870	347,106	399,541	[3] 541,835	257,921

[1] Data are "general imports," that is, include lead imported for immediate consumption plus material entering the country under bond.
[2] In addition to data shown "flue dust or fume containing lead and zinc, and other minerals or metals" (lead content), imported as follows—11 tons.
[3] Revised figure.
[4] Less than 0.5 ton.

TABLE 17.—Lead imported for consumption in the United States, 1947–51, by classes [1]

[U. S. Department of Commerce]

Year	Lead in ores, flue dust, and mattes, n.s.p.f.		Lead in base bullion		Pigs and bars		Sheets, pipe, and shot		Not otherwise specified (value)	Total value
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value		
1947	44,442	$8,561,174	1,758	$416,643	158,705	$38,008,443	67	$42,434	$10,453	$50,111,298
1948	33,932	8,350,507	10,922	3,239,135	244,692	80,922,779	181	100,519	35,554	100,968,922
1949	121,848	34,397,026	1,133	374,954	272,437	80,148,110	178	101,084	29,830	119,054,978
1950	[2] 95,068	[2]21,045,414	[2] 1,148	[2] 193,356	[2] 434,410	[2]104,340,645	207	78,111	78,690	[2]129,613,215
1951	31,470	8,310,145	--------	--------	178,896	63,641,204	255	123,377	174,265	74,426,044

[1] In addition to quantities shown (value included in total values), "reclaimed, scrap, etc." imported as follows—1947: 15,963 tons, $3,072,151; 1948: 28,897 tons, $8,320,428; 1949: 14,076 tons, $4,003,974; 1950: Revised figures, 22,524 tons, $3,876,999; 1951: 7,890 tons, $2,100,389, and flue dust or fume containing lead and zinc and other minerals or metals, (lead content) imported as follows—1951: 11 tons, $76,664. Figures include lead received by the Government and held in stockpiles, but exclude imports for manufacture in bond and export, which are classified as "imports for consumption" by the U. S. Department of Commerce.

[2] Revised figure.

TABLE 18.—Miscellaneous products containing lead, imported for consumption in the United States, 1947–51

[U. S. Department of Commerce]

Year	Babbitt metal, solder, white metal, and other combinations containing lead			Type metal and antimonial lead		
	Gross weight (short tons)	Lead content (short tons)	Value	Gross weight (short tons)	Lead content (short tons)	Value
1947	264	171	$208,185	2,406	2,219	$753,664
1948	257	184	213,614	14,732	13,163	5,279,080
1949	281	127	459,236	5,861	5,207	2,255,909
1950 [1]	4,345	2,744	2,814,264	12,518	10,582	3,431,650
1951	1,533	988	1,494,792	9,336	8,660	3,845,671

[1] Revised figures.

Exports.—Total exports of pig lead in 1951 were 1,281 tons compared with 2,735 tons in 1950. Export restrictions imposed under the Export Control Act of 1940 remained in force throughout 1951.

TABLE 19.—Lead pigs, bars, and anodes exported from the United States, 1947–51, by country of destination, in short tons [1]

[U. S. Department of Commerce]

Destination	1947	1948	1949	1950	1951
Country:					
Argentina	894	2	7		55
Belgium-Luxembourg			76		37
Brazil	63	1	126	47	62
Canada	10	8	14	306	138
Canal Zone	52		15	19	24
Chile	52	42	40	35	107
China	10	21			
Colombia	12	16	60	123	42
Cuba	38	40	68	61	48
Denmark			131		
El Salvador	9	1	34	96	35
Honduras	7	1	29	6	14
Hong Kong	23	2		4	
India	19	121	4		11
Israel			1	174	112
Madagascar	44				
Mexico	16	14	3	3	4
Netherlands	100	1			
Pakistan				569	
Panama	[2]	1	[2]	3	2
Philippines	24	1	53	306	17
Portugal			3	2	
Saudi Arabia	3	24	7	1	3
Turkey	50	11	7		
United Kingdom				67	
Uruguay	27		69	734	424
Venezuela	30	71	148	95	62
Other countries	40	33	74	84	84
Total	1,523	411	969	2,735	1,281
Continent:					
North America	144	75	179	525	288
South America	1,079	133	475	1,052	756
Europe	119	10	215	75	40
Asia	134	189	85	1,068	197
Africa and Oceania	47	4	15	15	[2]
Total: Short tons	1,523	411	969	2,735	1,281
Value	$388,599	$169,075	$356,819	$790,480	$513,671

[1] In addition 102 tons of foreign lead was reexported in 1947, none in 1948, 86 tons in 1949, 53 tons in 1950, and none in 1951.
[2] Less than 0.5 ton.

WORLD REVIEW

Lead is produced in many countries, but four—United States, Mexico, Australia, and Canada—have accounted for about three-fifths of the world output in recent years, as is apparent from tables 20 and 21, which show world mine and smelter production by countries 1945–51, insofar as statistics are available.

Algeria.—*See* French Morocco.

Argentina.—The chief lead-producing district in Argentina is the Aguilar, where the Compania Minera Aguilar, S. A., a subsidiary of the St. Joseph Lead Co., operates the Aguilar group of mines. Production in 1951 was 70 percent of the mill capacity, because of exchange difficulties which made it difficult to get adequate supplies and equipment. During the year, 199,904 metric tons of ore was milled, from which 26,219 tons of lead concentrate was produced. This represents an increase over the previous year, when 174,398 tons was milled to produce 23,777 metric tons of concentrate. The lead con-

centrate was smelted at the National Lead Co., S. A., smelter at Barranqueras, Chaco Territory.

Australia.—Both mine and smelter output of lead increased slightly above the 1950 level despite continued shortages of labor and supplies and the requirement that producers supply domestic needs at a price approximately one-third of that received for export lead. Mine output in 1951 was 228,000 metric tons or approximately 14 percent of the world total.

The most important districts are Broken Hill, New South Wales, and Mount Isa, Queensland. Other large deposits occur at Captain's Flat (Lake George Mines) New South Wales and the Read-Roseberry mine in Tasmania.

TABLE 20.—World mine production of lead, 1946–51, by countries, in metric tons [1]

[Compiled by Pauline Roberts]

Country [1]	1946	1947	1948	1949	1950	1951
Algeria	1,015	1,295	1,047	1,222	1,408	2,838
Argentina	18,100	21,200	21,800	16,000	[2] 20,000	[2] 20,000
Australia	186,786	199,779	220,437	216,918	[2] 222,694	228,407
Austria	981	1,971	3,482	4,297	4,440	4,522
Belgian Congo	870	670	400	180		
Bolivia (exports)[4]	8,434	11,310	25,610	26,351	31,203	30,032
Burma		22	[3] 36	([5])	78	[2] 2,000
Canada	160,559	146,662	} 151,727	144,945	[3] 150,317	143,193
Newfoundland	25,213	21,121				
Chile	86	3,507	[3] 6,223	2,859	3,318	[2] 4,000
Czechoslovakia	2,200	([5])	([5])	([5])	([5])	([5])
Ecuador	[3] 307	[3] 172	[2] 269	380	[2] 229	30
Finland	149	182	72	130	142	136
France	8,296	7,495	7,645	9,936	[3] 11,459	10,605
French Equatorial Africa	2,807	2,336	2,603	731	1,814	2,504
French Morocco	11,202	21,200	28,600	[3] 37,200	[3] 48,759	68,134
Germany: West Germany	15,378	14,756	22,344	40,944	44,830	50,368
Greece	475	936	1,280	2,051	[3] 2,307	4,852
Guatemala	([5])	([5])	([5])	3,154	3,000	3,300
Honduras			143	449	[3] 279	454
Hungary	100	200		([5])	300	([5])
Italy	13,900	24,000	30,400	34,600	[3] 38,300	38,738
Japan	[3] 4,344	[3] 5,208	[3] 6,672	[3] 9,132	[3] 10,896	12,672
Korea: Korea, Republic of		900	300	[3] 143	136	136
Mexico	140,144	223,133	193,317	220,763	238,078	225,468
Nigeria		93	273	[3] 29	[3] 12	[6] 56
Northern Rhodesia [7]	8,371	[3] 15,891	13,229	14,169	13,905	14,194
Norway	26	141	265	[3] 301	[3] 360	[3] 360
Peru	44,518	54,814	48,538	65,357	[3] 62,118	82,350
Philippines			([5])	550	879	571
Poland [7]	10,915	12,761	16,874	17,850	18,000	18,000
Portugal	375	398	635	746	845	[2] 900
Rumania	3,224	3,495	([5])	([5])	([5])	([5])
Salvador [2]			203	530	530	470
Southern Rhodesia				83		
South-West Africa		[3] 13,100	33,600	[3] 38,400	[3] 33,680	39,230
Spain	38,662	30,382	29,792	31,550	[3] 32,257	55,745
Spanish Morocco	240	65	215	159	[3] 178	[2] 300
Sweden	21,290	20,858	23,579	23,900	22,673	15,059
Tunisia	8,655	12,340	13,219	14,860	[3] 19,260	21,250
Turkey			2,756	[3] 200	260	600
Union of South Africa	152	133	156	166	[3] 600	900
U. S. S. R. [2] [7]	48,000	63,000	75,000	90,000	[3] 111,600	128,400
United Kingdom	[3] 2,807	[3] 3,228	[3] 2,432	[3] 2,505	[3] 3,338	4,158
United States [4]	304,336	348,558	354,232	371,860	[3] 390,838	352,135
Yugoslavia	[3] 45,523	[3] 54,786	[3] 62,861	[3] 72,144	[3] 86,039	78,750
Total (estimate)	[3] 1,150,000	[3] 1,359,000	[3] 1,424,000	[3] 1,535,000	[3] 1,643,000	1,679,000

[1] Lead may be produced in Brazil, China, Cuba, East Germany, India, and North Korea, but accurate data on production are not available and estimates by the senior author of chapter have been included in the world total.
[2] Estimate.
[3] Revised figure.
[4] Tonnage recoverable from ore.
[5] Data not available; estimate by the senior author of the chapter included in the total.
[6] Exports.
[7] Smelter production.

TABLE 21.—World smelter production of lead, 1946–51, by countries, in metric tons [1]

[Compiled by Pauline Roberts]

Country	1946	1947	1948	1949	1950	1951
Argentina	16,190	17,800	17,830	[2] 18,037	[2] 18,960	24,000
Australia	139,665	161,093	162,057	[2] 152,464	[2] 163,102	173,767
Austria	4,476	3,795	9,350	9,841	10,910	11,147
Belgium [3]	23,762	40,520	66,035	79,304	62,094	70,646
Brazil	420	402	(4)	1,172	[2] 4,200	[5] 3,000
Burma			7,570	[2] 230	[2] 11	4,966
Canada	150,360	147,104	145,246	132,608	154,551	147,609
China	14	771	834	2,062	[5] 4,000	[5] 5,000
Czechoslovakia	2,800	4,460	5,770	(4)	(4)	(4)
France	32,010	29,218	38,288	54,450	61,236	47,970
French Morocco			2,818	7,073	12,097	22,322
Germany:						
East Germany	[2] 27,659	(4)	(4)	(4)	(4)	(4)
West Germany		[2] [6] 24,356	[2] [6] 49,382	[2] 99,372	118,140	121,524
Greece	1,127	948	1,166	[2] 2,389	2,125	3,890
Guatemala	131	110	(4)	68	271	60
Hungary	10	60	(4)	(4)	(4)	(4)
India		234	554	603	[2] 639	878
Italy	14,269	17,701	[2] 26,734	[2] 26,346	37,469	36,000
Japan	4,032	6,168	6,972	7,596	9,984	10,740
Korea:						
Korea, Republic of		250	299	100	(4)	(4)
North Korea	[5] 2,000	[5] 2,000	(4)	(4)	(4)	(4)
Mexico	137,742	217,827	187,067	212,004	230,831	219,107
Northern Rhodesia	8,371	15,891	13,229	14,169	13,905	14,194
Peru	36,478	32,810	34,297	[2] 36,017	[2] 31,693	44,247
Poland	10,915	12,761	16,874	17,850	18,000	18,000
Portugal	260	321	233	304	591	(4)
Rumania	3,225	3,316	(4)	(4)	(4)	(4)
South-West Africa		64	82			
Spain	32,346	34,382	25,313	33,021	[2] 40,568	41,240
Sweden	11,223	9,229	6,228	10,757	[2] 16,681	9,435
Tunisia	7,498	9,891	[2] 17,957	19,498	23,536	22,906
U. S. S. R. [5]	48,000	63,000	75,000	90,000	[2] 111,600	128,400
United Kingdom [5]	2,540	[2] 2,845	2,312	[2] 2,134	[2] 3,048	4,158
United States (refined) [7]	306,717	400,018	363,092	431,695	458,171	376,142
Yugoslavia	[2] 32,600	40,400	[2] 49,200	56,800	[2] 57,200	60,100
Total (estimate)	1,057,000	1,320,000	[2] 1,365,000	[2] 1,550,000	[2] 1,696,000	1,652,000

[1] Data derived in part from Monthly Bulletin of the United Nations, Statistical Summary of the Mineral Industry (Imperial Institute, London), and the Yearbook of the American Bureau of Metal Statistics.
[2] Revised figure.
[3] Includes scrap.
[4] Data not yet available; estimate by senior author of chapter included in total.
[5] Estimate.
[6] American and British zones only.
[7] Figures cover lead refined from domestic and foreign ores; refined lead produced from foreign base bullion not included.

Four companies—the North Broken Hill, Ltd., the Broken Hill South, Ltd., the New Broken Hill Consolidated, Ltd., and the Consolidated Zinc Corp., Ltd.—mine and mill the Broken Hill ores. During 1951 the Consolidated Zinc Corp., Ltd., continued its program of developing and equipping its mine for increased output. In the course of the year the company mined and milled 440,302 tons of ore containing 58,981 tons of recoverable lead. In addition, it hoisted and milled 211,608 tons of ore (16,706 tons recoverable lead content) for the account of New Broken Hill Consolidated, Ltd. The latter company made excellent progress during the year with development of the No. 19 level and construction of new mine shafts, concentrator, and power plant, which were expected to be placed in service in late 1952. Broken Hill South, Ltd., reported mining 279,319 long tons of ore which assayed 12.0 percent lead, 12.1 percent zinc, and 7.8 ounces of silver per ton. The tonnage mined by North Broken Hill, Ltd., increased slightly, but recoveries of both lead and zinc declined because

the ores treated from the British, Junction, and Block 14 areas were partly oxidized.

The Electrolytic Zinc Co. of Australasia operated the Hercules and Roseberry mines in the Read-Roseberry district of Tasmania, increasing both reserves and output of lead during the year. Output of ore for the year ended June 30, 1951, was 159,429 long tons, which yielded 10,084 long tons of lead concentrate, 46,153 of zinc concentrate, and 3,781 of copper concentrate.

Mount Isa Mines, Ltd., which owns and operates the great Mount Isa deposits in Queensland, continued its operations at a normal rate. During the year the company became interested in working the Protheroe lead mine at Northampton, Western Australia, which produced about 500 tons of lead concentrate monthly.

Bolivia.—In 1951 Bolivia exported 30,000 metric tons of recoverable lead in ore. Small miners continued to dominate the lead industry and provided 63 percent of the total lead exported, with the Aramayo and Hochschild groups furnishing 15 percent each. Although official figures were not available on the amount of lead smelted in Bolivia, it was known that the 3 smelters at La Paz, Cochabamba, and Tupiza had a bullion capacity of about 500 tons per month. A fourth smelter under construction at Oruru was expected to increase total capacity to an estimated 700 tons of bullion per month.

Canada.—Although the value of recoverable lead from Canadian mines was 17 percent greater than in 1950, the output (143,000 metric tons) was the least since 1933. The Sullivan mine of the Consolidated Mining & Smelting Co., Kimberley, British Columbia, continued to be the principal source of Canadian lead. Ore production in 1951 at this mine totaled 2,533,212 short tons compared to 2,680,962 tons in 1950. As in 1950 the grade decreased somewhat because of the mining of lower grade ores and the dilution consequent to mining pillars. The company milled about 10,000 tons of ore daily, using a combination of sink-float and flotation equipment. The waste from the sink-float plant, which amounted to about 25 percent of the feed, was used for backfill in the mine. Lead concentrate was treated at the company smelter, Trail, B. C., with ores and concentrate from other properties. Production of refined pig lead at the Trail plant totaled 162,712 tons in 1951 compared with 170,364 in 1950. Work progressed on construction of new lead-smelting facilities that would both improve metallurgical efficiency and increase capacity. Accumulated and current lead-bearing residues from the Trail zinc smelter were to be smelted.

The Big Bull and Tulsequah Chief mines in northwest British Columbia came into production during the year, jointly producing 250 tons of complex ore per day. The Yale Lead and Zinc Mine, 30 miles northeast of Nelson, B. C., began producing at the rate of 190 tons of ore daily in April. Other mines were being developed in British Columbia and Nova Scotia, and exploration of the Pine Point mine on the south shore of Great Slave Lake was continued.

French Morocco and Algeria.—Perhaps the outstanding development in the lead industry abroad in 1951 was the increased production of the mines of French Morocco. Mine output of 68,100 metric tons of lead was 40 percent above that of 1950. It was unofficially reported that Société des Mines Zellidja milled 835,889 tons of ore to recover

38,885 tons of 74-percent lead concentrate and 29,820 tons of 54-percent zinc concentrate. The company No. 2 mill had a daily ore-treatment capacity of 3,300; it was scheduled to treat all Zellidja ore after August 1, 1952. Total Zellidja reserves were estimated to be 27,000,000 tons, of which 10,000,000 tons may be marginal. Other important producers of lead in French Morocco were the Société des Mines d'Aouli and the Compagnie Royale Astusienne des Mines.

The lead-zinc district extends into adjacent Algeria, where the Société Nord Africaine du Plomb was developing an ore deposit containing 16 percent zinc and 2 percent lead. The operations were directed from Zellidja, and plans provided for milling 600 tons of ore daily at Zellidja's No. 1 mill beginning about August 1952.

The lead smelter of the Société des Mines de Zellidja at Qued-el-Heimer produced 18,400 tons of refined lead in 1951. Capacity of the smelter was said to be 4,000 tons of concentrate monthly.

Guatemala.—Output of the Caquipec mine in the Department of Alta Verapaz more than tripled that of 1950 and would have been greater except for transportation difficulties. The lead ores, which ranged from 20 to 42 percent lead, were shipped to the United States and Canada for smelting. Small producers in the Department of Huehuetenango continued to mine and smelt pig lead for the domestic market by primitive methods.

Mexico.—Mine production of lead declined somewhat in 1951 as higher prices permitted lower grade ores to be profitably treated. According to the annual report to the stockholders of the San Francisco Mines of Mexico, Ltd., shortage of electrical power forced some curtailment of production. The company milled 597,400 metric tons of ore compared to 623,000 tons in 1950 and produced 45,756 tons of 64.34-percent lead concentrate, 68,452 tons of 55.18-percent zinc concentrate, and 6,148 tons of 26.24-percent copper concentrate. Ore reserves at the end of September 1951 were 4,208,000 tons, containing 6.50 percent lead, 9.35 percent zinc, and 0.65 percent copper.

South-West Africa.—The Tsumeb Corp., Ltd. operated the very rich and important Tsumeb mine near the north boundary of the territory. In spite of transportation difficulties with the narrow-gage railway between Tsumeb and Vsajos, progress continued in expansion of facilities and production. In the year ended June 30, 1951, the concentrator treated 392,780 short tons of ore, from which 32,637 tons of lead, 11,231 tons of copper, and 12,847 tons of zinc were recovered. Sinking of the new vertical 7-compartment De Wet shaft progressed to a depth of 2,460 feet by the end of 1951. The shaft was to be sunk to 4,150 feet and equipped with a hoist and skips capable of handling 2,000 tons of ore daily. During the year the Tsumeb Corp. investigated a lead-zinc deposit near Windhoek. The South-West Africa Co. expanded milling capacity at the Abenab-West lead-vanadium property near Grootfontein.

Tunisia.—During 1951, 12 mines in Tunisia produced 33,915 tons of lead concentrate containing 21,250 metric tons of lead. In the same period the Megrine, Djebel Hallouf, and Bizerte lead smelters smelted 39,350 tons of ore and concentrate to produce 22,906 metric tons of pig lead.

802512—54——49

Lead and Zinc Pigments and Zinc Salts

By Robert L. Mentch

GENERAL SUMMARY

MODERATE declines in shipments of lead and zinc pigments and zinc salts featured the industry in 1951. However, owing largely to continuing defense activities, shipments remained substantially above those of 1949. Decreases from 1950 to 1951 in shipments of zinc pigments ranged from 3 percent for lithopone to 31 percent for leaded zinc oxide. Litharge and white lead (dry and in oil) declined 13 and 22 percent, respectively, while red-lead shipments were approximately the same as in 1950. Zinc salts (zinc sulfate and zinc chloride) decreased 2 and 6 percent, respectively.

Decreases in shipments of pigments and salts are attributed partly to decreases in the volume of business in industries that are important consumers of these products: Passenger-automobile production dropped 20 percent in 1951 (truck output rose 7 percent), and consumption of natural and synthetic rubber declined 3 percent (natural rubber fell 37 percent and synthetic rubber increased 41 percent) compared with 1950. The value of sales of varnish and lacquer materials was 5 percent greater than in 1950, the value of public construction increased 27 percent, and the value of private construction was approximately the same as in 1950; paint and construction gains, however, in part reflected rising costs of materials and labor.

Supplies of lead and zinc, the chief raw materials of the pigments industry, were smaller in 1951 than in 1950; yet the demand for these as metal continued high, causing a reduction in quantities available for the manufacture of pigments and also partly accounting for the decreases in shipments. Ceiling prices were established for lead and zinc on January 26, 1951, at the highest price (for each seller) at which sales were made between December 19, 1950, and January 25, 1951. Thus a number of ceiling prices were maintained for both lead and zinc. The bulk of lead and zinc sales, however, was at 17 cents per pound and 17.50 cents, respectively. These prices were for common lead, New York, and Prime Western grade slab zinc, East St. Louis, and remained in effect until October 2, 1951, when the Office of Price Stabilization permitted rises of 2 cents per pound for both metals.

Lead- and zinc-pigment price quotations maintained their historically close relationship to pig-lead and slab-zinc prices throughout the year. There were virtually no fluctuations, owing to imposition of ceiling prices by the Office of Price Stabilization early in the year. Quotations advanced up to 2 cents a pound shortly after the 2-cent rise in lead- and zinc-metal prices in October. Zinc-pigment prices reached alltime highs during the year. Lead-pigment prices, although relatively high, did not attain the record levels of 1948 and early 1949.

TABLE 1.—Salient statistics of the lead and zinc pigments industry of the United States, 1942–46 (average) and 1947–51

	1942–46 (average)	1947	1948	1949	1950	1951
Production (shipments) [1] of principal pigments:						
White lead (dry and in oil)—short tons	[2] 72,641	68,787	46,070	27,355	45,176	35,415
Red lead—do	47,125	36,064	30,787	24,866	35,072	35,352
Litharge—do	123,081	167,050	154,775	121,052	177,658	154,753
Zinc oxide—do	133,912	160,771	150,958	110,132	160,829	147,716
Leaded zinc oxide short tons	57,384	81,459	67,441	36,722	63,973	44,341
Lithopone—do	139,822	165,024	140,033	78,335	105,650	102,837
Value of products:						
All lead pigments	$42,106,000	[3] $90,199,000	[3] $90,915,000	[3] $58,564,000	[3] $79,858,000	[3] $89,273,000
All zinc pigments	37,434,000	63,891,000	65,547,000	43,152,000	71,322,000	74,599,000
Total	79,540,000	[3] 154,090,000	[3] 156,462,000	[3] 101,716,000	[3] 151,180,000	[3] 163,872,000
Value per ton received by producers:						
White lead (dry)	$165	$308	$363	$351	$335	$426
Red lead	174	333	396	333	314	397
Litharge	154	313	387	324	292	383
Zinc oxide	139	186	218	230	258	311
Leaded zinc oxide	134	204	245	242	262	320
Lithopone	79	105	115	115	124	141
Foreign trade:						
Lead pigments:						
Value of exports	$1,212,000	$1,041,000	$970,000	$1,157,000	$950,000	$984,000
Value of imports	7,000	150,000	633,000	143,000	344,000	1,797,000
Zinc pigments:						
Value of exports	2,537,000	6,554,000	5,229,000	3,426,000	2,124,000	6,855,000
Value of imports	5,000	31,000	7,000	52,000	1,275,000	930,000
Export balance	3,737,000	7,414,000	5,559,000	4,388,000	1,455,000	5,112,000

[1] Reported as sales before 1945.
[2] Includes shipments of basic lead sulfate in 1946, figure for which is withheld to avoid disclosure of individual company operations.
[3] Excludes value of basic lead sulfate; withheld to avoid disclosure of individual company operations.

The supply-demand situation in lead led to a National Production Authority Order, M–38, effective February 16, 1951, which set forth limitations on inventories of lead and materials containing lead, other than ores and concentrates. This order was amended on May 28 and again on July 26 to set forth certain limitations on the acceptance of rated orders to permit equitable distribution of such orders, provide for the creation of a set-aside reserve of pig lead to meet emergency situations, and establish limitations on the use of lead and lead products.

National Production Authority Order M–15, effective December 1, 1950, restricted civilian use of zinc metal and zinc-metal products in 1951 to an average quarterly rate of 80 percent of the use during the first 6 months of 1950. Rated orders and mandatory NPA orders were to be in addition to the civilian limitation. Inventories were restricted to a 45-day supply or to a "practicable minimum working inventory," whichever was less. This order was amended on June 15, 1951, to restrict use of Special High-Grade zinc, during the calendar quarter commencing July 1 and each calendar quarter thereafter, to an average quarterly rate of 70 percent of the use during the base period; consumption of all other zinc was to be the same as stated in the earlier order. Under NPA Order M–9, effective November 16, 1950, producers of zinc, zinc oxide, and other zinc products were not

required to accept rated orders for shipment in one month exceeding 10 percent of production.

Shipments of white lead (dry) and of the "in-oil" variety dropped 18 and 28 percent, respectively, from 1950 totals. Shipments of the "in-oil" variety, moreover, were the smallest by far since long before the beginning of the present century. White lead (dry) shipments, except for 1949 and 1918, were also smaller than at any time in more than 50 years. Litharge shipments decreased 13 percent in 1951 but were well above average yearly shipments during World War II. Shipments of red lead were approximately the same as in 1950 but considerably lower than in World War II years. Figure 1 shows trends in shipments of lead pigments for 1910–51.

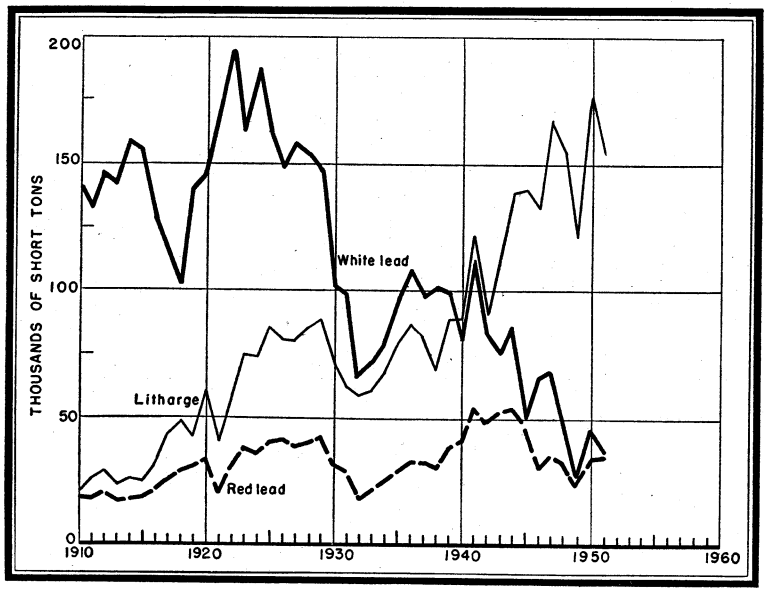

FIGURE 1.—Shipments of lead pigments, 1910–51.

Shipments of zinc oxide (lead-free), although declining 8 percent in 1951, were comparable in quantity to those during the World War II period. Shipments of leaded zinc oxide decreased 31 percent from the previous year, the largest drop among the products covered by this report. Shipments of lithopone were down 3 percent from the 1950 total and considerably lower than all years from 1925–48, inclusive. Trends in shipments of zinc pigments are shown in figure 2.

Shipments of zinc salts changed relatively little compared with 1950; zinc chloride decreased 6 percent, and zinc sulfate fell 2 percent.

The distribution of shipments of pigments to consumers in 1951 remained essentially the same as in previous years. The paint industry continued to be the largest user of white lead, leaded zinc oxide, and lithopone, accounting for approximately 81, 99, and 75 percent, respectively, of shipments. In addition, 42 percent of red-lead shipments, 22 percent of zinc oxide shipments, and 11 percent

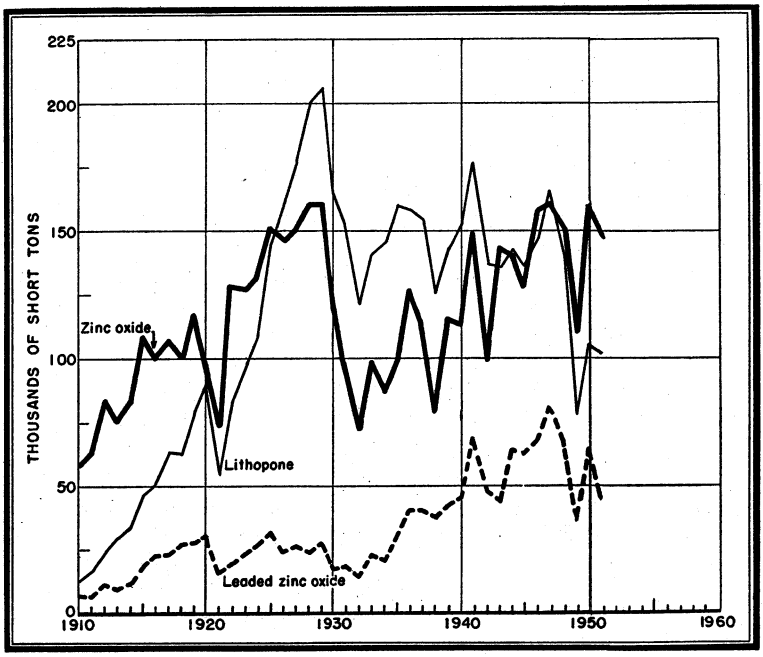

FIGURE 2.—Shipments of zinc pigments, 1910–51.

of litharge shipments went into paint manufacture. Storage-battery makers were the chief users of litharge and red lead, receiving 61 and 47 percent, respectively, of producers' shipments. Shipments of zinc oxide to the rubber industry remained on a high level, being nearly half of total shipments. Relatively small quantities of litharge, lithopone, and leaded zinc oxide are also used in manufacturing rubber. The ceramics industry ranks fourth in consumption of lead and zinc pigments, being surpassed only by the paint, storage-battery, and rubber industries. In 1951, 15 percent of litharge shipments, 7 percent of zinc oxide shipments, and smaller quantities of white lead and red lead were used in making ceramics.

Titanium pigments continued to furnish the chief competition to lead and zinc pigments in paintmaking. Production and shipments of titanium pigments were at alltime highs in 1951, 5 and 2 percent, respectively, above the previous records established in 1950. Inadequate plant capacity and shortages of raw materials have been limiting factors in titanium-pigment production for several years, preventing even greater increases. At present, the Bureau of Mines is not at liberty to publish statistics covering pigments of this class.

PRODUCTION

The value of shipments of lead and zinc pigments in 1951 (exclusive of that for basic lead sulfate, which cannot be shown) was $163,872,000, an 8-percent increase over 1950 despite a 12-percent decrease in tonnage. Lead pigments and zinc pigments comprised 54 and 46

percent, respectively, of the total value in 1951 compared with 53 and 47 percent, respectively, in 1950.

For many years, figures on "sales" were used in this series of reports as a better guide than production to activity in the pigments industry. Beginning with 1945, the base was changed to "shipments" to conform with data compiled on Bureau of Mines lead and zinc schedules. Available information for 1945 (the year of change) indicates little difference between sales and shipments in that year. In reporting tonnages of pigments, an attempt is made to avoid all duplication, one of the chief problems being that finished pigments frequently are blended to make another product. Basic lead sulfate and zinc oxide, for example, are blended to make leaded zinc oxide, and in this instance the pigment weights appear in the total for the last-named class only. Pigments consumed by producing companies to make products beyond those covered by this report—that is, paints, storage batteries, and other articles—are considered as shipments.

LEAD PIGMENTS

Shipments of lead pigments decreased 13 percent in quantity but increased 12 percent in value in 1951 compared with 1950. Substantial gains in average prices received by producers increased the total value. Shipments of white lead (dry and in oil) and litharge declined 22 and 13 percent, respectively, while red-lead shipments were slightly higher than in 1950.

Average values of lead pigments reported by producers reached alltime highs: The yearly average for white lead (dry) was $426 per ton, 27 percent above the 1950 average; red lead sold at an average of $397 per ton, an increase of 26 percent; and litharge brought $383 per ton, 31 percent higher than the 1950 average.

White Lead.—The general decline in shipments of white lead—first evident in the late 1920's—continued, as competitive pigments supplanted both classes in many paint formulas. Total shipments declined 22 percent and, except for 1949, were the lowest by far since much before the beginning of the twentieth century.

TABLE 2.—Production and shipments of lead pigments [1] in the United States, 1950–51

Pigment	1950				1951			
	Production (short tons)	Shipments			Production (short tons)	Shipments		
		Short tons	Value [2]			Short tons	Value [2]	
			Total	Average			Total	Average
White lead:								
Dry	27,954	28,506	$9,553,687	$335	22,982	23,359	$9,952,883	$426
In oil [3]	16,778	16,670	7,403,032	444	11,177	12,056	6,007,291	498
Red lead	34,066	35,072	11,013,908	314	34,065	35,352	14,025,182	397
Litharge	178,225	177,658	51,887,453	292	152,155	154,753	59,287,262	383

[1] Except for basic lead sulfate, figure for which is withheld to avoid disclosure of individual company operations.
[2] At plant, exclusive of container.
[3] Weight of white lead only, but value of paste.

TABLE 3.—Lead pigments shipped by manufacturers in the United States, 1942–46 (average) and 1947–51, in short tons

Year	White lead			Basic lead sulfate or sublimed lead		Red lead	Orange mineral	Litharge
	Dry	In oil	Total	White	Blue			
1942–46 (average)[1]	[1] 38,226	34,415	[1] 72,641	[2] 5,642	[2] 1,279	47,125	169	123,081
1947	39,075	29,712	68,787	(3)	(3)	36,064	----------	167,050
1948	26,551	19,519	46,070	(3)	(3)	30,787	----------	154,775
1949	15,719	11,636	27,355	(3)	(3)	24,866	----------	121,052
1950	28,506	16,670	45,176	(3)	(3)	35,072	----------	177,658
1951	23,359	12,056	35,415	(3)	(3)	35,352	----------	154,753

[1] Basic lead sulfate for 1946 included with white lead (dry) in order to avoid disclosure of individual company operations.
[2] 1941–45 average; *see* footnote 1.
[3] Figure withheld to avoid disclosure of individual company operations.

Basic Lead Sulfate.—Because there was only one producer, the Bureau of Mines is not at liberty to publish figures on basic lead sulfate for 1946–51.

Red Lead.—Shipments of red lead in 1951 were approximately the same as in 1950 but were 25 to 35 percent lower than in World War II years.

Orange Mineral.—No shipments of orange mineral were reported in 1947–51

Litharge.—Although declining 13 percent from the 1950 total, litharge shipments remained at a comparatively high level, being exceeded only in 1947, 1948, and 1950. In recent years litharge has been the largest quantity pigment of the group covered by this report.

Battery manufacturers produced 77,000 tons of black or gray oxide or suboxide of lead in 1951 for their own use in place of litharge. This quantity compares with 80,000 tons in 1950 and 55,000 tons in 1949. Oxide production required 73,000 tons of pig lead in 1951, 77,000 tons in 1950, and 53,000 tons in 1949.

ZINC PIGMENTS AND SALTS

Owing to substantial gains in average prices received by producers, the value of shipments of zinc pigments increased 5 percent in 1951, despite an 11-percent decrease in the quantity of shipments. Shipments of zinc oxide (lead-free), the most important of the zinc pigments in tonnage and value, declined 8 percent; shipments of leaded zinc oxide fell 31 percent; and shipments of lithopone decreased 3 percent.

Producers' average values attained new peaks in 1951, surpassing the records established in 1950. Average values received by primary shippers were as follows: Zinc oxide (lead-free), $311 per ton, a gain of 21 percent; leaded zinc oxide, $320 per ton, an increase of 22 percent; and lithopone, $141 per ton, or 14 percent higher than in 1950.

Shipments of the zinc salts—zinc chloride and zinc sulfate—declined 6 and 2 percent, respectively, from 1950 totals but otherwise compared favorably with tonnages in previous years. Average values of the two compounds were $85 and $160 per ton, respectively, compared with $73 and $131 in 1950.

TABLE 4.—Production and shipments of zinc pigments and salts in the United States, 1950–51

Pigment or salt	1950				1951			
	Production (short tons)	Shipments			Production (short tons)	Shipments		
		Short tons	Value [1]			Short tons	Value [1]	
			Total	Average			Total	Average
Zinc oxide [2]	161,374	160,829	$41,439,269	$258	158,714	147,716	$45,948,219	$311
Leaded zinc oxide [2]	63,194	63,973	16,752,888	262	50,972	44,341	14,179,993	320
Lithopone	99,321	105,650	13,129,363	124	107,519	102,837	14,470,742	141
Zinc chloride, 50° B	63,843	64,564	4,703,250	73	62,527	60,730	5,152,382	85
Zinc sulfate	23,587	23,912	3,124,413	131	23,663	23,524	3,769,825	160

[1] Value at plant, exclusive of container.
[2] Zinc oxide containing 5 percent or more lead is classed as leaded zinc oxide. In this table data for leaded zinc oxide include a small quantity containing less than 5 percent lead.

TABLE 5.—Zinc pigments and salts shipped [1] by manufacturers in the United States, 1942–46 (average) and 1947–51, in short tons

Year	Zinc oxide	Leaded zinc oxide	Lithopone	Zinc chloride (50° B.)	Zinc sulfate
1942–46 (average)	133,912	57,384	139,822	55,434	18,584
1947	160,771	81,459	165,024	65,521	21,547
1948	150,958	67,441	140,033	68,701	21,513
1949	110,132	36,722	78,335	55,208	20,065
1950	160,829	63,973	105,650	64,564	23,912
1951	147,716	44,341	102,837	60,730	23,524

[1] Reported as sales before 1945.

Zinc Oxide.—Shipments of lead-free zinc oxide were 8 percent lower in 1951 than in 1950, owing partly to the reduced availability of raw materials from which the oxide is produced.

Leaded Zinc Oxide.—Shipments of leaded zinc oxide declined 31 percent in 1951, the largest decrease among the pigments covered by this report.

Four grades of leaded zinc oxide, classified according to lead content, are produced in the United States. The bulk of the output, however, is the 5- to 35-percent grade; only relatively small quantities of the other grades—5 percent or less lead, over 35 to 50 percent lead, and over 50 percent lead—are produced. Production by grades in 1951 (1950 in parentheses) was as follows: 35 percent lead and under, 46,960 (54,641) tons; over 35 percent lead, 4,012 (8,553) tons.

Lithopone.—Shipments of lithopone fell 3 percent below those in 1950 and were much lower than in all years from 1924–48, inclusive.

TABLE 6.—Production of zinc oxide (lead-free) by processes, 1946–51, as percent of total

Process	1946	1947	1948	1949	1950	1951
American process (ore and primary residues)	75	73	76	71	72	75
French process (metal and scrap)	17	17	15	17	18	18
Other	8	10	9	12	10	7
Total	100	100	100	100	100	100

The lithopone statistics in this report are given on the basis of ordinary lithopone sold as such plus the ordinary lithopone content of the high-strength product.

Consumption of ordinary lithopone in the manufacture of titanated lithopone has diminished to very small proportions. The trend has been downward almost continuously since 1937, when 19,400 tons was used in making the titanated product. The tonnage consumed for this purpose in 1951 was 55 percent below the quantity used in 1950 and the smallest on record. The lithopone figures in table 7 are included in the totals for ordinary lithopone in other tables.

TABLE 7.—Titanated lithopone produced in the United States and ordinary lithopone used in its manufacture, 1942–46 (average) and 1947–51, in short tons

Year	Titanated lithopone produced	Ordinary lithopone used	Year	Titanated lithopone produced	Ordinary lithopone used
1942–46 (average)	9,600	8,150	1949	2,000	1,700
1947	2,600	2,200	1950	3,400	2,900
1948	2,100	1,700	1951	1,550	1,300

Zinc Sulfide.—In 1951 as in several preceding years, only one company produced zinc sulfide, hence the Bureau of Mines is not at liberty to publish figures for this pigment.

Zinc Chloride.—Shipments of 50° B. solution zinc chloride declined 6 percent in 1951 but were at a comparatively high level, being exceeded in only 4 earlier years.

Zinc Sulfate.—Although zinc sulfate shipments decreased 2 percent in 1950, the total was the third-highest on record and was only 6 percent below the peak established in 1946.

RAW MATERIALS USED

Lead pigments and zinc pigments and salts are manufactured from a variety of materials, including ore, refined metal, and such secondary materials as scrap, residues, ashes, drosses, and skimmings. In 1951, as in 1950 and 1949, approximately 94 percent of the lead in pigments was derived from pig lead and the remainder from ore. Of the lead in ore used to make leaded zinc oxide, about 12 percent (14 in 1950) was from foreign sources. The sources of zinc in zinc pigments were as follows: 76 percent (73 in 1950) from ore and concentrates, 9 (9) percent from slab zinc, and 15 (17) percent from secondary materials; about 19 (22) percent of the ore used was of foreign origin.

Tables 8 and 9 give the quantities and sources of the metal used in manufacturing each pigment and salt. Pig lead is employed exclusively, either directly or indirectly, in manufacturing white lead, litharge, red lead, and orange mineral and is used also in manufacturing basic lead sulfate. The lead content of leaded zinc oxide made from basic lead sulfate, which in turn is made from pig lead, is credited to pig lead in the table. Zinc oxide is the only pigment in which considerable slab zinc is used. Ore is employed in manufacturing zinc oxide, leaded zinc oxide, lithopone, zinc sulfide, zinc sulfate, and basic lead sulfate. Over half of the zinc contained in lithopone (53 percent in 1951 and 59 in 1950) and virtually all of that in zinc chloride (100

percent in 1951 and 1950) produced in the United States are derived from secondary material. The proportion of zinc oxide production derived from metal and scrap dropped to 24 percent in 1951 compared with 29 percent in 1950. For a number of years before the United States entered World War II, there had been a large increase in the quantity of secondary zinc used in manufacturing zinc oxide. The scarcity of supplies of both metal and scrap caused the proportion of the total oxide made by the French process—which uses only metal and scrap—to drop sharply in 1942 and to continue comparatively low in 1943–46, despite the fact that the total percentage from metal and scrap rose in 1943 and continued upward almost without interruption in 1944–50. The production of zinc oxide from metal and scrap accounted for the following percentages in relation to total production: 41 percent in 1939, 16 percent in 1942, 19 percent in 1943, 22 percent in 1944, 25 percent in 1945, 26 percent in 1946, 28 percent in 1947, 26 percent in 1948, and 29 percent in 1949.

TABLE 8.—Lead content of lead and zinc pigments [1] produced by domestic manufacturers, 1950–51, by sources, in short tons

Pigment	1950				1951			
	Lead in pigments produced from—			Total lead in pigments	Lead in pigments produced from—			Total lead in pigments
	Ore		Pig lead		Ore		Pig lead	
	Domestic	Foreign			Domestic	Foreign		
White lead			35,897	35,897			27,409	27,409
Red lead			30,884	30,884			30,880	30,880
Litharge			165,428	165,428			141,215	141,215
Leaded zinc oxide	12,606	2,061		14,667	11,237	1,581		12,818
Total	12,606	2,061	232,209	246,876	11,237	1,581	199,504	212,322

[1] Excludes lead in basic lead sulfate, data for which are withheld to avoid disclosure of individual company operations.

TABLE 9.—Zinc content of zinc pigments [1] and salts produced by domestic manufacturers, 1950–51, by sources, in short tons

Pigment or salt	1950					1951				
	Zinc in pigments and salts produced from—				Total zinc in pigments and salts	Zinc in pigments and salts produced from—				Total zinc in pigments and salts
	Ore		Slab zinc	Secondary material [2]		Ore		Slab zinc	Secondary material [2]	
	Domestic	Foreign				Domestic	Foreign			
Zinc oxide	69,412	22,327	16,866	19,749	128,354	77,805	18,275	15,655	14,909	126,644
Leaded zinc oxide	26,946	5,274			32,220	21,364	4,046			25,410
Lithopone	6,380	1,507	30	11,494	19,411	7,684	2,010	59	11,098	20,851
Total pigments	102,738	29,108	16,896	31,243	179,985	106,853	24,331	15,714	26,007	172,905
Zinc chloride				14,346	14,346				14,078	14,078
Zinc sulfate	2,127	461		4,710	7,298	2,203	458		5,008	7,669

[1] Excludes zinc sulfide, data for which are withheld to avoid disclosure of individual company operations.
[2] These figures are higher than those shown in the report on Secondary Metals—Nonferrous because they include zinc recovered from byproduct sludges, residues, etc., not classified as purchased scrap material.

CONSUMPTION AND USES

LEAD PIGMENTS

White Lead.—The paint industry is by far the largest user of white lead, generally accounting for 90 percent or more of total consumption of this pigment. Available statistics show a lower percentage for 1951, but this is probably due to the inability of shippers to give complete data on end-use classification. It is known that in the past some white lead sold to the Government has been reported under "Other" for want of information on actual end use, and it is likely that a substantial part of the entire "Other" classification belongs properly under paint. Shipments to ceramics makers and manufacturers of plasticizers and stabilizers accounted for 4 and 3 percent, respectively, of total distribution in 1951.

TABLE 10.—Distribution of white lead (dry and in oil) shipments [1], 1942–46 (average) and 1947–51, by industry, in short tons

Industry	1942–46 [2] (average)	1947	1948	1949	1950	1951
Paints	66,117	61,265	40,892	24,284	38,920	28,718
Ceramics	1,282	1,665	1,369	894	1,815	1,548
Other	5,242	5,857	3,809	2,177	[3] 4,441	[3] 5,149
Total	72,641	68,787	46,070	27,355	45,176	35,415

[1] Reported as sales before 1945.
[2] Shipments of basic lead sulfate included with white lead for 1946 to avoid disclosure of individual company operations.
[3] Includes the following tonnages for plasticizers and stabilizers: 1950—1,257; 1951—1,003.

Basic Lead Sulfate.—A distribution of basic lead sulfate shipments by uses has not been available for publication since 1945, when 3,009 tons went to the paint industry, 200 tons to the rubber industry, and 686 tons to other industries. Substantial quantities of lead sulfate are also used as an intermediate product in manufacturing leaded zinc oxide. Such quantities have always been shown in this chapter under leaded zinc oxide rather than basic lead sulfate.

Red Lead.—Producers' deliveries to manufacturers of storage batteries again accounted for the largest proportion of red-lead shipments—47 percent compared with 50 percent in 1950. As in the past, the paint industry was the second largest consumer of this pigment, taking 42 percent (40 in 1950) of total shipments. Relatively small quantities were used in making ceramics.

TABLE 11.—Distribution of red-lead shipments [1], 1942–46, (average) and 1947–51, by industry, in short tons

Industry	1942–46 (average)	1947	1948	1949	1950	1951
Storage batteries	25,242	20,883	14,854	12,163	17,478	16,722
Paints	17,424	11,362	10,863	9,634	14,103	14,740
Ceramics	[redacted] 859	977	1,275	603	981	834
Other	3,600	2,842	3,795	2,466	2,510	3,056
Total	47,125	36,064	30,787	24,866	35,072	35,352

[1] Reported as sales before 1945.

Orange Mineral.—No shipments of orange mineral have been reported since 1946, when 78 tons went to the ink industry, 18 tons to the color-pigment industry, and 27 tons to other industries.

Litharge.—The largest single use of litharge is for storage batteries. This use took 61 percent of total shipments in 1951 and since 1947 has accounted for roughly two-thirds of all shipments. The ceramics industry is the second largest consumer of litharge; shipments for this purpose were the second highest on record in 1951 despite an 18-percent decrease from the previous year. Shipments to insecticide makers were 47 percent less than in 1950, the largest drop among the end-use items in this report. Tonnages used for chrome pigments and varnish increased 11 and 28 percent, respectively, while shipments to oil refineries and rubber manufacturers decreased 6 and 13 percent. Shipments for use in floor coverings, regularly a very small item, increased over eight fold in 1951.

TABLE 12.—Distribution of litharge shipments [1], 1942–46 (average) and 1947–51, by industry, in short tons

Industry	1942–46 (average)	1947	1948	1949	1950	1951
Storage batteries	65,354	111,840	100,645	77,163	105,558	94,064
Ceramics	11,290	18,360	19,979	13,299	27,771	22,815
Chrome pigments	9,440	9,228	7,455	8,557	10,017	11,117
Oil refining	5,741	7,688	7,248	5,720	6,488	6,068
Insecticides	18,669	7,288	6,033	5,353	10,651	5,691
Varnish	3,184	4,258	4,424	4,286	4,347	5,584
Rubber	2,956	2,205	2,835	1,398	3,047	2,641
Floor coverings	156	141	152	62	220	1,772
Other	6,291	6,042	6,004	5,214	9,559	5,001
Total	123,081	167,050	154,775	121,052	177,658	154,753

[1] Reported as sales before 1945.

ZINC PIGMENTS AND SALTS

Zinc Oxide.—The distribution pattern of lead-free zinc oxide shipments was essentially the same in 1951 as in previous years. The largest tonnages went to rubber manufacturers, 48 percent (52 in 1950); the paint industry, 22 percent (25); and ceramics makers, 7 percent (8). Shipments to all consuming industries, except manufacturers of coated fabrics and textiles, whose consumption increased

TABLE 13.—Distribution of zinc oxide shipments [1], 1942–46 (average) and 1947–51, by industry, in short tons

Industry	1942–46 (average)	1947	1948	1949	1950	1951
Rubber	65,472	82,248	82,895	58,496	82,944	71,507
Paints	28,554	32,867	26,779	26,205	39,699	32,934
Ceramics	4,786	11,350	12,327	6,982	12,679	10,324
Coated fabrics and textiles [2]	9,293	9,100	9,474	5,200	6,303	7,265
Floor coverings		4,735	4,938	2,665	3,670	3,114
Chemical warfare	10,308					
Other	15,499	20,471	14,545	10,584	15,534	22,572
Total	133,912	160,771	150,958	110,132	160,829	147,716

[1] Reported as sales before 1945.
[2] Includes the following tonnages for rayon: 1947—7,302; 1948—8,209; 1949—4,470; 1950—4,850; 1951—5,275.

15 percent, declined in 1951. One company reported shipments of oxide for chemical warfare purposes; but, since coverage for this item is not complete, the tonnage is included under the "Other" classification.

Leaded Zinc Oxide.—Leaded zinc oxide (all grades) is used almost exclusively as a pigment in paint manufacturing; in 1951 about 99 percent of total shipments was for this purpose. Small quantities (less than 1 percent of shipments) are used by the rubber industry. Shipments of leaded zinc oxide were well below production for the year, and, as a result, stocks increased considerably. The fact that leaded zinc oxide is produced from ores rather than metal or secondary materials improves its competitive position for paint manufacture when metal and scrap are in short supply.

TABLE 14.—Distribution of leaded zinc oxide shipments [1], 1942–46 (average) and 1947–51, by industry, in short tons

Industry	1942–46 (average)	1947	1948	1949	1950	1951
Paints	55,049	77,994	64,912	35,938	63,002	43,678
Rubber	105	131	218	124	240	82
Other	2,230	3,334	2,311	660	731	581
Total	57,384	81,459	67,441	36,722	63,973	44,341

[1] Reported as sales before 1945.

Lithopone.—Lithopone is used principally in the manufacture of paints, varnish, and lacquers; approximately three-fourths of total shipments are to these industries. In 1951 this purpose accounted for 75 percent (74 in 1950) of the total. The consumption of lithopone in paper manufacturing increased 69 percent in 1951 to become the second largest use of the pigment. In contrast, shipments for all other purposes except printing ink declined; deliveries to manufacturers of coated fabrics and textiles, rubber, and floor coverings dropped 39, 19, and 13 percent, respectively.

TABLE 15.—Distribution of lithopone shipments [1], 1942–46 (average) and 1947–51, by industry, in short tons

Industry	1942–46 (average)	1947	1948	1949	1950	1951
Paint, varnish, and lacquers [2]	110,911	134,830	104,441	56,146	78,177	76,614
Paper	4,010	4,069	4,814	2,375	[3] 3,821	6,462
Coated fabrics and textiles	5,646	8,421	8,436	6,602	7,945	4,814
Floor coverings	9,856	9,048	12,423	6,380	5,297	4,620
Rubber	1,087	3,085	4,192	3,245	4,092	3,295
Printing ink	[4]	[4]	[4]	[4]	838	868
Other	8,312	5,571	5,727	3,587	[3] 5,480	6,164
Total	139,822	165,024	140,033	78,335	105,650	102,837

[1] Reported as sales before 1945.
[2] Includes a small quantity, not separable, used for printing ink, except in 1950 and 1951.
[3] Revised figure.
[4] Included in "Other" before 1950, except for those quantities reported under "Paint, varnish, and lacquers."

Zinc Chloride.—Statistics on the end-use distribution of zinc chloride shipments are not available. This salt is used principally in wood preserving, battery manufacturing, vulcanized fiber, oil refining, and as a soldering flux.

Zinc Sulfate.—The textile (rayon) industry has been the largest consumer of zinc sulfate since 1946, when agricultural use led; in 1951 the quantity used for rayon fell 10 percent from 1950 but was higher than in all years except 1950 and 1949. Agriculture and chemicals continued as the second and third largest uses, with shipments for agricultural purposes decreasing 4 percent from the previous year and shipments to producers of chemicals increasing 53 percent. Shipments for textile dyeing and printing in 1951 were almost 11 times higher than in 1950, by far the largest gain for any one end use of any of the pigments covered by this report. Shipments for flotation reagents, glue, electrogalvanizing, and paint and varnish processing decreased markedly in 1951.

TABLE 16.—Distribution of zinc sulfate shipments [1], 1942–46 (average) and 1947–51, by industry, in short tons

Industry	1942–46 (average)	1947		1948		1949		1950		1951	
	Gross weight	Gross weight	Dry basis	Gross weight	Dry basis	Gross weight	Dry basis	Gross weight	Dry basis	Gross weight	Dry basis
Rayon	5,601	8,210	6,173	9,900	7,333	10,591	7,957	11,217	8,322	10,073	7,925
Agriculture	5,977	7,827	6,125	5,210	4,248	4,429	3,595	5,841	4,880	5,588	4,847
Chemicals	2,113	2,120	1,439	1,734	1,193	1,197	851	1,879	1,377	2,871	2,243
Textile dyeing and printing	272	60	38	102	66	30	21	145	129	1,400	1,163
Flotation reagents	1,017	1,112	717	1,632	1,366	921	757	952	727	858	736
Glue	490	624	444	561	462	453	370	579	464	396	337
Electrogalvanizing	285	233	146	319	205	217	154	324	203	190	129
Paint and varnish processing	1,290	61	51	121	104	663	585	189	119	32	20
Other	1,539	1,300	864	1,934	1,191	1,564	979	2,786	1,820	2,116	1,274
Total	18,584	21,547	15,997	21,513	16,168	20,065	15,269	23,912	18,041	23,524	18,674

[1] Reported as sales before 1945.

PRICES

Total and average values received by producers for lead and zinc pigments and zinc salts are given in the tables in the early part of this chapter. Average values for white lead and red lead established new peaks in 1951, 17 percent and less than 1 percent, respectively, over the previous highs set in 1948. The average value for litharge was only 1 percent under the 1948 record. As previously stated, lead-pigment quotations were relatively steady throughout the year, the only notable changes occurring on October 2, when the price of lead advanced 2 cents a pound.

Average values received by producers of zinc pigments reached unprecedented highs in 1951, with gains over the previous peaks, recorded in 1950, ranging from 14 percent for lithopone to 22 percent for leaded zinc oxide. Quotations for pigments began at high levels and increased up to 2 cents a pound in October following the rise in zinc-metal prices.

New highs were also recorded for zinc chloride and zinc sulfate; average values were 16 and 22 percent, respectively, above the peaks established in 1950.

TABLE 17.—Range of quotations on lead pigments and zinc pigments and salts at New York (or delivered in the East), 1948–51, in cents per pound

[Oil, Paint and Drug Reporter]

Product	1948	1949	1950	1951
White lead (basic lead carbonate), dry, carlots, barrels	16.00–22.10	14.75–22.10	14.00–18.50	18.50–20.10
Basic lead sulfate (sublimed lead), less than carlots, barrels	15.75–21.25	14.25–21.25	13.25–18.75	18.75–20.19
Red lead, dry, 95 percent or less, less than carlots, barrels	18.00–25.25	15.75–25.25	14.25–20.75	20.75–22.57
Orange mineral, American, small lots, barrels	20.50–27.60	18.10–27.60	16.60–23.10	23.10–24.92
Litharge, commercial, powdered, barrels	16.60–24.25	13.75–24.25	13.25–19.75	19.75–21.65
Zinc oxide:				
American process, lead free, bags, carlots	10.00–13.50	10.00–15.50	11.00–16.00	16.00–17.60
American process, 5 to 35 percent lead, barrels, carlots	10.25–15.38	10.25–17.38	11.25–16.88	16.88–18.35
French process, red seal, bags, carlots	11.25–14.75	11.50–16.75	12.25–17.25	17.25–18.85
French process, green seal, bags, carlots	11.75–15.25	11.75–17.25	12.75–17.75	17.75–19.35
French process, white seal, barrels, carlots	12.50–16.00	12.50–18.00	13.50–18.50	18.25–19.85
Lithopone, ordinary, small lots, bags	6.25– 6.75	6.50– 6.75	6.50– 8.50	8.50– 8.90
Zinc sulfide, less than carlots, bags, barrels	10.75–14.00	12.50–14.00	13.50–25.00	25.00–26.30
Zinc chloride, works:				
Solution, tanks	3.00– 3.25	3.25	3.25– 4.10	4.10– 5.35
Fused, drums	6.25– 7.90	6.75– 8.15	7.00– 9.85	9.85
Zinc sulfate, crystals,[1] barrels	4.55– 6.85	4.95– 6.85	4.95–10.15	10.15–11.20

[1] Includes granulated.

FOREIGN TRADE [1]

Foreign trade in lead and zinc pigments and salts is of relatively minor importance in relation to domestic shipments of these commodities. A "favorable balance of trade"—that is, excess of value of exports over value of imports—is generally maintained with respect to these products. In 1951 the value of exports totaled $7,839,000 compared with imports valued at $2,727,000. These figures represented increases over 1950 of 155 percent for exports and 68 percent for imports.

Imports of white lead (basic carbonate) and litharge, the chief lead-compound entries, were 7 and 1 percent, respectively, of domestic shipments; and imports of zinc oxide, lithopone, and zinc chloride, the outstanding zinc-compound items, each amounted to only 1 percent of domestic shipments. Small quantities of zinc sulfate, red lead, lead suboxide, lead arsenate, and other lead compounds were also imported for consumption in 1951.

Lithopone and zinc oxide are the pigments exported in greatest tonnages from the United States. Exports of these pigments increased to 20,473 and 8,895 tons, respectively, in 1951 compared with 1950 exports of 9,357 and 3,094 tons. The 1951 export tonnages amount to 20 and 6 percent of the total shipments for these items.

Litharge, white lead, red lead, and lead arsenate are also exported by the United States, but exports constitute only a small portion of shipments by domestic producers.

[1] Figures on imports and exports compiled by M. B. Price and E. D. Page, of the Bureau of Mines, from records of the U. S. Department of Commerce.

TABLE 18.—Value of foreign trade of the United States in lead and zinc pigments and salts, 1949–51

[U. S. Department of Commerce]

	Imports for consumption			Exports		
	1949	1950	1951	1949	1950	1951
Lead pigments:						
White lead	$73,485	$271,035	$886,973	$276,888	$243,344	$272,695
Red lead	11,848	27,114	89,351	408,491	194,939	266,098
Litharge	39,822	4,570	788,064	471,143	511,942	445,201
Other lead pigments	17,448	40,781	32,373	(1)	(1)	(1)
Total	142,603	343,500	1,796,761	(1)	(1)	(1)
Zinc pigments:						
Zinc oxide	49,809	1,081,816	779,299	1,507,205	875,829	3,238,685
Zinc sulfide	-------	14,479	-------	(1)	(1)	(1)
Lithopone	2,053	179,197	151,165	1,918,913	1,248,538	3,615,915
Total	51,862	1,275,492	930,464	3,426,118	2,124,367	6,854,600
Lead and zinc salts:						
Lead arsenate	-------	-------	2,664	186,991	216,034	165,215
Other lead compounds	4	1,055	68,609	(1)	(1)	(1)
Zinc chloride	2,650	30,447	194,595	(1)	(1)	(1)
Zinc sulfate	6,472	11,202	15,565	(1)	(1)	(1)
Total	9,126	42,704	281,433	(1)	(1)	(1)
Grand total	203,591	1,661,696	3,008,658	(1)	(1)	(1)

[1] Data not available.

TABLE 19.—Lead pigments and salts imported for consumption in the United States, 1947–51

[U. S. Department of Commerce]

Year	Short tons							Total value
	White lead (basic carbonate)	Red lead	Litharge	Lead suboxide	Lead pigments n. s. p. f.	Lead arsenate	Other lead compounds	
1947	1	22	416	33	-------	60	-------	$171,060
1948	203	247	1,064	34	30	-------	1	633,776
1949	161	23	96	23	6	-------	(1)	142,607
1950	944	70	12	57	27	-------	2	344,555
1951	2,575	215	1,855	53	-------	7	180	1,868,034

[1] Less than 0.5 ton.

TABLE 20.—Zinc pigments and salts imported for consumption in the United States, 1947–51

[U. S. Department of Commerce]

Year	Short tons						Total value
	Zinc oxide		Lithopone	Zinc sulfide	Zinc chloride	Zinc sulfate	
	Dry	In oil					
1947	117	1	(1)	-------	-------	295	$47,482
1948	27	(1)	-------	-------	-------	180	17,758
1949	239	(1)	12	-------	17	120	60,984
1950	5,093	2	1,201	33	210	159	1,317,141
1951	1,772	10	794	-------	714	201	1,140,624

[1] Less than 0.5 ton.

TABLE 21.—Lead pigments and salts exported from the United States, 1947–51

[U. S. Department of Commerce]

Year	Short tons				Total value
	White lead	Red lead	Litharge	Lead arsenate	
1947	863	787	1,212	1,552	$1,632,143
1948	663	953	644	1,019	1,404,001
1949	699	1,042	1,357	430	1,343,513
1950	815	549	1,612	520	1,166,259
1951	767	585	1,038	313	1,149,209

TABLE 22.—Zinc pigments and salts exported from the United States, 1946–51

[U. S. Department of Commerce]

Year	Short tons		Total value	Year	Short tons		Total value
	Zinc oxide	Lithopone			Zinc oxide	Lithopone	
1946	10,955	9,651	$2,911,457	1949	5,040	14,460	$3,426,118
1947	19,082	13,652	6,554,250	1950	3,094	9,357	2,124,367
1948	8,642	21,015	5,228,962	1951	8,895	20,473	6,854,600

Lime[1]

By Oliver Bowles, F. M. Barsigian, and A. L. Marks

GENERAL SUMMARY

LIME is applied to a multitude of uses in many branches of industry, and as industrial activity continued its upward trend during 1951 the output of lime increased substantially. Lime sales in 1951 reached 8.3 million short tons, an increase of 10 percent over the record output of 1950. Of the total sales, 77 percent was in the form of quicklime or dead-burned dolomite and 23 percent hydrated lime. The average value of quicklime per ton increased from $10.57 in 1950 to $11.42 in 1951. Hydrated-lime value increased from $12.80 in 1950 to $12.81 in 1951. The number of active plants declined from 168 to 155.

TABLE 1.—Salient statistics of open-market lime in the United States, 1925–29 (average), 1935–39 (average), and 1949–51

	1925–29 (average)	1935–39 (average)	1949	1950	1951
Active plants	419	310	180	168	155
Sold by producers:					
By types:					
Quicklime, short tons	2,871,236	2,488,269	4,624,356	5,593,315	6,335,729
Hydrated, do	1,585,631	1,204,128	1,693,946	1,885,101	1,919,783
Total lime:					
Short tons	4,456,867	3,692,397	6,318,302	7,478,416	8,255,512
Value[1]	$38,548,498	$26,592,115	$69,319,374	$83,247,990	$96,934,611
Per ton	$8.65	$7.20	$10.97	$11.13	$11.74
By uses:					
Agricultural, short tons	318,224	350,535	328,528	332,687	343,619
Building, do	2,096,744	870,335	1,052,097	1,248,989	1,234,136
Chemical and other industrial, do	1,623,885	1,929,947	3,618,969	4,137,297	4,711,297
Refractory (dead-burned dolomite), short tons	418,014	541,580	1,318,708	1,759,443	1,966,460
Imports for consumption, do	16,683	14,108	34,332	34,284	34,025
Exports, do	15,752	10,905	59,927	50,491	63,295

[1] Selling value, f. o. b. plant, excluding cost of containers.

As indicated in figure 1, the use of lime in industry has attained such importance that chemical and refractory lime sales have followed closely for many years the trend of industrial production and since 1945 have been considerably higher than the level of industrial activity. On the other hand, the use of lime in the building trades has progressively declined in relative importance compared with other major uses. Sales of building lime have failed to keep pace with the indicated level of new construction (fig. 1).

Figure 2 shows the trends in sales of lime by principal uses over a period of years.

[1] Figures in this chapter pertain chiefly to open-market lime, excluding coverage of most captive lime operations.

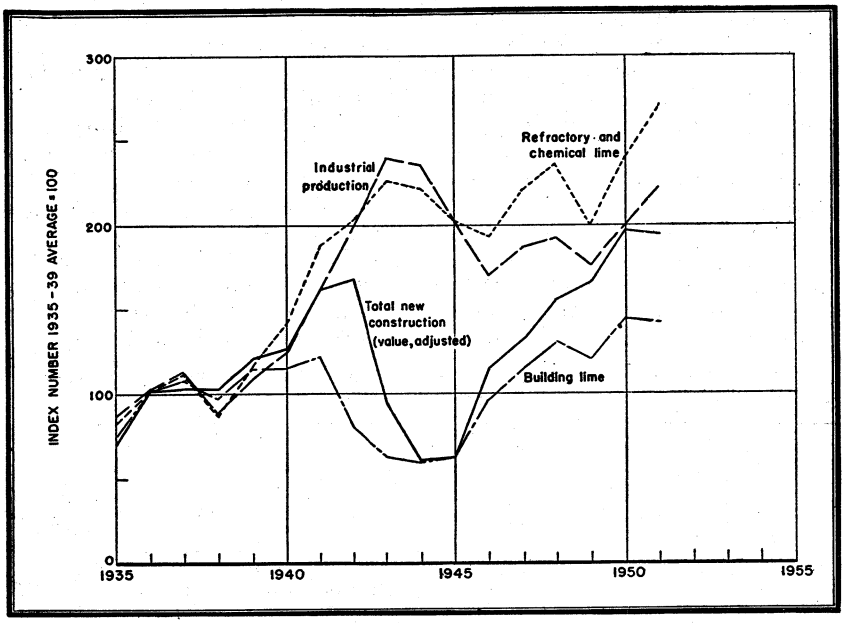

FIGURE 1.—Sales of building lime compared with total new construction and sales of refractory and chemical lime compared with industrial production, 1935–51. Units are reduced to percentages of the 1935–39 average. Statistics on value of construction (adjusted to 1939 prices) from the U. S. Department of Commerce (Statistical Abstract of the United States, 1952, p. 725) and on industrial production from the Federal Reserve Board.

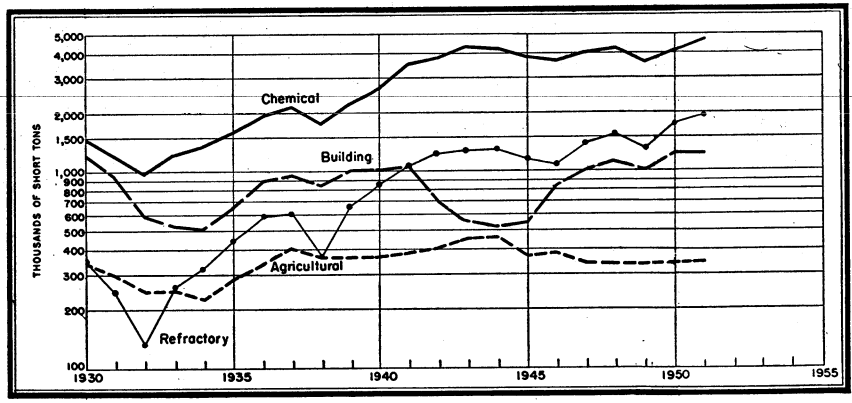

FIGURE 2.—Major uses of lime, 1930–51.

DOMESTIC PRODUCTION

Production (as indicated by sales) of open-market lime increased 10 percent in quantity and 16 percent in value from 1950 to 1951. The major gains in volume of production were in chemical and industrial lime, 14 percent, and refractory lime (dead-burned dolomite), 12 percent. Agricultural lime sales gained 3 percent, while building lime decreased 1 percent. Chemical, industrial, and refractory lime sales combined accounted for 81 percent of the total. Building lime was 15 percent of the total and agricultural 4 percent.

Captive Tonnage.—The statistics included in this chapter pertain primarily to open-market lime, but in some instances relatively small quantities of captive tonnage are included where it is particularly desirable to show complete figures for consumption by use. Specifically, in the figures for lime sales in the United States in 1951, there was included a total of 535,179 short tons of captive tonnage, used by producers, distributed as follows: 52,985 tons for building, 353,904 tons for metallurgical uses, 98,684 tons for miscellaneous chemical uses, and 29,606 tons of refractory lime (dead-burned dolomite). A more complete figure for total lime production can be obtained by adding to the total given herein the quantity calculated from the limestone tonnages (shown in the chapter on Stone in this volume) consumed in the uses in which limestone is generally calcined.

TABLE 2.—Lime sold by producers in the United States,[1] 1950–51, by type and by major use

	1950				1951					
	Quantity		Value [2]		Quantity		Value [2]		Percent change from 1950 in—	
	Short tons	Percent of total	Total	Average	Short tons	Percent of total	Total	Average	Tonnage	Average value
By type:										
Quicklime	5,593,315	75	$59,126,427	$10.57	6,335,729	77	$72,347,501	$11.42	+13	+8
Hydrated lime	1,885,101	25	24,121,563	12.80	1,919,783	23	24,587,110	12.81	+2	(4)
Total lime [3]	7,478,416	100	83,247,990	11.13	8,255,512	100	96,934,611	11.74	+10	+5
By use:										
Agricultural:										
Quicklime	103,823	1	1,037,222	9.99	118,673	1	1,144,083	9.64	+14	−4
Hydrated lime	228,864	3	2,567,149	11.22	224,946	3	2,568,525	11.42	−2	+2
Total	332,687	4	3,604,371	10.83	343,619	4	3,712,608	10.80	+3	(4)
Building:										
Quicklime	281,924	4	3,585,189	12.72	252,098	3	3,227,501	12.80	−11	+1
Hydrated lime	967,065	13	13,296,618	13.75	982,038	12	13,203,027	12.44	+2	−2
Total	1,248,989	17	16,881,807	13.52	1,234,136	15	16,430,528	13.31	−1	−2
Chemical and other industrial:										
Quicklime	3,448,125	46	32,778,456	9.51	3,998,498	48	41,600,604	10.40	+16	+9
Hydrated lime	689,172	9	8,257,796	11.98	712,799	9	8,815,558	12.37	+3	+3
Total	4,137,297	55	41,036,252	9.92	4,711,297	57	50,416,162	10.70	+14	+8
Refractory (dead-burned dolomite)	1,759,443	24	21,725,560	12.35	1,966,460	24	26,375,313	13.41	+12	+9

[1] Includes Hawaii and Puerto Rico.
[2] Selling value, f. o. b. plant, excluding cost of container.
[3] Includes lime used by producers (captive tonnage) as follows—1950. 456,191 tons, $3,977,905; 1951: 535,179 tons, $4,933,013.
[4] Less than ±0.5 percent.

Size of Plants.—As indicated in table 3, the consistent trend toward fewer and larger plants continued in 1951. The total number of plants reporting declined by 13; the reduction in number was confined entirely to the smaller plants. Plants producing 5,000 tons or less accounted for only 1 percent of the total. The 26 plants producing individually 100,000 tons or more contributed 60 percent of the total output in 1951, whereas the 21 plants in this size range produced 56 percent in 1950.

TABLE 3.—Distribution of open-market lime (including refractory) plants, 1949–51, according to size of production

Size group (short tons)	1949			1950			1951		
	Plants	Production		Plants	Production		Plants	Production	
		Short tons	Percent of total		Short tons	Percent of total		Short tons	Percent of total
Less than 1,000	21	6,991	(1)	17	6,199	(1)	11	4,483	(1)
1,000 to less than 5,000	38	106,799	2	29	77,098	1	23	62,869	1
5,000 to less than 10,000	21	147,016	2	19	136,637	2	13	96,617	1
10,000 to less than 25,000	33	523,073	8	30	480,555	6	30	497,545	6
25,000 to less than 50,000	29	1,060,247	17	30	1,143,169	15	28	1,054,314	13
50,000 to less than 100,000	23	1,637,382	26	22	1,473,928	20	24	1,563,026	19
100,000 and over	15	2,836,794	45	21	4,160,830	56	26	4,976,658	60
Total	180	6,318,302	100	168	7,478,416	100	155	8,255,512	100

[1] Less than 0.5 percent.

PRODUCTION BY STATES

As in 1950, open-market lime was produced in 32 States and 2 Territories. Ohio, Pennsylvania, and Missouri continued to be the leading producers. These 3 States together contributed 56 percent of the United States total output in 1951.

TABLE 4.—Lime (quick and hydrated) sold by producers in the United States, 1950–51, by States

State or Territory	1950			1951		
	Active plants	Short tons	Value	Active plants	Short tons	Value
Alabama	7	389,071	$3,577,850	7	455,953	$4,395,922
Arizona	4	51,530	717,885	4	54,023	772,899
Arkansas	1	(1)	(1)	1	(1)	(1)
California	6	171,440	2,722,835	6	203,344	3,366,959
Connecticut	1	(1)	(1)	1	(1)	(1)
Florida	2	(1)	(1)	2	(1)	(1)
Georgia	1	11,998	121,556	1	10,616	104,626
Hawaii	1	8,141	219,861	1	8,740	236,052
Illinois	6	367,485	4,465,413	6	462,690	5,878,289
Indiana	1	(1)	(1)	1	(1)	(1)
Maine	1	(1)	(1)	1	(1)	(1)
Maryland	8	64,687	691,843	7	67,684	722,011
Massachusetts	3	139,357	1,830,625	3	143,316	1,930,225
Michigan	3	(1)	(1)	3	(1)	(1)
Minnesota	1	(1)	(1)	1	(1)	(1)
Missouri	7	1,035,176	9,447,669	6	1,122,299	11,285,877
Montana	2	(1)	(1)	1	(1)	(1)
Nevada	3	(1)	(1)	3	(1)	(1)
New Jersey	3	(1)	(1)	1	(1)	(1)
New York	2	(1)	(1)	2	(1)	(1)
Ohio	18	2,142,344	26,273,098	18	2,289,473	29,046,196
Oklahoma	1	(1)	(1)	1	(1)	(1)
Oregon	2	(1)	(1)	2	(1)	(1)
Pennsylvania	30	1,086,451	12,663,074	28	1,181,100	14,260,054
Puerto Rico	4	8,166	180,828	3	10,350	191,415
South Dakota	1	(1)	(1)	1	(1)	(1)
Tennessee	5	98,232	958,325	3	108,970	1,097,874
Texas	9	216,439	2,074,367	9	279,957	2,532,387
Utah	4	49,419	456,471	3	(1)	(1)
Vermont	3	32,843	415,910	3	32,179	432,483
Virginia	11	428,339	3,861,932	11	452,680	4,551,656
Washington	2	(1)	(1)	2	(1)	(1)
West Virginia	5	(1)	(1)	5	(1)	(1)
Wisconsin	10	124,530	1,448,095	8	124,852	1,562,200
Undistributed [1]	-------	1,052,768	11,120,353	-------	1,247,286	14,567,486
Total	168	7,478,416	83,247,990	155	8,255,512	96,934,611

[1] Figures that may not be shown separately are combined as "Undistributed" to avoid disclosure of individual operations.

Hydrated Lime.—Most of the lime sold is in the form of quicklime and the balance as hydrated lime. The proportion of hydrated to total lime in 1949 was 27 percent; in 1950, 25 percent; and in 1951, 23 percent. Production by States is indicated in table 5.

TABLE 5.—Hydrated lime sold by producers in the United States, 1950–51, by States

State or Territory	1950			1951		
	Active plants	Short tons	Value	Active plants	Short tons	Value
Alabama	4	43,490	$553,203	5	46,254	$520,225
California	5	31,191	476,319	5	34,554	536,425
Georgia	1	11,998	121,556	1	9,554	99,431
Hawaii	1	8,138	219,726	1	8,736	235,872
Illinois	3	35,753	430,429	4	46,781	585,574
Maryland	4	20,724	224,724	4	23,058	249,865
Massachusetts	3	59,782	810,830	3	56,215	754,019
Missouri	6	181,448	1,911,574	5	192,167	2,165,807
Ohio	14	729,826	9,771,646	14	716,289	9,330,363
Pennsylvania	13	321,634	4,172,983	15	341,625	4,311,696
Tennessee	5	28,599	337,594	3	22,194	280,455
Texas	5	53,171	622,438	6	67,173	769,702
Vermont	1	8,569	128,535	1	9,264	143,593
Virginia	9	73,856	836,864	9	68,875	807,538
Other States [1]	35	276,922	3,503,142	29	277,044	3,796,545
Total	109	1,885,101	24,121,563	105	1,919,783	24,587,110

[1] Includes the following States and number of plants in 1951 (1950 same as 1951 unless shown differently in parentheses): Arizona 3 (2), Arkansas 1, Connecticut 1, Florida 1, Indiana 1, Maine 1, Michigan 1, Minnesota 1, Montana 0 (1), Nevada 2, New Jersey 1 (3), New York 2, Oklahoma 1, Oregon 0 (2), Puerto Rico 2 (3), Utah 2, Washington 1, West Virginia 3, and Wisconsin 5 (6).

CONSUMPTION AND USES

Geographic data on sales of lime by uses are given in table 6. Although it is necessary to conceal many figures to avoid revealing confidential information, the table shows, in general, the more important uses to which the lime of each State is applied and the relative importance of each State as a lime producer.

Table 7 is of particular interest because it indicates the wide diversity in the uses of lime in industry. The chemical and other industrial uses have attained increasing importance during recent years; in 1951, 57 percent of the total output was applied to such uses compared with 55 percent in 1950. Nearly all of the major industrial uses showed substantial gains over 1950. The quantities of lime used for fluxing purposes in the steel industry gained 17 percent, for paper manufacture 19 percent, for making calcium carbide 20 percent, in glassworks 13 percent, for ore concentration 16 percent, in sewage and trade-waste treatment 10 percent, and in water purification 2 percent. The quantities of lime used in insecticides and related products and in sugar refining each declined 1 percent, while that used in tanneries declined 18 percent. Refractory lime (dead-burned dolomite) increased 12 percent.

The quantities of lime used in agriculture and in the building trades showed little change. Agricultural applications gained 3 percent, while building uses declined 1 percent.

The sales distribution of hydrated lime by uses is indicated in table 8.

TABLE 6.—Lime sold by producers in the United States in 1951, by State and use

State or Territory	Agricultural		Building		Chemical and other industrial										Refractory		Total	
					Metallurgical		Paper mills		Tanneries		Water purification		Other					
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	(1)	(1)	85,905	$896,619	197,459	$1,724,528	89,746	$895,244	(1)	(1)	21,467	$215,834	(1)	(1)	(1)	(1)	455,953	$4,395,922
Arizona			7,396	137,649	39,109	467,606			(1)	(1)	(1)	(1)	7,377	$164,775			54,023	772,899
Arkansas	(1)	(1)			(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)			(1)	(1)
California	(1)	(1)	36,473	703,490	58,744	929,898	(1)	(1)	(1)	(1)	11,377	147,359	11,908	208,784	(1)	(1)	203,344	3,366,959
Connecticut	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)					(1)	(1)			(1)	(1)
Florida	(1)	(1)	(1)	(1)							(1)	(1)	(1)	(1)			(1)	(1)
Georgia	1,062	$5,195	9,554	99,431													10,616	104,626
Hawaii			939	25,425									7,801	210,627			8,740	236,052
Illinois			17,723	229,306	148,486	1,682,790	(1)	(1)	(1)	(1)	38,552	463,323	25,480	312,320	(1)	(1)	462,690	5,878,289
Indiana			(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)			(1)	(1)
Maine	(1)	(1)	(1)	(1)			(1)	(1)									(1)	(1)
Maryland	58,975	637,136	8,709	84,875													67,684	722,011
Massachusetts	11,959	148,730	44,577	644,189	(1)	(1)	34,099	438,353	(1)	(1)	(1)	(1)	(1)	(1)			143,316	1,930,225
Michigan	(1)	(1)					(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)			(1)	(1)
Minnesota	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)			(1)	(1)
Missouri			83,608	921,462	245,324	2,247,937	(1)	(1)	(1)	(1)	(1)	(1)	420,589	4,070,066	(1)	(1)	1,122,299	11,285,877
Montana					(1)	(1)							(1)	(1)			(1)	(1)
Nevada			(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)			(1)	(1)
New Jersey	(1)	(1)	(1)	(1)							(1)	(1)					(1)	(1)
New York	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)			(1)	(1)	(1)	(1)			(1)	(1)
Ohio	47,092	519,367	623,236	8,290,569	95,187	939,000	26,802	272,361			(1)	(1)	(1)	(1)	1,181,254	$15,744,947	2,289,473	29,046,196
Oklahoma			(1)	(1)	(1)	(1)					(1)	(1)	(1)	(1)			(1)	(1)
Oregon	(1)	(1)															(1)	(1)
Pennsylvania	134,559	1,532,813	126,048	1,740,850	330,135	3,864,291	95,875	1,066,725	27,056	$298,452	59,661	682,257	(1)	(1)	178,820	2,435,380	1,181,190	14,260,054
Puerto Rico	(1)	(1)	(1)	(1)							(1)	(1)	(1)	(1)			10,350	191,415
South Dakota					(1)	(1)											(1)	(1)
Tennessee	175	867	2,371	30,019	23,854	251,279	47,236	441,755	1,813	17,390	7,027	92,339	26,494	264,225			108,970	1,097,874
Texas	300	2,750	44,633	472,563	(1)	(1)	34,280	269,376			64,232	642,552	(1)	(1)			279,957	2,532,387
Utah			(1)	(1)	(1)	(1)					(1)	(1)	(1)	(1)			(1)	(1)
Vermont	360	2,048	1,181	17,718	1,245	15,577	24,681	324,246	110	1,705	105	1,628	4,497	69,561			32,179	432,483
Virginia	22,840	285,443	6,309	81,005	85,885	865,709	75,163	723,793	5,159	50,624	(1)	(1)	(1)	(1)			452,680	4,551,656
Washington			(1)	(1)	(1)	(1)	(1)	(1)			(1)	(1)	(1)	(1)			(1)	(1)
West Virginia	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Wisconsin	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	7,157	163,611			124,852	1,562,200
Undistributed [1]	66,297	578,259	135,474	2,055,358	453,858	4,744,891	307,511	3,671,691	34,101	415,870	375,532	3,936,453	1,139,123	12,149,357	606,386	8,194,986	1,247,286	14,567,486
Total	343,619	3,712,608	1,234,136	16,430,528	1,679,286	17,733,506	735,393	8,103,544	68,239	784,041	577,953	6,181,745	1,650,426	17,613,326	1,966,460	26,375,313	8,255,512	96,934,611

[1] Figures that may not be shown separately are combined as "Undistributed" to avoid disclosure of individual operations.

TABLE 7.—Lime (quick and hydrated) sold by producers in the United States, 1950–51, by uses

Use	1950			1951		
	Short tons	Value		Short tons	Value	
		Total	Average		Total	Average
Agricultural	332,687	$3,604,371	$10.83	343,619	$3,712,608	$10.80
Building:						
Finishing lime	614,349	8,825,406	14.37	599,301	8,524,569	14.22
Mason's lime	462,220	6,227,144	13.47	469,101	6,140,350	13.09
Prepared masonry mortars	100,323	1,034,101	10.31	92,586	954,352	10.31
Unspecified	72,097	795,156	11.03	73,148	811,257	11.09
Total	1,248,989	16,881,807	13.52	1,234,136	16,430,528	13.31
Chemical and other industrial:						
Alkalies (ammonium, potassium and sodium compounds)	(1)	(1)	(1)	(1)	(1)	(1)
Asphalts and other bitumens	1,639	20,363	12.42	(1)	(1)	(1)
Bleach, liquid and powder [2]	6,770	81,863	12.09	2,504	29,155	11.64
Brick, sand-lime and slag	28,297	329,676	11.65	23,517	286,980	12.20
Brick, silica (refractory)	15,126	191,070	12.63	17,187	226,444	13.18
Calcium carbide and cyanamide	480,891	4,053,972	8.43	576,659	5,592,490	9.70
Calcium carbonate (precipitated)	24,208	246,030	10.16	26,988	305,237	11.31
Coke and gas (gas purification and plant byproducts)	26,642	273,490	10.27	28,681	317,035	11.05
Explosives	2,693	30,753	11.42	4,407	56,313	12.78
Food products:						
Creameries and dairies	823	12,729	15.47	741	12,137	16.38
Gelatin	6,409	72,524	11.32	6,444	78,340	12.16
Stock feed	19,933	212,493	10.66	21,109	235,365	11.15
Other [3]	1,972	24,702	12.53	2,432	32,466	13.35
Glassworks	210,273	2,106,404	10.02	237,479	2,403,987	10.12
Glue	9,279	97,635	10.52	9,598	109,746	11.43
Grease, lubricating	4,804	64,808	13.49	7,724	89,691	11.61
Insecticides, fungicides, and disinfectants	80,051	974,192	12.17	79,136	988,996	12.50
Medicines and drugs	13,671	132,170	9.67	(1)	(1)	(1)
Metallurgy:						
Nonferrous smelter flux	3,428	53,069	15.48	4,063	64,763	15.94
Steel (open-hearth and electric furnace flux)	1,132,073	11,038,896	9.75	1,354,883	14,190,178	10.47
Ore concentration [4]	211,993	2,010,627	9.48	275,022	2,869,987	10.44
Wire drawing	19,637	247,359	12.62	21,495	282,688	13.15
Other [5]	13,956	160,176	11.48	13,601	145,638	10.71
Paints	26,472	306,902	11.59	28,536	352,258	12.34
Paper mills	617,956	6,332,894	10.25	735,393	8,103,544	11.02
Petroleum refining	43,535	475,138	10.91	52,509	621,556	11.84
Rubber manufacture	908	11,455	12.62	1,126	13,579	12.06
Salt refining	9,382	82,455	8.79	9,852	95,809	9.72
Sewage and trade-wastes treatment	91,244	1,052,356	11.53	100,553	1,181,644	11.75
Soap and fat	1,743	17,637	10.12	753	9,310	12.36
Sugar refining	35,366	513,779	14.53	34,941	529,822	15.16
Tanneries	83,152	925,679	11.13	68,239	784,041	11.49
Varnish	366	6,266	17.12	(1)	(1)	(1)
Water purification	566,727	5,622,409	9.92	577,953	6,181,745	10.70
Wood distillation	6,484	67,313	10.38	5,467	61,563	11.26
Undistributed [6]	112,977	1,169,970	10.36	122,459	1,307,902	10.68
Unspecified	226,417	2,016,498	8.91	259,846	2,855,753	10.99
Total	4,137,297	41,036,252	9.92	4,711,297	50,416,162	10.70
Refractory lime (dead-burned dolomite)	1,759,443	21,725,560	12.35	1,966,460	26,375,313	13.41
Grand total lime [7]	7,478,416	83,247,990	11.13	8,255,512	96,934,611	11.74
Hydrated lime included in above distribution	1,885,101	24,121,563	12.80	1,919,783	24,587,110	12.81

[1] Included with "Undistributed" to avoid disclosure of individual operations.
[2] Bleach used in paper mills excluded from "Bleach" and included with "Paper mills."
[3] Includes citrates, tartrates, and miscellaneous food products.
[4] Includes flotation, cyanidation, bauxite purification, and magnesium manufacture.
[5] Includes barium and vanadium processing, cupola, gold recovery, and unspecified metallurgical uses.
[6] Includes alcohol, alkalies, asphalt (1951 only), medicines and drugs (1951 only), oil drilling, petrochemicals (glycol), plastics, polishing compounds, retarder, sulfur, tobacco, varnish (1951 only), and miscellaneous industrial uses.
[7] Includes lime used by producers (captive tonnage) as follows—1950: 456,191 tons, valued at $3,977,905; 1951: 535,179 tons, $4,933,013.

TABLE 8.—Hydrated lime sold by producers in the United States, 1950–51, by uses

Use	1950			1951		
	Short tons	Value		Short tons	Value	
		Total	Average		Total	Average
Agricultural	228,864	$2,567,149	$11.22	224,946	$2,568,525	$11.42
Building	967,065	13,296,618	13.75	982,038	13,203,027	13.44
Chemical and other industrial:						
Bleach, liquid and powder	1,064	13,087	12.30	807	10,123	12.54
Brick, sand-lime and slag	8,316	103,234	12.41	8,255	107,328	13.00
Brick, silica	12,514	164,734	13.16	14,911	200,744	13.46
Coke and gas	904	10,380	11.48	462	5,278	11.42
Food products	16,859	201,860	11.97	16,914	209,292	12.37
Insecticides, fungicides, and disinfectants	67,494	837,554	12.41	66,647	840,004	12.60
Metallurgy	22,489	294,919	13.11	29,741	402,777	13.54
Paints	17,679	215,441	12.19	18,222	235,445	12.92
Paper mills	52,251	636,442	12.18	53,598	678,446	12.66
Petroleum	26,503	316,100	11.93	35,231	446,841	12.68
Sewage and trade-waste treatment	52,855	630,145	11.92	49,434	591,733	11.97
Sugar refining	24,635	400,802	16.27	25,618	421,176	16.44
Tanneries	47,556	565,178	11.88	37,580	452,839	12.05
Water purification	225,638	2,540,915	11.26	249,102	2,891,629	11.61
Undistributed [1]	37,504	462,692	12.34	36,089	447,832	12.41
Unspecified	74,911	864,313	11.54	70,188	874,071	12.45
Total	689,172	8,257,796	11.98	712,799	8,815,558	12.37
Grand total, hydrated lime	1,885,101	24,121,563	12.80	1,919,783	24,557,110	12.81

[1] Includes cement products, glass, glue, grease (lubricating), medicines and drugs, oil-well drilling, rubber, wood distillation, and miscellaneous industrial uses.

To furnish a more comprehensive picture of the various materials used for liming land, table 9 shows, in addition to agricultural lime, the quantities of oystershell, limestone, and calcareous marl that are applied to soil amendment.

TABLE 9.—Agricultural lime and other liming materials sold by producers in the United States, 1950–51, by kinds

Kind	1950				1951			
	Short tons		Value		Short tons		Value	
	Gross weight	Effective lime content [1]	Total	Average	Gross weight	Effective lime content [1]	Total	Average
Lime:								
Quicklime	103,823	88,250	$1,037,222	$9.99	118,673	100,870	$1,144,083	$9.64
Hydrated lime	228,864	160,200	2,567,149	11.22	224,946	157,460	2,568,525	11.42
Oystershells (crushed) [2]	55,075	25,890	[3] 324,157	5.89	75,528	35,500	411,616	5.45
Limestone	19,348,820	9,093,950	30,393,075	1.57	19,400,610	9,118,290	31,051,933	1.60
Calcareous marl	347,843	146,090	246,451	.71	269,955	113,380	233,787	.87
Total		9,514,380	[3] 34,568,054			9,525,500	35,409,944	

[1] Calculated upon basis of average percentages used by the National Lime Association, as follows: Quicklime (including lime from oystershells), 85 percent; hydrated lime, 70 percent; pulverized uncalcined limestone and oystershells, 47 percent; calcareous marl, 42 percent.
[2] Figures compiled by Fish and Wildlife Service.
[3] Revised figure.

Apparent Consumption by States.—Lime plants are widely distributed in the United States. Although most of the lime manufactured is used in local markets, some States produce a surplus while other areas are deficient in supplies. Accordingly, as indicated in table 10, considerable quantities enter interstate trade. Furthermore, limes vary considerably in physical and chemical properties, and the specialized needs of consuming industries commonly demand shipments from distant points. The principal States that exported lime beyond their borders in 1951 were Ohio, Missouri, Pennsylvania, Virginia, and West Virginia. Data on origin and destination of lime shipments, by States and groups of States, are given in tables 11 and 12.

TABLE 10.—Apparent consumption of open-market lime in continental United States in 1951, by States, in short tons

State	Sales by producers	Shipments from State [1]	Shipments into State	Apparent consumption		
				Quicklime	Hydrated lime	Total
Alabama	455,953	143,706	19,472	318,214	13,505	331,719
Arizona	54,023	4,693	3,302	47,855	4,777	52,632
Arkansas	(2)	(2)	(2)	25,474	6,027	31,501
California	203,344	29,543	77,380	188,116	63,065	251,181	
Colorado			29,696	22,387	7,309	29,696
Connecticut	(2)	(2)	(2)	22,145	27,090	49,235
Delaware			68,172	50,728	17,444	68,172
District of Columbia			13,754	163	13,591	13,754
Florida	(2)		(2)	53,850	53,155	107,005
Georgia	10,616	1,370	89,130	67,729	30,647	98,376
Idaho			6,223	4,158	2,065	6,223
Illinois	462,690	209,188	381,673	492,167	143,008	635,175
Indiana	(2)	(2)	(2)	254,857	44,514	299,371
Iowa			120,499	100,142	20,357	120,499
Kansas			46,821	30,895	15,926	46,821
Kentucky			234,782	208,774	26,008	234,782
Louisiana			135,137	85,340	49,797	135,137
Maine	(2)		(2)	90,821	5,287	96,108
Maryland	67,684	17,166	139,245	142,121	47,642	189,763
Massachusetts	143,316	95,019	55,238	44,951	58,584	103,535
Michigan	(2)	(2)	(2)	292,204	75,894	368,098
Minnesota	(2)	(2)	(2)	82,375	18,885	101,260
Mississippi			29,677	22,146	7,531	29,677
Missouri	1,122,299	963,241	25,627	125,535	59,150	184,685
Montana	(2)		(2)	22,112	2,117	24,229
Nebraska			10,705	3,114	7,591	10,705
Nevada	(2)	(2)	(2)	24,898	1,518	26,416
New Hampshire			10,126	3,415	6,711	10,126
New Jersey	(2)	(2)	(2)	83,399	133,264	216,663
New Mexico			6,474	1,210	5,264	6,474
New York	(2)	(2)	(2)	380,435	164,707	545,142
North Carolina			61,334	25,283	36,051	61,334
North Dakota			7,038	3,781	3,257	7,038
Ohio	2,289,473	1,567,233	356,716	908,771	170,185	1,078,956
Oklahoma	(2)	(2)	(2)	35,827	13,068	48,895
Oregon	(2)		(2)	50,860	7,482	58,342
Pennsylvania	1,181,100	481,011	712,003	1,152,670	259,422	1,412,092
Rhode Island			17,090	8,727	8,363	17,090
South Carolina			14,998	4,325	10,673	14,998
South Dakota	(2)		(2)	3,778	2,699	6,477
Tennessee	108,970	90,869	24,185	15,289	26,997	42,286
Texas	279,957	34,196	35,474	216,496	64,739	281,235
Utah	(2)	(2)	(2)	80,673	6,502	87,175
Vermont	32,179	30,968	943	572	1,582	2,154
Virginia	452,680	386,463	66,786	86,022	46,981	133,003
Washington	(2)	(2)	(2)	37,792	10,785	48,577
West Virginia	(2)	(2)	(2)	259,947	24,320	284,267
Wisconsin	124,852	65,646	79,977	96,899	42,284	139,183
Wyoming			2,580	477	2,103	2,580
Undistributed [2]	1,247,286	720,262	1,871,737			
Total	8,236,422	4,840,574	4,753,994	6,279,919	1,869,923	8,149,842

[1] Includes 86,580 tons exported or unclassified as to destination.
[2] Figures that may not be shown separately are combined as "Undistributed" to avoid disclosure of individual company operations.

TABLE 11.—Apparent consumption of open-market lime in continental United States in 1951, by region of origin and destination, in short tons

Destination	Origin														
	Illinois, Indiana, Michigan, Ohio			Maryland, New Jersey, New York, Pennsylvania, West Virginia			Connecticut, Maine, Massachusetts, Vermont			Florida, Georgia, Virginia			Alabama, Tennessee		
	Quicklime	Hydrated lime	Total	Quicklime	Hydrated lime	Total	Quicklime	Hydrated lime	Total	Quicklime	Hydrated lime	Total	Quicklime	Hydrated lime	Total
Illinois, Indiana, Michigan, Ohio	1,431,655	344,780	1,776,435	78,591	6,927	85,518	18	338	356	55,466	5,877	61,343	5,115	3,243	8,358
Delaware, District of Columbia, Maryland, New Jersey, New York, Pennsylvania, West Virginia	541,710	204,392	746,102	1,146,231	404,256	1,550,487	54,057	19,167	73,224	244,052	23,862	267,914	11,988	755	12,743
Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont	2,673	33,304	35,977	65,498	8,171	73,669	95,941	65,339	161,280	3,716	120	3,836	1,175	90	1,265
Florida, Georgia, North Carolina, South Carolina, Virginia	7,332	86,868	94,200	11,454	6,936	18,390	21	-------	21	101,954	52,997	154,951	114,349	29,942	144,291
Alabama, Kentucky, Louisiana, Mississippi, Tennessee	76,034	43,682	119,716	174	506	680	-------	-------	-------	3,683	1,373	5,056	363,848	25,387	389,235
Arkansas, Kansas, Nebraska, Oklahoma, Texas	12,724	11,590	24,314	25	-------	25	-------	-------	-------	-------	-------	-------	-------	-------	-------
Iowa, Minnesota, Missouri, Wisconsin	52,321	53,516	105,837	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, Wyoming	23,966	5,479	29,445	60	16	76	36	-------	36	-------	30	30	-------	-------	-------

TABLE 11.—Apparent consumption of open-market lime in continental United States in 1951, by region of origin and destination, in short tons—Continued

Destination	Origin											
	Arkansas, Oklahoma, Texas			Minnesota, Missouri, Wisconsin			Arizona, California, Colorado, Montana, Nevada, Oregon, South Dakota, Utah, Washington			Total		
	Quicklime	Hydrated lime	Total	Quicklime	Hydrated lime	Total	Quicklime	Hydrated lime	Total	Quicklime	Hydrated lime	Total
Illinois, Indiana, Michigan, Ohio	2,009	72	2,081	375,145	72,364	447,509	.....	.....	.....	1,947,999	433,601	2,381,600
Delaware, District of Columbia, Maryland, New Jersey, New York, Pennsylvania, West Virginia	2,429	62	2,491	68,996	7,896	76,892	.....	.....	.....	2,069,463	660,390	2,729,853
Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont	.....	.....	.....	1,628	593	2,221	.....	.....	.....	170,631	107,617	278,248
Florida, Georgia, North Carolina, South Carolina, Virginia	312	70	382	1,787	694	2,481	.....	.....	.....	237,209	177,507	414,716
Alabama, Kentucky, Louisiana, Mississippi, Tennessee	43,676	28,845	72,521	162,348	24,045	186,393	.....	.....	.....	649,763	123,838	773,601
Arkansas, Kansas, Nebraska, Oklahoma, Texas	251,810	73,061	324,871	47,247	22,700	69,947	.....	.....	.....	311,806	107,351	419,157
Iowa, Minnesota, Missouri, Wisconsin	4,754	228	4,982	347,876	86,932	434,808	.....	.....	.....	404,951	140,676	545,627
Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, Wyoming	2,007	5,287	7,294	60,076	19,206	79,282	401,952	88,925	490,877	488,097	118,943	607,040

TABLE 12.—Apparent consumption of open-market hydrated lime from plants in Ohio and total continental United States in 1951, by region of destination

Destination	From Ohio plants			From all plants in continental United States	
	Short tons	Distribution (percent)	Percent of total consumption	Short tons	Distribution (percent)
Illinois, Indiana, Michigan, Ohio	298,332	42	69	433,601	23
Delaware, District of Columbia, Maryland, New Jersey, New York, Pennsylvania, West Virginia	204,195	29	31	660,390	34
Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont	33,304	5	31	107,617	6
Florida, Georgia, North Carolina, South Carolina, Virginia	86,856	12	49	177,507	9
Alabama, Kentucky, Louisiana, Mississippi, Tennessee	37,951	5	31	123,838	6
Arkansas, Kansas, Nebraska, Oklahoma, Texas	10,905	1	10	107,351	6
Iowa, Minnesota, Missouri, Wisconsin	36,433	5	26	140,676	7
Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, Wyoming	5,338	1	4	118,943	6
Undistributed and exports	2,975	(1)	6	49,860	3
Total	716,289	100	37	1,919,783	100

[1] Less than 0.5 percent.

The small quantities of lime shipped from the United States to various island possessions are shown in table 13.

TABLE 13.—Lime shipped to possessions and other areas administered by the United States, 1948–51

[U. S. Department of Commerce]

Area	1948		1949		1950		1951 [1]	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Guam	1	$64						
Puerto Rico	1,912	30,508	5,964	$112,334	5,056	$92,086	3,112	$55,930
Virgin Islands	100	2,313	256	7,268	273	8,070	54	1,531

[1] Data cover period January through July; effective August, not separately classified.

PRICES

Prices of lime continued to advance in 1951; the average selling price, f. o. b. plant, was $11.74 per short ton compared with $11.13 in 1950. The average selling price of quicklime in 1951 was $11.42 ($10.57 in 1950) and of hydrated lime $12.81 ($12.80 in 1950).

FOREIGN TRADE [2]

Imports.—As indicated in tables 14 and 15, imports of lime into the United States are small and show little change from year to year. They originate chiefly in Canada to satisfy local needs in border areas, particularly in the State of Washington.

[2] Figures on imports and exports compiled by M. B. Price and E. D. Page, of the Bureau of Mines, from records of the U. S. Department of Commerce.

TABLE 14.—Lime imported for consumption in the United States, 1947–51

[U. S. Department of Commerce]

Year	Hydrated lime		Other lime		Dead-burned dolomite [1]		Total	
	Short tons [2]	Value	Short tons [2]	Value	Short tons [2]	Value	Short tons [2]	Value
1947	1,903	$24,588	25,454	$271,253	53	$2,194	27,410	$298,035
1948	2,861	48,157	30,336	401,473	2,427	91,613	35,624	541,243
1949	1,674	35,129	30,807	545,792	1,851	72,680	34,332	653,601
1950	1,253	23,910	30,904	524,132	2,127	86,425	34,284	634,467
1951	1,131	22,704	29,849	554,362	3,045	128,207	34,025	705,273

[1] "Dead-burned basic refractory material consisting chiefly of magnesia and lime."
[2] Includes weight of immediate container.

TABLE 15.—Lime imported for consumption in the United States, 1949–51, by country and customs district [1]

[U. S. Department of Commerce]

Country of origin	Customs district of entry	1949		1950		1951	
		Short tons [2]	Value	Short tons [2]	Value	Short tons [2]	Value
Canada	Buffalo	2,824	$27,145	7,847	$76,892	8,946	$89,530
	Duluth and Superior	(3)	2	4	100		
	Maine and New Hampshire	116	741	85	688	1	32
	Michigan			6	485	2	35
	Washington	29,541	553,033	24,214	469,852	22,031	487,469
United Kingdom	Virginia			1	25		
Total		32,481	580,921	32,157	548,042	30,980	577,066

[1] Exclusive of dead-burned basic refractory material.
[2] Includes weight of immediate container.
[3] Less than 0.5 ton.

Exports.—Exports are small (tables 16 and 17) and are confined chiefly to destinations in Canada and Central America.

TABLE 16.—Lime exported from the United States, 1946–51

[U. S. Department of Commerce]

Year	Short tons	Value	Year	Short tons	Value
1946	33,540	$423,948	1949	59,927	$937,444
1947	50,784	713,703	1950	50,491	825,927
1948	63,088	865,157	1951	63,295	1,157,652

TABLE 17.—Lime exported from the United States, 1949–51, by country of destination

[U. S. Department of Commerce]

Country	1949		1950		1951	
	Short tons	Value	Short tons	Value	Short tons	Value
Argentina	2	$154	4	$284		
Bahamas	58	1,115	15	360	10	$370
Belgium-Luxembourg	75	3,872				
Brazil	1	106	6	885	7	619
British Honduras	101	1,551				
British Western Pacific Islands	140	3,795				
Canada	17,304	199,855	18,725	260,195	16,757	248,072
Canal Zone	87	2,491			138	4,105
Chile	5,021	83,387	5	174	8	546
Colombia	2,369	46,501	3,643	81,082	4,022	85,902
Costa Rica	8,244	144,785	8,225	141,902	15,494	289,472
Cuba	40	709	20	641	72	2,241
Dominican Republic	611	10,970	624	11,654	649	12,539
El Salvador	55	1,829	75	2,999	100	4,456
Haiti	275	5,119	309	5,846	600	12,961
Honduras	9,393	148,318	8,367	136,554	14,317	251,822
Liberia			10	140	15	450
Mexico	7,254	91,160	4,541	67,405	2,474	62,368
Netherlands Antilles	156	3,148	277	5,112	85	1,621
New Zealand	100	2,016				
Nicaragua	345	6,866	231	4,489	281	5,715
Panama	6,123	109,199	3,859	67,697	6,545	125,776
Philippines	507	20,351	240	6,939	170	3,983
Saudi Arabia	19	1,228	90	2,612	119	1,782
United Kingdom	456	23,940				
Venezuela	980	19,206	1,104	22,437	1,310	35,619
Other countries	211	5,773	121	6,520	122	7,233
Total	59,927	937,444	50,491	825,927	63,295	1,157,652

NEW DEVELOPMENTS

Effective October 1951, the Bureau of Mines inaugurated a new statistical service comprising regular monthly reports summarizing lime shipments.

Calcination problems are receiving unusual attention in current literature. Kiln efficiencies have been discussed in detail by Azbe in a series of nine articles.[3] A discussion by Seaman is of special interest to operators of rotary kilns.[4] Theory and practice of limestone calcination have been discussed by Cunningham.[5]

A method has been patented for making by a quick process a lime putty having the desirable properties of putties ordinarily kept for long periods in aging tanks.[6]

High-pressure hydration, which has been applied to shaft kiln products, is now being applied to lime produced in rotary kilns.[7]

Metallic calcium is a unique coproduct manufactured by the New England Lime Co., at Canaan, Conn. The market for calcium and its alloys is expanding because of increasing chemical and metallurgical applications.

[3] Azbe, Victor J., Evaluation and Development of Kiln Efficiencies: Rock Products, vol. 54, No. 4, 1951. pp. 113–116, 126; No. 5, pp. 73–75, 104; No. 6, pp. 113–115, 140; No. 7, pp. 65–68; No. 8, pp. 161–164, 191; No. 9, pp. 71–74; No. 10, pp. 109–112; No. 11, pp. 85–87, 109; No. 12, pp. 99–101, 136.

[4] Seaman, W. C., Passage of Solids Through Rotary Kilns (Factors Affecting Time of Passage): Chem. Eng. Progress, vol. 47, No. 10, October 1951, pp. 508–514.

[5] Cunningham, W. A., Fundamentals of Lime Burning: Ind. Eng. Chem., vol. 43, No. 3, March 1951, pp. 635–638.

[6] Pit and Quarry, New "M. K." Lime Process Eliminates Aging Tanks, Reduces Cooling Time: Vol. 44, No. 2, August 1951, pp. 144 and 145.

[7] Rock Products, High-Pressure Hydration: Vol. 54, No. 5, May 1951, p. 61.

The chemical applications of lime have been discussed by Boynton [8] and also are covered in a report of the National Lime Association.[9]

Committee C–7 on Lime of the American Society for Testing Materials has been concentrating on specifications of lime for leather tanning and for silica-brick manufacture, on new methods of test for iron content and available lime, and on a new slaking test.

[8] Boynton, R. S., Lime—An Industrial Chemical: Chem. Engineering, vol. 57, No. 7, July 1950, pp. 104–108.

[9] National Lime Association, Chemical Lime Facts: Bull. 214, 1951, 42 pp.

Magnesium

By H. B. Comstock

GENERAL SUMMARY

CONSUMPTION of primary magnesium during 1951 increased 98 percent above 1950 consumption. The rising demand was met and exceeded by the increase in production, which was 160 percent above 1950 production. Six of the seven Government-owned magnesium plants were reactivated during 1951 and produced 48 percent of the year's primary output. The remaining 52 percent came from the privately owned Dow Chemical Co. plant at Freeport, Tex., the sole producer of primary magnesium during 1946–50. At the close of 1951, stocks of primary magnesium, distributed almost equally in producers' and consumers' inventories, were slightly above 2 months' supply at the rate of consumption during December. Recovery of magnesium from secondary sources in 1951 increased 22 percent over 1950.

The price of domestic primary magnesium remained at 24.5 cents per pound throughout 1951.

The demand for primary magnesium in the defense program during 1951 was reflected strongly in increased production of structural products and purchases for the National Stockpile.

World production of primary magnesium during 1951 was estimated at 80,000 metric tons (88,000 short tons), almost twice that in 1950. About one-half was produced by the United States. The remainder was produced chiefly by the U. S. S. R., United Kingdom, Canada, France, Norway and Italy.

TABLE 1.—Salient statistics of the magnesium metal industry in the United States, 1947–51

	1947	1948	1949	1950	1951
Production:					
Primary magnesium [1] ..... short tons	12,344	10,003	11,598	15,726	40,881
Secondary magnesium [1] ..... do	9,503	7,553	5,962	[2] 9,476	11,526
Average quoted price per pound, primary [3] ..... cents	20.5	20.5	20.5	22.0	24.5
Consumption of primary magnesium [1] ..... short tons	6,869	9,698	11,947	18,051	35,710
Imports [4] ..... do	201	678	2,560	843	3,871
Exports [5] ..... do	315	274	432	586	575
World primary production ..... do	35,000	[2] 34,000	39,000	[2] 45,000	88,000

[1] Ingot equivalent and magnesium content of magnesium-base alloys.
[2] Revised figure.
[3] Magnesium ingots (99.8 percent) in carlots. Before Dec. 1, 1947, in New York; subsequently, f. o. b. Freeport, Tex. (Source: Metal Statistics, 1952.)
[4] Metallic and scrap. Magnesium content in imports of alloys, sheets, tubing, ribbons, wire, and other forms, were: 1 ton in 1947; less than one-half ton in 1948 and 1949; 25 tons in 1950; and 108 in 1951.
[5] Metal in primary form. Exports of powder, ribbons, and metal in other forms, were: 40 tons in 1947; 170 in 1948; 276 in 1949; 322 in 1950; and 186 in 1951.

DOMESTIC PRODUCTION

Primary.—The production of primary magnesium in 1951 was 40,881 tons or 160 percent above production in 1950. Output from the Dow Chemical Co. plant at Freeport, Tex., was 52 percent of 1951 production. This plant had been the sole producer of primary magnesium during 1946–50. The remaining 48 percent of the output in 1951 was produced in 6 of the 7 Government-owned magnesium plants which had been idle and held in standby condition since 1945. The seventh, a silicothermic plant at Luckey, Ohio, was used for production of beryllium.

The reactivation program for the six Government-owned plants, begun in 1950, was completed by December 31, 1951. This brought the annual production capacity of primary magnesium ingot in the United States to 121,000 short tons.

TABLE 2.—Production of primary magnesium in the United States, 1947–51, by months, in short tons

Month	1947	1948	1949	1950	1951
January	1,398	883	988	1,002	1,876
February	1,232	830	884	913	1,709
March	1,472	887	988	948	1,885
April	1,153	801	958	957	2,043
May	926	797	987	972	2,194
June	848	766	950	1,175	2,512
July	905	792	985	1,332	2,998
August	849	809	970	1,400	3,418
September	886	819	974	1,635	4,166
October	912	873	941	1,690	5,147
November	870	814	969	1,760	6,010
December	893	932	1,004	1,942	6,923
Total	12,344	10,003	11,598	15,726	40,881

The value placed upon these six plants when they were shut down at the close of World War II was $74,240,000. The cost of shutting down the six plants and maintaining them until reactivation was estimated at $2,155,400. Reactivation cost was approximately $12,500,000. The cost of building the six plants in 1941–43 was $106,000,000. Time to build 6 new magnesium plants of the same types and capacities and get them into full production was estimated at 2 years, assuming that steel and electrical equipment were easily available. However, under conditions that existed in these industries during 1950 and 1951, a greater lapse of time might have been experienced before completion.

Under the reactivation program, the Government-owned plants were operated by various industrial organizations on management contracts and/or leases for production of magnesium for defense. Actual production of magnesium in the reactivated Government-owned plants was begun in March 1951 at Canaan, Conn. This silicothermic plant, with a rated annual capacity of 5,000 tons, and the 5,000-ton silicothermic plant at Wingdale, N. Y., which began production in November 1951, were operated by Nelco Metals, Inc. Under the management contract, these 2 reactivated plants were scheduled to operate for 2 years at cost plus a fixed fee.

The Velasco, Tex., plant reported initial production of 157 tons in April 1951. This electrolytic plant, with an annual capacity of 36,000 tons, was operated by Dow Chemical Co., owner of the magnesium plant at Freeport, Tex. That company contracted to produce 80,000 tons of primary magnesium at the Velasco plant, at current market price, during an estimated period of 2½ years. Under the terms of the rental contract, the Government was to pay for all repairs to the plant and assume all increases in costs resulting from changes in wage scales. This plant proved to have the lowest cost of operation in 1951 of all of the reactivated Government-owned plants.

In June 1951 the 10,000-ton silicothermic plant at Manteca, Calif., operated by Kaiser Magnesium Co., started production. The Government contract with the company covered a 5-year commitment for production at this reactivated plant, for cost plus a fixed fee. The contract was subject to cancellation at any time after the plant had been in operation 1 year and 9 months.

By the close of August 1951 the 18,000-ton electrolytic plant at Painesville, Ohio, operated by Diamond Magnesium Co., and the 24,000-ton silicothermic plant at Spokane, Wash., had begun production, bringing the total output to 1,826 tons in the Government-owned plants that month. The Diamond Magnesium Co. contract with the Government covered rehabilitation of the Painesville plant and operation of the plant for a 2-year period at cost plus a fixed fee.

The Spokane plant was operated by Pacific Northwest Alloys, Inc., a subsidiary of Chromium Mining & Smelting Corporation, a Canadian company. The Government lease agreement with Pacific Northwest Alloys covered operation of the Spokane plant for 2½ years, or until 48,000 tons of magnesium should have been produced and delivered, at cost plus a fixed fee.

In September 1951 production in the Government-owned plants rose to 2,443 tons, in October to 3,229 tons, and in November to 4,166 tons, or 48 percent of their total rated annual capacity. By December 1, 1951, these plants were producing at the rate of 60 percent of their annual capacity.

Secondary.—Total recovery of secondary magnesium, including alloying ingredients and secondary magnesium incorporated in primary ingot, was 11,526 short tons in 1951 compared with 9,476 (revised) tons in 1950. Of this quantity 9,093 tons was recovered from 10,388 tons of magnesium-base scrap in 1951. The remaining 2,433 tons was recovered from aluminum scrap. Old scrap constituted about 59 percent of the magnesium scrap consumed compared with 62 percent in 1950, which indicated a continuous rising percentage of new scrap as consumption of mangesium continued to increase. Of the 1951 recovery, 5,662 tons was in ingot form, 1,675 tons in castings, 25 tons in magnesium-alloy shapes, 3,393 tons in aluminum-base alloys, 55 tons in zinc and other alloys, 615 tons in anodes and strip for cathodic protection, and 101 tons in chemicals and other nonrecoverable forms.

More magnesium scrap was consumed in 1951 than was received. Stocks at the end of 1951 were 676 tons lower than at the beginning of the year.

Additional information on secondary magnesium may be found in the Secondary Metals—Nonferrous chapter of this volume.

CONSUMPTION AND USES

Total consumption of primary magnesium in 1951 amounted to 35,710 tons, an increase of 17,659 tons above 1950 consumption and 5,171 tons below 1951 production.

In 1951 the curves of magnesium production and consumption moved up much faster than those of any other structural metal. The demand for magnesium in the defense program during 1951 was evidenced by the increased consumption of the primary metal in structural products. Production of sand castings and die castings during 1951 was almost four times the quantity produced in 1950. The rise in requirements for large, intricate magnesium castings in both jet and reciprocating aircraft engines explained a major portion of the increase in production of sand castings. Main frames and the housings and miscellaneous parts of the air-compression system of turbojet engines were built entirely of magnesium castings. In 1951 wide use was made of magnesium in gun turrets and other attached ordnance equipment, while increasing use was made of the metal in air-portable ordnance and construction equipment.

The use of magnesium increased in a wide variety of wrought products in 1951. The greatest increase was in the production of stretch-formed sheet for airframes. A limited quantity of annealed sheet was worked cold. However, heat was required for more severe forming.

The use of magnesium in forgings increased from 104 tons in 1950, to 735 tons in 1951. They were used extensively in applications

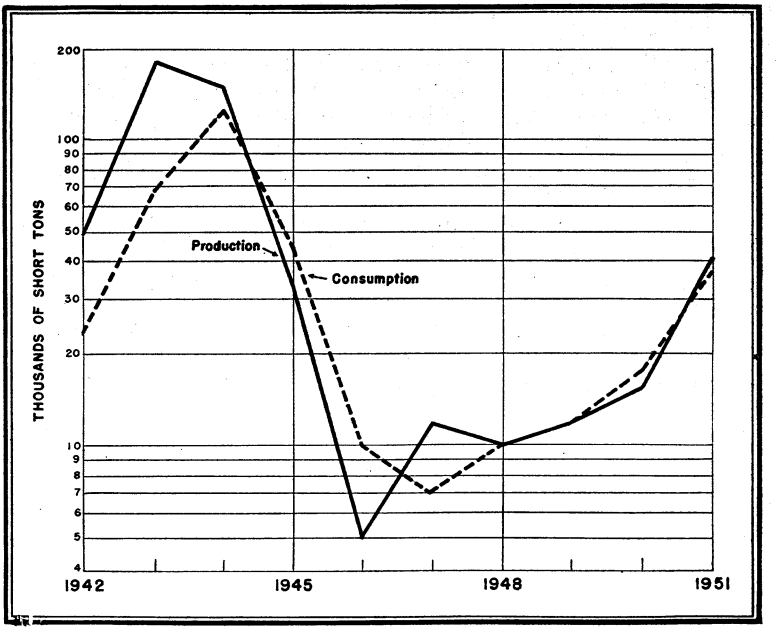

FIGURE 1.—Domestic production and consumption of primary magnesium, 1942–51.

TABLE 3.—Consumption of primary magnesium in the United States, 1947–51, by uses, in short tons [1]

Product	1947	1948	1949	1950	1951
Structural products:					
Castings:					
Sand	892	1,930	3,088	3,090	10,179
Die	182	213	127	242	994
Permanent mold	9	12	44	573	646
Wrought products:					
Sheet	1,053	1,261	2,155	3,357	5,761
Extrusions (structural shapes, rods, tubing)	1,619	2,529	3,364	3,400	5,241
Forgings	105	103	200	104	735
Total structural	3,860	6,048	8,978	10,766	23,556
Other products:					
Powder	9	(2)		56	482
Aluminum alloys	1,935	2,171	1,759	3,722	5,994
Other alloys	40	43	39	255	401
Scavenger and deoxidizer	427	418	404	473	1,332
Chemical	266	407	224	373	447
Cathodic protection	94	385	235	1,937	2,364
Other [3]	238	226	308	469	1,134
Total other products	3,009	3,650	2,969	7,285	12,154
Grand total	6,869	9,698	11,947	18,051	35,710

[1] Ingot equivalent and magnesium content of magnesium-base alloys.
[2] Less than 0.5 ton.
[3] Includes primary metal consumed in making secondary alloy, and as a reducing agent in production of titanium.

where pressure-tightness was important. Unlike aluminum and steel, the high-strength magnesium alloys ordinarily used for aircraft forgings are not easily hammer forgeable and are forged in presses to avoid cracking. Capacity of presses in use during 1951 ranged from 1,400 tons to 18,000 tons. In 1951, the Air Force began the installation of an additional press of 50,000-ton capacity, which was expected to be in operation by the close of 1952.

The use of approximately 500 tons of magnesium as a reducing agent in production of titanium in 1951 established a new use that would expand as production of titanium increased, if the same reduction process were continued in operation. The quantity of magnesium used in 1951 as a scavenger and deoxidizer was the highest ever to have been reported and almost trebled the amount used in 1950.

Two other large increases in 1951 were in the use of magnesium in aluminum alloys and for cathodic protection.

STOCKS

Inventories of primary magnesium on December 31, 1951, were slightly above 2 months' supply, almost equally divided between producers' and consumers' stocks. Government agencies continued to hold surplus quantities of magnesium left from stocks which were accumulated during World War II, and purchases for the national stockpile were increased during 1951.

PRICES

The base price of primary magnesium in the United States, which had increased three times during 1950, remained at 24.5 cents per pound throughout 1951, in conformity with the General Ceiling Price Regulation issued January 26, 1951.

FOREIGN TRADE [1]

Imports.—During 1951 imports of magnesium, most of which were scrap metal, increased to 3,979 tons, over 4 times the imports of 1950; they were received from 28 countries, as compared with 10 countries in 1950. About 90 percent of metal and scrap imported in 1951 came from Italy (1,000 tons), United Kingdom (547 tons), Germany (537 tons), France (479 tons), Japan (438 tons), Austria (236 tons), Canada (213 tons), and India (153 tons). Tariff rates on magnesium in 1951 remained as follows: Metallic, 20 cents per pound; alloys, powder, sheets, tubing, wire, manufactures, etc., 20 cents per pound on magnesium content plus 10 percent ad valorem; and metallic scrap, duty free.

TABLE 4.—Magnesium imported for consumption and exported from the United States, 1947–51

[U. S. Department of Commerce]

Year	Imports						Exports			
	Metallic and scrap		Alloys (magnesium content)		Sheets, tubing, ribbons, wire, and other forms, (magnesium content)		Metal in primary form		Powder, ribbons, and metal in other forms	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1947	201	$87,499	------	------	1	$11,902	315	$140,214	40	$80,210
1948	678	184,066	(1)	$57	(1)	943	274	122,374	170	149,891
1949	2,560	537,113	(1)	80	(1)	28	432	184,707	276	214,732
1950	843	218,129	3	5,056	22	38,280	586	245,539	322	213,641
1951	3,871	998,214	18	29,525	90	190,050	575	308,865	186	228,427

[1] Less than 0.5 ton.

Exports.—Total exports of magnesium in 1951 were 761 tons, a 16-percent decrease from the 908 tons shipped in 1950. Of the metal exported in primary form during 1951, 435 tons was delivered to Mexico, 92 to Canada, and 48 to other countries.

Canada received 70 tons of the metal exported as powder, ribbons, and other forms; Saudi Arabia received 31 tons; Japan, 23 tons; Venezuela, 22 tons; and other countries, 40 tons.

TECHNOLOGY

Better working techniques were developed by the magnesium industry in 1951. Progress in developing impact-extrusion techniques resulted in the commercial production of the magnesium-cell battery in 1951. The magnesium impact-extrusion process, as practiced in 1951, consists of four operations: Slug preparation; impact extrusion; can trimming; and can cleaning. Slugs used for impact extruding could be cast, powder compact, extruded bar, or plate. They were made by parting on a lathe or screw machine, sawing from bar stock, casting, shearing from plate and bar, and from powder. Further

[1] Figures on imports and exports compiled by M. B. Price and E. D. Page of the Bureau of Mines, from records of the U. S. Department of Commerce.

studies of extrusion techniques were in process in 1951 to develop the economical production of such items as collapsible tubes for toothpaste, salves, creams, etc., shell cases, shields for electronic devices, caulking guns, blow torches, flashlight cases, and drinking cups.[2]

Magnesium is the easiest of commercial metals to machine. When it is worked in the temperature range of 450° to 700° F., it is possible to accomplish, in a single draw, all that could be done in three operations in steel, brass, or aluminum. Magnesium-alloy sheet and extrusions are worked in much the same manner as other metals. Magnesium is well adapted to hot-spinning techniques. Small quantities of parts may be spun to close tolerances with inexpensive tools. By the close of 1951 magnesium spinnings were being made in thicknesses ranging from 0.032 inch to over 1.25 inches.

The Bureau of Mines continued research during 1951 to develop a more efficient thermic process of producing magnesium, utilizing dolomite as the source of the metal.

The silicothermic process, as practiced in 1951 in the Government-owned magnesium plants, is described briefly as follows: Dolomite is calcined and mixed with ferrosilicon containing 75 percent silicon, and the mixture is briquetted. The briquets are charged into tubular retorts of chrome-nickel steel. The retorts are heated and evacuated. The magnesium oxide in the calcined dolomite is reduced by the silicon, producing magnesium vapor and leaving a residual dicalcium silicate containing iron, magnesium, and other materials. The magnesium vapor distills from the charge and is condensed into crystals on a removable condenser, the end of which projects from the furnace. The process has the advantage of producing metallic magnesium in one operation directly from the calcine. One ton of magnesium requires about 14 tons of raw dolomite or 7 tons of calcined dolomite and about 1.25 tons of 75-percent-grade ferrosilicon.

The average loss of metal in melting magnesium crystals to form ingot was 11 percent in the silicothermic plants during 1951; and the remelting cost was estimated at 3 cents per pound of ingot produced.

The research work conducted by the Bureau of Mines in the 1930's upon production of magnesium by the use of ferrosilicon as a reducing agent led to the establishment, during World War II, of the large silicothermic plant at Spokane, Wash., where low-cost power and fuel were available. Magnesium-rich ores and ferrosilicon were plentiful in that area and in many other localities throughout continental United States. An ample supply of dolomite was near each of the operating silicothermic plants.

The silicothermic plants have been proved to be advantageous as standby plants because of the simplicity of design and operation. The equipment was easily and economically stored after World War II and did not deteriorate in storage to any great extent. Another advantage was the saving of electric energy. When the retorts in the silicothermic plants were heated by the use of other means than electricity, the production of 1 pound of magnesium required approximately 4½ kilowatt-hours of electricity, which was consumed in production of the reducing agent ferrosilicon. The electrolytic plants have consumed 10 kilowatt-hours of electric current for each pound

[2] Patton, T. L., Impact Extrusion of Magnesium: Iron Age, vol. 168, No. 13, September 27, 1951, pp. 81–85.

of magnesium ingot produced. This saving of electricity has been an important factor in times of defense emergency.

During 1951 the Bureau of Mines continued research toward the development of new magnesium alloys having greater strength and better resistance to corrosion.

WORLD REVIEW

World production of primary magnesium in 1951 was estimated at 80,000 metric tons, or about 100 percent above the 1950 total. World markets continued to gain, both for military and civilian consumption. The United States again led in the production and consumption of magnesium for military and civilian uses.

TABLE 5.—World production of magnesium metal, 1945–51, by countries, in metric tons [1]

[Compiled by Pauline Roberts]

Country [1]	1945	1946	1947	1948	1949	1950	1951
Canada	3,338	145	136	(2)	(2)	(2)	(2)
China, Manchuria	200				(2)	(2)	(2)
France	279	704	1,043	[3] 546	[3] 492	[3] 446	875
Germany, West	(2)			[4] 17		(2)	(2)
Italy	346	1,005					(2)
Japan	1,104						
Korea	1,014						
Norway						(2)	(2)
Switzerland (estimate)	500	300	500				(2)
Taiwan (Formosa)	21				(2)	(2)	(2)
United Kingdom [5]	6,900	1,700	2,500	3,500	5,100	4,900	[6 7] 7,700
United States	29,748	4,823	11,198	9,075	10,521	14,266	37,086
Total (estimate)	62,000	24,000	32,000	[3] 31,000	35,000	[3] 41,000	80,000

[1] Magnesium is also produced in Australia, Soviet zone of Germany, and U. S. S. R., but production data are not available; estimate by author of chapter included in total.
[2] Data not available; estimate by author of chapter included in total.
[3] Revised figure.
[4] British and American zones only.
[5] Includes secondary metal.
[6] Estimated figure.
[7] Includes magnesium alloys.

Canada.—All the primary magnesium produced in Canada in 1951 came from Dominion Magnesium, Ltd., at Haley, Ontario. The plant employed the Pidgeon process, using dolomite as a source of magnesium and ferrosilicon as a reducing agent. The company owned several dolomite deposits; but the largest, near Haley, was the only one operated in 1951. This deposit has been estimated to contain 4,000,000 tons of ore, adequate for approximately 70 years at the rate of depletion in 1951 and if worked by quarrying methods then used. Erection of a new plant at Beauharnois, Quebec, with annual capacity of 6,000 long tons, was begun in 1951; it was to produce 75-percent grade ferrosilicon. The plant was expected to be ready to start operating early in 1953. It was being built by Electric Reagents (Quebec), Ltd., a subsidiary of Dominion Magnesium, Ltd., and was to be operated by Chromium Mining & Smelting Corp. This plant was expected to furnish requirements of ferrosilicon for the production of magnesium that had been previously imported from Norway.[3]

[3] Northern Miner (Toronto), Oversubscription Seems Certain on Dominion Magnesium Bond Issue: Vol. 37, No. 50, March 6, 1952, p. 2.

The greater portion of the magnesium exported from Canada in 1951 was sent to the United Kingdom, but most of the output of ingot was fabricated in Canada for defense aircraft. Light Alloys, Ltd., a subsidiary of Dominion Magnesium, Ltd., at Renfrew, Ontario, was the largest producer of magnesium alloys in Canada.[4]

Italy.—Production of magnesium in Italy in 1951 came from the one silicothermic plant at Bolzano. This plant, with an annual capacity of approximately 3,000 metric tons, appeared to be of adequate capacity to meet domestic demands, with a small surplus for export.[5]

Japan.—Although the Ube plant of Riken Kinzoku was reported to be intact, no production of magnesium in Japan has been reported since 1945. A large supply of electric power and considerable reconstruction funds through Government aid would have been required before production of magnesium could be resumed. The Light Metal Association estimated Japan's requirements for magnesium in the 1952 fiscal year at 1,200 tons.[6]

Norway.—Production of magnesium in Norway was started in 1951 at the Herøya Elecktrokjemiske Fabriker A/S (HEFA) plant in South Norway, at the rate of 3,000 metric tons a year. High-quality dolomite and brines were being used in this plant, which was originally constructed for the use of sea water as a source of magnesium.[7]

U. S. S. R.—No figures were published on magnesium production in Russia in 1951. However, it was believed that production of the metal had greatly increased since the reported transfer to that country of the Aachen, Germany, plant in 1950. Magnesium raw materials were known to be readily available in many localities. In addition to sea water and coastal lagoon salt brines, salt lakes containing magnesium salts extended from the Crimea across the deserts of Kazakstan to the Irtysh River valley in western Siberia. An extensive bed of magnesium chloride occurred in the Solikamsk-Bereznike Basin of the northern Urals. Immense deposits of magnesite have been reported at Satka and the Khalilovo in the southern Urals and in Siberia.

United Kingdom.—In July 1951 the magnesium-extraction plant of Magnesium Elektron, Ltd., at Clifton Junction, Manchester, resumed production after about 4 years of idleness. Between 3 and 4 years of consumption of the metal from stocks created an acute shortage of both primary and secondary magnesium, which developed early in 1951. It became necessary for the Government to control usage and to assume responsibility for future supplies, whether imported from abroad or from domestic production.

The increased cost of electric power in Great Britain made the 1951 cost of power required to produce primary magnesium equal the total cost of crude metal in 1936. This made it virtually impossible to produce the metal by the electrolytic process in England in competition with countries like the United States, Canada, or Norway, where fuel and power were available at lower cost, for increased production of metals.[8]

[4] Northern Miner (Toronto), Defense Program Takes Magnesium: Vol. 37, No. 36, November 29, 1951, p. 133.
[5] Magnesium Metal Industry (London), vol. 79, No. 14, October 5, 1951, p. 300.
[6] The Metal Bulletin (London), Japan Note: No. 3670, February 22, 1952, p. 18.
[7] Light Metals, Magnesium Production in Norway: Vol. 15, No. 166, January 1952, p. 4.
Metal Bulletin, Norwegian Note: No. 336, February 29, 1952, p. 17.
[8] Ball, C. J. P., A Century of Magnesium: Research, vol. 5, No. 1, January 1952, pp. 5–9.

Technological and commercial progress in Great Britain in 1951 was reported in the development and use of magnesium alloys for castings and wrought products, in jet aircraft, and in propeller turbine engines. Worldwide demand for the new alloys, containing zirconium and zinc, led to issuance of licenses for their production in the United States, Canada, Australia, Sweden, Switzerland, France, and Holland.[9]

About 75 percent of Britain's annual magnesium consumption has always been used in the form of casting alloys. Most of its magnesium foundries were working at capacity by the end of 1951.

[9] Wilkinson, R. G., Magnesium in Britain: Light Metals, vol. 15, No. 166, January 1952, pp. 23–24.

Magnesium Compounds

By Donald R. Irving and F. P. Uswald

GENERAL SUMMARY

DOMESTIC production of crude magnesite, caustic-calcined and refractory magnesia, and dead-burned dolomite all increased during 1951 as a result of the steel-industry expansion. Additional expansion of production facilities is planned to meet further projected increases in iron- and steel-making capacity. Production of other magnesium compounds, such as high-grade magnesias and magnesium chloride, increased because of the high level of industrial and defense activity.

TABLE 1.—Salient statistics of magnesite, magnesia, and dead-burned dolomite in the United States, 1947–51

	1947	1948	1949	1950	1951
Crude magnesite:					
Mined:					
Short tons	375,993	(1)	287,315	429,392	670,167
Value [2]	$2,596,747	(1)	$1,950,153	$3,091,135	$4,506,712
Average per ton	$6.91	(1)	$6.79	$7.20	$6.72
Caustic-calcined magnesia:					
Sold or used by producers:					
Short tons	26,831	33,209	32,505	41,447	49,981
Value	$2,508,624	$3,380,528	$3,109,381	$4,136,898	$4,810,379
Average per ton [3]	$93.50	$101.80	$95.66	$99.81	$96.24
Refractory magnesia:					
Sold or used by producers:					
Short tons	314,921	330,069	250,389	335,440	432,197
Value	$10,127,585	$13,444,587	$10,477,856	$14,915,854	$18,400,131
Average per ton [3]	$32.16	$40.73	$41.85	$44.47	$42.57
Dead-burned dolomite:					
Sold by producers:					
Short tons	1,395,203	1,544,755	1,318,708	1,759,443	1,966,460
Value	$14,295,359	$17,847,182	$15,930,226	$21,725,560	$26,375,313
Average per ton	$10.25	$11.55	$12.08	$12.35	$13.41

[1] Figures withheld to avoid disclosure of individual company operations.
[2] Partly estimated; most of crude is processed by mining companies, and very little enters open market.
[3] Average receipts f. o. b. mine shipping point.

DOMESTIC PRODUCTION

Magnesite.—Domestic production of crude magnesite in 1951 was 670,167 short tons, an increase of 56 percent over 1950. This was the second largest annual tonnage on record, being exceeded only by the 1943 war-year production of 754,832 short tons.

Magnesia.—Refractory magnesia sold and used by producers reached an alltime high of 432,197 short tons, an increase of 29 percent over the previous high year (1950), reflecting the increased output of basic steel and the construction of new basic open-hearth furnaces. The domestic iron and steel industry consumed a record 114,837,112 long tons of iron ore during 1951 and had a rated annual capacity of 108,587,670 short tons of steel at the year end. Annual capacity exceeding 121,000,000 short tons was projected for January 1, 1954.

Since basic open-hearth furnaces represent about 87 percent of the total steel-making capacity, further expansion of refractory magnesia production was anticipated.

Production of caustic-calcined magnesia in 1951 increased to 49,981 short tons, a 21-percent gain over 1950.

TABLE 2.—Magnesia sold or used by producers in the United States, 1950–51, by kind and source

Magnesia	From magnesite, brucite, and dolomite [1]		From well brines, raw sea water, and sea-water bitterns [1]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1950						
Caustic-calcined	6,418	$740,369	35,029	$3,396,529	41,447	$4,136,898
Refractory	232,283	9,358,483	103,157	5,557,371	335,440	14,915,854
Total	238,701	10,098,852	138,186	8,953,900	376,887	19,052,752
1951						
Caustic-calcined	7,689	889,624	42,292	3,920,755	49,981	4,810,379
Refractory	295,243	10,610,788	136,954	7,789,343	432,197	18,400,131
Total	302,932	11,500,412	179,246	11,710,098	482,178	23,210,510

[1] Magnesia made from a combination of dolomite and sea water is included with that from sea water.

Dolomite.—Sales of dead-burned dolomite, the bulk of which goes to the iron and steel industry, reached an alltime high of 1,966,460 short tons in 1951, an increase of 12 percent over the previous high reached in 1950.

Additional information on dolomite may be found in the Stone and Lime chapters of this volume.

TABLE 3.—Dead-burned dolomite sold in and imported into the United States, 1946–51

Year	Sales of domestic		Imports [1]		Year	Sales of domestic		Imports [1]	
	Short tons	Value	Short tons [2]	Value		Short tons	Value	Short tons [2]	Value
1946	1,077,983	$10,101,707	-------	-------	1949	1,318,708	$15,930,226	1,851	$72,680
1947	1,395,203	14,295,359	53	$2,194	1950	1,759,443	21,725,560	2,127	86,425
1948	1,544,755	17,847,182	2,427	91,613	1951	1,966,460	26,375,313	2,719	128,207

[1] "Dead-burned" basic refractory material consisting chiefly of magnesia and lime.
[2] Includes weight of immediate container.

Other Magnesium Compounds.—Sales of light and heavy high-grade magnesias in 1951 increased over 1950. Production of magnesium chloride increased sharply as demand from the magnesium-metal industry continued to increase.

TABLE 4.—Specified magnesium compounds produced, sold, and used by producers in the United States, 1950–51 [1]

Product [1]	Plants	Produced (short tons)	Sold [2]		Used (short tons)
			Short tons	Value	
1950					
Specified magnesias (basis 100 percent MgO), U. S. P. and technical:					
Extra-light and light	5	2,480	2,392	$1,214,844	----------
Heavy	3	1,850	1,734	513,586	(3)
Total	[4] 5	----------	4,126	1,728,430	(3)
Precipitated magnesium carbonate	10	54,633	7,389	1,134,499	47,153
1951					
Specified magnesias (basis 100 percent MgO), U. S. P. and technical:					
Extra-light and light	5	2,251	2,221	1,114,037	(3)
Heavy	2	(3)	(3)	(3)	----------
Total	[4] 5	----------	(3)	(3)	(3)
Precipitated magnesium carbonate	10	60,530	8,415	1,177,999	51,987

[1] In addition to the compounds shown, magnesium chloride, hydroxide, nitrate, phosphate, and sulfate were produced. Figures for these items are withheld to avoid disclosure of individual company operations.
[2] Sales by a producer to an affiliated consumer for immediate use are not included with "Sold" but with "Used."
[3] Figure withheld to avoid disclosure of individual company operations.
[4] A plant producing more than 1 grade is counted but once in arriving at total.

REVIEW BY STATES

California.—Johns-Manville Products Corp., 22 East 40th Street, New York 16, N. Y., produced magnesium carbonate from purchased magnesium hydroxide at Redwood City, Calif., for use in 85-percent magnesia insulation. Kaiser Aluminum & Chemical Corp., Kaiser Building, Oakland, Calif., operated its magnesia-from-sea-water plant at Moss Landing, producing refractory and caustic-calcined magnesias. Marine Magnesium Products Corp. became Marine Magnesium Products Div., Merck and Co., Inc. on February 28, 1951. The plant at South San Francisco continued to produce precipitated magnesium carbonate, magnesium hydroxide, and specialty magnesias, using lime, dolomite, and sea-water bitterns as raw materials. Pabco Products, Inc., 1550 Powell Street, Emeryville 8, Calif., produced magnesium carbonate from purchased magnesium hydroxide and magnesia, for use in 85-percent magnesia insulation. Westvaco Chemical Division, Food Machinery & Chemical Corp., 161 East 42d Street, New York 17, N. Y., produced a small quantity of magnesite from its Western mine near Livermore, produced refractory and caustic-calcined magnesia from sea-water bitterns and dolomite at Newark, and recovered magnesium chloride from sea-water bitterns at Chula Vista.

Illinois.—Johns-Manville Products Corp., 22 East 40th Street, New York 16, N. Y., produced precipitated magnesium carbonate from purchased dolomite by the Pattinson process at its Waukegan, Ill., plant for use in 85-percent magnesia insulation.

Michigan.—The Dow Chemical Co., Midland, Mich., produced magnesium chloride and epsom salt from well brines and dolomite at Midland and in a new plant at Ludington, Mich. Michigan Chemical Corp., St. Louis, Mich., produced magnesium carbonate and magnesia from well brines and dolomite. The Morton Salt Co., 120

South LaSalle St., Chicago 4, Ill., produced precipitated magnesium carbonate from well brines at its Manistee, Mich., plant. Standard Lime & Stone Co., 2000 First National Bank Building, Baltimore 3, Md., produced refractory-grade magnesia from well brines and lime at its plant at Manistee.

Nevada.—Basic Refractories, Inc., 845 Hanna Building, Cleveland, Ohio, produced magnesite and brucite at its operation near Gabbs, Nev. Part of this material was processed into a line of refractories at its Maple Grove, Ohio, plant; the balance was calcined to produce refractory magnesia in a new plant at Gabbs that began production during 1951.

Sierra Magnesite Co., Box 8–A, Newark, Calif., produced magnesite from its Segerstrom mine near Gabbs, Nev. The Standard Slag Co., 1200 Wick Building, Youngstown, Ohio, produced magnesite from its mine near Gabbs, Nev., and shipped raw magnesite and caustic-calcined magnesia.

New Jersey.—The J. T. Baker Chemical Co., Phillipsburg, N. J., produced a line of high-purity magnesium compounds from purchased magnesium carbonate. Johns-Manville Products Corp., produced precipitated magnesium carbonate by the Pattinson process at its Manville plant for use in 85-percent magnesia insulation. Northwest Magnesite Co., 1922 Farmers National Bank Building, Pittsburgh 22, Pa., continued to recover refractory-grade magnesia from sea water and dolomite at its Cape May, N. J., plant.

Ohio.—The Diamond Alkali Co., 200 Union Commerce Building, Cleveland, Ohio, produced refractory magnesia from dolomite at Fairport.

Pennsylvania.—Keasbey & Mattison Co., Ambler, Pa., and the Philip Carey Mfg. Co., Cincinnati, Ohio (plant at Plymouth Meeting, Pa.), produced magnesia and magnesium carbonate for use in 85-percent magnesia insulation from raw dolomite. The Ehret Magnesia Mfg. Co., Valley Forge, Pa., produced magnesium carbonate for magnesia pipe and boiler covering. During the year dolomite was replaced by sea-water magnesia as the raw material used in manufacture.

Texas.—The Dow Chemical Co., at Freeport, Tex., recovered magnesium chloride from raw sea water as an intermediate in the production of magnesium metal. It also produced some magnesia.

Washington.—The Laucks Chemical Co., 1008 Western Ave., Seattle 4, Wash., produced epsom salt, by solar evaporation, from a natural deposit near Tonasket. Northwest Magnesite Co., 1922 Farmers Bank Building, Pittsburgh 22, Pa., the largest producer of natural magnesite in the United States, produced refractory magnesia near Chewelah.

West Virginia.—The Standard Lime & Stone Co., 2000 First National Bank Building, Baltimore 3, Md., produced a refractory magnesia from dolomite at its Millville, W. Va., plant.

PRICES

According to quotations in E&MJ Metal and Mineral Markets, the price of dead-burned grain magnesite per ton, carlots, f. o. b. Chewelah, Wash., remained unchanged in 1951 at $36.30 in bulk and $41.80 in bags. The Westvaco Chemical Division of Food Machinery & Chemical Corp. increased the price of its kiln-run 90-percent sea-water periclase from $50.50 per ton, carlots, bulk, f. o. b. Newark, Calif., to $55.00 per ton, effective January 1, 1951, where it remained for the rest of 1951. Powdered caustic-calcined magnesite in bags, carlots, f. o. b. California, remained at $75 per ton throughout the year.

According to quotations in the Oil, Paint and Drug Reporter, prices on the magnesium compounds listed below remained constant throughout the year. Espom salt, technical, bags, carlots, f. o. b. works, was quoted at $2.15 per 100 pounds. Technical-grade calcined magnesia, cartons, f. o. b. works, was quoted at 32 to 34¾ cents per pound; synthetic, rubber grade, cartons, f. o. b. works, at 31 cents per pound; U. S. P. light, cartons, at 34 to 36 cents per pound; and U. S. P. heavy, barrels, at 36 to 38 cents per pound. Magnesium carbonate, technical-grade, bags, carlots, freight equalized, was quoted at 9½ cents per pound; U. S. P. grade, at 11¼ cents per pound. Magnesium carbonate is quoted freight allowed to New Jersey (except to Atlantic, Burlington, Cape May, Cumberland, Gloucester, Ocean, and Salem Counties) and to Philadelphia County, Pa. Freight is equalized with New York City on all other destinations. Magnesium chloride, flake, barrels, carlots, f. o. b. works, was $45.00 per ton. Magnesium hydroxide, medicinal grade, was 29 to 30 cents per pound.

FOREIGN TRADE[1]

The greatly increased domestic demand for refractory magnesia accounted for an increase in imports of more than 100 percent in 1951 as compared with 1950, from 14,120 short tons to 28,785. Imports from Austria dropped slightly; those from Canada and Italy increased sharply; and imports were received from Brazil, Germany, Norway, and the United Kingdom, not previously listed.

[1] Figures on imports and exports compiled by M. B. Price and E. D. Page, of the Bureau of Mines, from records of the U. S. Department of Commerce.

TABLE 5.—Magnesite imported for consumption in the United States, 1949–51, by countries

[U. S. Department of Commerce]

Country	1949		1950		1951	
	Short tons	Value	Short tons	Value	Short tons	Value
CRUDE MAGNESITE						
Brazil			2	$28		
Greece			1	22		
Philippines			5	75		
Total			8	125		
LUMP CAUSTIC-CALCINED MAGNESITE						
Canada			8	$467	8	$467
India	568	$19,616	399	14,696	1,963	71,792
Netherlands	240	14,909	546	25,911	1,277	58,732
Yugoslavia			55	2,400		
Total	808	34,525	1,008	43,474	3,248	130,991
GROUND CAUSTIC-CALCINED MAGNESITE						
Austria			6	$245	496	$19,949
Canada	1	$63			32	1,267
Germany					209	7,800
Greece			44	1,720		
India	662	23,898	1,059	40,063		
Netherlands	5	324			204	10,405
United Kingdom	8	1,108	9	1,247	3	382
Total	676	25,393	1,118	43,275	944	39,803
DEAD-BURNED AND GRAIN MAGNESITE AND PERICLASE						
Austria			11,839	$622,927	11,314	$516,886
Brazil					56	1,995
Canada	1,369	$133,518	2,104	188,690	3,995	365,263
Czechoslovakia	1,102	48,000				
Germany					1,000	47,628
Italy			177	6,009	3,808	195,377
Norway					1,000	41,833
United Kingdom					7,612	227,422
Total	2,471	181,518	14,120	817,626	28,785	1,396,404

TABLE 6.—Magnesium compounds imported for consumption in the United States, 1947–51

[U. S. Department of Commerce]

Year	Oxide or calcined magnesia		Magnesium carbonate, precipitated		Magnesium chloride (anhydrous and n. s. p. f.)		Magnesium sulfate (epsom salt)		Magnesium salts and compounds, n. s. p. f.[1]		Manufactures of carbonate of magnesia	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1947	(2)	$20	136	$34,799	3	$348	(3)	$5	6	$4,335		
1948			282	82,305	6	767			9	7,809	(4)	$49
1949	(5)	2	192	61,385	6	852	358	9,928	9	7,601		
1950			234	51,043	8	835	1,962	45,233	158	24,851	3	1,479
1951			194	59,847	3	292	2,547	59,373	562	90,826	96	31,914

[1] Includes magnesium silicofluoride or fluosilicate and calcined magnesium sulfate.
[2] 198 pounds. [3] 138 pounds. [4] 200 pounds. [5] 50 pounds.

TECHNOLOGY

A new precision self-setting process for the manufacture of 85-percent magnesia insulation is said to result in a product with a lower conductivity factor, higher strength-weight ratio, and closer tolerances than can be produced by the filter-mold process.[2] A specially prepared pure magnesium oxide refractory was developed to withstand the 2100° C. furnace temperature of the new Daniels or Wisconsin thermal process of nitrogen fixation.[3] The use of magnesite brick or monolithic magnesite cupola linings was reported to result in the production of low-sulfur iron suitable for making new nodular or ductile-type irons.[4] The operation of the magnesia-base sulfite process at the Weyerhaeuser Timber Co., Longview, Wash., mill was described and illustrated with flow diagrams.[5] The chemistry and operations of sea-water magnesia recovery plants in England were described.[6] The U. S. Geological Survey published a report on the magnesium-mineral resources of the Currant Creek District, Nev.[7] Numerous other technical articles on magnesium compounds appeared during the year.[8]

[2] Abrahams, S. A., Better Magnesia Insulation by New Process: Chem. Eng., vol. 58, No. 9, September 1951, pp. 140–142; No. 12, December 1951, pp. 208–211.

[3] Chemical and Engineering News, vol. 29, No. 40, Oct. 1, 1951, p. 4053.
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[4] Burgess, C. O., Casting Basic-Melted Gray Iron Ideal for Ductile Types: Steel, vol. 128, No. 1, Jan. 1, 1951, pp. 194–195.

[5] Hull, W. Q., Baker, R. E., and Rogers, C. E., Magnesia-Base Sulfite Pulping: Ind. Eng. Chem., vol. 43, No. 11, November 1951, pp. 2424–2435.

[6] Gilbert, F. C., and Gilpin, W. C., Production of Magnesia from Sea-Water and Dolomite: Research (London, England), vol. 4, No. 8, August 1951, pp. 348–353.

[7] Vitaliano, Charles J., Magnesium-Mineral Resources of the Currant Creek District, Nev.: Geol. Survey Bull. 978–A, 1951, 24 pp.

[8] Eubank, W. R., Calcination Studies of Magnesium Oxides: Jour. Am. Ceram. Soc., vol. 34, No. 8, August 1951, pp. 225–229.
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WORLD REVIEW

World magnesite production reached an estimated 3,800,000 metric tons in 1951, 27 percent more than in 1950, as shown in table 7.

TABLE 7.—World production of magnesite, 1947–51, by countries,[1] in metric tons

[Compiled by Helen L. Hunt]

Country [1]	1947	1948	1949	1950	1951
Australia	37,402	32,962	34,129	[2] 35,960	38,856
Austria	223,200	405,600	520,500	543,817	664,296
Brazil	(3)	850	43,110	(3)	(3)
Cyprus (exports)	30	1	20	20	20
Czechoslovakia	173,300	(3)	(3)	[4] 173,000	(3)
Germany, West	(3)	(3)	11,264	(3)	(3)
Greece	13,700	12,168	17,090	26,256	63,859
India	52,363	49,103	92,018	55,829	118,650
Italy	1,691	1,002	456	200	246
Kenya	41		10	181	
New Zealand	368	549	568	346	589
Norway	1,710	1,740	[2] 1,108	1,800	(3)
Poland	3,802	(3)	(3)		(3)
Southern Rhodesia	5,321	5,722	7,640	8,615	14,814
Spain	5,394	9,897	6,691	7,632	13,733
Tanganyika (exports)				83	2,716
Turkey	890	3,621	6,370	450	505
Union of South Africa	8,415	10,660	10,487	11,782	18,773
United States	341,093	(5)	260,646	389,536	607,962
Venezuela	2,980	1,900		1,400	(3)
Yugoslavia	15,200	51,700	87,900	58,971	89,915
Total (estimate) [6]	2,000,000	2,400,000	2,700,000	3,000,000	3,800,000

[1] Unless otherwise stated, quantities in this table represent crude magnesite mined. In addition to countries listed, magnesite is also produced in Canada, China, Korea, and U. S. S. R., but data on tonnage of output are not available; estimates by senior author of chapter included in total.
The Canadian production was actually magnesitic dolomite and brucite, valued as follows: 1947: C$1,167,584; 1948: C$1,587,709; beginning in 1949, value includes magnesium metal: 1949: C$1,536,200; 1950: C$1,717,879 (revised); 1951: C$2,451,778.
[2] Revised figure.
[3] Data not available; estimate by senior author of chapter included in total.
[4] Estimate.
[5] Figure withheld to avoid disclosure of individual company operation; included in total.
[6] World totals revised to include higher undisclosed estimates on U. S. S. R.

Austria.—The 1951 crude magnesite production of 664,296 metric tons, 22 percent greater than the previous year, was derived from the mines and occupation zones shown in table 8.

Finland.—A magnesite deposit, reported to be the largest in Europe, has been discovered in Lapland. The grade of the ore is said to average 90 percent $MgCO_3$.[9]

Greece.—Magnesite ore exports in 1951 were 17,630 tons, valued at US$200,182, more than 2½ times the 1950 exports. Output of caustic-calcined magnesite was 20,372 tons in 1951, with exports amounting to 17,687 tons and valued at US$694,992.[10]

Italy.—Output of magnesite in Italy declined from a peak of 13,686 metric tons in 1942 to 200 metric tons in 1950, and rose slightly to 246 metric tons in 1951. Recent activities at the largest operating mine (the Querceto mine in the Val d'Elsa) have been limited to sorting ore from surface workings. The Societa Magnesite Val d'Elsa proposed to implement a program to increase output to 3,000 or 4,000 tons per year. This level of output would supply one-third of Italy's requirements of crude magnesite, currently supplied by imports from

[9] Oil, Paint and Drug Reporter, vol. 159, No. 9, Feb. 26, 1951, p. 38.
[10] Bureau of Mines, Mineral Trade Notes: Vol. 34, No. 4, April 1952, p. 50.

TABLE 8.—Magnesite production in Austria, 1951, by mines [1]

Mine	Province	Occupation zone	Metric tons
Gross Veitsch	Styria	British	132,613
Trieben	do	do	99,884
Breiteneau	do	do	85,231
Kraubath	do	do	7,628
Oberdorf	do	do	49,975
Lassing	do	do	19,941
Radenthein	Corinthia	do	221,952
Leogang	Salzburg	American	11,600
Mayrhofen	Tirol	French	34,884
Tieberbrunn	do	do	418
Undetermined			170
Total			664,296

[1] From data obtained by the U. S. Embassy, Vienna, Austria.

Greece. Caustic-calcined magnesia requirements in 1951 were obtained from Austria and Czechoslovakia.[11]

Southern Rhodesia.—Vereeniging Brick & Tile Co., Ltd., and Consolidated Rand Brick, Pottery & Lime Co., Ltd., announced the formation of Rhodesian Refractories, Ltd., to manufacture magnesia refractories.[12]

[11] Bureau of Mines, Mineral Trade Notes: Vol. 34, No. 3, March 1952, p. 36.
[12] Mining World, vol. 13, No. 7, June 1951, p. 54.

Manganese

By Edgar J. Gealy and Gilbert L. DeHuff

GENERAL SUMMARY

IMPORTS of manganese ore into the United States dropped slightly in 1951 and failed to pace the sharp increase in consumption. Receipts, although lower than those of 1950, exceeded those for 1946, to make 1951 the second highest manganese-ore import year on record. None was received from the Soviet Union.

Receipts from India were reduced to 90 percent of the 1950 volume but supplied 32 percent of the total, and were large enough to maintain that country's position as the supplier of the largest quantity of manganese ore to the United States. Indian imports, in addition to dropping in quantity, decreased slightly in grade, averaging 47.1 percent manganese. This drop in quantity and grade of imports occurred even though the total production of ore in India was much higher than in 1950. This was attributed, in part, to the unusually heavy pur chases of Indian ore by Japanese industry, which was buying to replenish stocks as well as to provide for reviving steel production.

Gold Coast replaced the Union of South Africa as the second largest supplier in 1951 and furnished 20 percent of the total. Although total imports from Gold Coast increased 10 percent over 1950, the tonnage of battery- and chemical-grade ores decreased 12 percent. Gold Coast supplies the bulk of the natural oxide ores which are suitable for the manufacture of dry-cell batteries and for many chemical products, including hydroquinone, permanganates, fluxes, dyes, and dye intermediates. Although some chemical consumers can use ores from other sources, the virtual lack of other substantial sources of battery-grade material assigns strategic importance to this material.

The Union of South Africa showed the largest decline from 1950 of any of the major United States sources of manganese ore and fell from 26 percent in 1950 to 20 percent of the 1951 import total. This loss of ore from the Union more than accounted for the reduction in total imports from 1950 and was viewed with apprehension by United States consumers and Government alike. The shortage of rail facilities and dock facilities has been cited as the main deterrent to increased export of ore, but a growing feeling for conservation of natural resources in the Union appeared to be gaining headway.

Cuba assumed new importance as a supplier of manganese ore by substantially increasing exports to the United States for the third straight year. General imports in 1951 were 1.5 times as great as in 1950, 2.4 times as great as in 1949, and 4.5 times as great as in 1948, representing a remarkable recovery in response to higher prices and a firm market. Indications were that Cuban mine production was still expanding and could support an even higher export level in 1952.

Mexican production and exports of manganese ore to the United States revived from 1950 under the impetus of higher prices. The uncertainty of rail facilities still plagued producers and United States importers, and further expansion of Mexican production appeared possible in the future under more favorable transportation conditions.

With elimination of receipts from the U. S. S. R., owing to the Soviet embargo on movement of manganese ore to the United States, and the reduced supplies available from such major sources as India and the Union of South Africa, a much greater degree of dependence was placed on the smaller producing areas of the world. Whereas the tonnages from the first five supplying countries in 1950 totaled almost 240,000 short tons less than in 1951, the total loss was held to 66,000 tons because of increased imports from new and minor sources.

TABLE 1.—Salient statistics of manganese in the United States, 1947–51, gross weight in short tons

	1947	1948	1949	1950	1951
Manganese ore (35 percent or more Mn):					
Mine shipments:					
Metallurgical ore	125,428	119,828	110,928	122,944	95,255
Battery ore	6,189	10,845	14,983	11,507	9,752
Miscellaneous ore	10	427	224		
Total mine shipments	131,627	131,100	126,135	134,451	105,007
General imports	1,541,818	1,256,597	1,544,584	1,834,925	1,768,773
Consumption	1,419,131	1,538,398	1,360,042	1,650,429	1,892,609
Ferromanganese:					
Domestic production	614,626	647,617	577,345	719,680	791,260
Imports for consumption	81,307	98,220	65,014	109,948	119,764
Exports	20,168	19,696	6,627	580	633
Consumption	662,214	670,774	617,745	774,852	883,841
Spiegeleisen:					
Domestic production	134,329	112,610	78,167	42,375	77,017
Imports for consumption			1,737	8,595	
Exports	305	51		363	85
Consumption	120,019	102,392	75,841	76,280	80,556

Increased consumption of manganese ores, coincidental with reduced receipts, resulted in a severe drain on the stocks of ore held at ferroalloy furnaces. Alloy-producing companies ended 1950 with approximately 720,000 short tons of ore on hand, and this inventory was reduced at a rate of 25 to 30 thousand tons a month during 1951. Imports were erratic, and some consumers were reduced to dangerously low stocks. The demand for manganese alloys continued at a high level, and any interruption in alloy production could have had a serious effect on steel production. Under the authority of the Defense Production Act of 1950, the Defense Minerals Administration issued Mineral Order MO–2 covering manganese ore, effective April 1, 1951. The purpose of this order was to conserve and provide for the distribution of manganese ore so as best to serve the interest of national defense and essential civilian production. The order provided that no person should deliver manganese ore or accept delivery of manganese ore except in accordance with the terms of an allocation authorization issued by the Defense Minerals Administration. Allocation restrictions were limited to metallurgical and chemical-grade ore, since the battery industry is restricted naturally to the use of specific grades of ore.

On June 27 General Services Administration was authorized to purchase manganese ore of domestic origin which was amenable to concentration to purchase specifications for the National Strategic Stockpile. On July 19 three depots for such purchases were opened—at Butte and Philipsburg, Mont., and Deming, N. Mex. Prices and grades of ore accepted at each depot varied with the type of ore available in the areas covered. At Butte prices started at $6.05 per long dry ton of ore with 12 percent manganese content and went up to $40.42 for ore containing 30 percent Mn; at Philipsburg the range was from $6.43 at 15 percent Mn to $34.81 at 30 percent Mn; and at Deming the range was from $6.10 at 15 percent to $76.00 at 40 percent. The Montana depots accepted only ore in which at least 90 percent of the contained manganese was present as a carbonate. The Deming depot imposed no restrictions as to the type of ore to be accepted other than it be amenable to concentration to the required specifications; for ore deliveries exceeding 200 long tons a month, payments were adjusted on the basis of laboratory-determined recoverability.

On August 28 the functions of Defense Minerals Administration were split between Defense Minerals Exploration Administration and Defense Materials Procurement Agency. Assistance for exploration of areas geologically favorable for the discovery of new reserves was made the function of DMEA, while development loans and other assistance, along with ore purchasing and allocation of ores, became the function of DMPA.

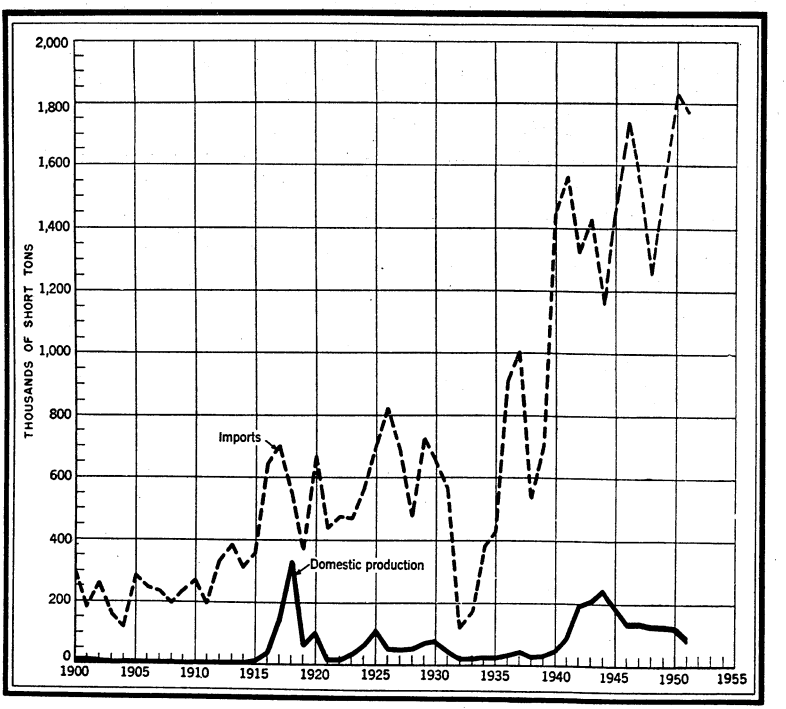

FIGURE 1.—General imports and domestic production (mine shipments) of manganese ore. 1900–51.

Bureau of Mines manganese research made considerable progress in 1951. The pilot plant at Pittsburgh for extracting manganese from open-hearth slags was completed in part, and test runs were made in the experimental blast furnace, using open-hearth slags and ore from Aroostook County, Maine; there were indications that these materials were amenable to blast-furnace smelting with coke to recover the manganese in a high-phosphorus spiegeleisen. The converter to investigate the oxidation step of the proposed process was being constructed at the end of 1951. Work on open-hearth slags and Aroostook ore at College Park, Md., consisted of applying standard ore-dressing techniques as well as various chemical and metallurgical methods to determine the most likely field of research. By the end of 1951 it was determined that mechanical means of beneficiation were unsuccessful and that the best results probably could be obtained from some form of an ammonium carbonate leaching process.

A cooperative agreement between the Bureau of Mines and the American Iron and Steel Institute, which provided assistance in the investigation of open-hearth slags and made larger funds and additional technical aid available, was signed on May 1.

Plans were completed for the 50-ton-a-day pilot plant at Boulder City, Nev., and several portions of the plant were completed and tested. Meanwhile laboratory work of gathering information and data for use in the plant operation continued. When completed, the pilot plant would investigate beneficiation of lowgrade ores from Artillery Peak and other sources.

DOMESTIC PRODUCTION

Table 2 shows the various types of manganiferous materials shipped by domestic producers 1947 to 1951.

TABLE 2.—Manganiferous raw materials shipped by producers in the United States, 1947–51, in short tons

Year	Metallurgical ore				Battery ore (25 percent or more Mn)	Miscellaneous ore	
	Manganese ore (35 percent or more Mn)	Ferruginous manganese ore (10 to 35 percent Mn)	Manganiferous iron ore (5 to 10 percent Mn)	Manganiferous zinc residuum		35 percent or more Mn	10 to 35 percent Mn
1947	125,428	128,562	1,044,961	227,547	6,189	10	832
1948	119,828	139,580	1,198,523	291,383	10,845	427	2,462
1949	110,928	24,885	1,052,231	158,902	14,983	224	1,279
1950	122,944	115,269	972,328	183,842	11,507	----------	----------
1951	95,255	106,203	1,117,761	267,751	9,752	----------	----------

Shipments of various grades of manganese-bearing ores during the last 5 years are given by States in tables 3 to 5. In addition, battery ores containing 35 percent or more manganese were produced in Montana and Nevada, and manganiferous zinc residuum was produced from New Jersey zinc ores.

TABLE 3.—Metallurgical manganese ore shipped from mines in the United States, 1947–51, by States, in short tons

State	1947	1948	1949	1950	1951	State	1947	1948	1949	1950	1951
Ala.				138		S. C.					
Ariz.	133	240	223	222	173	Tenn.	39	37	175	133	
Ark.	841	212	2,851	1,224	3,718	Utah				120	
Calif.			280	37		Va.				56	
Mont.	123,490	119,339	107,399	119,694	91,080	Wash.					
Nev.	67				58						
N. Mex.	858			1,320	226	Total	125,428	119,828	110,928	122,944	95,255

TABLE 4.—Ferruginous manganese ore shipped from mines in the United States, 1947–51, by States, in short tons [1]

State	1947	1948	1949	1950	1951	State	1947	1948	1949	1950	1951
Ariz.	62				224	Nev.	13,117	8,707	4,964	8,942	1,250
Ark.	2,094	1,165	5,555	6,359	1,429	N. Mex.	97,007	122,879		74,348	79,605
Calif.			386	640		Utah	7,198	2,694	4,981	1,964	1,369
Colo.	37					Va.	6,208	2,462	1,279		
Mich.											
Minn.			3,482	16,206	14,728	Total	129,394	142,042	26,164	115,269	106,203
Mont.	3,671	4,135	5,517	6,810	7,598						

[1] Includes miscellaneous ore containing 10 to 35 percent manganese.

TABLE 5.—Manganiferous iron ore shipped from mines in the United States, 1947–51, by States, in short tons

State	1947	1948	1949	1950	1951
Michigan				117,619	
Minnesota	1,044,961	1,198,523	986,720	853,632	1,117,522
New Mexico			65,511		239
Utah				1,077	
Total	1,044,961	1,198,523	1,052,231	972,328	1,117,761

MINING BY STATES

Arizona.—A. F. Denison shipped manganese ore containing (natural) 52 percent manganese from Coconino County, U. S. Manganese shipped a (natural) 40-percent ore from Gila County, and Business Service, Inc., shipped a (natural) 37-percent ore. In addition, some shipments of ferruginous ore of (natural) 28-percent manganese were made.

Arkansas.—Denison Manganese Co. shipped a (natural) 37-percent ore and Westmoreland Manganese Co. a (natural) 50-percent ore from Independence County. Ferruginous ore of (natural) 27 percent manganese also was shipped from Independence County.

Minnesota.—The Hanna Coal & Ore Corp., Oliver Mining Co., and Pickands, Mather & Co. shipped manganiferous iron ore from Crow Wing and St. Louis Counties averaging (natural) 5.8 percent manganese. Ferruginous ore containing (natural) 12.2 percent manganese was also shipped from Crow Wing County.

TABLE 6.—Manganese and manganiferous ores [1] shipped from mines, in the United States in 1951, by States

	Shippers	Short tons		Value
		Gross weight	Manganese content	
Manganese ore: [2]				
Arizona	3	173	80	(3)
Arkansas	2	3,718	1,442	(3)
Montana	3	100,562	57,362	(3)
Nevada	2	328	178	(3)
New Mexico	2	226	100	(3)
Total	12	105,007	59,162	[4] $6,045,452
Ferruginous manganese ore: [5]				
Arizona	1	224	64	(3)
Arkansas	1	1,429	395	(3)
Minnesota	1	14,728	1,792	(3)
Montana	1	7,598	1,809	(3)
Nevada	2	1,250	347	(3)
New Mexico	5	79,605	7,965	(3)
Utah	1	1,369	411	(3)
Total	12	106,203	12,783	[4] 532,197
Manganiferous iron ore: [6]				
New Mexico	1	239	24	(7)
Minnesota	3	1,117,522	64,652	(7)
Total	4	1,117,761	64,676	4,853,789

[1] All metallurgical ores except shipments of battery ores as follows: Montana, 2 shippers, 9,482 gross weight, 4,074 manganese content; and Nevada, 1 shipper, 270 gross weight, 151 manganese content. All this battery ore contained 35 percent or more manganese (natural).
[2] Containing 35 percent or more manganese (natural).
[3] Not available: estimate included in total.
[4] Estimate.
[5] Containing 10 to 35 percent manganese (natural).
[6] Containing 5 to 10 percent manganese (natural).
[7] Figure withheld to avoid disclosure of individual company operations.

Montana.—Montana continued to be the leading manganese-ore-producing State, with 96 percent of the total domestic output. This position was due principally to the Anaconda Copper Mining Co., which processes crude ore from the Emma and Butte Hill mines in Silver Bow County into nodules containing (dry) 58.5 percent manganese. The Trout Mining Division of the American Machine & Metals, Inc., shipped ferruginous ore containing (natural) 23.8 percent manganese. Trout Mining Division, along with Taylor-Knapp Co., shipped 9,482 short tons of battery-grade manganese ore averaging (natural) 43 percent manganese or 67 percent manganese dioxide.

Nevada.—Western Electrochemical Co. shipped battery-grade ore containing (dried) 56 percent manganese from a new plant in Henderson, Nev. Combined Metals Reduction Co. shipped metallurgical ore containing (natural) 46 percent manganese from Henderson, processed from low-grade ores from Lincoln County. Two other companies produced ferruginous ore averaging (natural) 28 percent manganese.

New Mexico.—The Deming purchase depot accepted the first shipment of ore late in November 1951, and deliveries for the balance of the year indicated a stimulation of small mines in the area. Two operators shipped ore containing (natural) 44 percent manganese,

5 operators shipped ferruginous ore containing (natural) 10 percent manganese, and 1 producer shipped manganiferous ore averaging 9.8 percent manganese. The Luck Mining & Construction Co. produced the major portion of the ferruginous ore from the Boston Hill mine in Grant County.

Utah.—One producer shipped ferruginous ore containing (natural) 30 percent manganese.

CONSUMPTION AND STOCKS

The continuing expansion of steel production during 1951 created a heavy demand for manganese alloys and manganese ores, with the overall consumption of ores increasing 11 percent over 1950. In 1951, as in 1950, domestic sources supplied 7 percent of the ore while foreign sources supplied 93 percent as compared with 10 percent and 90 percent respectively in 1949. Dry-cell batteries consumed 2.5 percent of the total and chemicals consumed 1.5 percent, the remaining 96 percent being consumed in metals industries. The stocks of ore held by industry showed an alarming reduction from 826,757 short tons to 545,769 tons, a 34-percent decrease. In addition to decreasing in tonnage, inventories dropped in grade, particularly those held by alloy producers. As the stocks decreased, a smaller proportion of the higher grade ores was available, which was reflected in the drop in the grade of ferromanganese produced in 1951 as compared with 1950.

TABLE 7.—Apparent consumption of manganiferous raw materials in the United States in 1951

	Ore containing 35 percent or more Mn		Ore and residuum containing 10 to 35 percent Mn		Ore containing 5 to 10 percent Mn	
	Short tons	Mn content (percent)	Short	Mn content (percent)	Short tons	Mn content (percent)
Domestic shipments	105,007	56.34	373,954	13.00	1,117,761	5.78
Imports for consumption	1,902,859	46.36	175,261	26.62	----------	----------
Total available for consumption	2,007,866	46.89	549,215	17.28	1,117,761	5.78

Table 8 shows the actual tonnages of manganese ore containing (natural) 35 percent or more manganese and manganese alloys consumed during 1950 and 1951 by the product for which consumed, together with consumers' stocks at the end of 1951.

TABLE 8.—Consumption of manganese ore and manganese alloys in the United States, 1950–51, and stocks Dec. 31, 1951, gross weight in short tons

Category of use and form in which consumed	Quantity consumed		In stock Dec. 31, 1951 [1]	
	1950	1951	At plant, including bonded warehouses	In bonded warehouses only
Manganese alloys and manganese metal:				
Manganese ore:				
Domestic	99,441	116,864	18,129	
Foreign	1,421,053	1,593,891	422,510	174,893
Total manganese ore	1,520,494	1,710,755	440,639	174,893
Ferromanganese			20,782	8,992
Spiegeleisen			4,439	
Silicomanganese			(2)	(2)
Manganese briquets			(2)	(2)
Steel ingots and steel castings: [3]				
Manganese ore:				
Domestic	2,667	653	25	
Foreign	858	1,937	777	
Total manganese ore	3,525	2,590	802	
Ferromanganese:				
High-carbon	688,972	773,776	125,347	
Medium-carbon, Low-carbon	50,731	51,235	9,188	
Total ferromanganese	739,703	825,011	134,535	
Spiegeleisen	59,573	60,204	29,531	
Silicomanganese	70,303	77,916	9,975	
Manganese metal and miscellaneous alloys	(2)	1,335	294	
Steel castings: [4]				
Manganese ore:				
Domestic	210	7	271	
Foreign	477	910	233	
Total manganese ore	687	917	504	
Ferromanganese:				
High-carbon	23,703	34,701	6,988	
Medium-carbon, Low-carbon	1,399	2,748	891	
Total ferromanganese	25,102	37,449	7,879	
Spiegeleisen	6,741	6,820	1,538	
Silicomanganese	8,107	11,851	1,960	
Manganese briquets	(2)	2,337	595	
Manganese metal and miscellaneous alloys	(2)	250	94	
Pig iron:				
Manganese ore:				
Domestic	2,049	5,930	3,662	
Foreign	57,079	101,024	65,768	
Total manganese ore	59,128	106,954	69,430	
Dry cells:				
Manganese ore:				
Domestic	3,369	3,191	1,502	
Foreign	37,950	40,936	19,189	13,509
Total manganese ore	41,319	44,127	20,691	13,509
Chemicals:				
Manganese ore:				
Domestic	8,603	4,733	564	
Foreign	16,673	22,533	13,139	
Total manganese ore	25,276	27,266	13,703	

For footnotes, see end of table.

TABLE 8.—Consumption of manganese ore and manganese alloys in the United States, 1950–51, and stocks Dec. 31, 1951, gross weight in short tons—Con.

Category of use and form in which consumed	Quantity consumed		In stock Dec. 31, 1951 [1]	
	1950	1951	At plant, including bonded warehouses	In bonded warehouses only
Miscellaneous products:				
Ferromanganese:				
High-carbon	[5] 7,203	14,655	4,497	----
Medium-carbon	[5] 2,844	6,726	2,253	----
Low-carbon				
Total ferromanganese	[5] 10,047	21,381	6,750	----
Spiegeleisen	[5] 9,966	13,532	4,217	----
Silicomanganese	[5] 910	3,003	799	----
Manganese briquets	[5] 8,427	16,405	5,546	----
Grand total:				
Manganese ore:				
Domestic	116,339	131,378	24,153	----
Foreign	1,534,090	1,761,231	521,616	188,402
Total manganese ore	[6] 1,650,429	[6] 1,892,609	[7] 545,769	188,402
Ferromanganese:				
High-carbon	719,878	823,132	169,946	8,992
Medium-carbon	54,974	60,709		
Low-carbon				
Total ferromanganese	774,852	883,841	169,946	8,992
Spiegeleisen	76,280	80,556	39,725	----
Silicomanganese	79,320	92,770	[8] 12,734	----
Manganese briquets	8,427	18,742	[8] 6,141	----
Manganese metal and miscellaneous alloys	(2)	1,585	[8] 388	----

[1] Excluding Government stocks.
[2] Data not available.
[3] Includes only that part of castings made by companies that also produce steel ingots.
[4] Excludes companies that produce both steel castings and steel ingots.
[5] Data for 1950 not available; 1949 figures carried over to show approximate magnitude of consumption.
[6] The greater part of the consumption of ore was used in the manufacture of ferromanganese and silicomanganese. Combining consumption of ore with that of ferromanganese and silicomanganese would result in duplication.
[7] Excludes small tonnages of dealers' stocks.
[8] Excludes small tonnages of producers' stocks.

In 1951 the consumption of manganese as ferroalloys and directly charged ore was 13.2 pounds per short ton of steel manufactured compared to 13.6 pounds in 1950 and 13.2 in 1949. Of the manganese used per ton of steel in 1951, 11.9 pounds was in the form of ferromanganese, 1.0 pound silicomanganese, 0.25 pound spiegeleisen, and 0.05 pound ore, metal, and miscellaneous alloys. These data apply to the consumption of manganese in the manufacture of steel ingots and that part of steel castings manufactured by companies that also produce steel ingots. The companies reporting in this part of the survey are those reporting production of ingots and castings to the American Iron and Steel Institute. Adding the manganese consumed by those companies producing castings only, the total figure becomes 13.95 pounds, broken down to 12.5 pounds as ferromanganese 1.1 pounds as silicomanganese, 0.25 pound as spiegeleisen, and 0.1 pound as metal, ore, briquets, and miscellaneous alloys.

TABLE 9.—Ferromanganese and spiegeleisen imported into and made from domestic and imported ores in the United States, 1950–51

	1950		1951	
	Gross weight (short tons)	Mn content (short tons)	Gross weight (short tons)	Mn content (short tons)
Ferromanganese: [1]				
Imported	109,948	87,493	119,764	94,946
Domestic production—total	719,680	553,834	791,260	601,758
From domestic ore [2]	66,426	51,119	73,512	55,906
From imported ore [2]	653,254	502,715	717,748	545,852
Total	829,628	641,327	911,024	696,704
Spiegeleisen: [3]				
Imported	8,595	1,719		
Domestic production [4]	42,375	8,719	77,017	15,735
Total	50,970	10,438	77,017	15,735
Total available supply of metallic manganese in ferromanganese and spiegeleisen		651,765		712,439
Open-hearth, bessemer, and electric furnace steel produced	96,836,075		105,199,848	
	Percent		Percent	
Percent of available supply of metallic manganese in:				
Ferromanganese and spiegeleisen imported	13.69		13.33	
Ferromanganese made from imported ore	77.13		76.62	
Ferromanganese made from domestic ore	7.84		7.85	
Spiegeleisen made from domestic ore	1.34		2.20	
Ferromanganese and spiegeleisen made from domestic ore	9.18		10.05	
Spiegeleisen made and imported	1.60		2.20	
Percent of Mn in ferromanganese of domestic origin to total Mn in ferromanganese made and imported	8.00		8.00	
Percent of Mn in spiegeleisen of domestic origin to total Mn in spiegeleisen made and imported	83.53		100.00	

[1] Number of domestic plants making ferromanganese: 1950, 10; 1951, 14.
[2] Estimated.
[3] Number of domestic plants making spiegeleisen: 1950, 4; 1951, 5.
[4] No spiegeleisen produced from foreign ore.

Electrolytic Manganese.—The Electro Manganese Corp., Knoxville, Tenn., was the only producer of electrolytic manganese in 1951.

Ferromanganese.—Ferromanganese production in the United States increased 10 percent to 791,260 short tons in 1951 compared with 719,680 tons in 1950. The following plants were active producers during the year: Anaconda Copper Mining Co., Anaconda and Black Eagle, Mont.; Bethlehem Steel Co., Johnstown, Pa.; The Electro Metallurgical Co., division of Union Carbide & Carbon Corp., Alloy, W. Va., Ashtabula, Ohio, and Niagara Falls, N. Y.; E. J. Lavino & Co., Sheridan, Pa., and Reusens, Va.; New Jersey Zinc Co., Palmerton, Pa.; Tennessee Coal, Iron & Railroad Co., Ensley, Ala.; United States Steel Co., Clairton, Duquesne, and Etna, Pa. Electro Metallurgical Co. and Anaconda Copper Mining Co. produced in electric furnaces, and New Jersey Zinc Co. produced by an aluminothermic reduction; the remaining companies produced ferromanganese in blast furnaces. Manganese ore consumed in the manufacture of ferromanganese totaled 1,527,420 short tons in 1951 of which 7 percent was of domestic

origin and 93 percent foreign, the same ratio as in 1950. In spite of the lower average grade of ore used in the production of ferromanganese, the recovery of manganese from the ore increased to 86.2 percent compared with 83.6 percent in 1950, 83.3 percent in 1949 and 84.6 in 1948. Shipments from producing furnaces increased 9 percent in quantity and 5 percent in value from 1950.

TABLE 10.—Ferromanganese produced in the United States and metalliferous materials consumed in its manufacture, 1947–51

Year	Ferromanganese produced			Materials consumed (short tons)			Manganese ore used per ton of ferromanganese made (short tons)
	Short tons	Manganese contained		Manganese ore (35 percent or more Mn, natural)		Iron and manganiferous iron ores	
		Percent	Short tons	Foreign	Domestic		
1947	614,626	78.67	483,509	1,075,043	109,987	1,340	1.928
1948	647,617	78.42	507,843	1,209,249	78,702	5,930	1.989
1949	577,345	78.33	452,249	1,054,445	114,924	2,540	2.025
1950	719,680	76.96	553,834	1,311,421	105,382	----------	1.969
1951	791,260	76.05	601,758	1,416,813	110,607	11,667	1.930

TABLE 11.—Manganese ore used in manufacture of ferromanganese in the United States, 1947–51, by source of ore

Source of ore	1947		1948		1949		1950		1951	
	Gross weight (short tons)	Mn content, natural (percent)	Gross weight (short tons)	Mn content, natural (percent)	Gross weight (short tons)	Mn content, natural (percent)	Gross weight (short tons)	Mn content, natural (percent)	Gross weight (short tons)	Mn content, natural (percent)
Domestic	109,987	59.53	78,702	59.26	114,924	59.13	105,382	58.02	110,607	58.34
Foreign:										
Africa	313,027	47.35	386,503	46.69	367,339	46.24	606,248	46.00	641,013	44.36
Brazil	139,300	40.49	159,668	40.81	138,917	40.76	128,940	40.82	146,108	40.83
Chile	8,298	47.23	5,195	47.91	3,838	47.78	7,279	47.68	8,484	47.15
Cuba	74,102	44.00	35,328	42,87	36,344	38.83	42,893	39.20	103,263	39.50
India	369,101	49.94	304,607	47.82	258,372	46.96	447,749	48.15	449,780	48.03
Mexico	33,382	41.16	40,420	41.79	27,952	40.81	25,851	41.48	40,402	40.81
Philippines	2,196	51.64	7,763	46.13	10,922	45.12	5,036	46.84	5,232	44.76
Turkey	----------	----------	----------	----------	----------	----------	2,928	45.97	9,505	42.64
U. S. S. R.	135,637	47.71	269,765	46.08	210,761	44.91	44,497	43.59	10,097	46.01
Other	----------	----------	----------	----------	----------	----------	----------	----------	2,929	41.65
Grand total	1,185,030	48.14	1,287,951	46.61	1,169,369	46.41	1,416,803	46.77	1,527,420	45.71

TABLE 12.—Ferromanganese shipped from furnaces in the United States, 1946–51

Year	Short tons	Value	Year	Short tons	Value
1946	493,808	$61,355,778	1949	560,180	$86,463,708
1947	614,647	79,972,673	1950	731,421	116,043,055
1948	659,193	90,126,657	1951	795,745	122,346,198

Silicomanganese.—The Bureau of Mines first published data on the consumption of manganese alloys for 1941, at which time the consumption of silicomanganese was 8 percent of ferromanganese. By 1951 silicomanganese consumption had increased to 10.5 percent of ferromanganese. Silicomanganese is used by the steel industry as a furnace block, as a deoxidizer, and for manganese additions. Although both silicon and manganese are good deoxidizers, silicon has the greater affinity for oxygen and thus protects the manganese. This property of silicomanganese in addition to the relatively low carbon content of the alloy makes it particularly useful for manganese additions to low carbon or high manganese steels.

Spiegeleisen.—United States production of spiegeleisen increased 82 percent in 1951 to 77,017 short tons from 42,375 tons in 1950. Shipments from spiegeleisen furnaces increased 21 percent in quantity and 39 percent in value. Four companies produced spiegeleisen at five plants in 1951; Inland Steel Co., East Chicago, Ind.; New Jersey Zinc Co., Palmerton, Pa.; Tennessee Coal, Iron & Railroad Co., Ensley, Ala.; and United States Steel Co., Clairton and Etna, Pa. Virtually all of the material used in the manufacture of spiegeleisen was of domestic origin.

TABLE 13.—Spiegeleisen produced and shipped in the United States, 1946–51

Year	Produced (short tons)	Shipped from furnaces		Year	Produced (short tons)	Shipped from furnaces	
		Short tons	Value			Short tons	Value
1946	111,696	114,982	$3,793,673	1949	78,167	53,888	$2,972,653
1947	134,329	124,517	4,980,030	1950	42,375	65,163	3,875,823
948	112,610	108,960	5,261,650	1951	77,017	79,168	5,368,989

Manganiferous Pig Iron.—Pig-iron furnaces consumed 1,132,409 short tons of manganese-bearing ores containing (natural) over 5 percent manganese in 1951. Domestic ore used totaled 943,928 tons and foreign ore 188,481 tons. Of the domestic material used, 829,575 tons contained (natural) 5 to 10 percent manganese, 108,423 tons 10 to 35 percent manganese, and 5,930 tons over 35 percent manganese. Of the foreign material used, none contained below 10-percent manganese, 87,457 tons contained (natural) 10 to 35 percent manganese, and 101,024 tons contained over 35 percent manganese.

Battery and Miscellaneous Industries.—Manufacturers of dry cell batteries used 44,127 short tons of manganese ore in 1951, an increase of 7 percent over 1950; of this total 3,191 tons was domestic and 40,936 tons foreign ore. Chemical plants used 27,266 tons, of which 4,733 tons was domestic and 22,533 tons foreign ore. All ore used contained (natural) over 35 percent manganese. The principal use of chemical ore is in the manufacture of dyes, manganese sulfate for fertilizer, hydroquinone, and permanganates. Manganese ore for battery use should have a high content of available oxygen, with a minimum of iron and virtually no arsenic, nickel, copper, cobalt, or other metals electronegative to zinc. Preferably, battery-grade manganese ore should be poorly crystallized and consist of the gamma

oxide. Ore for chemical use usually is predominantly pyrolusite. Domestic ore used for chemicals is chiefly a semireduced oxide material soluble in sulfuric acid.

TABLE 14.—Foreign ferruginous manganese ore and manganiferous iron ore consumed in the United States, 1947–51, in short tons

Source of ore	Ferruginous manganese ore					Manganiferous iron ore				
	1947	1948	1949	1950	1951	1947	1948	1949	1950	1951
Africa			4,673	2,034	2	44,227	24,074	67,466	43,725	
Australia						1,558				
Egypt				92,905	87,455					
Mexico		52	6							
Palestine		10,376								
Total		10,428	4,679	94,939	87,457	45,785	24,074	67,466	43,725	

PRICES

Manganese Ore.—Prices of manganese ore, containing 48 percent manganese, as quoted by E&MJ Metal and Mineral Markets, ranged from 92 to 96 cents per long-ton unit, c. i. f., United States ports, duty to account of buyer, at the beginning of 1951, to $1.20 to $1.25 per unit at the end of the year. These prices were quoted for current business while long-term contracts ranged from about 80 cents at the beginning of 1951 to 90 to 95 cents per unit at the end of the year, c. i. f., United States ports, duty paid, on 48-percent manganese ore.[1] Foreign chemical ore increased about $5 per ton for 80 and 85 percent manganese dioxide to $65 to $70 and $75 to $80 respectively. Domestic material, 70 to 72 percent manganese dioxide was steady at $45 to $50 f. o. b. mines. Duty remained at one fourth cent per pound of contained manganese; Cuba and the Republic of the Philippines material entered exempt from duty.

Manganese Alloys.—The average value, f. o. b. producer's furnaces, for ferromanganese shipped during 1951 was $153.75 per short ton compared with $158.65 in 1950. According to Iron Age, the selling price of ferromanganese in eastern centers in carlots was $185.24 per long ton in January, rose to $186.25 in February, and held constant through the remainder of the year with an average price of $186.16. The average value for spiegeleisen was $67.82 per short ton, f. o. b. domestic furnaces, in 1951 as compared with $59.48 for 1950; the quoted price on a long-ton basis, as given by Iron Age, was $75 throughout 1951. These materials were under price control by the Office of Price Stabilization from almost the beginning of 1951. The decrease in value of ferromanganese shipped from furnaces was due to the drop in the grade of the ferromanganese to lower than 78 percent manganese, at which point price penalties were invoked.

[1] The long-ton unit upon which the price of manganese ore is based is 1 percent of a long ton (22.4 pounds) of contained manganese. Prices of chemical ore are given on a per ton basis, with a minimum requirement of manganese dioxide.

FOREIGN TRADE [2]

Imports of all grades of manganese ore (battery, chemical, and metallurgical) are shown by countries in table 15. These data include general imports of battery-grade ore totaling 68,282 short tons in 1951: 55,571 tons originating in Gold Coast, 5,294 tons in French Morocco, 4,256 tons in Cuba, 1,436 tons in India, 1,120 tons in Angola, 560 tons in Chile, and 45 tons in Mexico. This ore averaged 54.7 percent manganese or 86.8 percent manganese dioxide, and it is known that these imports include some receipts of chemical ore. Imports for consumption of battery ore totaled 65,685 short tons valued at $2,446,393 or $37.24 per short ton f. o. b., foreign ports. Of this total, Gold Coast supplied 52,974 tons valued at $1,981,090; French Morocco, 5,294 tons at $236,113; Cuba, 4,256 tons at $112,419; India, 1,436 tons at $47,511; Angola, 1,120 tons at $50,000; Chile, 560 tons at $18,240; and Mexico, 45 tons at $1,020.

Imports for consumption of ferromanganese increased 8.9 percent in 1951 over 1950 to 119,764 short tons while the value increased 23.5 percent to $20,046,139. Exports of manganese ore and concentrates totaled 8,030 short tons valued at $465,897.

[2] Figures on imports and exports compiled by M. B. Price and E. D. Page, of the Bureau of Mines, from records of the U. S. Department of Commerce.

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TABLE 15.—Manganese ore (35 percent or more Mn) imported into the United States, 1950–51, by countries

[U. S. Department of Commerce]

Country	General imports [1] (short tons)				Imports for consumption [2]					
					Short tons				Value	
	Gross weight		Mn content		Gross weight		Mn content			
	1950	1951	1950	1951	1950	1951	1950	1951	1950	1951
Angola	13,124	35,351	6,813	17,080	15,200	32,478	7,907	16,157	$417,809	$1,100,311
Belgian Congo	5,942	9,613	2,885	4,737	2,081	10,929	1,031	5,377	57,792	421,211
Brazil	129,721	94,436	58,652	43,293	136,343	97,624	60,454	44,247	2,590,287	1,841,810
British Malaya		34		18		34		18		785
Canada	57		31		57		31		2,789	
Chile	8,802	21,264	4,147	10,098	7,761	23,843	3,749	11,419	192,637	753,857
Cuba	96,917	147,086	[3] 44,117	65,319	96,917	147,086	[3] 44,117	65,319	[3] 2,529,677	4,849,172
French Morocco	27,836	49,823	14,696	25,648	27,633	44,952	14,712	23,155	1,015,491	1,743,330
Gold Coast	328,099	361,571	163,206	174,012	378,105	360,326	184,930	174,755	7,805,805	8,541,374
Greece	440	2,524	178	1,189	440	2,524	178	1,189	13,500	83,130
India	630,146	565,557	299,545	266,586	642,505	616,892	312,022	295,105	15,432,202	14,180,911
Indonesia		2,278		1,093						
Iran	1	3,239	(4)	1,426	1	3,239	(4)	1,426	35	110,758
Mexico	38,845	92,227	17,334	39,803	34,546	99,927	15,445	43,324	913,969	2,548,180
Peru	823	1,516	485	824	823	1,244	485	709	29,847	42,833
Philippines	6,073	12,301	2,663	5,830	6,073	12,301	2,663	5,830	140,260	351,062
Portugal	447		188			447		188		8,567
Portuguese Asia		621		261		621		261		14,679
Turkey	5,675	21,673	3,120	10,331	1,075	19,615	473	9,213	26,000	645,706
Union of South Africa	475,316	347,659	204,599	147,999	510,025	423,985	218,115	182,086	7,867,928	7,630,216
U. S. S. R.	65,563		31,632		65,563	2,586	31,632	1,282	2,085,225	78,742
Western Portuguese Africa, n. e. s	1,098	(4)	593	(4)		2,206		1,180		72,996
Total	1,834,925	1,768,773	[3] 854,884	815,547	1,925,148	1,902,859	[3] 897,944	882,240	[3] 41,121,253	45,019,630

[1] Comprises ore received in the United States during year; part went into consumption, and remainder entered bonded warehouses.
[2] Comprises receipts during year for consumption and ore withdrawn from bonded warehouses during year (irrespective of time of importation).
[3] Revised figure.
[4] Less than 0.5 ton.

TABLE 16.—Ferromanganese imported for consumption in the United States, 1949–51, by countries

[U. S. Department of Commerce]

Country	1949			1950			1951		
	Gross weight (short tons)	Mn content (short tons)	Value	Gross weight (short tons)	Mn content (short tons)	Value	Gross weight (short tons)	Mn content (short tons)	Value
Belgium-Luxembourg				215	170	$28,133			
Canada	32,526	25,783	$4,762,495	24,029	19,099	3,315,823	67,374	52,878	$10,918,197
Chile				110	87	14,494			
China	14	8	1,407						
France				19,965	15,533	2,578,054	13,356	10,444	1,714,963
Germany				110	95	26,636	67	32	5,198
Japan	11	11	2,543	622	504	80,467	165	133	22,773
Korea	56	45	4,670						
Norway	32,407	26,320	6,534,494	60,223	48,378	9,542,794	38,637	31,344	7,358,514
Sweden				50	45	11,160			
U. S. S. R.				4,122	3,215	574,080			
United Kingdom				58	45	12,464			
Yugoslavia				444	322	53,670	165	115	26,494
Total	65,014	52,167	11,305,609	109,948	87,493	16,237,775	119,764	94,946	20,046,139

TABLE 17.—Spiegeleisen imported for consumption in the United States, 1945–51 [1]

[U. S. Department of Commerce]

Year	Short tons	Value	Year	Short tons	Value
1945	3,146	$142,883	1949	1,737	$86,217
1946	[2] 360	17,512	1950	8,595	474,259
1947–48			1951		

[1] Does not include minor quantities of spiegeleisen under 1 percent carbon.
[2] Revised.

TABLE 18.—Ferromanganese exported from the United States, 1946–51

[U. S. Department of Commerce]

Year	Gross weight (short tons)	Value	Year	Gross weight (short tons)	Value
1946	2,951	$381,194	1949	6,627	$1,360,279
1947	20,168	2,811,653	1950	580	139,876
1948	19,696	2,990,645	1951	633	206,614

WORLD REVIEW

World production of manganese ore from 1946 to 1951 is shown in table 19, insofar as the statistics are available, with average manganese content indicated where possible. These data are from official statistics of the countries, supplemented by information from semi-official and other sources.

TABLE 19.—World production of manganese ore, 1946–51, by countries, in metric tons [1]

[Compiled by Pauline Roberts]

Country [1]	Percent Mn	1946	1947	1948	1949	1950	1951
North America:							
Canada (shipments)			204	3			
Cuba	36–50+	130,764	50,397	29,073	62,503	[2] 79,209	154,091
Mexico	41–45	25,000	31,400	53,800	53,900	32,400	66,100
United States (shipments)	35+	130,303	119,409	118,931	114,427	[2] 121,971	95,260
South America:							
Brazil (exports)	38–50	149,149	142,092	141,253	149,896	[2] 148,339	[3]
Chile	40–50	[2] 21,885	19,352	22,119	[2] 28,870	[2] 33,530	[4] 42,000
Europe:							
Greece	60–62	15		900	[2] 150	320	2,290
Hungary	35–48	14,780	33,470	[4] 40,000	[3]	[3]	[3]
Italy	30	8,383	26,547	[2] 25,233	[2] 24,302	16,208	27,743
Portugal	35–45	5,932	2,444	280	508	798	7,615
Rumania	30–36	18,807	[3]	[4] 47,000	[4] 65,000	[3]	[3]
Spain	40+	29,589	22,428	18,525	18,651	[2] 19,002	21,912
Sweden	30+	[2] 13,292	[2] 11,343	[2] 9,079	[2] 16,110	11,847	[3]
U. S. S. R. (estimate)	41–48	1,700,000	1,800,000	1,800,000	1,500,000	2,000,000	2,000,000
Yugoslavia	30+	[4] 7,000	[4] 11,700	[4] 12,000	[2 4] 12,000	13,338	12,743
Asia:							
China	41	[5] 9,600	20,000	[4] 22,000	[3]	[3]	[3]
India	47–52	256,975	458,274	534,316	656,190	[2] 897,100	1,179,680
Iran	36–46				[4 6] 4,200	[4 6] 9,360	[3]
Japan	32–40	29,394	34,473	55,000	100,000	134,066	198,000
Philippines, Republic of	35–51		3,375	25,565	26,288	29,867	22,343
Portuguese India	32–50+	[3]	[7] 100	[2] 5,893	[2] 16,220	[2] 38,220	86,789
Turkey	30–50	2,370	5,833	8,327	25,002	[2] 32,178	50,517
Africa:							
Angola	50	1,900	700	400	18,600	9,308	46,192
Belgian Congo	50+	12,231	17,646	12,765	12,247	16,990	70,945
Egypt	30+	25	29	59,919	138,568	152,169	155,364
French Morocco	32–50	57,990	114,290	214,412	[2] 233,825	287,265	372,233
Gold Coast (exports) [8]	50+	777,583	598,655	640,088	752,963	[2] 722,784	819,018
Southern Rhodesia				10	166		
South-West Africa						993	6,560
Spanish Morocco	50			13	653	[2] 36	[4] 900
Tunisia	35–40		25				
Union of South Africa	40–50	237,897	288,213	276,393	655,175	790,937	758,870
Oceania:							
Australia		1,407	1,804	3,502	[2] 13,303	[2] 15,108	[4] 8,600
Fiji				71	102	203	[7] 641
New Caledonia	45–48				2,100	[2] 5,392	20,135
New Zealand		408	[2] 335	533	310	358	408
Papua		44	83	[3]	[2 9] 163	[9] 60	[9] 21
Total (estimate)		3,700,000	3,900,000	4,200,000	4,800,000	5,800,000	6,500,000

[1] In addition to countries listed, Argentina, Bulgaria, and Korea have produced manganese ore; data of output are not available, but estimates for them are included in the totals. Czechoslovakia, Germany, and Northern Rhodesia report production of manganese ore, but it is believed that the product so reported averages less than 30 percent Mn and therefore would be considered ferruginous manganese ore under the classification used in this report, and the output not included in this table.

[2] Revised figure.

[3] Data not available; estimate by chapter author included in total.

[4] Estimate.

[5] Incomplete data.

[6] Fiscal year ended March 20 of year following that stated.

[7] Exports.

[8] Dry weight.

[9] Fiscal year ended June 30 of year stated.

Brazil.—Three new deposits of manganese ore discovered recently were in production. One deposit is near Sao Felipe, State of Espirito Santo, another at Chapadao, Guacui in the same State, and the third is at Betim, State of Minas Gerais.[3] United States Steel Corp. was granted the exploration rights to the manganese deposit at Urucum and negotiated a loan from the Export-Import Bank for development of the property.[4] Following the grant of the exploration rights and the negotiation for the loan, it was found that the arrangements were apparently contrary to Brazilian laws on concessions and on operations of foreign companies. This matter was then placed in the Brazilian courts, and activity stopped. Although development of the Urucum deposit was still of interest, it appeared that some new arrangements would have to be made in the future. Bethlehem Steel Co. was interested in developing manganese deposits at Amapa, which would require more development than Urucum, owing to their geographic location.

Chile.—The Fabrica Nacional de Carburo y Metalurgica was operating a flotation mill and a ferromanganese plant at Nos for the production of the alloy from the manganese ores of the Corral Quemada mines near Coquimbo. Smelting was done in electric furnaces, presumably with hydroelectric power.[5] This company intended to enlarge its operations with an additional ferromanganese installation at Huachipato.

Costa Rica.—Small shipments of manganese ore have been made from a concession in Guanacaste Province operated by Minerals Operating Co., a subsidiary of the Latin American Resources Development.[6]

French Morocco.—To facilitate moving manganese ore mined from the deposits south of the Atlas Mountains to the port of Marrakech, an aerial tramway was being constructed over a distance of 28 kilometers. This was expected to eliminate the most difficult part of the transportation, the cost of which represented nearly two-thirds of the export selling price.[7]

Greece.—The Economic Cooperation Administration authorities were to finance attempts to speed production of Greek manganese ore by contributing about 70 percent of the cost of exploration, the loans to be repaid by deliveries of ore to the National (United States) Strategic Stockpile.[8]

India.—The Shivrajpur Syndicate, one of India's largest producers, entered into contracts for about 75 percent of its production for the next 3 years and planned to spend $100,000 to expand production facilities.[9] Indian officials announced that the export quota for high-grade ore was 800,000 long tons, with no limit on low-grade ore.[10]

Philippines.—The Luzon Stevedoring Co. took over the operations of the Palawan Mining Co. in Busuanga, and a large output was expected from this prominent prewar producer. Current high prices for manganese ore have stimulated mining, and about 2,000 tons a

[3] Mining World, vol. 13, No. 2, February 1951, p. 49.
[4] Mining world, vol. 13, No. 6, May 1951, p. 52.
Engineering and Mining Journal, vol. 152, No. 4, April 1951, pp. 170 and 172.
[5] Engineering and Mining Journal, vol. 152, No. 7, July 1951, pp. 208, 209.
[6] Bureau of Mines, Mineral Trade Notes: Vol. 33, No. 2, August 1951, p. 20.
[7] Mining World, vol. 13, No. 5, April 1951, p. 76.
[8] Engineering and Mining Journal, vol. 52, No. 5, May 1951, p. 140.
[9] Engineering and Mining Journal, vol. 152, No. 5, May 1951, p. 144.
[10] Mining World, vol. 13, No. 7, June 1951, p. 48.

month is being shipped from Bohol, now the most important producing area in the Philippines.[11]

South-West Africa.—A report was given to the South African Minerals Corp. by a consulting engineer on the recent discovery northeast of Okahandja in the Otjiqarongo field. The report stated that the discovery was of great value and suggested an annual production rate of 70,000 tons. The prospected portion is 20 miles long and varies in width from 10 to 150 feet. The deposit is about 210 miles from the port of Walvis Bay.[12] Later in 1951, South African Minerals announced an arrangement with U. S. Steel Corp. for regular shipments of manganese ore from properties in South-West Africa. It was indicated that this ore would be concentrated to about a 48-percent product.[13]

[11] Engineering and Mining Journal, vol. 152, No. 7, July 1951, p. 211.
[12] Mining World, vol. 13, No. 2, February 1951, p. 57.
[13] Engineering and Mining Journal, vol. 152, No. 5, May 1951, p. 145.

Mercury

By Helena M. Meyer and Gertrude N. Greenspoon

GENERAL SUMMARY

CONSUMPTION of 56,848 flasks of mercury, second only to the all-time annual peak established in 1945, was the outstanding feature of the mercury industry in 1951. Other features were the high though not record rate of imports, reversal in the downtrend in domestic production that followed the 61-year peak of 1943, and the top annual-average price for all time.

The completion and placing in operation in November of a new large chlorine and caustic-soda plant using mercury cells at Saltville, Va., was the chief reason for the record peacetime mercury consumption. The assurance that additional similar plants would begin to operate in 1952 indicated that withdrawals of mercury from new supply or stocks would continue large for another year at least. Except for chlorine and caustic-soda manufacture, the agricultural use of mercury made the most spectacular gain in 1951; most other uses took smaller quantities of mercury in 1951 than 1950.

Production of mercury in the United States did not rise in response to the high prices of 1951, as at the outset of World War II, despite seemingly similar stimulation. The history of price fluctuations in that war was fresh in producers' minds, and they sought some assurance as to price stability before they expanded production. Production did increase to 7,293 flasks (61 percent more than the 4,535 flasks in 1950), but the latter total was the smallest annual quantity, by a substantial margin, in 100 years. Except for 1950, the output in 1951 was the lowest since 1922. Output in the fourth quarter of 1951 was 3,270 flasks or 45 percent of the annual total.

Because world production capacity is adequate for known world needs and because the United States National Stockpile is more comfortably supplied with mercury than with most other strategic commodities, mercury was put low on the list for aid under the Defense Production Act. The Defense Minerals Administration decided that, under conditions prevailing in 1951, mercury was ineligible for production expansion assistance, that is, Government production loans, Government purchase contracts, and tax amortization benefits. It was decided, however, that exploration loans would be granted to properties that fulfilled established specifications. These loans were granted on a matching-funds principle, the Government meeting 75 percent and the operator 25 percent of costs.

Mercury prices were rising sharply as the year began, and quotations were $225 to $227 a flask at the end of January. The General Ceiling Price Regulation, approved by the Economic Stabilization Agency on January 26, provided that prices be held at not to exceed the highest level prevailing from December 19, 1950, to January 25, 1951, inclusive. This regulation established ceilings on an individual basis, and

TABLE 1.—Salient statistics of the mercury industry in the United States, 1942–46 (average) and 1947–51

[Flasks of 76 pounds]

	1942–46 (average)	1947	1948	1949	1950	1951
Production	39,315	23,244	14,388	9,930	4,535	7,293
Number of producing mines	110	37	20	23	16	47
Average price per flask: New York	$148.61	$83.74	$76.49	$79.46	$81.26	$210.13
Imports for consumption	37,762	13,008	31,951	103,141	56,080	47,860
Exports	685	884	526	577	447	241
Consumption	48,216	35,581	46,253	39,857	49,215	56,848

as most domestic producers had not sold metal during this period a problem was created. In such cases the Office of Price Stabilization was called upon to determine ceiling prices. On August 10 mercury was exempted from price control, along with some other strategic items, by General Overriding Regulation 9, Amendment 4. Quoted prices were at their lowest level of the year in the third quarter and

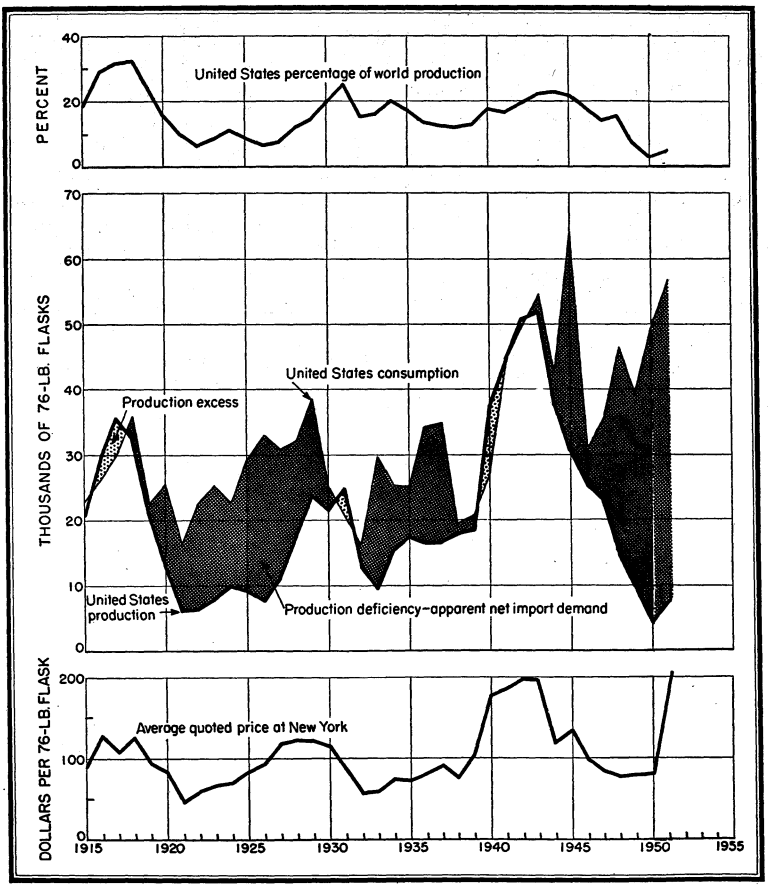

FIGURE 1.—Trends in production, consumption, and price of mercury, 1915–51.

advanced to the year's highest level in the final quarter. The average quotation for the year—$210 a flask—established a new annual peak. The previous record price of $196 in 1942 doubtless would have been exceeded in the early part of World War II, except for ceiling price limitations established by the Office of Price Administration. The development of adequate supplies of mercury during the war, however, resulted in the price falling far below ceiling limitations for many months before the war's end.

Imports (general) of mercury were 44,925 flasks—26 percent less than in 1950 and 54 percent less than in 1949—but were greater than in all earlier years except the war years 1945 and 1943. Metal moved into the United States during 1951 at a relatively uniform quarterly rate. The four chief suppliers—Italy, Spain, Yugoslavia, and Mexico, in order of importance—were the same as in 1950, although the positions of Italy and Spain were reversed. Of the 1951 total 39 percent came from Italy and 30 percent from Spain. Mercury came to the United States again in 1951 from countries that are normally importing areas; the metal possibly represented, in large part, mercury obtained for speculative purposes, following the start of Korean hostilities in June 1950, and reexported.

Mercury exports, always small, fell from 447 flasks in 1950 to 241 in 1951; reexports dropped from 886 flasks to 675 during the period.

Industrial stocks of 35,619 flasks in the hands of producers, consumers, and dealers at the beginning of the year were abnormally high, owing in large part to accumulation of metal for the Saltville, Va., chlorine plant. At the end of the year, the reduced inventories of 30,172 flasks no longer included metal held for the Saltville plant, which was then in operation, but included substantial quantities held for planned new installations at McIntosh and Muscle Shoals, Ala., and Plymouth, N. C.

DOMESTIC PRODUCTION

Production in the United States rose 61 percent in 1951, but this increase seemed large only by comparison with the 100-year record-low quantity in 1950; output in 1951 was less than in any other year

TABLE 2.—Mercury produced in the United States, 1948–51, by States

Year and State	Producing mines	Flasks of 76 pounds	Value [1]
1948:			
Alaska	1	100	$7,649
California	13	11,188	855,770
Idaho	1	543	41,534
Nevada	4	1,206	92,247
Oregon	1	1,351	103,338
Total	20	14,388	1,100,538
1949:			
Alaska	1	100	7,946
California	15	4,493	357,014
Nevada	5	4,170	331,348
Oregon	2	1,167	92,730
Total	23	9,930	789,038
1950:			
California	14	3,850	$312,851
Nevada	1	680	55,257
Oregon	1	5	406
Total	16	4,535	368,514
1951:			
Arizona and Texas	3	77	16,180
California	27	4,282	899,777
Idaho	1	357	75,016
Nevada	12	1,400	294,182
Oregon	4	1,177	247,323
Total	47	7,293	1,532,478

[1] Value calculated at average price at New York.

since 1922. The 1951 output supplied 13 percent of domestic consumption despite the all-time peak annual-average price. Evidently producers feared reversal of the rapid price gains and a possible precipitous slump. The ability of foreign producers to supply foreseeable mercury demand at more favorable costs for the short term, at least, deterred expansion of domestic production.

Most of the increase in output was in the final quarter, when 45 percent of the total was produced. Even at the expanded rate in October to December, however, output amounted to only 75 percent of the 1935–39 quarterly average and to only 28 percent of the quarterly rate in 1940–43, when output had responded to the rapid price gains of that period. If prices for mercury are "deflated" by changes in the Bureau of Labor Statistics general index for wholesale commodities, the peak 1951 price is reduced substantially. Actual and adjusted prices follow:

	Average annual prices (range)	
	Actual	*Adjusted*
1935–39	$71. 99 to $103. 94	$90 to $135
1940–43	176. 87 to 196. 35	225 to 199
1950	81. 26	50
1951	210. 13	116

TABLE 3.—Mercury produced in the United States, 1944–45, by months, and 1946–51, by quarters, in flasks of 76 pounds

Month	1944	1945	1946	1947	1948	1949	1950	1951
January	4,400	2,500						
February	3,800	2,700	5,550	6,100	5,300	1,440	1,700	880
March	3,800	3,000						
April	3,700	3,000						
May	3,400	3,300	7,000	5,700	3,600	1,460	1,010	1,400
June	3,000	3,000						
July	2,700	3,600						
August	2,500	3,300	6,500	5,850	3,150		1,100	1,600
September	2,500	2,050				6,980		
October	2,700	1,200						
November	2,300	1,350	6,150	5,550	2,050		630	3,270
December	2,500	1,600						
Total: Preliminary	37,300	30,600	25,200	23,200	14,100	9,880	4,440	7,150
Final	37,688	30,763	25,348	23,244	14,388	9,930	4,535	7,293

The number of mines that contributed to total production in 1951 was three times that in 1950. Of the 47 properties that produced some metal during the year, however, 9 supplied 93 percent of the total. The largest producers were as follows:

California.—Contra Costa County, Mount Diablo mine; San Benito County, Juniper and New Idria (including San Carlos); Santa Clara County, New Almaden dumps; Sonoma County, Culver-Baer and Mount Jackson (including Great Eastern) mines.

Idaho.—Valley County, Hermes mine.

Nevada.—Humboldt County, Cordero mine.

Oregon.—Douglas County, Bonanza mine.

Of this group the Mount Diablo, Hermes, and Bonanza mines did not operate in 1950; the Mount Diablo did not begin to produce until the final quarter of 1951. All of the large contributors in 1951 had produced substantial quantities of mercury in the past.

In 1950, 11 mines supplied 99 percent of the United States total; in 1949, 7 mines produced 98 percent, but in 1942 it took 34 mines to furnish 89 percent.

TABLE 4.—Mercury ore treated and mercury produced therefrom in the United States, 1927–51 [1]

[That material from old dumps which is not separable is included with ore]

Year	Ore treated (short tons)	Mercury produced		Year	Ore treated (short tons)	Mercury produced	
		Flasks of 76 pounds	Pounds per ton of ore			Flasks of 76 pounds	Pounds per ton of ore
1927	99,969	10,711	8.1	1940	449,940	37,264	6.3
1928	142,131	14,841	7.9	1941	652,141	43,873	5.1
1929	248,314	19,461	6.0	1942	733,360	49,066	5.1
1930	288,503	18,719	4.9	1943	613,111	50,761	6.3
1931	260,471	22,625	6.6	1944	300,385	37,333	9.4
1932	108,118	11,770	8.3	1945	209,009	29,754	10.8
1933	78,089	8,381	8.2	1946	157,469	24,929	12.0
1934	126,931	13,778	8.2	1947	139,311	22,823	12.5
1935	135,100	15,280	8.6	1948	103,220	13,891	10.2
1936	141,962	14,007	7.5	1949	71,977	9,745	10.3
1937	186,578	16,316	6.6	1950	35,115	4,312	9.3
1938	199,954	17,816	6.8	1951	81,067	6,934	6.5
1939	191,892	18,505	7.3				

[1] Excludes mercury produced from placer operations and from clean-up activity at furnaces and other plants.

The long-time downtrend in grade of mercury ore treated in the United States was interrupted in 1944–47 but subsequently has been resumed; in 1951 the average grade was 2.8 pounds per ton lower than in 1950, 3.8 pounds under 1949, and 6 pounds under 1947.

In addition to the mercury produced at the mines in 1951, at least 2,000 flasks (the same as in 1950) was reported produced from old battery plates and other scrap compared with 1,385 flasks in 1949. Additional unreported quantities doubtless were recovered.

REVIEW BY STATES

Arizona.—A few flasks of mercury were reported to have been purchased from a property on Slate Creek adjoining the Ord mine. This is the first production reported since 1946.

California.—Production in California increased 11 percent in 1951, and the State retained its rank as the leading mercury-producing area in the United States; it contributed, however, only 59 percent of the total compared with 85 percent in 1950 and 69 to 45 percent in 1945 to 1949, inclusive. The Mount Jackson (including Great Eastern) mine, Sonoma County, continued to be the largest producer, not only in California but in the United States as well. Production came from 26 other properties, a total of 27 compared with 14 in 1950; 7 of the foregoing properties reported production from clean-up, dump, or placer operations. Ten counties—Contra Costa, Del Norte, Fresno, Lake, Napa, San Benito, San Luis Obispo, Santa Clara, Sonoma, and Yolo—reported production in 1951.

Mercury produced in Contra Costa County came from the Mount Diablo mine, where a rotary furnace was used.

All production in Del Norte County was from the Patricks Creek (Webb) mine, where more than one operator was active during the year.

At the Archer mine in Fresno County the 80-ton Gould furnace was operated intermittently for 4 months; 72 flasks of mercury were produced.

The Sulphur Bank, Abbott and Mirabel mines made the small output reported in Lake County.

Mercury was produced from old mine dumps at the James Creek and Knoxville mines, and some was recovered from sand and gravel washed down from dumps at the Oat Hill, all in Napa County.

In San Benito County nine properties contributed to the county total of 971 flasks. The New Idria mine—leading producer in the United States during World War II and second only to New Almaden, Santa Clara County, in total output from the start of production in this country over 100 years ago—resumed mining operations in the third quarter of 1951 and was the fourth-largest producer for the year as a whole. The property had been idle, except for clean-up activity, since 1948. In all, 7,671 tons of ore was mined and furnaced in 1951 and produced 643 flasks of metal; an additional 60 flasks resulted from treating dump material. The operator concentrated on reopening and repairing the mine, which had caved badly during the shut-down period. Extensive repairs to plant and surface equipment were also necessary. The mine is equipped with four 5- by 56-foot rotary furnaces. Some of the ore produced at the Juniper mine and the entire North Star tonnage was treated in New Idria's plants. Other productive properties in the county were the Valley View (Panoche), which had more than one operator, the Lone Oak, and Aurora (at all of which retorts were in use), and three others.

In San Luis Obispo County a small quantity of mercury was produced from a test run at the Rinconada mine.

Mercury was produced by several licensees at the New Almaden property as well as at the Guadalupe mine, both in Santa Clara County. All output at New Almaden ceased when the property was leased to the Cordero Mining Co. late in the year. The company obtained a Defense Minerals Exploration Administration contract to explore the property.

The Mount Jackson (including Great Eastern) mine, Sonoma County, was one of only three large mines in operation throughout the year. The Culver-Baer and Dewey-Buckman (formerly Dewey-Geyser) mines also produced in 1951; both used rotary furnaces. At the Culver-Baer, production in 1951 substantially exceeded that in 1950. Production at Dewey-Buckman was incidental to the main activity of developing ore, moving the furnace from the Contact mine, and other preparatory work. V. C. Harrison produced mercury in a retort at the Ella B. Eureka property.

A small quantity of mercury was recovered at the Reed mine, Yolo County.

Idaho.—The Hermes mine, Valley County, inactive since July 1948, resumed output in 1951 and was the only producer in the State. In all, 357 flasks were produced from 3,200 tons of ore treated in one of the two 80-ton rotary furnaces at the mine. As in 1948, the mine ranked fifth in the United States.

Nevada.—Nevada ranked second to California in output of mercury in 1951, a position held also in 1950 and 1949. The Cordero mine, Humboldt County, resumed production in the latter part of the year; it was the second-largest producer in the United States for the year as a whole, as it was in 1950, when production likewise was

restricted to less than a 6-month period. Other counties that produced some mercury in 1951 were Esmeralda, Nye, and Pershing. Twelve properties were productive.

In Humboldt County, in addition to the Cordero, the Cahill, Grayson Group, and Turillas mines also reported production. At the Cahill 29 flasks were recovered from 162 tons of ore treated in a rotary furnace. The operator was driving under existing workings in an effort to cut favorable structures at depth. Ore was retorted at the Grayson and dump material at the Turillas.

Elsewhere in the State production came from small retort operations at the Red Rock, in Esmeralda County; the Quicksilver Stone No. 1, Nevada Cinnabar, A & B, and Mercury Mine, in Nye County; and Hillside and one other, in Pershing County. One productive small mine, also in Pershing County, is equipped with a furnace.

Oregon.—Production of mercury resumed importance in 1951 with reopening in March of the Bonanza mine, Douglas County, closed since November 1949. At the mine, from which came all but a very small part of the total for the State, 12,180 tons of ore were mined and treated in a 4- by 6-foot rotary furnace, yielding 1,160 flasks of mercury. A 14-foot Herreshoff furnace at the mine was not operated. The Bonanza was the third-largest producer in the United States in 1951. Extensive development work was reported being carried on at both south and north extremities of the Bonanza vein. Most of the production in 1951 came from the 370 and 500 levels of the mine along the south ore zone, which had been bypassed for many years.

The Bonanza-Nonpareil district was described.[1]

Small quantities of mercury were produced in Oregon also at the Maury Mountain mine, Crook County; at the newly discovered property known as Deer Creek, in Grant County; and from cleaning-up operations at the Black Butte mine, Lane County.

According to a report describing the mercury deposits of the Horse Heaven district, cinnabar was discovered in commercial quantities in this district (north-central Oregon) in 1933, and the district has produced 15,000 flasks since then. The report states that most of the metal came from the Horse Heaven mine but that the Axe Handle has produced about 150 flasks.[2] The district was idle in 1951.

Texas.—Mercury was produced in Texas in 1951 for the first time since 1945. Two properties in Brewster County made the small production, the major part of which was from cleaning-up operations at a Scott furnace.

CONSUMPTION AND USES

The record peacetime consumption in 1951 resulted chiefly from the putting into operation of a new chlorine and caustic-soda plant late in the year. Such use of metal is not dissipative, although some mercury is lost in operating the plant. Were demand for chlorine and caustic soda to decline markedly or very urgent demands for mercury develop, the metal in chlorine plants and in such other plants as

[1] Brown, R. E., and Waters, A. C., Quicksilver Deposits of the Bonanza-Nonpareil District, Douglas County, Oreg.: U. S. Geol. Survey Bull. 955-F, 1951, pp. 225–251.

[2] Waters, A. C., Brown, Randall E., Compton, Robert R., Staples, Lloyd W., Walker, George W., and Williams, Howel, Quicksilver Deposits of the Horse Heaven Mining District, Oreg.: U. S. Geol. Survey Bull. 969-E, 1951, pp. 105–149.

TABLE 5.—Mercury consumed in the United States, 1947–51, in flasks of 76 pounds

Use	1947	1948	1949	1950	1951
Pharmaceuticals	3,047	3,382	3,443	5,996	2,761
Dental preparations	[1] 785	[1] 994	[1] 963	[1] 1,458	[1] 803
Fulminate for munitions and blasting caps	523	441	149	289	494
Agriculture	5,617	7,048	4,667	4,504	7,737
Antifouling paint	760	996	1,683	3,133	2,500
Electrolytic preparation of chlorine and caustic soda	693	806	755	1,309	1,543
Catalysts	5,078	3,262	2,520	2,743	2,635
Electrical apparatus	[1] 6,763	[1] 6,471	[1] 7,323	[1] 12,049	[1] 10,250
Industrial and control instruments	[1] 5,394	[1] 5,653	[1] 5,016	[1] 5,385	[1] 6,158
Amalgamation	138	143	165	192	154
General laboratory	333	442	345	646	524
Redistilled	[1] 4,689	[1] 6,499	[1] 6,642	[1] 7,600	[1] 8,776
Other	1,761	10,116	6,186	3,911	12,513
Total	35,581	46,253	39,857	49,215	56,848

[1] A partial breakdown of the "redistilled" classification showed 48 percent was for instruments, 9 percent for dental preparations, and 34 percent for electrical apparatus in 1951, compared with a range of 53 to 51, 16 to 10, and 22 to 16, respectively, in the 4-year period 1947–50.

mercury-boiler installations could be reclaimed and reused. If and when such plants are dismantled the metal reclaimed and used for other purposes is not included in Bureau of Mines statistics as consumption.

Consumption of mercury for agricultural purposes made a noteworthy increase to 7,737 flasks—72 percent above 1950. The manufacture of industrial and control instruments took 14 percent more than in 1950. Both uses consumed more mercury than in any other year in the period 1939 to date covered by detailed consumption data.

TABLE 6.—Mercury consumed in the United States, 1944–45, by months, and 1946–51, by quarters, in flasks of 76 pounds

Month	1944	1945	1946	1947	1948	1949	1950	1951
January	3,400	5,200						
February	3,700	5,100	6,800	9,000	10,000	10,400	10,600	16,000
March	3,600	6,100						
April	3,200	7,500						
May	3,100	8,900	8,100	8,500	15,700	7,600	11,300	11,600
June	3,400	8,500						
July	3,000	6,600						
August	3,900	5,300	7,400	7,700	9,400	8,000	12,400	7,400
September	3,900	3,100						
October	3,900	3,100						
November	3,900	2,500	8,900	9,900	10,300	13,900	15,300	21,600
December	3,900	2,000						
Total: Preliminary	42,900	63,900	31,200	35,100	45,400	39,900	49,600	56,600
Final		62,429	31,552	35,581	46,253	39,857	49,215	56,848

Most mercury uses took less metal in 1951 than in 1950; pharmaceuticals and dental preparations showed drops of 54 and 45 percent, respectively; electrical apparatus consumed 15 percent less mercury than in 1950.

Four new chlorine and caustic-soda plants using mercury cells were planned to go into operation in the near future. These are at McIntosh and Muscle Shoals, Ala.; Calvert City, Ky.; and Plymouth, N. C. In addition, some currently operating plants were being enlarged.

An extensive program for relighting 334 miles of the 1,350 miles of improved streets in Seattle, Wash., was about one-third completed by

August 1, 1951. Mercury lamps were selected because it was claimed that fewer units per block gave equal illumination with lower power consumption.[3]

Other articles that appeared during the year discussed improvements in mercury lamps, properties of various types of lamps, and other lighting factors.[4] Current operating results and developments at mercury boiler power plants were also described,[5] as were measures taken to assure protection from mercury leakage at mercury power plants.[6] Articles were also published on the use of sensitized paper for estimation of mercury vapor[7] and on some of the general hazards involved in using mercury and precautions required in its handling and use.[8]

An article published during the year described a new magnetic mercury cathode designed for use in making quantitative analytical separations. It was said to be particularly useful where large quantities of interfering metals must be separated from small quantities of other elements to be assayed.[9] Another article described the mercury cathode polarographic method of determining titanium in rocks.[10]

STOCKS

Above-normal industry stocks of 35,619 flasks at the beginning of 1951 were reduced to 30,172 flasks by the end of the year, an anticipated drop, owing chiefly to withdrawal of metal held for a large chlorine-plant installation. The inventories continued to be greater

TABLE 7.—Stocks of mercury in hands of producers and of consumers and dealers, 1947–51, in flasks of 76 pounds

End of year	Producers	Consumers and dealers	Total
1947	3,084	16,200	19,284
1948	5,165	25,000	30,165
1949	5,354	15,600	20,954
1950	2,719	32,900	35,619
1951	1,072	29,100	30,172

than customary, however, because before the year ended metal was being accumulated for further new installations to come into operation in 1952 or later.

[3] Electrical West, Seattle's Safety Lighting: Vol. 107, No. 3, September 1951, pp. 84 and 85.

[4] Fraser, H. D., and Till, W. S., Color Correction and Other Important Improvements in Mercury Lamps: Illuminating Eng., vol. 46, No. 9, September 1951, pp. 459–460. (Abs. of Illuminating Engineering Soc. Conf. Paper 8.)

Till, W. S., and Jones, J. R., Which Mercury Lamp is Best?: Illuminating Eng., vol. 46, No. 5, May 1951, pp. 251–255.

Illuminating Engineering, High Bay Installations of Mercury Lamps: Vol. 46, No. 5, May 1951, p. 268.

Electrical Review, Lamps for Blue-Printing Machines: Vol. 149, No. 3845, Aug. 3, 1951, p. 256.

Wyatt, F. D., Mercury Vapor vs. Incandescent for Street Lighting: Electrical World, vol. 135, No. 19, May 7, 1951, pp. 98–101.

[5] Hackett, Harold N., Mercury-Steam Power Plants: Mech. Eng., vol. 73, No. 7, July 1951, pp. 559–564.

[6] Ilfeld, R. M., Protection of Mercury Power Plants: Power Eng., vol. 54, No. 11, November 1950, pp. 76–77.

[7] Stitt, Fred., and Tomimatsu, Yoshio, Sensitized Paper for Estimation of Mercury Vapor: Anal. Chem., vol. 23, No. 8, August 1951, pp. 1098–1101.

[8] Lawrence, J. B., How Poisonous is Mercury?: Chem. and Eng. News, vol. 29, No. 35, Aug. 27, 1951, pp. 3529–3531.

[9] Center, E. J., Overbeck, R. C., and Chase, D. L., Magnetic Mercury Cathode: Anal. Chem., vol. 23, No. 8, August 1951, pp. 1134–1138.

[10] Graham, R. P., and Maxwell, J. A., Determination of Titanium in Rocks and Minerals: Anal. Chem., vol. 23, No. 8, August 1951, pp. 1123–1126.

Of the total metal stocked, the small part held by producers was reduced 61 percent in 1951, continuing the decline since 1949. The holders of much of the 1949 quantity, unwilling to dispose of their metal at less than the cost of production, were rewarded for their patience and were able to sell at much higher prices than could have been obtained from the end of World War II to 1951.

In addition to the metal shown in table 7, noteworthy quantities of mercury are held in the National Stockpile, but data on such quantities may not be disclosed.

PRICES

A sharp uptrend in prices was in progress at the beginning of the year, when the range in quotations was $150 to $153 a flask. The upward movement continued until the range reached $225–$227 for the week ended January 24. The upsurge in prices following the outbreak of hostilities in Korea—June 1950—thus followed the pattern established at the outset of World War II in 1939. In 7 months after the Korean disturbance, however, prices virtually trebled, whereas in the earlier period, of similar length, prices little more than doubled. Both movements were spectacular. Government price-control action, described below, prevented prices from rising further. They generally tended to decline from the last week in January until the latter part of August, when the price range was $195–$200. After August the price moved upward to an average of $216.96 in October, following which another decline began. The year's closing quotations were $212–$215 a flask.

The General Ceiling Price Regulation, issued by the Economic Stabilization Agency on January 26, provided that prices of mercury, among many other commodities, be held at not to exceed the highest prevailing from December 19, 1950, to January 25, 1951, inclusive.

TABLE 8.—Average monthly prices per flask (76 pounds) of mercury at New York and London, and excess of New York price over London price, 1949–51

Month	1949			1950			1951		
	New York [1]	London [2]	Excess of New York over London	New York [1]	London [2]	Excess of New York over London	New York [1]	London [2]	Excess of New York over London
January	$89.60	$73.57	$16.03	$71.00	$63.23	$7.77	$195.00	$167.37	$27.63
February	88.09	74.08	14.01	71.00	52.93	18.07	215.27	204.59	10.68
March	87.30	74.58	12.72	71.00	52.93	18.07	217.33	204.62	12.71
April	84.65	74.56	10.09	71.00	52.16	18.84	215.60	204.66	10.94
May	82.20	74.56	7.64	70.35	49.42	20.93	212.92	204.65	8.27
June	80.27	74.53	5.74	70.00	47.68	22.32	210.00	204.66	5.34
July	78.16	74.55	3.61	73.44	47.26	26.18	206.80	204.62	2.18
August	74.56	74.53	.03	78.00	55.66	22.34	195.85	204.52	[3] 8.67
September	72.80	63.71	9.09	84.20	62.46	21.74	206.25	204.52	1.73
October	73.00	73.66	[3] .66	89.52	72.82	16.70	216.96	204.57	12.39
November	71.87	73.52	[3] 1.65	99.35	81.05	18.30	216.30	204.65	11.65
December	71.00	73.52	[3] 2.52	126.24	100.89	25.35	213.20	204.24	8.96
Average	79.46	73.28	6.18	81.26	61.94	19.32	210.13	203.37	6.76

[1] Engineering and Mining Journal, New York.
[2] Mining Journal (London) prices in terms of pounds sterling are converted to American dollars by using average rates of exchange recorded by Federal Reserve Board.
[3] London excess.

The regulation established ceilings on an individual company basis; and most producers were caught without a ceiling price, not having made sales during the specified period. The problem thus created could be solved only by the Office of Price Stabilization setting individual ceilings. Mercury was exempted from price control by General Overriding Regulation 9, Amendment 4, which likewise dropped some other strategic items from price control.

In London mercury was quoted at £48 (equivalent to $134.40 a flask) per long ton during the first week in January, rose to £73 10s. (equivalent to $204.54 a flask) in the last week in the month, and remained there until the latter part of March, when it rose to £73 15s. (equivalent to $204.61) where it continued for the remainder of the year.

FOREIGN TRADE [11]

Imports of mercury into the United States dropped 15 percent from 1950 and 54 percent from 1949 but were higher, nonetheless, than in all other peacetime years; the quantity for 1951 was 30 percent less than in the war year 1945. The all-time peak in 1949 was due largely to purchases by the ECA with counterpart funds for the National Stockpile, a factor that did not influence entries in 1951.

TABLE 9.—Mercury imported for consumption in the United States, 1947–51

[U. S. Department of Commerce]

Country	1947		1948		1949	
	Pounds	Value	Pounds	Value	Pounds	Value
Canada	3,801	$2,783	2	$4	484	$319
Chile	20,536	17,504				
Czechoslovakia			15,212	9,920		
Italy	220,352	180,336	299,983	205,735	6,451,947	5,830,409
Japan	236,161	251,899	279,326	175,460	205,894	142,772
Mexico	135,521	103,015	265,140	179,266	234,935	179,206
Spain	265,843	201,766	1,473,137	931,201	704,074	448,592
Yugoslavia	106,400	71,400	95,448	65,273	241,371	160,635
Total: Pounds	988,614	828,703	2,428,248	1,566,859	7,838,705	6,761,933
Flasks	13,008		31,951		103,141	

Country	1950		1951	
	Pounds	Value	Pounds	Value
Bolivia			1,409	$1,744
Canada	8,105	$9,407	50,150	125,906
Denmark	22,818	20,103		
Germany			19,006	39,904
Honduras			760	2,140
Italy	1,137,975	738,217	1,661,939	2,875,681
Japan	60,277	35,222	19,018	14,980
Mexico	264,460	180,418	388,257	843,523
Netherlands	43,724	32,289	26,600	21,700
Spain	2,163,123	1,265,719	909,884	1,555,502
Sweden	80,619	64,441	59,301	125,850
Switzerland			15,515	23,450
United Kingdom	60,800	49,600	3,588	3,285
Yugoslavia	420,155	298,856	490,911	952,924
Total: Pounds	4,262,056	2,694,272	3,637,338	6,586,589
Flasks	56,080		47,860	

[11] Figures on imports and exports compiled by M. B. Price and E. D. Page, of the Bureau of Mines, from records of the U. S. Department of Commerce.

Anticipated defense requirements and speculation caused the large receipts in 1950. The noteworthy expansion in demand for chlorine for defense purposes was a factor in the maintenance of large imports of metal in 1951.

Exports of mercury declined 46 percent in 1951, continuing the downtrend in progress since 1945 in this regularly small quantity item. Exports were equivalent to less than 1 percent of imports in 1951. Reexports, also regularly small, dropped 24 percent—a continuation of the decrease since 1947.

Imports.—Of the 47,860 flasks of mercury imported for consumption in 1951 (1950 in parentheses), 21,868 (14,973) came from Italy, 11,854 (28,462) from Spain, 6,459 (5,529) from Yugoslavia, 5,109 (3,480) from Mexico, and 2,570 (3,636) from other countries.

General imports—a better measure of goods actually arriving in the country during a given period—were 44,925 flasks in 1951 (60,564 in 1950). Of the 1951 total, 17,633 (18,073 in 1950) flasks came from Italy, 13,608 (29,439) from Spain, 6,523 (5,980) from Yugoslavia, 4,988 (3,986) from Mexico, 660 (107) from Canada, 250 (793) from Japan, and the remainder from countries that normally import mercury.

Imports of mercury compounds, generally insignificant, more than tripled those in 1950 and were the largest since 1937. Receipts of mercuric chloride in 1951 were 22,598 pounds from Yugoslavia, 2,205 pounds from Spain, and 112 pounds from the United Kingdom; of oxide (red precipitate), 3,307 pounds from Germany and 1,400 pounds from the United Kingdom; and of mercury preparations not specifically provided for, 53,286 pounds, of which 48,590 pounds were from Sweden, 4,480 from Italy, 110 from Belgium, and 106 from Yugoslavia.

Exports.—Of the exports of 241 flasks, 55 (43 in 1950) went to Venezuela, 40 (215) to Canada, 22 (70) to Colombia, 20 (15) to Cuba, 18 (none) to Peru, 14 (28) to Brazil, 13 (6) to Belgium and Luxembourg, and smaller quantities to 21 other countries.

TABLE 10.—Mercury exported from the United States, 1946–51

[U. S. Department of Commerce]

Year	Pounds	Flasks of 76 pounds	Value	Year	Pounds	Flasks of 76 pounds	Value
1946	68,932	907	$113,817	1949	43,860	577	$54,413
1947	67,148	884	90,659	1950	33,977	447	37,985
1948	40,013	526	42,620	1951	18,311	241	57,502

TABLE 11.—Mercury reexported from the United States, 1946–51

[U. S. Department of Commerce]

Year	Pounds	Flasks of 76 pounds	Value	Year	Pounds	Flasks of 76 pounds	Value
1946	179,103	2,357	$192,899	1949	62,945	828	$53,057
1947	235,196	3,095	200,218	1950	67,311	886	63,839
1948	70,022	921	52,849	1951	51,326	675	111,274

Reexports totaled 675 flasks (886 in 1950). Of the total, 400 (none) went to Japan, 215 (578) to Canada, 37 (221) to Brazil, 17 (46) to Colombia, and the remainder in quantities of 1 or 2 flasks to four other countries.

WORLD REVIEW

World output of mercury rose slightly in 1951 despite a drop of 14 percent in Spain. The Italian rate was virtually unchanged, and that in Yugoslavia continued at the high level attained in 1950. Increases in the United States, Mexico, and China more than offset the decline in Spain and explained the small world gain.

TABLE 12.—World production of mercury, 1943–51, by countries,[1] in flasks of 34.5 kilograms (76 pounds)

[Compiled by Helen L. Hunt]

Country [1]	1943	1944	1945	1946	1947	1948	1949	1950	1951
Algeria	146	165	326	340	346	381	102	-------	(2)
Australia	15	12	3	-------	-------	-------	-------	-------	-------
Austria	(3)	(3)	(2)	(2)	(2)	(2)	[4] 6	44	26
Bolivia (exports)	51	2	3	-------	-------	1	-------	-------	19
Canada	22,240	9,682	-------	-------	-------	-------	-------	-------	-------
Chile	2,563	1,181	862	827	445	467	754	319	(2)
China	3,133	3,510	1,828	1,189	290	290	[5] 290	[5] 1,450	[5] 4,000
Czechoslovakia	1,973	1,248	435	841	[6] 768	800	[5] 800	(2)	(2)
Germany	[5 7] 3,480	[5 7] 3,480	(2)	-------	(2)	(2)	(2)	(2)	(2)
Honduras	-------	-------	23	-------	-------	-------	-------	-------	11
Italy	[8] 58,004	[8] 28,705	[8] 25,410	50,822	53,984	38,233	44,527	53,346	53,839
Japan	6,706	7,096	3,139	1,372	1,622	1,689	2,461	1,312	1,847
Mexico	28,321	26,063	16,443	11,661	9,700	4,786	5,250	3,713	8,093
New Zealand	93	90	30	-------	-------	-------	-------	-------	-------
Peru	326	152	209	5	-------	-------	-------	-------	(2)
Rumania	176	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Southern Rhodesia	[9] -------	-------	[4] 1	-------	-------	-------	-------	-------	-------
Spain	47,756	34,349	40,694	41,801	55,608	22,684	32,289	[4] 51,808	44,480
Sweden	-------	21	1	-------	-------	-------	-------	-------	(2)
Tunisia	[4] 1	-------	-------	-------	-------	-------	-------	-------	-------
Turkey	186	97	158	-------	98	27	-------	-------	(2)
Union of South Africa	1,189	1,192	852	764	-------	-------	-------	-------	-------
United States	51,929	37,688	30,763	25,348	23,244	14,388	9,930	4,535	7,293
Yugoslavia	(5)	(5)	(5)	8,876	9,457	10,936	12,764	14,368	14,649
Total [5]	236,000	163,000	131,000	[4] 154,000	[4] 168,000	[4] 107,000	[4] 121,000	[4] 143,000	148,000

[1] Mercury is also produced in U. S. S. R., but production data are not available; estimates by authors of chapter included in total.
[2] Data not yet available; estimates by authors of chapter included in totals.
[3] Included with Germany.
[4] Revised figure.
[5] Estimate.
[6] Byproduct of pyrites production in Slovakia only.
[7] Includes Austria.
[8] Output of Idria mine (Yugoslavia) included with Italy through 1945.
[9] Less than 1 flask.

Chile.—The quicksilver deposits of Chile were described in a recent cooperative report prepared by members of the Geological Survey, United States Department of the Interior, and the Department de Minas y Petroleo of Chile. The Los Mantos mine, Chile's largest gold mine and the country's only recent producer of mercury, is in the Punitaqui district, Province of Coquimbo.[12]

Italy.—During the year it was estimated that production for 1951 might increase as much as 20 percent over 1950, but no increase developed. Production was from the following companies with mines

[12] McAllister, J. F., Flores W., Hector, and Ruiz F., Carlos, Quicksilver Deposits of Chile: Geol. Survey Bull. 964-E, 1950, 40 pp. (Bull. 964, pp. 361–400).

in Tuscany: Societá Monte Amiata, Stabilimento Minerario del Siele, Societá Mineraria Argus, and Societá Italiana An. Mercurio (S. I. A. M.). Monte Amiata was said to have accounted for 50 percent of the 1950 production and Stabilimento Minerario del Siele about 25 to 30 percent. Monte Amiata was engaged in a 800,000,000-lire program for rehabilitation and expansion of output. The program was aimed at mechanization of mine and furnaces. The company was rehabilitating and mechanizing its mine at Morone (Siena). This mine, closed for more than 20 years, was scheduled for full production in October or November 1952. Stabilimento Minerario del Siele also was undertaking a program of modernization and of expansion of output. Italian consumption of mercury was said to be 8,000 to 10,000 flasks annually.[13]

Mexico.—The increased production—from 3,713 flasks in 1950 to 8,093 flasks in 1951—caused Mexico to replace the United States as the fifth largest producer in the world. Output of the U. S. S. R. is not known, but doubtless it easily outranked that of Mexico and the United States in both years.

Peru.—Mercury mines in Peru were described in a report published in 1951. The report points out that the Huancavelica district, south-central Peru, was the world's largest quicksilver-producing area for over a century and a half. During the Spanish colonial period, it states, the mines produced over 1,400,000 flasks, most of which came from the Santa Barbara mine. Little has been produced in the past 100 years, and it appears unlikely that the district will again become an important quicksilver-mining center unless new discoveries are made.[14]

Spain.—New equipment ordered from the United States is expected to increase the production capacity of the Almaden mine materially.[15] An early estimate placed production in 1951 at 75,500 flasks, but a later report indicated this total was grossly overstated and cut the quantity to 44,480 flasks. The all-time record output of 86,473 flasks was established in 1941. Domestic consumption in 1951 was about 3,000 flasks and exports 48,310. The United Kingdom took 32 percent of total exports, the United States 20 percent, France 13 percent, Switzerland 11 percent, and Germany 9 percent. Until the end of the year export sales were limited to small quantities to avoid speculation.[16]

United Kingdom.—In the post-World War II period the United Kingdom has ranked second only to the United States in consumption of mercury. The sharp reduction in imports of mercury in 1951 was not unexpected, in view of the receipt of excessive quantities in 1950. Entries in 1950 were three times imports in 1949 and one and one-half times the prewar average for 1935–38. Imports were 18,780 flasks in 1951 and 54,199 in 1950 and reexports 6,127 and 14,317 flasks, respectively, leaving 12,653 and 39,882 flasks of newly imported metal available for consumption in the 2 years. These figures do not consider inventories of mercury, which are not reported.

[13] Bureau of Mines, Mineral Trade Notes: Vol. 33, No. 3, September 1951, pp. 19–21.
[14] Yates, Robt. G., Kent, Dean F., and Fernandez Concha, Jaime, Geology of the Huancavelica Quicksilver District, Peru: U. S. Geol. Survey Bull. 975–A, 1951, 45 pp.
[15] Mining World, World-Wide Mining Report * * * Spain * * *: Vol. 14, No. 5, Apr. 15, 1952, p. 107.
[16] Bureau of Mines, Mineral Trade Notes: Vol. 35, No. 4, October 1952, p. 18.

Mica

By Waldemar F. Dietrich, Robert D. Thomson, and G. E. Tucker

GENERAL SUMMARY

DOMESTIC production of sheet mica during 1951 remained small in terms of world production, but the United States continued to be the principal producer of ground mica. Sheet-mica output in 1951 increased 3 percent in quantity and 27 percent in value. The quantity of scrap mica and mica recovered from kaolin and schist sold or used by the producers increased 4 percent. Consumption of mica splittings increased 24 percent; production of built-up mica, which is made from splittings, increased 18 percent.

A report on the occurrence, geographical distribution, mining, and marketing of mica in the United States was published during 1951 by the Bureau of Mines.[1] The U. S. Geological Survey published a report on the physical characteristics of commercial sheet muscovite mica in the southeastern United States. Over 230,000 pieces of mica from at least 850 deposits in Alabama, Georgia, North Carolina, South Carolina, and Virginia were tested for this report.[2] Summaries of pegmatite investigations in Colorado, Wyoming, Utah, Idaho, and Montana were recently released by the U. S. Geological Survey.[3]

TABLE 1.—Salient statistics of the mica industry in the United States, 1947–51

	1947	1948	1949	1950	1951
Domestic mica sold or used by producers:					
Total uncut sheet and punch: [1]					
Pounds	415,589	270,042	513,994	578,818	594,884
Value	$116,110	$45,940	$132,097	$125,928	$160,322
Average per pound	$0.28	$0.17	$0.26	$0.22	$0.27
Scrap (sales):					
Short tons	49,797	52,157	32,856	69,360	71,871
Value	$1,095,578	$1,091,698	$795,782	$1,742,616	$1,884,087
Average per ton	$22.00	$20.93	$24.22	$25.12	$26.21
Total sheet and scrap:					
Short tons	50,005	52,292	33,113	69,650	72,168
Value	$1,211,688	$1,137,638	$927,879	$1,868,544	$2,044,409
Total ground:					
Short tons	64,540	64,642	56,393	72,250	70,122
Value	$2,967,713	$3,232,632	$2,860,956	$3,935,697	$3,842,628
Consumption of splittings:					
Pounds	9,309,981	7,917,365	8,114,804	10,783,198	13,379,295
Value	$6,680,753	$6,300,581	$7,096,365	$8,631,421	$11,760,617
Imports for consumption, short tons	11,685	17,896	12,738	[2] 18,511	18,889
Exports, do	1,493	1,403	1,108	1,547	1,895

[1] Includes a small quantity of splittings in 1949.
[2] Revised figure.

[1] Gwinn, G. Richards, Domestic Mica: Bureau of Mines Inf. Circ. 7617, 1951, 37 pp.
[2] Jahns, Richard H., and Lancaster, Forrest W., Physical Characteristics of Commercial Sheet Muscovite in the southeastern United States: U. S. Geol. Survey Prof. Paper 225, 1950, 110 pp.
[3] Hanley, John B., Heinrich, E. W., and Page, Lincoln R., Pegmatite Investigations in Colorado, Wyoming, and Utah: U. S. Geol. Survey Prof. Paper 227, 1950, 125 pp.
Stoll, W. C., Mica and Beryl Pegmatites in Idaho and Montana: U. S. Geol. Survey Prof. Paper 229, 1950, 64 pp.

TABLE 2.—Mica sold or used by producers in the United States, 1935–39 (average) and 1943–51

Year	Sheet mica [1]						Scrap mica and mica recovered from kaolin and schists		Total	
	Uncut punch and circle mica		Uncut mica larger than punch and circle		Total uncut sheet mica					
	Pounds	Value	Pounds	Value	Pounds	Value	Short tons	Value	Short tons	Value
1935–39 (average)	888,313	$46,408	252,411	$139,306	1,140,724	$185,714	21,986	$285,512	22,557	$471,226
1943	2,691,083	473,955	757,116	2,754,787	3,448,199	3,228,742	46,138	738,025	47,862	3,966,767
1944	835,402	147,635	687,911	3,115,076	1,523,313	3,262,711	51,727	1,089,072	52,489	4,351,783
1945	1,166,858	166,116	131,729	571,226	1,298,587	737,342	41,060	812,322	41,709	1,549,664
1946	986,891	126,039	91,976	91,916	1,078,867	217,955	53,602	1,041,423	54,141	1,259,378
1947	343,832	47,099	71,757	69,011	415,589	116,110	49,797	1,095,578	50,005	1,211,688
1948	216,794	23,928	53,248	22,012	270,042	45,940	52,157	1,091,698	52,292	1,137,638
1949:										
North Carolina	410,630	67,117	59,442	54,153	470,072	121,270	24,801	640,374	25,036	761,644
South Dakota	7,206	846	1,161	2,542	8,367	3,388	1,125	31,285	1,129	34,673
Other States [2]	32,999	4,613	2,556	2,826	35,555	7,439	6,930	124,123	6,948	131,562
Total	450,835	72,576	63,159	59,521	513,994	132,097	32,856	795,782	33,113	927,879
1950:										
North Carolina	457,428	71,323	26,308	30,856	483,736	102,179	48,193	1,281,584	48,435	1,383,763
South Dakota	12,560	1,375	458	309	13,018	1,684	1,902	24,989	1,909	26,673
Other States [2]	76,445	13,977	5,619	8,088	82,064	22,065	19,265	436,043	19,306	458,108
Total	546,433	86,675	32,385	39,253	578,818	125,928	69,360	1,742,616	69,650	1,868,544
1951:										
North Carolina	419,524	84,056	45,425	43,148	464,949	127,204	52,550	1,441,886	52,782	1,569,090
South Dakota							2,292	42,714	2,292	42,714
Other States [2]	124,522	24,373	5,413	8,745	129,935	33,118	17,029	399,487	17,094	432,605
Total	544,046	108,429	50,838	51,893	594,884	160,322	71,871	1,884,087	72,168	2,044,409

[1] Includes small quantities of splittings in certain years.
[2] Includes Arizona, Colorado (1950–51), Connecticut (1950–51), Georgia, Maine, New Hampshire (1950–51), New Mexico (1950), New York (1950), Pennsylvania, and Virginia.

DOMESTIC PRODUCTION

Sheet Mica.—Production of sheet mica in 1951 increased slightly to 595,000 pounds valued at $160,000, representing a minor percentage of total sheet-mica consumption. Uncut punch and circle mica in 1951 represented 92 percent of the total sheet output. Of the 5 States reporting production, North Carolina ranked first with 78 percent of the total domestic production.

Mica is produced in the United States by a large number of small producers, many of which are not canvassed by the Bureau of Mines. Statistics for sheet-mica production must be compiled from reports submitted by purchasers. High cost of production restricts extensive production in the United States. Domestic production cannot compete with mica produced from deposits of equivalent mica content in certain foreign countries having low-cost labor because of large hand-labor requirements to mine, process, and prepare sheet mica. However, a shortage of good-quality sheet mica in 1951 enlivened the interest in domestic production, actual and potential. Exploration of domestic pegmatites in search of sheet mica and other strategic minerals was assisted by provisions of the Defense Production Act of 1950. Numerous exploration loans were made available to mica miners.

During the year, the W. N. C. Miners' Association was founded by the miners of Franklin, N. C., to include all miners and producers of mineral ores in the tri-State area (North Carolina, Georgia, and Tennessee). Main objectives of the association were to assist fulfillment of national defense requirements for mica and other minerals and gain closer relationships between industry and Government.

Scrap Mica.—Sales of scrap mica, including reclaimed mica, to grinders in 1951 totaled 71,900 short tons, an all time high for this industry. Of the total, scrap mica amounted to 59,500 short tons valued at $1,475,000 and reclaimed mica, recovered from kaolin and mica schist, totaled 12,400 short tons valued at $409,000.

TABLE 3.—Scrap and reclaimed mica sold or used by producers in the United States, 1935–39 (average) and 1947–51

	Scrap		Reclaimed [1]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1935–39 (average)	13,582	$168,688	8,404	$116,824	21,986	$285,512
1947	35,199	709,745	14,598	385,833	49,797	1,095,578
1948	(2)	(2)	(2)	(2)	52,157	1,091,698
1949	24,942	526,268	7,914	269,514	32,856	795,782
1950	58,250	1,401,411	11,110	341,205	69,360	1,742,616
1951	59,514	1,475,059	12,357	409,028	71,871	1,884,087

[1] Mica recovered from kaolin and mica schist.
[2] Figure withheld to avoid disclosure of individual company operations.

Ground Mica.—Sales of ground mica totaled 70,100 short tons valued at $3,843,000, a decline of 3 percent and 2 percent, respectively, compared to 1950. Dry-ground mica represented 84 percent of the total sales. Producers were vigorously searching for new and expanded markets.

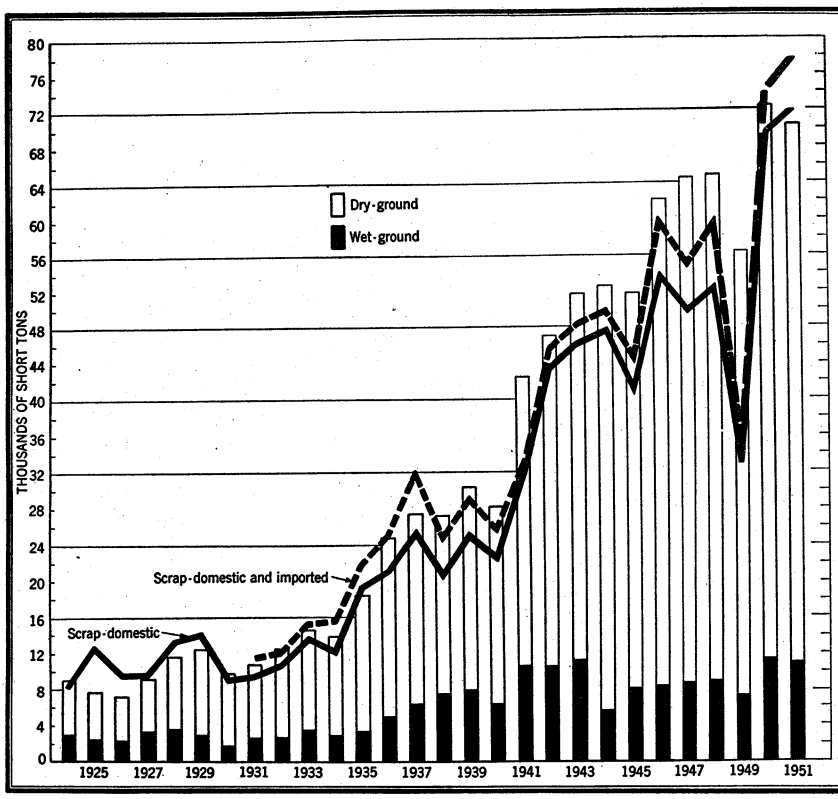

FIGURE 1.—Scrap and ground mica sold in the United States, 1924–51.

TABLE 4.—Ground mica (including mica from kaolin and schist) sold by producers in the United States, 1947–51, by method of grinding

Year	Dry-ground		Wet-ground		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1947	55,731	$1,852,768	8,809	$1,114,945	64,540	$2,967,713
1948	55,494	2,035,618	9,148	1,197,014	64,642	3,232,632
1949	49,133	1,850,400	7,260	1,010,556	56,393	2,860,956
1950	61,139	2,374,089	11,111	1,561,608	72,250	3,935,697
1951	59,200	2,294,620	10,922	1,548,008	70,122	3,842,628

CONSUMPTION

Sheet Mica.—In 1951, apparent consumption of sheet mica, which comprises block, film, and splittings, totaled 17.5 million pounds, representing about a 20-percent increase over the previous year (table 5). About 97 percent of the consumption was supplied from foreign sources. Block and film mica were used mainly in the manufacture of electrical commutators; armatures; radio, television, and radar tubes; capacitors; and household appliances, such as flatirons and toasters.

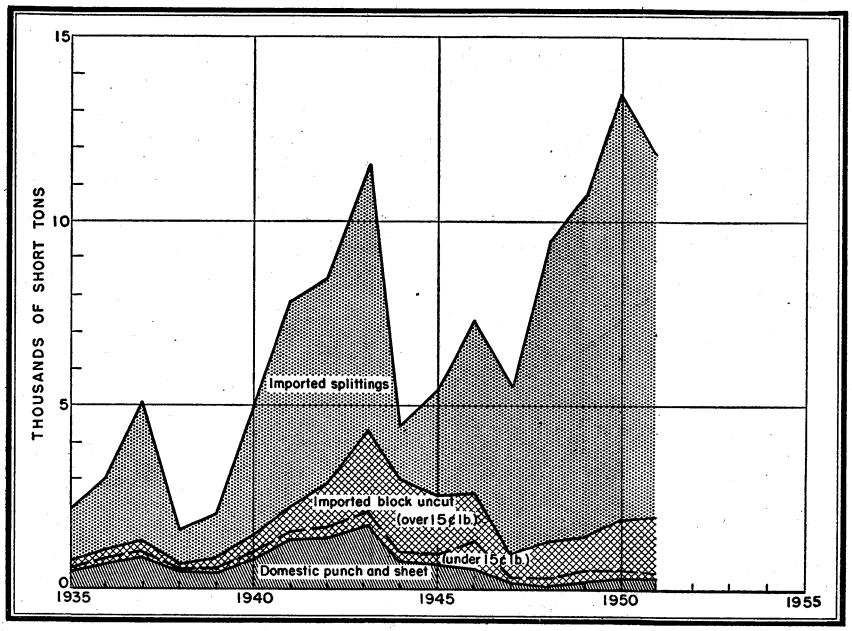

FIGURE 2.—Block mica and splittings imported for consumption in the United States and sales of domestic sheet and punch mica, 1935–51.

Considerable difficulty continued to be experienced in acquiring adequate quantities of both block and condenser film for the National Stockpile.

Consumption of mica splittings, as reported by consumers, reached an alltime high of 13.4 million pounds valued at $11.8 million (table 6). Approximately 92 percent of the splittings supply was imported from India. Consumer stocks were near a normal and adequate level. Supplies of Indian muscovite splittings and Madagascan phlogopite splittings were adequate for industry's needs and National Stockpile requirements. Stockpile goals for splittings were reached during the year.

TABLE 5.—Production of sheet and punch mica and apparent consumption of sheet and punch mica and mica splittings in the United States, 1942–51, in pounds

Year	Production	Apparent consumption	Year	Production	Apparen consumption
1942	2,761,844	12,888,273	1947	415,589	11,302,644
1943	3,448,199	17,296,196	1948	270,042	11,009,970
1944	1,523,313	15,185,998	1949	513,994	[1] 11,005,987
1945	1,298,587	13,310,700	1950	578,818	[1] [2] 14,624,315
1946	1,078,867	13,287,337	1951	594,884	[1] 17,465,024

[1] The sum of the domestic production of sheet and punch mica, consumption of mica splittings, imports of unmanufactured mica except waste and scrap, imports of manufactured mica except films and splittings and ground or pulverized mica, minus exports of manufactured mica other than ground or pulverized.
[2] Revised figure.

TABLE 6.—Consumption and stocks of mica splittings in the United States, 1947–51, by sources, as reported by consumers

	1947		1948		1949		1950		1951	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Consumption:										
Domestic	81,800	$66,020	[1] 75,395	[1] $33,106	81,001	$45,767	[2] 200,728	[2] $105,717	[2] 164,213	[2] $104,868
Canadian	[2] 254,135	[2] 139,504	237,350	150,487						
Indian	8,424,625	6,074,465	7,228,660	5,866,441	7,462,101	6,624,447	9,847,591	8,032,918	12,306,853	10,995,620
Madagascan	549,421	400,764	375,960	250,547	571,702	426,151	734,879	492,786	908,229	660,129
Mexican	[3]	[3]	[1]	[1]			[2]	[2]	[2]	[2]
Total	9,309,981	6,680,753	7,917,365	6,300,581	8,114,804	7,096,365	10,783,198	8,631,421	13,379,295	11,760,617
Stocks in consumers' hands Dec. 31:										
Domestic	50,700	23,818	147,297	78,992	[2] 85,934	[2] 34,141	[2] 235,537	[2] 182,999	50,784	24,486
Canadian	[2] 110,162	[2] 64,561								
Indian	5,846,763	4,470,649	3,168,801	2,723,175	3,858,495	4,003,621	5,464,294	5,552,016	9,756,536	9,379,176
Madagascan	339,220	224,615	402,217	283,170	413,434	365,098	450,581	432,872	522,110	497,658
Mexican	[3]	[3]			[2]	[2]	[2]	[2]		
Total	6,346,845	4,783,643	3,718,315	3,085,337	4,357,863	4,402,860	6,150,412	6,167,887	10,329,430	9,901,320

[1] Mexican included with domestic.
[2] Mexican included with domestic and Canadian.
[3] Mexican included with Canadian.

Built-up mica.—The production of 9.5 million pounds of built-up mica (made from splittings) valued at $26.3 million in 1951 was the greatest output recorded in a single year. Manufacture of segment plate used 29 percent of the total quantity of built-up mica; molding plate, 23 percent; and all other (tape, etc.) 26 percent.

TABLE 7.—Built-up mica [1] sold or used in the United States, 1949–51, by kind of product

Product	1949		1950		1951	
	Pounds	Value	Pounds	Value	Pounds	Value
Molding plate	1,579,846	$2,131,727	2,114,502	$3,860,049	2,184,654	$3,898,117
Segment plate	1,727,212	3,041,809	2,548,442	4,928,870	2,778,482	5,488,492
Heater plate	1,033,035	1,965,678	898,333	2,416,478	1,140,404	2,901,670
Flexible (cold)	431,660	677,753	711,412	1,914,911	917,326	2,596,787
All other (tape, etc.)	1,523,515	5,386,887	1,773,912	7,120,539	2,439,289	11,457,814
Total	6,295,268	13,203,854	8,046,601	20,240,847	9,460,155	26,342,880

[1] Made from splittings.

Ground Mica.—Ground mica sold or used by producers in 1951 totaled 70,100 tons. This was a slight decrease in comparison to the 72,300 short tons consumed in 1950.

Approximately 40 percent of the ground mica was used by the roofing industry. The remainder was consumed by a large number of other industries of which paint industry used 17 percent; rubber industry, 9 percent; plastics industry, 2 percent; and wallpaper industry, 1 percent.

TABLE 8.—Ground mica (including mica from kaolin and schist) sold by producers in the United States to various industries, 1950–51

Industry	1950			1951		
	Short tons	Percent of total	Value	Short tons	Percent of total	Value
Roofing	32,594	45	$1,083,584	27,919	40	$846,801
Wallpaper	622	1	82,565	865	1	121,065
Rubber	5,776	8	580,840	6,551	9	507,602
Paint	14,386	20	1,102,524	11,760	17	1,028,490
Plastics	1,542	2	145,599	1,186	2	138,778
Miscellaneous [1]	17,330	24	940,585	21,841	31	1,199,892
Total	72,250	100	3,935,697	70,122	100	3,842,628

[1] Includes mica used for molded electric insulation, house insulation, Christmas-tree snow, manufacture of axle greases and oil, annealing, pipeline enamel, oil-well drilling, welding, and other purposes.

The Wet-Ground Mica Association, Inc., issued several pamphlets on the use of ground mica in paints.[4]

[4] Wet-Ground Mica Association, Inc., The Effect of Platy Pigment Extenders on the Moisture Resistance of Paint Films: Tech. Bull. 6, Test Ser. 1, April 1951, 4 pp.; Tech. Bull. 7, Test Ser. 2, May 1951, 4 pp.; Tech. Bull. 8, Test Ser. 3, June 1951, 6 pp.
Wet-Ground Mica Association, Inc., An Investigation of the Effect of Platy Extender on the Behavior of Vinyl-Alkyd Paints: Tech. Bull. 9, August 1951, 4 pp.

PRICES

Prices of domestic sheet mica increased during the year but were not high enough to permit domestic producers in most instances to compete with low-cost output from foreign sources. Quoted prices for domestic mica are nominal, and actual selling prices are generally determined by direct negotiation between buyer and seller under agreement as to grade and quality of particular lots. The following quotations from E&MJ Metal & Mineral Markets serve only as a general indication of the range of prices during 1951: North Carolina district, clear sheet, 1½ by 2 inches, 80 to 85 cents per pound; 2 by 2 inches, $1.10 to $1.20; 2 by 3 inches, $1.50 to $1.60; 3 by 3 inches, $1.80 to $1.90; 3 by 4 inches, $2.20 to $2.30; 3 by 5 inches, $2.40 to $2.50; 4 by 6 inches, $2.15 to $3.25; 6 by 8 inches, $4.00 to $4.50; and punch mica, 12 to 22 cents per pound, according to size and quality. Stained or electric mica was sold at approximately the same prices as clear sheet.

North Carolina wet-ground mica ranged from $140 to $155 per ton during 1951, depending on fineness and quality; dry-ground from $32.50 to $70; and scrap, $32 to $35, depending on quality.

Raw mica and mica parts, except mica scrap and ground mica, wet and dry, were decontrolled by GOR–9, May 1, 1951.

FOREIGN TRADE [5]

Imports.—In 1951, imports of mica of all types totaled 18,889 short tons, compared with 18,511 (revised) in 1950. Mica, not cut or stamped to dimensions, not above 12/10,000 of an inch in thickness, represents the bulk of the splittings for built-up mica. Imported splittings in 1951 totaled 19.1 million pounds, as compared to 23.1 million pounds in 1950. Approximately 93 percent of the total splittings imports came from India. The remaining 7 percent came mainly from Madagascar and Canada and was phlogopite splittings. Imports of unmanufactured mica valued above 15 cents per pound, plus the imports from Brazil of manufactured films and splittings, not cut or stamped to dimensions, over 12/10,000 inch in thickness, is an approximate index of the imports of block mica suitable for electronic applications. In 1951 these items totaled 3,796,000. The imports from India over 12/10,000 of an inch thick, generally accepted as film, amounted to 1,050,000 pounds during the year.

Exports.—Total exports of mica and mica products in 1951 increased 22 percent in quantity and 28 percent in value over 1950. Exports of unmanufactured mica to Canada represented 73 percent of the total unmanufactured exports, and Belgium-Luxembourg 15 percent. Exports of manufactured mica, excluding ground or pulverized, to Canada represented 61 percent of such exports, Mexico 10 percent, and Austria 4 percent.

[5] Figures on imports and exports compiled by M. B. Price and E. D. Page of the Bureau of Mines, from records of the U. S. Department of Commerce.

TABLE 9.—Mica imported for consumption in the United States, 1947–50 [1] (totals), and 1951, by kind and country

[U. S. Department of Commerce]

Country	Unmanufactured									
	Waste and scrap, valued not more than 5 cents per pound				Untrimmed phlogopite mica from which no rectangular piece exceeding in size 1 by 2 inches may be cut		Other			
	Phlogopite		Other				Valued not above 15 cents per pound, n. e. s.		Valued above 15 cents per pound	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
1947	3,229,691	$23,355	6,987,900	$43,053	305,688	$57,066	186,631	$21,149	1,262,100	$1,072,743
1948	4,834,354	38,046	9,414,366	69,494	434,429	77,167	330,455	35,354	2,064,451	2,365,077
1949	981,156	5,658	2,534,919	16,082	28,304	4,238	635,313	94,182	1,802,929	2,012,675
1950	896,400	6,988	7,908,526	52,026	129,400	21,755	429,269	41,384	[2] 2,775,983	[2] 3,031,477
1951:										
Angola			109,710	527					31,623	122,345
Argentina							292,314	24,380	124,102	86,283
Bolivia							6,864	549		
Brazil							37,695	4,210	1,396,017	1,700,109
British East Africa									5,991	13,758
Canada	494,740	4,284	470,141	5,762	169,586	28,827	5,000	500	331,472	293,096
French Morocco			237,663	2,080						
India			9,575,792	72,690			22,621	3,732	1,105,434	1,522,841
Madagascar									2,699	5,991
Mexico									2,769	1,462
Mozambique			73,980	675					1,380	1,446
Southern Rhodesia			384,167	3,890					10,197	6,714
nion of South Africa			374,361	3,449					6,800	32,937
United Kingdom									4,878	3,174
Total	494,740	4,284	11,225,814	89,073	169,586	28,827	364,494	33,371	3,023,362	3,790,156

Country	Manufactured—films and splittings							
	Not cut or stamped to dimensions				Cut or stamped to dimensions		Total films and splittings	
	Not above 12/10,000 of an inch in thickness		Over 12/10,000 of an inch in thickness					
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
1947	9,075,818	$5,460,243	467,548	$611,995	11,128	$39,714	9,554,494	$6,111,952
1948	16,148,048	12,231,738	367,052	417,931	28,905	63,220	16,544,005	12,712,889
1949	18,402,145	16,208,432	447,884	701,346	18,722	154,641	18,868,751	17,064,419
1950	23,086,329	18,387,967	1,090,082	1,505,827	27,799	363,097	24,204,210	20,256,891
1951:								
Belgium-Luxembourg	7,714	2,870					7,714	2,870
Brazil	15,933	13,406	772,481	800,037	2,328	11,487	790,742	824,930
British East Africa	3,747	1,220					3,747	1,220
Canada	36,250	4,274	44	40			36,294	4,314
China	250	78					250	78
Germany	650	564			7,825	117,729	8,475	118,293
India	18,328,451	12,791,194	1,049,928	3,044,187	4,371	74,854	19,382,750	15,910,235
Japan					1,166	22,021	1,166	22,021
Madagascar	1,260,954	708,063					1,260,954	708,063
Mexico			401	809	14,805	267,018	15,206	267,827
Pakistan	1,875	766					1,875	766
United Kingdom	9,233	10,883	1,084	3,604	12,910	235,950	23,227	250,437
Total	19,665,057	13,533,318	1,823,938	3,848,677	43,405	729,059	21,532,400	18,111,054

For footnotes, see end of table.

TABLE 9.—Mica imported for consumption in United States, 1947–50[1] (totals), and 1951, by kind and country—Continued

Country	Manufactured—cut or stamped to dimensions, shape, or form		Manufactured—other					
			Mica plates, and built-up mica		All mica manufactures of which mica is the component material of chief value		Ground or pulverized	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
1947	131,776	$103,118			1,976	$3,128	1,710,090	$33,415
1948	162,540	161,917	3,053	$2,139	25,698	33,204	1,978,960	50,769
1949	81,551	102,083	4,002	11,989	5,247	16,935	533,833	16,993
1950	82,353	112,136	9,779	25,619	25,590	86,314	560,000	25,814
1951:								
Brazil	82,570	89,451	6,739	31,285	43,238	194,875		
Canada			304	883	3,022	896	700,160	37,872
France			4,597	7,670				
Germany			4,973	7,786	112	363		
India	13,800	18,567	200	247	300	356	39,750	965
Madagascar					2,425	5,240		
Mexico	8,896	10,420	6,304	27,881	6,462	15,347	40,000	2,400
Switzerland			2,723	3,816				
United Kingdom	910	570			7	204		
Total	106,176	119,008	25,840	79,568	55,566	217,281	779,910	41,237

[1] Changes in Minerals Yearbook, 1950, p. 796 should read as follows: Unmanufactured (other), valued above 15 cents per pound—Brazil, 1,213,144 pounds ($1,031,958) and India, 955,494 pounds ($1,552,265).
[2] Revised figure.

TECHNOLOGY

Research at the Bureau of Mines Electrotechnical Laboratory, Norris, Tenn., continued on synthesis of mica, and some progress was reported. Sheets of mica with physical characteristics comparable with natural mica have been produced but only in small sizes. A general history of the progress in synthetic mica was published recently.[6] The Office of Naval Research, Department of the Navy, issued a report on Samica mica paper, describing the Samica process and possible uses of the new mica-paper insulator.[7] Experiments on a new method for recovering flake mica were reported.[8] English Mica Co., Spruce Pine, N. C., has installed Humphrey spirals to aid recovery of mica.[9]

Recently, a patent was issued for producing an electrical coating on glass and mica.[10] Mica Insulator Co. issued a publication discussing properties, applications, facilities, and services of micanite and additional information pertaining to laminated plastics, varnished fabrics, and specialty coatings.[11] Two firms were reported to be planning commercial production of sheet mica from domestic scrap mica as a possible substitute for built-up mica products made from imported splittings.

[6] Jackel, Roland D., Progress in Synthetic Mica: Elec. Mfg., vol. 45, No. 3, May 1950, pp. 99–103.
[7] Jackel, Roland D., Samica Mica Paper: Office of Naval Research, Monthly Research Rept., December 1951, pp. 6–9.
[8] Adair, R., McDaniel, W. T., and Hudspeth, W. R., New Method for Recovery of Flake Mica: Min. Eng., vol. 3, No. 3, March 1951, pp. 252–254.
[9] Engineering and Mining Journal, vol. 152, No. 7, July 1951, p. 194.
[10] Mochel, John M. (assigned to Corning Glass Works), Producing Electrically Conducting Coatings on Glass and Mica Sheets: U. S. Patent 2,522,531, Sept. 19, 1950.
[11] Mica Insulator Co., Micanite, Empire, Lamicoid and Fabricated Mica: Schenectady, N. Y., 1951, 60 pp.

TABLE 10.—Mica and manufactures of mica exported from the United States, 1947–50 (totals) and 1951, by country of destination

[U. S. Department of Commerce]

Country	Unmanufactured		Manufactured			
			Ground or pulverized		Other	
	Pounds	Value	Pounds	Value	Pounds	Value
1947	330,900	$76,695	2,343,657	$129,091	311,097	$764,540
1948	338,768	68,632	2,268,403	124,926	198,063	526,801
1949	113,776	43,140	1,922,179	102,147	180,157	531,465
1950	335,941	98,614	2,567,807	158,947	190,075	602,235
1951:						
North America:						
Canada	290,804	21,695	1,536,600	75,746	155,640	541,366
Cuba			84,163	8,114	5,189	11,424
Guatemala			30,600	1,579	118	438
Haiti			5,000	425		
Mexico	20,671	3,633	91,300	3,613	25,523	41,494
Netherlands Antilles	285	178			267	1,489
Other North America					288	1,189
South America:						
Argentina			1,200	210	6,221	13,890
Bolivia					756	7,854
Brazil	83	188	69,600	3,442	5,995	18,323
Chile	1,013	2,793			7,100	17,194
Colombia	197	237			2,208	7,117
Peru			8,450	727	9,836	9,896
Uruguay	770	2,541			1,396	3,683
Venezuela	230	617	288,500	17,429	593	1,775
Europe:						
Austria					10,969	93,139
Belgium-Luxembourg	60,104	2,253	341,800	27,696	34	157
France			117,810	9,614	7,677	5,571
Germany			274,100	21,928	2,850	6,795
Italy	445	239	51,000	4,080	110	825
Netherlands			44,000	3,520	240	1,336
Sweden			11,050	992	260	853
Switzerland			30,050	2,443		
Trieste					238	432
Turkey					419	1,123
United Kingdom	10,637	40,948			65	690
Other Europe					208	334
Asia:						
Afghanistan					2,005	1,523
Ceylon					39	477
India	10,785	10,267	43,800	3,130	739	611
Indonesia	40	161			316	1,021
Iran					89	358
Israel and Palestine			1,500	105	463	1,333
Japan	1,298	1,551			131	131
Philippines	600	4,821	1,000	148	453	2,649
Taiwan (Formosa)	200	920			2,634	11,329
Thailand					362	890
Africa:						
Belgian Congo					221	758
Egypt	500	530			13	166
Union of South Africa			92,400	4,016	2,514	8,876
Oceania: New Zealand			12,625	879		
Total	398,662	93,572	3,136,548	189,836	254,179	818,509

WORLD REVIEW

Angola.—Production of mica increased to 136 metric tons in 1951 from 24 tons in 1950. The principal producing vein was reported nearly exhausted at the end of the year. At the only other mine of importance, production improved slightly in quantity and quality, although classification standards remained low.[12]

Argentina.—The Argentine Government established a price control on mica properly graded and packed in export containers delivered at the warehouse. Prices for stained mica ranged from 1.40 pesos per kilogram ($0.13 per pound) for punch to 170 pesos per kilogram ($15.45 per pound) for AA grade.

Brazil.—The U. S. Geological Survey recently released a publication on the geologic relations of pegmatites, production statistics and other information relative to mica in Minas Gerais, Brazil.[13]

Canada.—Sales of mica totaled 1,328 metric tons in 1951, a decline from the 1,760 tons reported in 1950. The Purdy mica mine at Eau Claire, Ontario, an outstanding producer of muscovite during World War II but closed in 1945, was reopened in 1951.[14] General geology, occurrence, and origin of mica in southeastern Ontario was discussed in an article.[15]

India.—A book of great interest and practical value covering all aspects of the India mica industry was published during 1951. Discussions of the geology, methods of prospecting, mining, and marketing mica are contained in this book.[16] An abstract of an article on Mica Industry of India—Its History and Development was published by the Bureau of Mines.[17]

The Mica Advisory Committee met in December 1951, at Jaipur, Rajasthan, to consider a number of proposals. One of them was that licenses for mica mining in Rajasthan be restricted to check overproduction of mica. The committee decided to recommend that export of scrap mica be banned for a year and advised the Railway Board to consider the use of funds collected under the Mica Mines Labor Welfare Act 1946 for road construction in the mica-mining areas. Fixing of mica prices was not proposed since the committee was of the opinion that there was no danger of the fall in prices in the United States adversely affecting the Indian mica industry.[18]

[12] Bureau of Mines, Mineral Trade Notes: Vol. 35, No. 2, August 1952, p. 31.
[13] Pecora, W. T., Klepper, M. R., Larrabee, D. M., Barbosa, A. L. M., and Frayha, Resk, Mica Deposits in Minas Gerais, Brazil: U. S. Geol. Survey Bull. 964–C, 1950, 100 pp.
[14] Canadian Mining and Metallurgical Bulletin, Mica Mine: vol. 44, No. 466, February 1951, p. 122.
[15] Currie, J. B., The Occurrence and Relationship of Some Mica and Apatite Deposits in Southeastern Ontario: Econ. Geol., vol. 46, No. 7, November 1951, pp. 765–778.
[16] Rajgarhia, Chand Mull, Mining, Processing, and Uses of Indian Mica: McGraw-Hill Book Co., Inc., 1951, 388 pp.
[17] Sahana, D. B., Mica Industry of India—Its History and Development: Metal Market Rev., 3d Ann. Number, February 1951, pp. 165–169; abs. in Bureau of Mines, Mineral Trade Notes: Vol. 32, No. 4, April 1951, pp. 41–44.
[18] Bureau of Mines, Mineral Trade Notes: Vol. 33, No. 6, December 1951, pp. 44–46.

TABLE 11.—World production of mica, 1945–51, by countries, in metric tons [1]

[Compiled by Helen L. Hunt]

Country [1]	1945	1946	1947	1948	1949	1950	1951
North America:							
Canada (sales)	3,195	3,955	3,773	3,584	1,583	[2] 1,760	1,328
Guatemala [3]	1	4					
Mexico (exports)	409	81	[2] 272	27	(4)	(4)	(4)
United States (sold or used by producers):							
Block	589	489	189	122	233	262	270
Scrap	37,249	48,627	45,175	47,316	29,806	62,922	65,200
South America:							
Argentina	719	430	(4)	(4)	[5] 273	[5] 308	(4)
Brazil	1,016	1,639	1,226	1,898	[5] 558	[5] 824	[5] 1,350
Peru	491	207	2				(4)
Uruguay		6	14	2	2	1	1
Europe:							
Austria	65	[2] 39	78	[2] 90	253	368	307
Italy	42	52	16	23	(4)	(4)	(4)
Norway (exports)	564	224	169	241	113	571	547
Portugal			3				(4)
Spain	18	4	12	11	9	14	11
Sweden	126	69	155	64	61	(4)	(4)
Asia:							
Ceylon	1	(6)	(6)				(6)
India	[5] 4,859	[5] 10,675	[5] 9,788	[5] 18,384	[5] 13,743	[2 5] 16,579	11,112
Korea:							
Korea, Republic of	95	(4)	(4)	(4)	(4)	(4)	(4)
North Korea							
Africa:							
Angola	20	31	89	108	57	24	136
Eritrea		(4)	3	[2] 1	(6)	1	
French Morocco		5		144	54	[2] 74	37
Kenya				(4)	4	6	1
Madagascar	620	468	450	507	959	[2] 819	958
Mozambique	2	2	1	1	103	[2] 41	11
Northern Rhodesia	7	[2] 1			3	2	6
Southern Rhodesia	196	335	296	293	303	407	348
Tanganyika (exports)	250	342	71	75	99	136	71
Uganda	6	(6)		2	2	(6)	(6)
Union of South Africa	1,131	1,785	2,008	1,362	1,066	1,371	1,779
Oceania:							
Australia	158	229	371	427	736	738	573
New Zealand	(6)						
Total (estimate)	60,000	80,000	77,000	87,000	64,000	[2] 104,000	101,000

[1] In addition to countries listed, mica is also produced in China, Colombia, Ethiopia, Rumania, and U. S. S. R., but data on production are not available; estimates for these countries are included in total.
[2] Revised figure.
[3] Imports into United States.
[4] Data not available; estimate by senior author of chapter included in total.
[5] Exports.
[6] Less than 0.5 ton.

Madagascar.—Production of phlogopite mica was 958 metric tons in 1951, compared to 819 tons (revised) for 1950. The output in 1951 consisted of 70 metric tons of block mica and 888 tons of splittings. About 90 metric tons of block mica and 593 tons of splittings together valued at 169,236,028 francs were exported, of which the United States received 87,783,406 francs worth.[19]

The ECA purchased 150 metric tons of phlogopite mica in 1951 from Syndicat du Mica de Madagascar.[20] This was the first Marshall Plan purchase of Madagascan mica.

As of January 18, 1951, the export tax on mica was reduced from 7 percent to 5 percent ad valorem.[21]

[19] Bureau of Mines, Mineral Trade Notes: Vol. 35, No. 3, September 1952, pp. 44–45.
[20] Rock Products, vol. 54, No. 3, March 1951, p. 65.
[21] Bureau of Mines, Mineral Trade Notes: Vol. 32, No. 2, February 1951, p. 33.

Molybdenum

By Robert W. Geehan

GENERAL SUMMARY

MOLYBDENUM and many other alloying metals were in short supply in 1951, and industry and the Government took steps to increase production and eliminate nonessential uses. The metal was employed in certain alloys to replace other ferroalloy metals that were even scarcer; this was particularly true of tool steel, where molybdenum replaced tungsten. During the early part of the year exports of molybdenum concentrates were at a very low level, but foreign trade was resumed at a more normal rate in the second half of 1951. Shipments for export of molybdic oxide, calcium molybdate, ferromolybdenum, and other primary products decreased 29 percent in 1951; production, on the other hand, increased 29 percent. Because of the increased demand for molybdenum concentrates in 1951, the quantity of concentrates converted to oxide was 29 percent more than in 1950. The output of concentrates increased in each quarter-year period from the last quarter of 1949 through the second quarter of 1951; however, during the third and fourth quarters of 1951 there was a slight decrease.

Production and shipments of molybdenum concentrates were 36 percent more and 15 percent less, respectively, in 1951 than in 1950. Colorado advanced from second to first place as a molybdenum-producing State and replaced Utah, which dropped to second place.

Industry stocks of molybdenum concentrates were 17 percent higher at the end of 1951 than at the close of 1950, and stocks of molybdenum products held by producers were 103 percent more.

There was no change in the quoted price of molybdenum concentrates in 1951.

TABLE 1.—Salient statistics of molybdenum concentrates in the United States, 1947–51

	Molybdenum contained, thousands of pounds				
	1947	1948	1949	1950	1951
Production	27,047	26,706	22,530	28,480	38,855
Shipments (including exports)	22,190	29,669	23,280	44,544	37,955
Exports [1]	2,989	4,132	5,320	6,235	3,729
Imports for consumption			48	3	4
Consumption	20,221	25,156	19,960	26,029	33,691
Stocks (industry), Dec. 31 [2]	23,661	21,206	19,159	[3] 4,326	5,058

[1] Include roasted concentrates.
[2] At mines and at plants making molybdenum products.
[3] Revised figure.

GOVERNMENT REGULATIONS

To stimulate the production of molybdenum the Government entered a long-term contract with Climax Molybdenum Co. in 1950; this contract was modified in 1951 to call for still greater output. Certificates of necessity covering a portion of the cost of new facilities were issued. Negotiations with copper producers for expanded production were initiated, and an increase in output of byproduct molybdenum was expected to result; similar negotiations with potential producers of molybdenum took place to lead to a further increase in direct production.

Several orders, designed to conserve the metal and provide for control of its distribution, were issued and are listed below:

National Production Authority orders:

M–33. Allowable inventory.
M–52. Reduced the percentage of molybdenum content which could be used in certain stainless steels.
M–1. Amended April 6. Established procedure for virtually complete control over the use of ferro-alloys in the production of alloy iron, steel, or nonferrous products.
M–80. Modification of above regulations.
M–81. Established procedure for control of substantially pure tungsten and molybdenum.
M–30. This order applied to tungsten but led to the use of increased amounts of molybdenum in tool steel.

Defense Minerals Administration orders (later Defense Materials Procurement Agency orders):

MO–8. Allocation of molybdenum ore and concentrates.

Office of Price Stabilization.

The general ceiling price regulation governed molybdenum concentrates and primary products.

The International Materials Conference Committee on Molybdenum and Tungsten issued allotments covering distribution of these metals which had been approved by the governments of the member nations. These agreements were in force during the third and fourth quarters of 1951. The molybdenum allotment for the third quarter was as follows, in metric tons of metal: United States 3,420, United Kingdom 515, France 195, Germany 125, Sweden 100, reserve 45. It was agreed that "normal" shipments, for export, of primary products would be continued by these nations. The distribution for the fourth quarter was as follows, in metric tons of metal: United States 3,620, United Kingdom 538, France 232, Germany 157, Sweden 106, Japan 40, Italy 20, Netherlands 5, and reserve 2. These quantities included specific allowances for metal to be exported as primary products as follows: United States 90, United Kingdom 25, France 25, Germany 1, and Sweden 13. Later in the quarter a small additional distribution was made to cover a 170-metric ton production that had not been expected; the amounts of distribution and deductions for export of products were: United States 116–3, United Kingdom 17–1, France 7–1, Germany 5–0, Sweden 3–0, Italy 1–0, Japan 1–0, reserve 20.

DOMESTIC PRODUCTION

During 1951 the industry-Government program for expanding production of molybdenum was continued. Production of concentrates totaled 38,855,000 pounds (contained molybdenum), an increase of

36 percent over 1950. In addition, development and construction done during 1951 at the Climax deposit were expected to increase productive capacity in future years. A strike at western copper mines temporarily halted production of byproduct molybdenum during the third quarter of 1951.

The chief mineral of molybdenum is molybdenite (MoS_2), which comprised virtually the entire output in 1951; powellite [$Ca(Mo, W)O_4$] contributed a relatively small quantity. The increased use of tungsten concentrates containing an appreciable amount of powellite provided a small amount of molybdenum that does not appear in the statistical tables. Wulfenite ($PbMoO_4$), once mined from several deposits in southwestern United States, has not been produced since 1944.

Molybdenite is produced at mines operated chiefly for molybdenum and as a byproduct of mines operated mainly for copper or tungsten. The molybdenite content of raw ore mined at the former ranges from about 0.4 to 1.5 percent; at the latter the range is about 0.015 to 0.055 percent. In both cases, a molybdenite concentrate is produced; the molybdenite content of the concentrates shipped ranges from about 57 to 94 percent, while 90 percent is considered a standard grade for price quotations.

Molybdenum was produced in six States in 1951; Colorado led, followed in order by Utah, Arizona, New Mexico, Nevada, and California. Output of mines operated solely or almost solely for molybdenum was 22,816,000 pounds in 1951, an increase of 89 percent from 1950 whereas byproduct concentrates from copper and tungsten operations totaled 16,039,000 pounds, a decrease of 2 percent. Byproduct molybdenum represented 41 percent of the total concentrates produced in 1951 compared with 58 percent in 1950.

Shipments of molybdenum concentrates were 37,955,000 pounds (contained molybdenum) in 1951, a decrease of 15 percent from 1950. These shipments comprised 34,685,000 pounds to domestic consumers and 3,270,000 pounds for export.

TABLE 2.—Molybdenum in ore and concentrates produced and shipped from mines in the United States, 1942–51

Year	Production (thousands of pounds)	Shipped from mines		Year	Production (thousands of pounds)	Shipped from mines	
		Weight (thousands pounds) [1]	Value (thousands of dollars) [2]			Weight (thousands of pounds) [1]	Value (thousands of dollars) [2]
1942	56,942	66,437	47,275	1947	27,047	22,190	15,178
1943	61,667	53,955	38,500	1948	26,706	29,669	20,418
1944	38,679	39,423	27,999	1949	22,530	23,280	19,332
1945	30,802	33,683	23,976	1950	28,480	44,544	37,729
1946	18,218	16,787	11,529	1951	38,855	37,955	36,177

[1] Figures for 1942–44 represent shipments from mines, plus concentrates converted to oxide by producer at Miami, Ariz.; those for 1945–51 represent shipments to domestic and foreign customers, plus concentrates converted to oxide at Miami, Ariz., and Langeloth, Pa.
[2] Largely estimated by Bureau of Mines.

Arizona.—The Miami Copper Co. has been a regular producer of molybdenum concentrates since 1938. They are recovered as a byproduct of its copper operations at Miami, Ariz., and are converted

to molybdic oxide at the same location. The Phelps Dodge Corp. produced 359 tons of molybdenite concentrates in 1951 as a byproduct of copper mining at its Morenci operations. The Bagdad Copper Corp. began to recover molybdenite concentrates during 1951 and produced 84 tons during the year. Concentrates produced by Phelps Dodge Corp. and Bagdad Copper Corp. are shipped to eastern plants for conversion to products. The S. W. Shattuck Chemical Co. operated the New Year's Eve mine, near Twin Buttes, primarily for molybdenum and produced 31 tons of concentrate in 1951, which was shipped to its Denver, Colo., plant for conversion to oxide and other products. Operations at this mine were discontinued October 31, 1951.

Output from Arizona was 76 percent more than in 1950; as a result, the State advanced from fourth to third place as a producer of molybdenum.

California.—California remained in sixth place as a producer of molybdenum in 1951. The only producer in California was the United States Vanadium Corp. at Bishop, where the metal is recovered as a byproduct of tungsten production. Recovery of molybdenum was 38 percent less than in 1950.

Colorado.—As a result of a 90-percent increase in production, Colorado advanced to first place as a producer of molybdenum in 1951. The Climax Molybdenum Co., operating its world-famous deposit near Climax, Colo., was the only producer of molybdenum concentrates in Colorado during 1951. The following data have been abstracted from the firm's annual report for 1951:

Production in 1951 was 22,538,739 pounds of molybdenum contained in concentrates, contrasted to 11,903,043 pounds in 1950. The mine produced 4,566,548 tons of ore during the year 1951, or substantially at mill capacity. During 1951 approximately 259,000 pounds of tungsten, contained in the form of concentrate, were produced, compared with 162,000 pounds in 1950. In 1951 the byproducts plant for recovery of tungsten, pyrite, tin concentrate, monazite, and topaz was limited to the treatment of residues from about 8,000 tons per day of ore as mined. After February of 1952 the capacity will be 20,000 tons.

An expansion program underway is planned to increase primary mill capacity to 20,000 tons per day. Major elements of facility expansion in addition to the mill include one of the largest gyratory crushers ever built, auxiliary crushing equipment, a 4,700-foot covered conveyor system, additional housing for employees, a reservoir for domestic water supply, a 4-mile 26-inch diameter mill-water pipeline, and the byproducts plant enlargement.

Steps are being taken to expand the broken ore reserve, which was greatly depleted during World War II, to 20,000,000 tons. This quantity of broken ore is needed to maintain an operation at the projected rate of 20,000 tons per day.

The Climax deposit is developed from long adits, and most of the ore is produced by a caving method. However, some ore is produced from an opencut. Slushing practice [1] and automatic traffic controls [2] have been described in articles published in 1951.

Nevada.—In 1951, the Nevada Mines Division of the Kennecott Copper Corp. continued to be the only producer of molybdenite concentrates in Nevada. The concentrates are recovered as a byproduct of the McGill concentrator, where copper ores from the company Ruth and Copper Flat operations and from the Emma Nevada group

[1] McGlothlin, Wm. K., and Henderson, R., Climax Slushing Practice: Min. Cong. Jour., vol. 37, No. 7, July 1951, pp. 26-29, and vol. 37, No. 8, August 1951, pp. 24-27.
[2] Engineering and Mining Journal, Automatic Traffic Controls: Vol. 152, No. 5, May 1951, pp. 94-95.

of Consolidated Coppermines Corp. are milled. The output of concentrates was 34 percent less than in 1950.

Small amounts of molybdenum were also recovered from tungsten ore and concentrate produced in Nevada and treated at the Bishop, Calif., plant of U. S. Vanadium Corp. or consumed at steel plants. The former production is included with California, and the latter is not tabulated because of lack of data.

New Mexico.—The Chino Mines Division of the Kennecott Copper Corp., Hurley, and the Molybdenum Corp. of America, Questa, continued to be the only producers of molybdenite in New Mexico in 1951. At Hurley, where molybdenite has been recovered as a byproduct of copper operations since 1937, production in 1951 was 30 percent more than in 1950. The Questa mine, which is operated for molybdenum only, was opened in 1919 and since 1923 has been a regular producer. A portion of the output is now from tailings produced in prior years. Output in 1951 was 24 percent less than in 1950. Concentrates produced at Questa are shipped to the processing plant of the Molybdenum Corp. of America at Washington, Pa., where the company produces ferromolybdenum, calcium molybdate, molybdic oxide, and other molybdenum products.

Utah.—Utah was the second largest molybdenum-producing State in 1951. The only producer is the Utah Copper Division of the Kennecott Copper Corp., which since 1936 has been recovering molybdenite as a byproduct of copper at its Arthur and Magna concentrators. Output of molybdenite concentrates in Utah was 5 percent less in 1951 than in 1950.

Washington.—Kromona Mines, Inc., reported that the Kromona mine, Snohomish County, was under development. A road had been completed to the property. Consolidated Mines & Smelting Co., Ltd., reported that its mine in Ferry County was developing ore. There was no production from Washington in 1951.

CONSUMPTION AND USES

Consumption (as measured by shipments to domestic consumers) of molybdenum products in the United States was 9 percent less in 1951 than in 1950. The defense program and restrictions on nonessential uses distorted the normal use pattern; however, the largest single use for molybdenum continued to be as an alloying element in the manufacture of steels, to which it is added as molybdic oxide, calcium molybdate, or ferromolybdenum. In general, when an entire open-hearth heat is to be alloyed to a degree not exceeding 0.8 percent molybdenum, the addition is in the form of molybdic oxide or calcium molybdate; ferromolybdenum is used when higher percentages of molybdenum are desired. A relatively small quantity of molybdenite is used by a few steel companies as an addition to molten metal in the ladle to raise the sulfur content to improve machinability, in addition to gaining the benefit of the contained molybdenum. Of the total molybdenum used in the United States in 1951, it is estimated that about 66 percent was consumed in steels. Smaller quantities (about 25 percent of the total) of molybdenum, chiefly in the form of ferromolybdenum and molybdic oxide, were employed in gray-iron and malleable castings. Molybdenum is also

used in the metallic form in the electrical industry, and alone or in nonferrous alloys for certain high-temperature applications; molybdenum disulfide (molybdenite) is used in special lubricants;[3] and various molybdenum compounds are used as fertilizers, in pigments, in the ceramic industry, and as catalysts.

The most noteworthy changes in the use pattern that resulted from the defense program were increases in use in tool steel, in special high-temperature alloys, and in catalysts and a decrease in the amount used in pigments and in the ceramic industry.

Many references to the possible use of molybdenum as fertilizer are contained in the volume, Bibliography of the Literature on Minor Elements and Their Relation to Plant and Animal Nutrition (4th ed., vol. I, 1948, pp. 724–731, and vol. II, 1951, pp. 90–94), published by Chilean Nitrate Educational Bureau, Inc., 120 Broadway, New York, N. Y. Growth of molybdenum crystals[4] and observations on crystal structure[5] were described in articles published in 1951.

TABLE 3.—Production and shipments of molybdenum products[1] in the United States, 1947–51, in pounds of contained molybdenum

Year	Production	Shipments		
		To domestic consumers	Exports[2]	Total
1947	20,659,700	19,878,500	866,400	20,744,900
1948	24,445,300	23,808,900	1,215,800	25,024,700
1949	19,624,200	15,019,000	1,314,100	16,333,100
1950	25,347,800	32,735,700	1,955,100	34,690,800
1951	32,775,000	29,845,000	1,387,700	31,232,700

[1] Comprises ferromolybdenum, molybdic oxide, and molybdenum salts and metal.
[2] Reported by producers to the Bureau of Mines.

STOCKS

Table 4 shows industry stocks of molybdenum concentrates and products, 1947–51. The industry stocks of both items increased during 1951.

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[3] Climax Molybdenum Co., Molybdenum Disulfide as a Lubricant: New York, 1951, 73 pp. Johnson, Robert L., Godfrey, Douglas, and Bisson, Edmond E., Friction of Solid Films on Steel at High Sliding Velocities: Nat. Advisory Committee for Aeronautics, Tech. Note 1578, April 1948, 65 pp.
Godfrey, Douglas, and Nelson, Erva C., Oxidation Characteristics of Molybdenum Disulfide and Effect of Such Oxidation on Its Role as a Solid-Film Lubricant: Nat. Advisory Committee for Aeronautics, Tech. Note 1882, May 1949, 28 pp.
Johnson, Robert L., Swikert, Max A. and Bisson, Edmond E., Friction and Wear of Hot-Pressed Bearing Materials Containing Molybdenum Disulfide: Nat. Advisory Committee for Aeronautics, Tech. Note 2027, February 1950, 27 pp.
Godfrey, Douglas, and Bisson, Edmond E., Effectiveness of Molybdenum Disulfide as a Fretting-Corrosion Inhibitor: Nat. Advisory Committee for Aeronautics, Tech. Note 2180, September 1950, 29 pp.
Bowden, F. P., Frictional Properties of Porous Metals Containing Molybdenum Disulfide: Research, London, vol. 3, No. 8, Aug. 1950. Bowden, F. P., and Shooter, K. V., Frictional Behavior of Plastics Impregnated with Molybdenum Disulfide: Research, London, vol. 3, No. 8, August 1950.
Milne, A. A., Lubrication of Steel Surfaces with Molybdenum Disulfide: Research, London, vol. 4, No. 2, February 1951.
Boyd, John, and Robertson, B. P., The Friction Properties of Various Lubricants at High Pressures; Trans. Am. Soc. Mech. Eng., vol. 67, No.1, January 1945, pp. 51–56.
White, H. S., and Zei, Dino, Static Friction Tests with Various Metal Combinations and Special Lubricants: Nat. Bureau of Standards, Research Paper 2198, Jour. Research, vol. 46, No. 4, April 1951, pp. 292–298.
[4] Chen, N. K., Madden, R., and Pond, R. B., Growth of Molybdenum Single Crystals: Jour. Metals, vol. 3, No. 6, June 1951, pp. 461–464.
[5] Chen, N. K., and Madden, R., Observations on Cleavage and Polygonization of Molybdenum Single Crystals: Jour. Metals, vol. 3, No. 7, July 1951, pp.531–532.

TABLE 4.—Industry stocks of molybdenum concentrates and products, Dec. 31, 1947–51, in thousands of pounds of contained molybdenum

Year	Concentrates [1]	Products [2]		Total
		Producers	Consumers	
1947	23,661	8,126	2,695	34,482
1948	21,206	7,547	(3)	[4] 28,753
1949	19,159	10,838	(3)	[4] 29,997
1950	[5] 4,326	1,495	(3)	[4] [5] 5,821
1951	5,058	3,037	(3)	[4] 8,095

[1] At mines and at plants making molybdenum products.
[2] Comprises ferromolybdenum, molybdic oxide, and molybdenum salts and metal.
[3] Figure not available.
[4] Excludes stocks of molybdenum products at consumers' plants.
[5] Revised figure.

PRICES

There was no change in the quoted prices for molybdenum concentrates or primary products during 1951. The published price, f. o. b. mines, of molybdenite in concentrates containing 90 percent MoS_2 was 60 cents a pound (equivalent to $1.00 a pound of contained molybdenum). The prices of the principal molybdenum products are based on 1 pound of contained molybdenum, f. o. b. producer's plant. During 1951 the prices quoted were as follows: Molybdic oxide $1.14, calcium molybdate $1.15, ferromolybdenum $1.32, and molybdenum metal $3.00.

FOREIGN TRADE [6]

Imports of molybdenum in ore and concentrates into the United States are normally small; 8,243 pounds (contained molybdenum) was received in 1951 compared with 2,784 pounds in 1950. Some molybdenum ore and concentrates are occasionally imported for conversion to molybdenum products for export; none has been so imported since 1946.

Exports of molybdenum in concentrates (including roasted concentrates) were 3,729,265 pounds (contained molybdenum) in 1951 compared with 6,234,521 pounds in 1950. Exports were at a very low rate during the first half of 1951 (29 percent of the year's total) but rose to a more normal rate in the last half of the year. United Kingdom and Germany were the chief foreign markets in 1951, taking 47 and 20 percent, respectively.

Exports of ferromolybdenum were 1,483,841 pounds (gross weight) [7] in 1951 compared with 1,178,604 pounds in 1950, and those of molybdenum metal and alloys were 109,129 pounds compared with 146,075 pounds in 1950.

Tariff.—The duty on molybdenum ore and concentrates continued to be 35 cents a pound on the metallic molybdenum contained. The General Agreement on Tariff and Trade, Torquay, effective June 6, 1951, reduced the duty on ferromolybdenum, molybdenum metal and powder, calcium molybdate, and other compounds and alloys of molybdenum to 25 cents a pound of contained molybdenum plus 7.5 percent ad valorem; the former rate was 50 cents and 15 percent ad valorem.

[6] Figures on imports and exports (unless otherwise indicated) compiled by M. B. Price and E. D. Page, of the Bureau of Mines, from records of the U. S. Department of Commerce.
[7] Ferromolybdenum contains about 60–65 percent molybdenum.

TABLE 5.—Molybdenum ore and concentrates (including roasted concentrates) exported from the United States, 1949–51, by country of destination

[U. S. Department of Commerce]

Country	1949		1950		1951	
	Molybdenum content (pounds)	Value	Molybdenum content (pounds)	Value	Molybdenum content (pounds)	Value
Austria	5,334	$7,952	20,918	$19,515	9,996	$11,397
Canada	62,289	50,332	226,297	194,187	294,687	313,957
Canal Zone			465	458	700	712
Finland					2,957	7,841
France	1,525,564	1,283,495	674,296	591,249	420,161	397,125
Germany	267,285	246,731	1,105,577	956,329	761,731	786,750
Italy	64,906	61,262	43,420	38,638	135,712	147,408
Japan			40,677	34,197	62,340	51,476
Mexico	5,370	3,250	345	247		
Netherlands	14,700	13,680	61,200	65,000	41,524	50,000
Norway	60,000	56,419				
Sweden	545,761	459,279	274,406	211,195	241,349	257,051
United Kingdom	2,768,571	2,441,723	3,786,920	3,342,637	1,758,108	1,711,739
Total	5,319,780	4,624,123	6,234,521	5,453,652	3,729,265	3,735,456

WORLD REVIEW

United States production of molybdenum in 1951 was 84 percent of estimated world production. Table 6 gives world production by countries.

TABLE 6.—World production of molybdenum in ores and concentrates, 1943–51, by countries, in metric tons [1]

[Compiled by Berenice B. Mitchell]

Country [1]	1943	1944	1945	1946	1947	1948	1949	1950	1951
Australia	15	9	(2)	4	2	2	4	3	1
Austria	5	7	1	20	1	(3)	9	18	19
Canada	178	509	228	184	207	83		28	95
Chile	680	1,051	841	560	402	532	558	965	[4] 2,500
China:									
Manchuria	[5] 516	[5] 516	[5] 30	(3)	(3)	(3)	(3)	(3)	(3)
Other Provinces	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)
Finland	108	110	92	99	70				(3)
France	11	7							(3)
Indochina	2	(2)							
Italy	16	(2)							
Japan	[6] 87	[6] 189	[6] 108	52	18	1		13	43
Korea, Republic of	291	394	54		5	2	11	(3)	(3)
Mexico	1,138	717	468	818	136				
Morocco, French	7			39	32				
Norway	227	248	76	10	98	79	71	62	119
Peru	85	62	29	4	3	2	2	1	3
Sweden	12	20	3			1	5	6	(3)
United States	27,972	17,545	13,972	8,264	12,268	12,114	10,219	12,918	17,625
Yugoslavia	(3)	(3)	215	72			243	174	(3)
Total (estimate)	31,400	21,400	[7] 16,200	10,800	14,000	13,600	11,500	[7] 14,600	21,000

[1] Molybdenum is also produced in Greece, North Korea, Rumania, Spain, Turkey, and U. S. S. R., but production data are not available. Estimates by author of chapter for these countries are included in total.
[2] Less than 0.5 ton.
[3] Data not yet available; estimate by author of chapter included in total.
[4] Estimated exports.
[5] Exports to Japan proper.
[6] Preliminary data for fiscal year ended March 31 of year following that stated.
[7] Revised figure.

Austria.—Output of lead-zinc-molybdenum ore in 1950 was 98,631 metric tons compared with 91,016 tons in 1949. The Bleiberg-Kreuth mine in Carinthia is the principal producer. In the first half of 1951, 2,927 tons of lead concentrate, 3,138 tons of zinc concentrate, and 91 tons of molybdenum concentrate were recovered from 53,592 tons of lead-zinc-molybdenum ore.[8]

Canada.—According to the Dominion Bureau of Statistics, 350,000 pounds of MoS_2 was produced by the Molybdenum Corp. of Canada at La Corne, Quebec.

Chile.—Molybdenum is produced as a byproduct of copper mining in Chile. Based on estimated exports, production of molybdenum reached an alltime high of 2,500 metric tons in 1951; production in 1950 was 965 tons (revised).

Norway.—The following is quoted from Mineral Trade Notes.[9]

Most of the molybdenum produced in Norway has been from the Knaben mine near Egersund on the southwestern coast of Norway. Total molybdenum concentrate output from the Knaben mine through 1950 has been about 9,000 metric tons. About 1,000 tons of concentrate has been produced by other mines. Ore from the Knaben mine contains 0.15 to 0.20 percent MoS_2 and is concentrated by flotation to a 95 percent concentrate. Capacity of the plant is about 800 tons of concentrate a year. Mining was suspended in the summer of 1949 in order to concentrate on development work, which had been neglected under German control during the war. The 1950 output was from ore mined in an opencut near the main mine. Before and during World War II a few small molybdenum mines were worked in the Knaben area, in Talemark in southern Norway, at Oterstrand and Laksaadal in northern Norway, and at Sorumsaasen in the Drammen area near Oslo. Norwegian output of molybdenum concentrate has been as follows (in metric tons):

	1938	*1944*	*1949*	*1950*
Knaben	735	387	128	111
Oterstrand	35	18	------	-------
Sorumsaasen	------	7	------	-------
Others	------	1	------	-------
	770	413	128	111

No estimate of ore reserves is known for the Knaben mine. However, possible ore reserves are large, though of low grade. Other molybdenum deposits that have been worked are small.

U. S. S. R.—No information on the magnitude of production has been published; however, an intensive expansion program was known to be in progress in 1947 at the deposit east of Kounrad near Lake Balkhash.

Yugoslavia.—Production is from the Mackatica mine in Serbia. There is no reliable information on 1951 production, but the increased production expected during the year was probably delayed because of lack of machinery.

[8] Bureau of Mines, Mineral Trade Notes: Vol. 33, No. 4, October 1951, p. 16.
[9] Bureau of Mines, Mineral Trade Notes: Vol. 33, No. 2, August 1951, p. 22.

Natural Gas[1]

By D. S. Colby and B. E. Oppegard

GENERAL SUMMARY

MARKETED production[2] of natural gas in 1950 increased 16 percent to 6,282 billion cubic feet and in 1951 rose another 19 percent to 7,457 billion. Texas, Louisiana, and New Mexico supplied 82 percent of the increase in 1951. Production in Pennsylvania increased after a long static period as the result of discoveries made in 1950.

Consumption of natural gas in the United States in 1951 increased to 7,103 billion cubic feet from 6,026 billion in 1950. North Carolina, South Carolina, Massachusetts, and New Hampshire received natural gas for the first time. Aside from Texas, California and New York

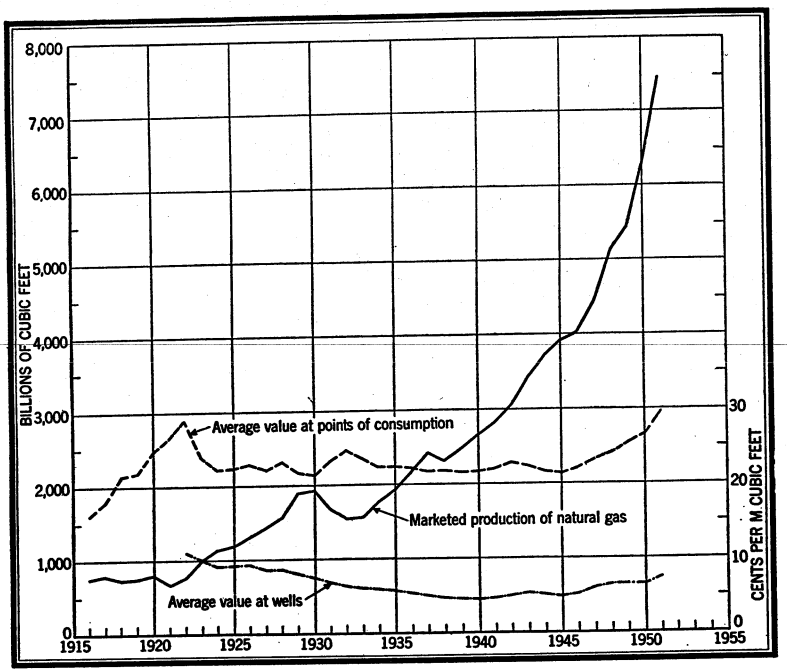

FIGURE 1.—Production and average value of natural gas in the United States, 1916–51.

showed the largest increases in consumption. In each case this increase resulted primarily from completion of an interstate pipeline. The quantities consumed by various classes of consumers in 1951 and the percent change compared with 1950 were as follows: Residential,

[1] Includes final figures for both 1950 and 1951.

[2] Comprises gas either sold or consumed by producers, including losses in transmission, amounts added to storage, and increases in gas in pipelines.

1,475 billion cubic feet (+23 percent); commercial, 464 billion (+20 percent); field, 1,442 billion (+21 percent); petroleum refineries, 538 billion (+18 percent); and all other industrial users, 3,184 billion (+14 percent).

The gross quantity of gas placed in underground storage in 1951 was 348 billion cubic feet, more than 50 percent over 1950. The net increase of gas in underground storage during 1951 was 138 billion cubic feet.

The average value of natural gas at the wellhead rose from 6.5 cents per thousand cubic feet in 1950 to 7.3 cents in 1951. This is the sharpest rise in the average value yet recorded during 1 year. Total value of marketed production at the wellhead in 1951 was $543 million. The total value at point of consumption of all natural gas used in the United States in 1951 was $2,119 million, averaging 29.8 cents per thousand cubic feet. This increase of 3.2 cents over the 1950 average was caused in part by a large expansion of consumption in areas removed from the producing fields where gas has a higher value.

Interstate shipments and exports of natural gas increased 27 percent, maintaining the same rate of increase recorded in 1950.

The number of residential consumers of natural gas increased by 4.5 million to 21.4 million. Half of this increase was in the number of consumers of mixed gas, primarily in New York. The number of commercial consumers increased 0.3 million to 1.6 million.

TABLE 1.—Salient statistics of natural gas in the United States, 1947–51

	1947	1948	1949	1950	1951
MILLION CUBIC FEET					
Supply:					
Marketed production [1]	4,582,173	5,148,020	5,419,736	6,262,060	7,457,359
Withdrawn from storage	86,643	79,035	106,368	175,260	209,428
Total supply	4,668,816	5,227,055	5,526,104	6,457,320	7,666,787
Disposition:					
Consumption	4,426,544	4,945,149	5,195,484	6,026,404	7,102,562
Exports	18,149	18,704	20,054	25,727	24,163
Stored	96,316	136,406	172,051	229,752	347,690
Lost in transmission, etc	127,807	126,796	138,515	175,437	192,372
Total disposition	4,668,816	5,227,055	5,526,104	6,457,320	7,666,787
VALUE					
Production (at wells)—thousand dollars	274,709	333,173	344,034	408,521	542,964
Average per M cubic feet—cents	6.0	6.5	6.3	6.5	7.3

[1] Comprises gas sold or consumed by producers, including losses in transmission, amounts added to storage, and increases in gas in pipelines.

GOVERNMENT REGULATIONS

The United States Supreme Court, in a case involving direct sale of natural gas to an industrial consumer by an interstate gas transmission company,[3] ruled that a State has the right to regulate the sale of natural gas piped across its border if it is to be sold in competition with an established utility.

Secretary of the Interior Oscar L. Chapman on July 27, 1951, approved Bureau of Land Management Circular 1795 requiring all pending and future applicants for natural-gas pipeline rights-of-way

[3] *Panhandle Eastern Pipe Line Co.* v. *Michigan Public Service Commission*, 341 U. S. 329.

across public lands to file a stipulation designed to assure the operation of their lines as common carriers, as provided in the Mineral Leasing Act of 1920.

The Petroleum Administration for Defense issued Order 2, effective August 22, 1951, which, with certain specified exceptions, prohibited extension of natural-gas service to new industrial and central heating customers in 15 States and the District of Columbia. The order was deemed necessary because steel shortages prevented pipeline construction from keeping pace with the demand for gas.

On August 22, 1951, the Federal Power Commission issued Opinion 217 on Docket G–1148, a hearing to determine whether Phillips Petroleum Co. was a "natural-gas company" within the meaning of the Natural Gas Act. Phillips does not engage in the interstate distribution of gas but sells at wholesale to interstate pipeline companies. The decision affirmed the position of the Federal Power Commission as recognizing that it had no jurisdiction over transportation or sales made in the process of production or gathering if exercising jurisdiction interfered with the regulatory functions of the States.

As part of an omnibus tax bill passed by the Texas Legislature, a gathering tax of 0.45 cent per thousand cubic feet was levied on natural gas.

RESERVES

Reserves of natural gas, as estimated by the reserves committee of the American Gas Association, were 193,812 billion cubic feet on December 31, 1951, a net increase in reserves of 8.2 trillion cubic feet from the estimate of the previous year. This is the second largest increase reported since estimates were first made by the American Gas Association in 1945. The largest increases in reserves were the addition of 4.3 trillion cubic feet of nonassociated gas in New Mexico and 3.9 trillion cubic feet of dissolved gas in Texas.

PRODUCTION

GROSS WITHDRAWAL

The gross withdrawal of natural gas in the United States increased 12 percent in 1950 to 8,480 billion cubic feet and 14 percent in 1951 to 9,689 billion. There has been a tendency in the last 5 years for production from gas wells to grow relatively more rapidly than that from oil wells. In 1951, 73 percent of the increase in gross withdrawals of natural gas was from gas wells whereas only 67 percent of the gross withdrawals total itself was from gas wells. In 1951 this tendency was most pronounced in New Mexico due to development of the San Juan Basin; however, Kansas, Louisiana, and Texas were among the States following in the same direction.

On the whole, repressuring continued its gradual rise. Oklahoma showed a large increase in 1951 owing to completion of a cycling plant. Texas declined slightly in 1951.

TABLE 2.—Estimated proved recoverable reserves of natural gas in the United States, 1950–51, in million cubic feet [1]

[Committee on Natural-Gas Reserves, American Gas Association]

State	Reserves [2] as of Dec. 31, 1950	Changes in reserves during 1951			
		Extensions and revisions [2]	Discoveries of new fields and new pools in old fields [2]	Net change in underground storage [3]	Net production [4]
Arkansas	907, 593	27, 545	38, 965	−4	42, 785
California [5]	9, 760, 386	170, 711	66, 827	−4, 317	511, 162
Colorado	1, 115, 473	22, 955	24, 504		24, 481
Illinois	229, 893	29, 795	5, 650		38, 205
Indiana	31, 190	2, 520	3, 340	297	6, 540
Kansas	13, 790, 834	76, 206	40, 971	2, 326	452, 839
Kentucky	1, 330, 583	59, 386	9, 520	−401	73, 500
Louisiana [5]	28, 533, 266	1, 147, 998	480, 933		1, 157, 166
Michigan	195, 074	8, 786	230	10, 347	11, 412
Mississippi	2, 519, 206	86, 321	35, 477	40	201, 075
Montana	797, 361	69, 336		3, 069	41, 659
Nebraska	44, 106	30, 947	26, 646		5, 889
New Mexico	6, 990, 670	4, 785, 791	132, 187	−2, 834	315, 835
New York	64, 779	100		4, 814	2, 900
Ohio	658, 862	32, 527	8, 450	30, 696	41, 400
Oklahoma	11, 634, 287	769, 182	117, 604	10, 380	727, 116
Pennsylvania	627, 171	38, 272	33, 000	43, 012	122, 000
Texas [5]	102, 404, 077	5, 311, 803	1, 854, 153	1, 330	3, 918, 134
Utah	84, 752	8, 784	6, 154		3, 845
West Virginia	1, 650, 675	147, 107	21, 900	33, 817	182, 000
Wyoming	2, 194, 989	161, 115	66, 518	179	82, 503
Other States [6]	27, 472	26, 419	66, 356		4, 495
Total	185, 592, 699	13, 013, 606	3, 039, 385	132, 751	7, 966, 941

State	Reserves of Dec. 31, 1951 [2]				
	Nonassociated [7]	Associated [8]	Dissolved [9]	Underground storage [10]	Total
Arkansas	478, 298	149, 733	301, 287	1, 996	931, 314
California [5]	2, 615, 335	2, 155, 881	4, 696, 387	14, 842	9, 482, 445
Colorado	487, 134	42, 142	609, 175		1, 138, 451
Illinois	4, 333	10, 000	212, 800		227, 133
Indiana	3, 500	4, 500	21, 760	1, 047	30, 807
Kansas	13, 015, 271	133, 419	277, 181	31, 627	13, 457, 498
Kentucky	1, 253, 003		61, 400	11, 185	1, 325, 588
Louisiana [5]	23, 147, 675	3, 829, 371	2, 027, 985		29, 005, 031
Michigan	119, 011		41, 366	42, 648	203, 025
Mississippi	1, 721, 717	405, 552	312, 660	40	2, 439, 969
Montana	700, 358	39, 469	80, 717	7, 563	828, 107
Nebraska	67, 351	7, 906	20, 553		95, 810
New Mexico	8, 273, 960	2, 351, 741	949, 026	15, 252	11, 589, 979
New York	50, 642		528	15, 623	66, 793
Ohio	551, 825		32, 800	104, 510	689, 135
Oklahoma	7, 368, 214	1, 007, 720	3, 393, 654	34, 749	11, 804, 337
Pennsylvania	480, 191		38, 400	100, 864	619, 455
Texas [5]	70, 322, 632	18, 228, 896	17, 099, 881	1, 820	105, 653, 229
Utah	78, 720		17, 125		95, 845
West Virginia	1, 504, 366		77, 150	89, 983	1, 671, 499
Wyoming	1, 479, 958	354, 385	505, 263	692	2, 340, 298
Other States [6]	47, 913		67, 839		115, 752
Total	133, 771, 407	28, 720, 715	30, 844, 937	474, 441	193, 811, 500

[1] Volumes are reported at a pressure base of 14.65 pounds per square inch absolute and at a standard temperature of 60° F.
[2] Excludes gas loss due to recovery of natural-gas liquids.
[3] The net difference between gas stored in and gas withdrawn from underground storage reservoirs.
[4] Net production equals gross withdrawals less gas injected into underground reservoirs; changes in underground storage are excluded. December production partly estimated.
[5] Includes offshore reserves.
[6] Includes Alabama, Florida, Maryland, Missouri, North Dakota, and Virginia.
[7] Nonassociated gas is free gas not in contact with crude oil in the reservoir.
[8] Associated gas is free gas in contact with crude oil in the reservoir.
[9] Dissolved gas is gas in solution with crude oil in the reservoir.
[10] Gas held in underground reservoirs for storage purposes only.

TABLE 3.—Gross withdrawals and disposition of natural gas in the United States, 1950–51, by States, in million cubic feet

State	Gross withdrawals [1]			Disposition		
	From gas wells	From oil wells	Total	Marketed production [2]	Repressuring	Vented and wasted [3]
1950						
Arkansas	38,260	31,160	69,420	48,047	16,844	4,529
California	225,130	548,550	773,680	558,398	204,142	11,140
Colorado	7,300	9,330	16,630	11,168	471	4,991
Illinois	500	37,200	37,700	13,285	2,350	22,065
Indiana	250	6,260	6,510	956	111	5,443
Kansas	311,400	89,300	400,700	364,024	1,352	35,324
Kentucky	68,000	8,480	76,480	73,316		3,164
Louisiana	883,320	253,500	1,136,820	831,771	191,466	113,583
Michigan	12,500	6,300	18,800	11,250	3,453	4,097
Mississippi	120,430	40,760	161,190	114,153	42,334	4,703
Montana	38,000	3,200	41,200	39,186	102	1,912
New Mexico	47,890	193,960	241,850	212,909	2,808	26,133
New York	3,220	150	3,370	3,336		34
Ohio	45,690	1,700	47,390	43,163	10	4,217
Oklahoma	378,510	280,330	658,840	482,360	29,333	147,147
Pennsylvania	87,650	3,800	91,450	91,137	209	104
Texas	3,099,600	1,308,200	4,407,800	3,126,402	889,850	391,548
Utah	3,950	180	4,130	3,950		180
West Virginia	186,400	6,000	192,400	189,980	228	2,192
Wyoming	44,000	48,050	92,050	62,062	11,483	18,505
Other States [4]	1,200	40	1,240	1,207		33
Total	5,603,200	2,876,450	8,479,650	6,282,060	1,396,546	801,044
1951						
Arkansas	37,060	30,050	67,110	44,656	18,911	3,543
California	200,200	611,800	812,000	566,751	239,955	5,294
Colorado	10,400	16,600	27,000	14,128	1,866	11,006
Illinois	500	43,300	43,800	11,425	1,394	30,981
Indiana	200	6,400	6,600	845	70	5,685
Kansas	379,500	80,700	460,200	417,538	1,401	41,261
Kentucky	73,100	5,000	78,100	76,097		2,003
Louisiana	1,088,900	302,700	1,391,600	1,054,199	202,383	135,018
Maryland	3,422		3,422	3,422		
Michigan	10,000	5,300	15,300	11,194	672	3,434
Mississippi	175,500	83,400	258,900	158,845	41,718	58,337
Montana	34,000	3,100	37,100	36,424	384	292
Nebraska	3,100	900	4,000	3,895		105
New Mexico	120,600	208,500	329,100	300,169	5,105	23,826
New York	3,100	150	3,250	3,214		36
Ohio	40,000	1,500	41,500	38,879	12	2,609
Oklahoma	420,000	338,000	758,000	538,756	57,119	162,125
Pennsylvania	126,000	3,100	129,100	128,715	260	125
Texas	3,518,500	1,411,600	4,930,100	3,781,136	856,930	292,034
Utah	3,690	160	3,850	3,733		117
West Virginia	188,000	5,000	193,000	191,146	373	1,481
Wyoming	45,000	50,600	95,600	71,508	10,274	13,818
Other States [5]	680	60	740	684		56
Total	6,481,452	3,207,920	9,689,372	7,457,359	1,438,827	793,186

[1] Marketed production plus quantities used in repressuring, vented and wasted.
[2] Gas sold or consumed by producers (*see* table 1, footnote 1.).
[3] Includes gas (mostly residue) blown to the air, but does not include direct waste on producing properties, except where data are available.
[4] Alabama, Florida, Maryland, Missouri, Nebraska, North Dakota, Tennessee, and Virginia.
[5] Alabama, Florida, Missouri, North Dakota, South Dakota, Tennessee, and Virginia.

STORAGE

Underground storage has been growing at an increasing annual rate. The total quantity of gas stored during 1951 was 51 percent above the 1950 figure, which in turn was 34 percent above the 1949 figure. West Virginia showed the largest increase in total volume stored in 1949–51. Also contributing to the large expansion were Michigan, Ohio, and Pennsylvania. Illinois, which previously had only negligible quantities in underground storage, in 1951 reported 1.6 billion cubic feet placed in storage as the result of a new project.

The American Gas Association reported that the number of underground storage projects increased from 125 in 1950 to 142 in 1951, and storage capacity from 774 to 916 billion cubic feet.

TABLE 4.—Natural gas stored underground in and withdrawn from storage fields, 1950–51, by State of location, in million cubic feet

State	1950			1951		
	Total stored	Total withdrawn	Net stored	Total stored	Total withdrawn	Net stored
Arkansas	72	220	−148	817	644	173
California	16,621	12,762	3,859	12,571	17,524	−4,953
Illinois	5	79	−74	1,606	445	1,161
Indiana	563	472	91	796	508	288
Kansas	13,634	13,676	−42	15,481	15,528	−47
Kentucky	4,652	6,131	−1,479	6,659	6,324	335
Michigan	29,958	22,182	7,776	54,409	34,755	19,654
Mississippi				40		40
Montana	2,303	942	1,361	3,479	538	2,941
New Mexico	8,066		8,066	2,668	4,823	−2,155
New York	6,322	4,937	1,385	10,311	5,577	4,734
Ohio	43,276	35,033	8,243	63,117	34,663	28,454
Oklahoma	13,383	5,144	8,239	17,836	7,308	10,528
Pennsylvania	35,179	33,920	1,259	72,620	29,797	42,823
Texas	3,958	1,030	2,928	2,544	1,548	996
West Virginia	50,075	37,635	12,440	81,312	47,726	33,586
Wyoming	1,685	1,097	588	1,424	1,720	−296
Total	229,752	175,260	54,492	347,690	209,428	138,262

MARKETED PRODUCTION [4]

Marketed production increased 16 percent to 6,282 billion cubic feet in 1950 and 19 percent to 7,457 billion in 1951.

Maryland and Nebraska reported a marketed production of natural gas for the first time in 1950, when pipeline connections were made to gas wells in these two States.

Increased marketed production in Colorado resulted from completion of a natural-gasoline plant at Rangely. In Wyoming increased marketed production was made possible by construction of sulfur- and natural-gasoline recovery plants and of a pipeline from Worland, Wyo., to Cabin Creek, Mont.

Most of the increased output of Kansas came from the Hugoton field. In New Mexico the development of the San Juan Basin boosted production. Most of the additional production of Mississippi came from the Baxterville and Gwinville gasfields. Pennsylvania's increased production resulted from the discovery and development of the Leidy gasfield.

Ten states showed a decline in marketed production over the 2-year period; these were Arkansas, Florida, Illinois, Michigan, Missouri, New York, North Dakota, Ohio, Utah, and Virginia. All except Florida also reported declines in 1949.

[4] *See* footnote 1, table 5.

TABLE 5.—Marketed production of natural gas in the United States, 1947–51, by States [1]

State	Quantity (million cubic feet)					Estimated value at wells (thousand dollars)	
	1947	1948	1949	1950	1951	1950	1951
Alabama				2	1	[2]	[2]
Arkansas	50,630	53,946	47,788	48,047	44,656	1,682	1,786
California	560,510	570,954	550,903	558,398	566,751	66,449	82,745
Colorado	8,392	8,967	8,490	11,168	14,128	436	608
Florida	8	27	39	8	10	[2]	1
Illinois	17,023	14,062	12,391	13,285	11,425	1,342	1,748
Indiana	877	553	334	956	845	67	83
Kansas	209,321	245,189	294,078	364,024	417,538	24,026	33,821
Kentucky	96,459	70,095	51,851	73,316	76,097	14,443	16,513
Louisiana	581,398	686,061	732,845	831,771	1,054,199	44,084	61,143
Maryland				373	3,422	74	684
Michigan	18,812	14,981	14,753	11,250	11,194	1,485	1,657
Mississippi	40,037	59,899	68,062	114,153	158,845	7,192	10,007
Missouri	38	27	24	21	14	3	2
Montana	34,282	36,551	35,291	39,186	36,424	2,077	2,003
Nebraska				17	3,895	2	499
New Mexico	142,740	194,749	204,961	212,909	300,169	6,387	11,406
New York	4,600	4,705	3,693	3,336	3,214	837	807
North Dakota	442	643	533	608	456	31	24
Ohio	68,946	65,619	46,512	43,163	38,879	8,374	7,854
Oklahoma	419,010	480,573	435,262	482,360	538,756	23,636	28,554
Pennsylvania	91,971	87,578	84,739	91,137	128,715	23,058	35,654
South Dakota	6	2	1		7		[2]
Tennessee	80	127	83	132	132	13	12
Texas	1,992,704	2,289,923	2,588,921	3,126,402	3,781,136	146,941	204,181
Utah	6,040	6,610	6,126	3,950	3,733	237	246
Virginia	64	74	65	46	64	4	10
West Virginia	192,233	203,681	181,176	189,980	191,146	31,917	35,553
Wyoming	45,550	52,424	50,815	62,062	71,508	3,724	5,363
Total	4,582,173	5,148,020	5,419,736	6,282,060	7,457,359	408,521	542,964

[1] Comprises gas either sold or consumed by producers, including losses in transmission, amounts added to storage, and increases in gas in pipelines.
[2] Less than $500.

NUMBER OF WELLS

In 1951, 3,030 gas wells were drilled in the United States, 187 more than in the previous year. In New Mexico, 254 gas wells were drilled in 1951 compared with 88 in 1950 and 53 in 1949. This rapid rise was due primarily to development of the San Juan Basin. The number of gas wells drilled in Texas increased by 79 in 1951 but was still below the number drilled in 1949. The total number of producing wells, which increased by approximately 1,600 in 1950, was held to a much smaller increase in 1951 by indicated abandonment of a large number of wells in Pennsylvania and Ohio.

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TABLE 6.—Gas wells in the United States, 1949–51, by States

State	Producing Dec. 31, 1949	Drilled during 1950 [1]	Producing Dec. 31, 1950	Drilled during 1951 [1]	Producing Dec. 31, 1951
Arkansas	168	2	179	10	190
California	395	51	440	40	360
Colorado	30	12	36	12	35
Illinois	100	17	90	10	50
Indiana	750	51	750	18	650
Kansas	3,300	400	3,700	376	4,000
Kentucky	3,610	157	3,500	155	3,570
Louisiana	2,400	196	2,550	176	2,690
Michigan	650	30	550	20	400
Mississippi	75	9	140	9	190
Missouri	[2] 90	10	59	2	30
Nebraska		10		13	
Montana	800	20	820	8	830
New Mexico	270	88	360	254	570
New York	1,400		1,400		1,380
Ohio	6,700	278	6,800	226	6,300
Oklahoma	3,500	249	3,600	265	3,600
Pennsylvania	18,400	210	18,500	239	17,700
Tennessee	18		18	2	20
Texas	[3] 6,500	647	7,300	726	8,300
West Virginia	[3] 14,000	384	13,900	419	14,000
Wyoming	150	18	165	21	165
Alabama, Maryland, North Dakota, South Dakota, Utah, and Virginia	40	4	43	29	70
Total	[3] 63,346	2,843	64,900	3,030	65,100

[1] From Oil and Gas Journal.
[2] Combined to avoid disclosure of individual company operations.
[3] Revised.

DEVELOPMENT AND PRODUCTION BY STATES [5]

Arkansas.—J. W. Sanders, chief engineer, Arkansas Oil and Gas Commission, reported that in 1951 gas production from the dry-gas fields in northwest Arkansas increased slightly to 8,182 million cubic feet from 8,017 million in 1950. Gas production from the oil and condensate wells in south Arkansas declined. Marketed production of all gas in 1951 was 44,656 million cubic feet compared with 48,047 million in 1950.

Five wildcat wells were drilled in northwest Arkansas, 1 of which resulted in a new discovery in Johnson County known as Low Gap field. Eight development wells were drilled in the northwest section, of which 6 were productive gas wells. Increasing interest was being shown in the northwestern part of the State.

California.—The Conservation Committee of California Oil Producers reported that the number of dry-gas well completions in 1951 was 11 less than in 1950. One new dry-gas field was discovered—Wild Goose field in Butte County. Of 31 new field wildcats drilled to find gas, only 1 was successful.

Reserves of both dry gas and oil-well gas continued to decline, as they have since 1948. Total production of oil-well gas in 1951 was the highest in California history; however, marketed production was only slightly higher than in 1950 because of the large increase in repressuring. Dry-gas production declined, largely because of the increased availability of gas brought in from Texas and New Mexico. By the end of 1951, imports of natural gas into California reached a total of approximately 815 million cubic feet per day.

[5] Based on latest available trade publications and reports from Federal and State agencies.

Colorado.—E. W. Henderson, U. S. Geological Survey, reported that 21 gas wells were completed in 1951, with a total initial open flow of 183 million cubic feet per day. Of this amount, 112 million was attributed to 1 completion at Barker Creek. New fields were discovered at Eskdale (Little Beaver Creek), Hell's Hole Canyon, High Line Canal, Padroni, and Twin Buttes (Douglas Pass).

A deeper pay zone was discovered in the Weber and Morgan formations in a deep test in the Thornburg field, and two shallower pay zones were found in the Fruitland and Pictured Cliffs sands in the Ignacio field. The Ignacio field in the San Juan Basin had considerable development but remained shut in, awaiting a pipeline connection. Wells on the Colorado side of the Barker Creek field, also in the San Juan Basin, were placed on production in October and contributed much of the increase in Colorado's gas production. Also, connected to pipeline outlets during 1951 were the 1950 Julesburg Basin discoveries—Armstrong, Lee, and Loveland fields.

Illinois.—A. H. Bell and L. L. Whiting, Illinois State Geological Survey, reported that 8 gas wells having a combined initial open flow capacity of 14 million cubic feet daily were completed in 1951. Five of these—3 in Louden and 1 each in Cottonwood and Herald fields—were being utilized. The others were shut in or abandoned owing to lack of market.

Marketed production of gas declined from 13,285 million cubic feet in 1950 to 11,425 million in 1951. Of this quantity, only 236 million cubic feet was used away from the producing fields.

Kansas.—J. M. Jewett of the Kansas Geological Survey reported that seven gas pools were discovered in Kansas during 1951: The Nippawalla pool in Barber County and the Brown West pool in Cowley County, producing from the Douglas group of the Pennsylvanian; the Theis pool in Clark County, the Wall pool in Harvey County, and the Graber North pool in McPherson County, producing from the Mississippian; the Greenwood pool in Morton County, producing from the Morrow group of the Pennsylvanian; and the Knoche pool in Stafford County, producing from the Viola limestone of the Ordovician period.

During 1951 the Hugoton field was reclassified as the Hugoton gas area and its producing area limited to gas produced from formations in the Chase group of the Permian system. The description of the former Hugoton field was adopted as the description of the Hugoton gas area. The eastern and western sides of the Hugoton gas area were each extended several miles. The discovery of gas and oil in the Light field in Seward County in 1950, along with the Greenwood-pool discovery in Morton County in 1951, indicated the possibility of future deeper development around the Hugoton gas area. Approximately 106,500 acres were added to the area, which totaled 2,255,000 acres as of the end of 1951. The Hugoton gas area produced 371 billion cubic feet from 2,595 gas wells in 1951, a 16-percent increase over 1950.

Kentucky.—C. D. Hunter, chief geologist, Kentucky-West Virginia Gas Co. reported that, during 1951, 254 wells were drilled for gas, of which 192 were productive and 62 dry holes. In the Big Sandy gas-field, which includes Pike, Floyd, Martin, Knott, Johnson, Magoffin, and Breathitt Counties, 151 gas wells and 25 dry holes were drilled, developing an initial daily open-flow capacity of 83 million cubic feet.

Marketed production increased from 73,316 million cubic feet in 1950 to 76,097 million in 1951. Most of the 1951 production came from the Big Sandy field, in which the Devonian black shales were the source of over 70 percent of the output.

In the old Artemus Himyar gasfield of Knox County, 23 gas wells were drilled, which developed an initial daily open flow of 29 million cubic feet.

In Scott County the shallow Trenton gasfield, discovered in 1950, was extended in 1951 into Grant County, and seven small wells of only local importance were drilled.

Louisiana.—The Louisiana Department of Conservation Petroleum Activity Report for 1951 reported that 244 gas wells were completed in 1951 compared with 394 in 1950. Thirteen new gasfields were discovered, whose names and locations, by parishes, are: Basile and Northwest Branch in Acadia, Sentell in Caddo, South Pecan Lake in Cameron, Lake Borgne in Orleans, Main Pass Area Block 35 in Plaquemines, Washington in St. Landry, Atchafalaya Bay and Patterson in St. Mary, Ship Shoal Area Block 23 and South Pelto Area Block 20 in Terrebonne, Angie in Washington, and Grosse Tete in West Baton Rouge.

Only one of these fields is in north Louisiana. Gas production from south Louisiana in 1951, as the result of several recently completed market outlets, increased 78 percent and approximated that of north Louisiana.

Marketed production for the whole State was 1,054 billion cubic feet in 1951, 27 percent over 1950.

Maryland.—Joseph T. Singewald, Jr., director of the Maryland Department of Geology, Mines and Water Resources, reported that at the close of 1951, 23 gas wells were producing in the Mountain Lake Park field in Garrett County. The field was producing along a 7-mile strike length, the full extent of which had not been determined. The Mountain Lake Park field is a structural high on the Deer Park anticline that has a strike length exceeding 40 miles across Garrett County.

Marketed production in 1951 was 3,422 million cubic feet compared with 373 million in 1950, the first year of production.

Michigan.—F. G. Pardee and W. L. Daoust, Geological Survey Division, Michigan Department of Conservation, reported no outstanding natural-gas developments in Michigan during 1951. Forty-three wells were completed in gas-storage reservoirs, and 20 new dry-gas wells were completed. The storage wells were drilled principally in the Austin Reservoir in Mecosta County and in the Freeman-Lincoln Reservoir of Clare County.

New gas wells were drilled in Muskegon, Mecosta, Missaukee, Kalkaska, Montcalm, Oceana, Newaygo, and Osceola Counties. The initial daily production for the new gas wells totaled 31,733 thousand cubic feet.

There were 10 storage fields at the end of 1951, with others scheduled to be converted to reservoir fields in the near future.

Mississippi.—Three wildcat gas wells and 23 development wells were completed in Mississippi in 1951. The southwest portion of the State continued to receive the bulk of the exploratory work, accounting for two of the gas discoveries.

A revival of interest in possible production from Paleozoic rocks in northeastern Mississippi was occasioned by reworking of an abandoned wildcat in southwest Monroe County. It had been abandoned in 1941, but persistent gas seepages since that time led to the reworking. The well blew out during the reworking and had not been completed at the end of 1951.

Interest in production from the Smackover was strengthened by completion of a gas and condensate well in the Tirsley field in Yazoo County. The gas had a very high sulfur content.

Missouri.—Frank C. Greene, district geologist, Missouri Division of Geological Survey and Water Resources, reported that there were no new gas discoveries in Missouri in 1951. A pipeline was laid to the reactivated East Smithville gasfield in Clay County. A small line was laid from the Lisle area in Cass County to Drexel, and arrangements had been made for a line into the small field south of Harrisonville in Cass County.

Marketed production dropped to 14 million cubic feet in 1951 from 21 million in 1950.

Montana.—E. W. Henderson, U. S. Geological Survey, reported that the only gas discovery in Montana in 1951 was a small well at Battle Creek. Extension wells were drilled at Apex, Bears Den, and Whitlark. In all, 27 producing wells were completed, with an initial open flow of 82 million cubic feet per day.

The towns of Havre and Chester were connected by pipeline to the Utopia field. A 16-inch line was completed from the international boundary to the natural-gasoline plant at Cut Bank for the purpose of importing gas from Alberta, Canada, but the line was not placed in operation until approval of the importation was granted in 1952.

Production from the Cut Bank and Regan fields increased by about 1,600 million cubic feet in 1951, while production from the Bowdoin and Cedar Creek fields decreased 4,500 million owing to substitution of gas piped from Worland, Wyo.

Nebraska.—Fourteen gas wells were completed in Nebraska in 1951—9 in Duel County and 5 in Cheyenne. In 1950, only one gas well was successful in Duel County. Three of the 1951 wells were wildcats. Wildcats northeast and southwest of production in the Big Spring field, Duel County, indicate an approximate field length of 6 miles. A southeast extension of the Southwest Sidney field was successful 2¼ miles from the discovery well.

New Mexico.—R. E. Canfield, U. S. Geological Survey, reported that the 451-mile, 24-inch natural-gas pipeline of El Paso Natural Gas Co. from the San Juan Basin to Toprock, Ariz., was completed in August 1951. By reason of this completion, drilling activities in the basin were accelerated. There were 92 gas-well completions in the New Mexico portion of the basin in 1951. Most of the wells were in the Blanco-Mesaverde area. Four new gasfields were discovered during the year.

In southeastern New Mexico, 28 gas wells were completed in Lea County and one in Eddy County.

New York.—W. L. Kreidler, senior geologist, New York Geological Survey, reported that very little exploratory drilling for new gas supplies was carried on in New York during 1951. An attempt was being made to revitalize the Sandy Creek field by acidization. This

field produces from the Trenton. An estimated 51 wells were drilled in the Medina gas area: 8 dry holes, 29 storage wells, and 13 producing wells in extensions of known fields. One Medina wildcat was drilled in Bennington Township, Wyoming County, and produced 400 thousand cubic feet per day.

In the Oriskany gas area, 1 productive wildcat and 1 dry hole were drilled in Cattaraugus County. Three storage wells were drilled in the Dundee field, and the South Addison field was being prepared for storage by reconditioning the old wells.

Marketed production in 1951 was 3,214 million cubic feet, the Medina producing roughly 70 percent and the Oriskany 30 percent.

North Dakota.—Wilson M. Laird, State geologist, North Dakota Geological Survey, reported that marketed production of natural gas in 1951 was 456 million cubic feet, 152 million less than in 1950. All of the gas was produced from the Baker-Glendive gasfield, which extends into the southwestern corner of North Dakota. No activity in gas-well drilling was reported. The first oil well in the State was completed in 1951 at Beaver Lodge in Williams County. It had a gas-oil ratio of 1,100 to 1,300 cubic feet per barrel from the Madison limestone.

Ohio.—R. L. Alkire, chief of the Oil and Gas Section, Ohio Geological Survey, reported that 420 gas wells were completed in 1951, with an average initial open-flow capacity of 506 thousand cubic feet per day. Extensions to known pools in 1951 added 9,500 proved acres. Approximately 1,900 acres were proved as the result of the discovery of three new pools: (1) In northwestern Jefferson Township, Tuscarawas County (Berea sand); (2) in southwestern Knox Township, Holmes County (Newburg sand); (3) in Worthington Township, Richland County.

The possibility of a major new Oriskany-sand field may result from 2 discovery wells, approximately 20 miles apart, drilled in Washington County: The B. H. Putnam-Lamp No. 1, lot 66, Belpre Township, and the B. H. Putnam-Arnold No. 1, lot 60, Watertown Township. The Oriskany sand lies at an average depth of 4,200 feet and has an initial rock pressure near 1,675 pounds per square inch.

Oklahoma.—Elmer Capshaw, Oklahoma Corporation Commission, reported that the most significant development in the gas industry in Oklahoma had been the continued shift of Oklahoma gas distributors from dry natural gas to casinghead gas, caused by rising field prices of dry gas.

The last large undeveloped acreage of the Guymon-Hugoton field in Texas County was in the process of being developed and was expected to have 125 to 150 wells. The Oklahoma Guymon-Hugoton produced 154 billion cubic feet of gas in 1951.

Pennsylvania.—J. G. Montgomery, Jr., vice president, United Natural Gas Co., reported that the more important developments in Pennsylvania in 1951 were intensive development of the Leidy pool, discovery of gas in the Driftwood pool in Cameron County, and completion of the two Cambro-Ordovician tests.

The Leidy gasfield in Clinton County underwent intensive development. Fifty-one producing wells with an average initial open flow of 10 million cubic feet per day and 12 dry holes were completed. One well, the H. E. Finnefrock No. 1, was completed with an initial open flow estimated at 145 million cubic feet of gas per day. This

was probably the largest gas well ever drilled in the Appalachian area. By the end of 1951, the pool had been developed approximately 9 miles in length and 1½ miles in width. The limits of production have probably been established on the southwest end of the structure, but not on the northeast end. It was estimated that the Leidy pool produced at the rate of 150 million cubic feet of gas per day during 1951. The life of the pool was expected to be relatively short because of the intensified competitive exploitation.

One productive gas well and 1 dry hole were completed in the Oriskany sand in the Driftwood pool in Cameron County. Completion of the producing well resulted in much activity, and by the end of 1951, 26 wells were being drilled and 11 locations made. The discovery well had an initial open flow of approximately 4 million cubic feet per day and an initial rock pressure of 3,825 pounds per square inch.

Two Cambro-Ordovician tests were completed in 1951; both were dry holes. One in Lycoming County on the Nippenose Dome had a small show of gas in the Upper Cambrian. The other, in Sullivan County, penetrated the upper Ordovician shales before being abandoned. This well was drilled to a depth of 12,343 feet with rotary tools and is one of the deepest wells in the Appalachian area. A third well, being drilled in Bedford County, had an estimated 600,000 cubic feet in the Beekmantown and by the end of 1951 had reached a depth of 8,979 feet.

In addition, 238 productive shallow-sand gas wells were drilled with a total initial open flow of 32 million cubic feet per day.

Texas.—Proved reserves of natural gas in Texas increased over 3 trillion cubic feet in 1951. Most of this increase was in the reserves of dissolved gas. Total gas-well completions increased from 647 in 1950 to 726 in 1951.

In the Panhandle district over 300 development gas wells were drilled, 5 times as many as in 1950. This has resulted in almost complete development of the Hugoton field, apparently defining its limits. About half of the wells were drilled in Sherman County.

In south Texas most of the development drilling was in the lower Oligocene. Exploratory drilling in this trend did not discover anything by 1951 that could be classed as a major reserve. The Blackjack field in Aransas County was discovered by Western Natural Gas Co. St. Charles Ranch No. 13, with an open flow of 86 million cubic feet.

The most important discovery in the upper Gulf-coast district appeared to be the Wadsworth gas-condensate field in Matagorda County. The discovery well was drilled to 14,524 feet, the deepest well drilled in the district in 1951. It produced from the Frio at 11,275 to 11,285 feet. The search for deeper producing reservoirs would necessitate leasing lands previously abandoned after shallow tests.

Development drilling in east Texas declined in 1951, whereas exploratory drilling increased substantially. New field discoveries showed a trend toward increasing gas-condensate rather than oil reserves.

In west-central Texas important gas reserves were indicated in Callahan, Coleman, Eastland, Parker, and Stephens Counties. Parker was outstanding, with three new gas discoveries producing from the Strawn. There were no oil discoveries in 1951.

Utah.—E. W. Henderson, U. S. Geological Survey, reported that one new gasfield was discovered at Clear Creek in Carbon County. The well had an initial daily open flow of 7.5 million cubic feet from the Ferron sandstone of the Mancos shale. This well is near the Gordon Creek field, where carbon dioxide was discovered in 1948. More drilling in the area was expected. An oil well in the Red Wash field in Uintah County was recompleted as a gas producer.

The only commercial gas production, as usual, was from the Clay Basin field. Carbon dioxide was produced commercially from the Farnham field.

Virginia.—William M. McGill, State geologist, Virginia Geological Survey, reported that in the Appalachian Plateaus section tests for natural gas were drilled in Buchanan, Dickenson, and Wise Counties and that in the Appalachian Ridges and Valley province tests for gas were drilled in Rockingham County. Of 27 tests completed, 11 were dry holes, and 16 were completed as potential producers (Buchanan County, 6; Dickenson County, 9; Rockingham County, 1). The potentially productive gas wells range in depth from 2,300 to 7,000 feet. The gas was encountered mainly in sandstone horizons of the lower Mississippian but was also found in overlying Pennsylvanian sandstone and in underlying Devonian shale.

Indications were that approximately 60 million cubic feet per day could be obtained from the completed and capped wells in Buchanan and Dickenson Counties. Commercial production in 1951 was obtained only from the Early Grove field in Scott and Washington Counties. Gas produced in other fields was used only for drilling operations. Marketed production in 1951 was 64 million cubic feet.

West Virginia.—R. C. Tucker, assistant State geologist, West Virginia Geological and Economic Survey, reported that 463 gas wells were completed in 1951—46 more than in 1950. These had a total initial daily open flow of 356 million cubic feet. The average initial open flow of gas wells was 757 thousand cubic feet compared with 1,079 thousand in 1950. The greatest number of gas-well completions was made in Wayne County with 61, Lincoln County with 58, and Mingo County with 57. Preston County, with 9 completions, had the largest average initial daily open flow (4,471 thousand cubic feet).

Wildcat discoveries by County and producing horizon include Wood County, Berea; Boone County, Big Lime; Mingo County, Big Lime; Wirt County, Oriskany; Webster County, Maxton Sand (first production for this county); and Pleasants County, Salt Sand.

Wyoming.—E. W. Henderson, U. S. Geological Survey, stated that 23 gas wells were completed in 1951 with a total initial daily production of 74 million cubic feet. Only one was an exploratory well—a shallow test at Fish Creek in Natrona County, and this was not considered a commercial discovery.

The Heart Mountain field in Park County was connected to a pipeline outlet and became a commercial producer. Excess gas from the Sand Creek field in Washakie County was delivered via pipeline to Worland for transmission with other local gas to Cabin Creek, Montana. Eighty-six miles of line was laid from the Big Sand Draw field to Rawlins, Wyo., to increase the gas supply of the Rawlins-Laramie area. The Salt Wells field in Sweetwater County was tied into the

Mountain Fuel Supply Co. system supplying the Salt Lake City-Ogden area in Utah.

Increased production was due mainly to the larger pipeline deliveries from the Worland and Church Buttes fields.

INTERSTATE SHIPMENTS AND EXPORTS

Interstate shipments and exports of natural gas increased by 535.7 billion cubic feet in 1950 and by 699.2 billion in 1951. Interstate shipments in 1949 were 37 percent of marketed production; they increased in 1950 to 40 percent and in 1951 to 43 percent of marketed production. Interstate shipments increased from all Census regions in 1950, and in 1951 only the South Atlantic and East North Central regions showed declines. The percentage of marketed production shipped interstate showed an upward trend during this period in Louisiana, New Mexico, and Texas. In Mississippi and Oklahoma the percentage shipped out of State remained steady and in Kansas declined.

The East North Central region remained the largest consumer of interstate natural gas during the 1949–51 period and also showed the largest increase during this period. The Pacific and Middle Atlantic regions showed the largest rate of increase. Completion of pipeline facilities to the Philadelphia and New York City areas accounted for much of the increase in the Middle Atlantic region. Also experiencing a steady rise in the consumption of interstate gas was the East South Central region, more particularly Alabama and Tennessee.

Exports to Mexico remained around 20 billion cubic feet per year for the 2-year period. Exports to Canada increased sharply from 226 million cubic feet in 1949 to 3,170 million in 1950 and then expanded less rapidly to 3,630 million in 1951.

PIPELINES

In 1951 the Federal Power Commission authorized natural-gas pipeline projects to cost $471,383,000 and including 5,791 miles of pipeline. The corresponding figures for 1950 were $632,201,000 and 7,618 miles (revised).

Three new major pipelines were completed during 1951. The Texas-Illinois Natural Gas Pipeline Corp. constructed a line from the lower Gulf coast of Texas to the Chicago area. The Trunkline Gas Supply Co. completed a line from the lower Texas Gulf coast to Tuscola, Ill. where it connects with the line of Panhandle Eastern Pipeline Co. The El Paso Natural Gas Co. completed its line from the San Juan Basin in northwest New Mexico to the California border.

TABLE 7.—Interstate shipments and exports of natural gas, 1950–51, by source and final destination, in million cubic feet [1]

Producing region and State	Quantity shipped		Consuming State or country	Quantity received [2]	
	1950	1951		1950	1951
Middle Atlantic:					
New Jersey			Canada	102	114
New York	407	419	New Jersey	2	18
Pennsylvania	21,601	38,632	New York	21,567	36,909
			Ohio	70	1,726
			Pennsylvania	267	284
Total	22,008	39,051		22,008	39,051
South Atlantic:					
Delaware			Canada	11	2
District of Columbia			District of Columbia	4,141	2,554
Florida			Kentucky	792	951
Georgia			Maryland	5,427	3,879
Maryland	249	2,155	New Jersey	3	8
North Carolina			New York	6,699	3,245
South Carolina			Ohio	63,821	68,019
Virginia	16	19	Pennsylvania	47,838	44,198
West Virginia	132,740	124,487	Tennessee	16	13
			Virginia	2,738	2,709
			West Virginia	1,519	1,083
Total	133,005	126,661		133,005	126,661
East North Central:					
Illinois			Canada	117	67
Indiana	529	515	Illinois	529	515
Michigan	117	67			
Ohio					
Wisconsin					
Total	646	582		646	582
East South Central:					
Alabama			Alabama	42,286	55,882
Kentucky	46,288	47,213	Arkansas	18	
Mississippi	79,226	110,047	Canada	1	
Tennessee			Delaware	4	2
			District of Columbia	1,115	401
			Florida	7,513	8,820
			Georgia	27,293	43,682
			Illinois	122	4
			Indiana	345	280
			Kentucky	960	697
			Louisiana	1,654	1,607
			Maryland	1,541	758
			Mississippi	226	56
			Missouri	124	
			New Jersey	14	7
			New York	623	324
			Ohio	25,305	30,101
			Pennsylvania	5,275	3,756
			Virginia	776	516
			West Virginia	10,319	10,367
Total	125,514	157,260		125,514	157,260
West North Central:					
Iowa			Canada	846	997
Kansas	228,167	269,273	Colorado	34,166	42,657
Minnesota			Delaware	6	4
Missouri			Illinois	8,781	9,083
Nebraska			Indiana	10,485	12,554
North Dakota	608	456	Iowa	24,770	30,607
South Dakota			Michigan	23,636	27,431
			Minnesota	36,850	45,928
			Missouri	34,388	35,574
			Montana	405	319
			Nebraska	37,961	43,628
			New Jersey	16	25
			New York	154	43
			North Dakota	109	67
			Ohio	9,733	13,270
			Oklahoma	1,250	1,430
			Pennsylvania	484	836
			South Dakota	3,990	4,337
			West Virginia	8	9
			Wyoming	737	930
Total	228,775	269,729		228,775	269,729

For footnotes, see end of table.

TABLE 7.—Interstate shipments and exports of natural gas, 1950–51, by source and final destination, in million cubic feet [1]—Continued

Producing region and State	Quantity shipped		Consuming State or country	Quantity received [2]	
	1950	1951		1950	1951
West South Central:					
Arkansas	1,467	1,371	Alabama	52,215	58,396
Louisiana	396,199	540,599	Arizona	34,166	35,550
Oklahoma	199,879	220,685	Arkansas	90,081	114,854
Texas	1,310,951	1,685,702	California	92,732	131,903
			Canada	2,093	2,450
			Colorado	50,318	53,730
			Delaware	1,139	1,886
			District of Columbia	6,424	8,949
			Florida	5,009	4,344
			Georgia	41,712	53,221
			Illinois	221,059	242,831
			Indiana	51,656	59,954
			Iowa	44,143	51,680
			Kansas	116,053	140,207
			Kentucky	35,019	48,175
			Louisiana	42,569	48,601
			Maryland	9,216	18,233
			Massachusetts		1,934
			Mexico	21,411	19,121
			Michigan	109,938	139,973
			Minnesota	32,287	39,124
			Mississippi	40,910	49,086
			Missouri	110,896	124,678
			Nebraska	21,993	25,304
			New Hamsphire		3
			New Jersey	3,807	32,543
			New Mexico	29,173	25,862
			New York	38,485	113,753
			North Carolina		1,759
			Ohio	208,969	264,513
			Oklahoma	18,510	14,802
			Pennsylvania	151,635	223,282
			South Carolina		917
			South Dakota	3,413	3,637
			Tennessee	70,201	90,258
			Texas	44,604	54,090
			Virginia	4,406	12,858
			West Virginia	83,075	101,895
			Wisconsin	18,042	32,783
			Wyoming	1,137	1,218
Total	1,908,496	2,448,357		1,908,496	2,448,357
Mountain:					
Arizona			Arizona	20,500	28,252
Colorado	6,133	6,385	California	55,307	111,846
Idaho			Colorado	740	1,048
Montana	6,203	4,619	Mexico	1,146	1,412
Nevada			Montana	5,590	9,985
New Mexico	87,257	156,231	Nebraska	2,713	781
Utah			New Mexico	4,760	6,709
Wyoming	25,501	33,902	North Dakota	3,415	3,661
			South Dakota	2,940	3,865
			Texas	4,804	6,964
			Utah	22,589	25,952
			Wyoming	590	662
Total	125,094	201,137		125,094	201,137
Grand total	2,543,538	3,242,777		2,543,538	3,242,777

[1] Includes exports as follows: 1950, total, 25,727 million cubic feet; to Mexico, 22,557 million; to Canada, 3,170 million; 1951, total 24,163 million; to Mexico, 20,533 million; to Canada, 3,630 million.
[2] Includes amounts consumed, stored, and lost in transmission.

CONSUMPTION

Consumption of natural gas in the United States in 1951 was 7,103 billion cubic feet. Increases of 831 billion cubic feet and 1,076 billion were recorded in 1950 and 1951, respectively. The largest rate of increase was experienced in the residential category.

Residential and Commercial.—The consumption of natural gas for residential use increased 21 percent in 1950 and 23 percent in 1951 to

1,475 billion cubic feet in the latter year. Residential use as a proportion of total consumption, which had been rising steadily since the close of World War II, increased from 16.5 percent in 1946 to 20.8 percent in 1951. Residential consumption increased in all reporting States over the period 1949 to 1951. Largest increases took place in Michigan, New York, Ohio, and Pennsylvania. In 1951 Ohio assumed first place as a consumer of gas for residential use, a position long held by California. The increased residential use of natural gas had not been limited to regions where the availability of natural gas was relatively recent; the West South Central region (Arkansas, Louisiana, Oklahoma, and Texas) showed a 17-percent gain from 1950 to 1951. The number of consumers of natural gas for residential use increased from 14.7 million in 1949 to 16.9 million in 1950 to 21.4 million in 1951. The residential consumers who received natural gas as a component of mixed gas are included in these figures, and the natural gas they consumed is included in the natural-gas consumption figures. Eliminating this use in mixed gas, the average annual residential consumption of straight natural gas per consumer rose from 77,500 cubic feet in 1949 to 83,600 in 1950 and 86,700 in 1951.

TABLE 8.—Consumption of natural gas in the United States, 1947–51, by States [1]

State	Quantity (million cubic feet)					Estimated value at point of consumption (thousand dollars)	
	1947	1948	1949	1950	1951	1950	1951
Alabama	50,713	61,113	71,072	92,466	111,030	25,401	32,357
Arizona	27,768	34,983	44,489	53,419	62,046	15,296	18,555
Arkansas	102,779	112,675	113,922	135,609	155,524	20,088	24,342
California	548,382	617,615	619,323	683,924	787,848	230,665	276,745
Colorado	49,027	60,585	73,664	88,692	102,769	26,186	30,473
Delaware			708	1,022	1,679	1,017	2,923
District of Columbia	8,474	9,361	9,305	10,694	11,904	13,637	14,638
Florida	7,891	8,973	10,185	12,348	13,044	2,438	2,728
Georgia	41,368	47,552	58,824	67,894	94,596	21,638	29,010
Illinois	132,153	168,796	202,546	235,211	250,812	106,640	120,770
Indiana	42,528	50,774	55,263	58,620	69,177	35,406	44,489
Iowa	40,948	50,350	57,620	66,233	79,640	24,868	33,226
Kansas	191,952	199,893	206,593	242,603	278,892	49,361	59,463
Kentucky	36,938	41,357	45,504	61,323	74,386	25,027	31,553
Louisiana	375,206	426,837	450,712	475,500	549,305	54,071	66,253
Maryland	3,402	4,280	4,821	13,813	22,286	17,498	27,813
Massachusetts					1,783		4,675
Michigan	80,571	75,978	84,315	127,180	154,283	92,859	114,878
Minnesota	43,198	52,376	59,040	67,861	84,205	29,517	36,072
Mississippi	52,461	65,245	60,987	76,918	97,786	16,959	21,142
Missouri	78,101	90,883	99,667	140,384	156,922	56,140	67,417
Montana	30,919	32,919	34,361	38,544	37,481	11,078	11,732
Nebraska	39,699	47,647	51,911	61,742	72,386	22,782	27,943
New Hampshire					3		9
New Jersey			3,172	3,209	30,887	1,721	55,236
New Mexico	102,766	110,132	127,423	147,509	174,808	15,954	19,151
New York	41,572	44,200	51,064	65,157	144,920	53,949	153,255
North Carolina					1,631		294
North Dakota	2,608	2,712	2,686	3,279	3,408	1,539	1,950
Ohio	221,571	236,137	246,212	324,594	375,820	171,202	199,153
Oklahoma	254,522	277,955	258,579	286,793	307,887	41,572	46,616
Pennsylvania	175,906	191,631	209,749	263,199	311,937	133,338	182,103
South Carolina					853		120
South Dakota	8,016	8,540	8,212	10,001	11,447	4,214	5,201
Tennessee	33,986	37,766	41,609	67,813	88,078	20,832	26,499
Texas	1,444,422	1,605,955	1,658,379	1,824,553	2,130,377	178,458	220,866
Utah	20,919	21,627	24,338	26,368	29,014	8,242	10,111
Virginia	3,055	3,877	4,324	7,639	14,853	7,261	14,799
West Virginia	106,105	112,702	111,802	132,273	139,608	40,053	44,805
Wisconsin	267	323	1,696	15,380	28,382	20,291	31,924
Wyoming	26,351	31,400	31,407	36,637	38,865	6,843	7,386
Total United States	4,426,544	4,945,149	5,195,484	6,026,404	7,102,562	1,604,041	2,118,675

[1] Includes natural gas mixed with manufactured gas.

TABLE 9.—Residential and commercial consumption of natural gas in the United States in 1950, by States [1]

State	Residential				Commercial				Total			
	Number of consumers	Quantity (million cubic feet)	Value at point of consumption		Number of consumers	Quantity (million cubic feet)	Value at point of consumption		Number of consumers	Quantity (million cubic feet)	Value at point of consumption	
			Total (thousand dollars)	Average (cents per M cubic feet)			Total (thousand dollars)	Average (cents per M cubic feet)			Total (thousand dollars)	Average (cents per M cubic feet)
Alabama	172, 825	11, 826	9, 563	80. 9	17, 642	4, 002	2, 076	51. 9	190, 467	15, 828	11, 639	73. 5
Arizona	109, 386	5, 381	4, 554	84. 6	13, 557	6, 435	2, 281	35. 4	122, 943	11, 816	6, 835	57. 8
Arkansas	151, 311	15, 042	7, 596	50. 5	23, 913	7, 967	2, 946	37. 0	175, 224	23, 009	10, 542	45. 8
California	2, 681, 814	179, 351	119, 037	66. 4	192, 136	72, 707	30, 105	41. 4	2, 873, 950	252, 058	149, 142	59. 2
Colorado	169, 834	22, 210	12, 712	57. 2	23, 141	11, 096	5, 390	48. 6	192, 975	33, 306	18, 102	54. 4
Florida	12, 808	858	725	84. 5	28	235	60	25. 5	12, 836	1, 093	785	71. 8
Georgia	171, 834	16, 056	10, 750	67. 0	17, 084	7, 007	2, 655	37. 9	188, 918	23, 063	13, 405	58. 1
Illinois	1, 606, 881	61, 067	59, 590	97. 6	92, 593	17, 275	11, 261	65. 2	1, 699, 474	78, 342	70, 851	90. 4
Indiana	424, 272	16, 894	18, 688	110. 6	28, 802	4, 767	4, 313	90. 5	453, 074	21, 661	23, 001	106. 2
Iowa	221, 006	18, 913	13, 017	68. 8	21, 595	7, 024	3, 838	54. 6	242, 601	25, 937	16, 855	65. 0
Kansas	349, 526	43, 184	20, 789	48. 1	41, 193	21, 963	7, 184	32. 7	390, 719	65, 147	27, 973	42. 9
Kentucky	252, 359	26, 048	14, 682	56. 4	27, 997	7, 580	3, 637	48. 0	280, 356	33, 628	18, 319	54. 5
Louisiana	394, 429	23, 468	14, 126	60. 2	38, 062	11, 797	3, 559	30. 2	432, 491	35, 265	17, 685	50. 1
Maryland	358, 207	9, 610	13, 451	140. 0	25, 200	1, 582	2, 109	133. 3	383, 407	11, 192	15, 560	139. 0
Michigan	1, 016, 586	75, 711	64, 625	85. 4	58, 359	10, 746	8, 297	77. 2	1, 074, 945	86, 457	72, 922	84. 3
Minnesota	282, 563	26, 310	19, 022	72. 3	14, 730	5, 070	2, 457	48. 5	297, 293	31, 380	21, 479	68. 4
Mississippi	138, 115	10, 160	7, 147	70. 3	19, 806	5, 876	2, 371	40. 4	157, 921	16, 036	9, 518	59. 4
Missouri	549, 999	49, 313	34, 456	69. 9	38, 051	12, 349	5, 693	46. 1	588, 050	61, 662	40, 149	65. 1
Montana	69, 081	12, 665	5, 985	47. 3	6, 766	7, 577	2, 489	32. 8	75, 847	20, 242	8, 474	41. 9
Nebraska	172, 744	19, 530	12, 922	66. 2	16, 198	8, 693	3, 586	41. 3	188, 942	28, 223	16, 508	58. 5
New Jersey and Delaware	748, 584	2, 893	2, 103	72. 7	51, 116	662	388	58. 6	799, 700	3, 555	2, 491	70. 1
New Mexico	84, 353	8, 800	5, 811	66. 0	8, 446	4, 719	1, 573	33. 3	92, 799	13, 519	7, 384	54. 6
New York	703, 862	45, 130	40, 033	88. 7	47, 312	9, 612	7, 743	80. 6	751, 174	54, 742	47, 776	87. 3
North Dakota, South Dakota, and Utah	115, 515	15, 167	8, 212	54. 1	4, 638	3, 344	1, 414	42. 3	120, 153	18, 511	9, 626	52. 0
Ohio	1, 531, 936	175, 093	105, 681	60. 4	122, 209	37, 357	20, 994	56. 2	1, 654, 145	212, 450	126, 675	59. 6
Oklahoma	410, 222	39, 800	18, 087	45. 4	49, 109	17, 883	5, 603	31. 3	459, 331	57, 683	23, 690	41. 1
Pennsylvania	1, 633, 420	111, 264	74, 521	67. 0	109, 821	21, 549	12, 167	56. 5	1, 743, 241	132, 813	86, 688	65. 3
Tennessee	147, 563	12, 036	8, 754	72. 7	18, 249	5, 300	3, 018	56. 9	165, 812	17, 336	11, 772	67. 9
Texas	1, 284, 100	81, 408	51, 388	63. 1	148, 691	37, 864	14, 746	38. 9	1, 432, 791	119, 272	66, 134	55. 4
Virginia and District of Columbia	293, 722	11, 949	15, 580	130. 4	23, 080	3, 282	3, 466	105. 6	316, 802	15, 231	19, 046	125. 0
West Virginia	262, 010	35, 205	14, 315	40. 7	26, 218	9, 280	3, 470	37. 4	288, 228	44, 485	17, 785	40. 0
Wisconsin	346, 726	9, 793	15, 290	156. 1	16, 512	1, 724	2, 252	130. 6	363, 238	11, 517	17, 542	152. 3
Wyoming	38, 087	6, 234	3, 181	51. 0	4, 949	3, 514	1, 289	36. 7	43, 036	9, 748	4, 470	45. 9
Total: 1950	16, 905, 680	1, 198, 369	826, 393	69. 0	1, 347, 203	387, 838	184, 430	47. 6	18, 252, 883	1, 586, 207	1, 010, 823	63. 7
1949	14, 689, 750	992, 544	665, 536	67. 1	1, 231, 055	347, 818	158, 105	45. 5	15, 920, 805	1, 340, 362	823, 641	61. 4

[1] Includes natural gas mixed with manufactured gas.

TABLE 10.—Residential and commercial consumption of natural gas in the United States in 1951, by States [1]

State	Residential				Commercial				Total			
	Number of consumers	Quantity (million cubic feet)	Value at point of consumption		Number of consumers	Quantity (million cubic feet)	Value at point of consumption		Number of consumers	Quantity (million cubic feet)	Value at point of consumption	
			Total (thousand dollars)	Average (cents per M cubic feet)			Total (thousand dollars)	Average (cents per M cubic feet)			Total (thousand dollars)	Average (cents per M cubic feet)
Alabama	199,952	15,981	12,923	80.9	16,178	5,572	2,880	51.7	216,130	21,553	15,803	73.3
Arizona	132,101	7,047	5,756	81.7	15,904	8,135	2,874	35.3	148,005	15,182	8,630	56.8
Arkansas	161,972	17,580	8,919	50.7	25,026	9,112	3,373	37.0	186,998	26,692	12,292	46.1
California	2,869,904	196,819	133,512	67.8	200,568	72,676	33,029	45.4	3,070,472	269,495	166,541	61.8
Colorado	193,038	27,166	15,220	56.0	25,720	13,958	6,518	46.7	218,758	41,124	21,738	52.9
Delaware, District of Columbia, and Maryland	585,615	24,772	34,139	137.8	44,718	5,408	6,893	127.5	630,333	30,180	41,032	136.0
Florida	14,112	1,124	915	81.4	25	208	54	26.0	14,137	1,332	969	72.7
Georgia	196,105	19,314	12,749	66.0	19,773	8,613	3,284	38.1	215,878	27,927	16,033	57.4
Illinois	1,648,203	71,056	66,876	94.1	93,876	18,651	12,284	65.9	1,742,079	89,707	79,160	88.2
Indiana	553,761	23,113	24,962	108.0	36,723	6,415	5,670	88.4	590,484	29,528	30,632	103.7
Iowa	227,837	22,627	17,264	76.3	21,845	9,919	5,535	55.8	249,682	32,546	22,799	70.1
Kansas	368,209	51,563	24,411	47.3	42,239	24,153	8,043	33.3	410,448	75,716	32,454	42.9
Kentucky	266,322	32,022	18,493	57.8	29,038	9,167	4,544	49.6	295,360	41,189	23,037	55.9
Louisiana	420,115	28,365	16,913	59.6	40,233	12,145	3,989	32.8	460,348	40,510	20,902	51.6
Massachusetts and New Hampshire	266,962	1,118	3,123	279.3	12,039	298	709	237.9	279,001	1,416	3,832	270.6
Michigan	1,073,656	99,307	83,265	83.8	61,476	13,272	10,076	75.9	1,135,132	112,579	93,341	82.9
Minnesota	285,892	31,970	22,152	69.3	14,723	5,932	2,904	49.0	300,615	37,902	25,056	66.1
Mississippi	153,698	12,778	8,725	68.3	20,546	6,875	2,765	40.2	174,244	19,653	11,490	58.5
Missouri	571,711	62,598	42,270	67.5	43,897	16,718	7,597	45.4	615,608	79,316	49,867	62.9
Montana	83,939	12,355	6,299	51.0	8,532	7,420	2,605	35.1	92,471	19,775	8,904	45.0
Nebraska	181,996	22,333	14,882	66.6	17,805	10,894	4,878	44.8	199,801	33,227	19,760	59.5
New Jersey	1,177,470	15,818	43,735	276.5	74,788	3,293	6,708	203.7	1,252,258	19,111	50,443	263.9
New Mexico	90,043	9,338	6,283	67.3	8,968	7,351	2,513	34.2	99,011	16,689	8,796	52.7
New York	3,427,796	89,177	113,868	127.7	185,310	17,650	21,433	121.4	3,613,106	106,827	135,301	126.7
North Carolina and South Carolina	9,676	78	122	156.4	1,244	56	81	144.6	10,920	134	203	151.5
North Dakota and South Dakota	37,875	5,178	3,732	72.1	4,970	3,687	1,790	48.5	42,845	8,865	5,522	62.3
Ohio	1,585,845	206,058	123,611	60.0	126,637	44,954	25,206	56.1	1,712,482	251,012	148,817	59.3
Oklahoma	431,352	45,156	20,450	45.3	47,973	22,364	6,458	28.9	479,325	67,520	26,908	39.9
Pennsylvania	1,688,361	131,365	104,800	79.8	111,993	25,097	16,336	65.1	1,800,354	156,462	121,136	77.4
Tennessee	159,818	15,699	11,357	72.3	21,297	7,027	3,918	55.8	181,115	22,726	15,275	67.2
Texas	1,386,471	96,297	60,305	62.6	160,879	43,511	17,417	40.0	1,547,350	139,808	77,722	55.6
Utah and Wyoming	122,692	15,339	7,742	50.5	16,351	7,603	3,065	40.3	139,043	22,942	10,807	47.1
Virginia	220,119	7,839	10,887	138.9	16,227	2,522	2,545	100.9	236,346	10,361	13,432	129.6
West Virginia	275,363	39,343	16,835	42.8	27,127	10,668	4,065	38.1	302,490	50,011	20,900	41.8
Wisconsin	375,969	17,032	23,324	136.9	19,060	2,985	3,570	119.6	395,029	20,017	26,894	134.4
Total: 1951	21,443,950	1,474,725	1,120,819	76.0	1,613,708	464,309	245,609	52.9	23,057,658	1,939,034	1,366,428	70.5
1950	16,905,680	1,198,369	826,393	69.0	1,347,203	387,838	184,430	47.6	18,252,883	1,586,207	1,010,823	63.7

[1] Includes natural gas mixed with manufactured gas.

Commercial consumption increased by 40 billion cubic feet to 388 billion in 1950. This was 6.4 percent of the total United States consumption, slightly less than in 1949. In 1951 commercial consumption increased at a faster rate than overall consumption and accounted for 6.5 percent of the total.

Treated for Natural Gas Liquids.—In 1950, 5,342 billion cubic feet of natural gas was treated at natural-gasoline and cycle plants, an increase of 686 billion cubic feet over 1949. In 1951, 6,203 billion cubic feet was treated. In the 5-year period 1946–51 the percentage of gross withdrawals treated rose from 59 percent to 64 percent. Average yield of natural-gas liquids was 1.43 gallons per thousand cubic feet of gas treated in 1950 and 1.39 gallons per thousand cubic feet in 1951. The total liquid volume of 181,961 thousand barrels recovered in 1950 is equivalent to approximately 260 billion cubic feet. This shrinkage is included in the field use of gas.

The volume of gas treated increased in all States in 1951 except Illinois, Michigan, New York, and Pennsylvania. A natural-gasoline plant operated in Nebraska in 1951 for the first time.

TABLE 11.—Natural gas treated at natural-gasoline and cycle plants in the United States, 1947–51, by States, in million cubic feet

State	1947	1948	1949	1950	1951
Arkansas	60,474	60,265	59,037	64,237	71,145
California	460,046	474,607	495,843	509,796	553,821
Colorado		364	5,521	7,785	11,739
Illinois	22,720	19,545	14,918	13,333	11,856
Kansas	216,644	230,119	252,864	361,744	397,294
Kentucky	38,717	44,748	43,472	47,660	86,950
Louisiana	345,975	405,101	463,138	534,550	598,420
Michigan	2,255	1,586	1,487	1,173	382
Mississippi	8,079	32,325	38,365	45,145	46,468
Montana	12,066	13,615	13,876	15,017	17,000
Nebraska					2,662
New Mexico	130,693	177,191	174,818	185,138	242,759
New York	12	12	22	13	20
Ohio	32,869	24,366	18,351	20,764	23,837
Oklahoma	236,673	266,479	307,014	332,764	419,868
Pennsylvania	52,437	37,289	37,367	41,406	37,386
Texas	2,235,185	2,382,804	2,526,885	2,938,158	3,406,670
West Virginia	193,044	193,086	170,831	183,957	229,654
Wyoming	22,261	29,998	32,333	39,164	45,139
Total	4,070,150	4,393,500	4,656,142	5,341,804	6,203,070

Field.—Field use of natural gas increased 12 percent in 1950 and 21 percent in 1951. Since 1938 field use has not increased as fast as marketed production, and this continued to be the case (except for Texas) in 1951.

Carbon-Black Manufacture.—The use of natural gas for the production of carbon black in 1950 declined 17,040 million cubic feet to 410,852 million and returned to approximately the 1949 level in 1951. Use by plants in the Panhandle region of Texas declined by 33,587 million cubic feet in 1950 and remained there in 1951. Eighty-six percent of the gas used in manufacturing carbon black in 1950 and 85 percent in 1951 were used to make channel-type blacks. Use of this black has been declining, as new furnace-type blacks have been developed and higher percentages of synthetic rubber are used.

TABLE 12.—Industrial consumption of natural gas in the United States in 1950–51, by State and use

State	Field (drilling, pumping, and operating gasoline-recovery plants)		Carbon-black manufacture			Fuel							Total industrial			Fuel at electric utility plants [1] (million cubic feet)
				Value at point of consumption		Million cubic feet					Value at point of consumption			Value at point of consumption		
	Million cubic feet (estimated)	Value at point of consumption (thousand dollars)	Million cubic feet	Total (thousand dollars)	Average (cents per M cubic feet)	Petroleum refineries	Portland-cement plants	Natural-gas-pipelines	Other industrial	Total	Total (thousand dollars)	Average (cents per M cubic feet)	Million cubic feet	Total (thousand dollars)	Average (cents per M cubic feet)	
1950																
Alabama	2	(2)				692	11,473	2,373	62,098	76,636	13,762	18.0	76,638	13,762	18.0	16,396
Arizona							(3)	3,050	[3] 38,553	41,603	8,461	20.3	41,603	8,461	20.3	13,807
Arkansas	20,110	1,204				9,704	(3)	5,644	[3] 77,142	92,490	8,342	9.0	112,600	9,546	8.5	19,483
California	139,584	16,998	(4)	(4)	(4)	56,671	17,340	5,223	[4] 213,048	[4] 292,282	[4] 64,525	[4] 22.1	431,866	81,523	18.9	78,322
Colorado	4,345	268				1,292	(3)	1,098	[3] 48,651	51,041	7,816	15.3	55,386	8,084	14.6	19,954
Florida	8	(2)							11,247	11,247	1,653	14.7	11,255	1,653	14.7	5,255
Georgia							(3)	122	[3] 44,709	44,831	8,233	18.4	44,831	8,233	18.4	24,299
Illinois	12,305	964				2,263		7,624	134,677	144,564	34,825	24.1	156,869	35,789	22.8	33,852
Indiana	225	16				455		3,377	32,902	36,734	12,389	33.7	36,959	12,405	33.6	1,066
Iowa							4,533	5,594	30,169	40,296	8,013	19.9	40,296	8,013	19.9	17,372
Kansas	33,996	2,375	(4)	(4)	(4)	12,432	11,839	9,332	[4] 109,857	[4] 143,460	[4] 19,013	[4] 13.3	177,456	21,388	12.1	39,466
Kentucky	4,796	942				1,789		6,571	14,539	22,899	5,766	25.2	27,695	6,708	24.2	3,257
Louisiana	140,704	7,272	21,989	1,050	4.8	75,936	(3)	8,947	[3] 192,659	277,542	28,064	10.1	440,235	36,386	8.3	60,845
Maryland	5	1						37	2,579	2,616	1,937	74.0	2,621	1,938	73.9	4
Michigan	1,521	218				287		911	38,004	39,202	19,719	50.3	40,723	19,937	49.0	73
Minnesota								322	36,159	36,481	8,038	22.0	36,481	8,038	22.0	17,764
Mississippi	8,830	720				566		9,415	42,071	52,052	6,721	12.9	60,882	7,441	12.2	15,378
Missouri	98	16				2,164	8,266	4,987	63,207	78,624	15,975	20.3	78,722	15,991	20.3	21,206
Montana	2,717	261				2,531	(3)	632	[3] 12,422	15,585	2,343	15.0	18,302	2,604	14.2	897
Nebraska	11	1				223	(3)	3,813	[3] 29,472	33,508	6,273	18.7	33,519	6,274	18.7	12,105
New Jersey and Delaware						35			641	676	247	36.5	676	247	36.5	
New Mexico	51,537	1,738	57,454	2,706	4.7	913		2,393	21,693	24,999	4,126	16.5	133,990	8,570	6.4	12,876
New York	233	51				248		105	9,829	10,182	6,122	60.1	10,415	6,173	59.3	66
North Dakota, South Dakota, and Utah						345	(3)	10	[3] 20,782	21,137	4,369	20.7	21,137	4,369	20.7	3,154

Ohio	698	146				162		3,213	108,071	111,446	44,381	39.8	112,144	44,527	39.7	2,490
Oklahoma	120,232	5,295	(4)	(4)	(4)	34,205	(3)	7,141	[3] [4] 67,532	[4] 108,878	[4] 12,587	[4] 11.6	229,110	17,882	7.8	35,266
Pennsylvania	4,386	1,266				2,405		3,364	120,231	126,000	45,384	36.0	130,386	46,650	35.8	1,574
Tennessee						412		6,557	43,503	50,477	9,060	17.9	50,477	9,060	17.9	5,928
Texas	601,251	28,054	313,034	14,856	4.7	243,166	23,941	18,661	505,228	790,996	69,414	8.8	1,705,281	112,324	6.6	165,406
Virginia and District of Columbia	15	1						106	2,981	3,087	1,851	60.0	3,102	1,852	59.7	30
West Virginia	22,017	4,387				1,613		4,136	60,022	65,771	17,881	27.2	87,788	22,268	25.4	188
Wisconsin								650	3,213	3,863	2,749	71.2	3,863	2,749	71.2	13
Wyoming	17,847	1,107				4,587		138	4,317	9,042	1,266	14.0	26,889	2,373	8.8	1,127
Unclassified by States			[4] 18,375	[4] 1,065	[4] 5.8		[3] 19,594									
Total: 1950	1,187,473	73,301	410,852	19,677	4.8	455,096	96,986	125,546	2,164,244	2,841,872	500,240	17.6	4,440,197	593,218	13.4	628,919
1949	1,059,628	65,210	427,892	20,355	4.8	422,357	84,521	(5)	1,860,724	2,367,602	411,383	17.4	3,855,122	496,948	12.9	550,121
1951																
Alabama	15	3				854	13,537	5,021	70,050	89,462	16,551	18.5	89,477	16,554	18.5	18,764
Arizona							(3)	4,294	[3] 42,570	46,864	9,925	21.2	46,864	9,925	21.2	16,010
Arkansas	22,745	1,415	(4)	(4)	(4)	10,336	(3)	6,302	[3] [4] 89,449	[4] 106,087	[4] 10,635	[4] 10.0	128,832	12,050	9.4	28,601
California	158,050	22,448	(4)	(4)	(4)	77,764	19,410	4,632	[4] 258,497	[4] 360,303	[4] 87,756	[4] 24.4	518,353	110,204	21.3	83,141
Colorado	6,802	285				1,700	(3)	1,521	[3] 51,622	54,843	8,450	15.4	61,645	8,735	14.2	22,725
Delaware, District of Columbia, and Maryland	51	10						402	5,236	5,638	4,332	76.8	5,689	4,342	76.3	3
Florida	10	1							11,702	11,702	1,758	15.0	11,712	1,759	15.0	5,505
Georgia							(3)	1,548	[3] 65,121	66,669	12,977	19.5	66,669	12,977	19.5	42,244
Illinois	11,780	1,373				5,526		6,936	136,863	149,325	40,237	26.9	161,105	41,610	25.8	30,865
Indiana	133	9				518		3,432	35,566	39,516	13,848	35.0	39,649	13,857	34.9	774
Iowa							5,358	6,443	35,293	47,094	10,427	22.1	47,094	10,427	22.1	20,314
Kansas	30,475	2,478	(4)	(4)	(4)	12,491	9,939	31,252	[4] 119,019	[4] 172,701	[4] 24,531	[4] 14.2	203,176	27,009	13.3	42,780
Kentucky	5,133	1,094				2,592		7,736	17,736	28,064	7,422	26.4	33,197	8,516	25.7	2,241
Louisiana	174,783	9,818	22,192	1,116	5.0	91,450	(3)	13,843	[3] 206,527	311,820	34,417	11.0	508,795	45,351	8.9	65,925
Massachusetts and New Hampshire								2	368	370	852	230.3	370	852	230.3	
Michigan	1,747	289				102		1,806	38,049	39,957	21,248	53.2	41,704	21,537	51.6	141
Minnesota								256	46,047	46,303	11,016	23.8	46,303	11,016	23.8	24,009
Mississippi	11,825	1,001				691	(3)	10,954	[3] 54,663	66,308	8,651	13.0	78,133	9,652	12.4	26,580
Missouri	12	2				2,347	6,087	5,902	63,258	77,594	17,548	22.6	77,606	17,550	22.6	15,949
Montana	1,365	130				2,970	(3)	322	[3] 13,049	16,341	2,698	16.5	17,706	2,828	16.0	889
Nebraska	421	54				254	(3)	4,238	[3] 34,246	38,738	8,129	21.0	39,159	8,183	20.9	14,894
New Jersey									11,776	11,776	4,793	40.7	11,776	4,793	40.7	6,129
New Mexico	68,710	2,784	(4)	(4)	(4)	4,407		2,907	[4] 82,095	[4] 89,409	[4] 7,571	[4] 8.5	158,119	10,355	6.5	15,411
New York	250	84				51		181	37,611	37,843	17,870	47.2	38,093	17,954	47.1	20,865
North Carolina and South Carolina								2,218	132	2,350	211	9.0	2,350	211	9.0	
North Dakota and South Dakota							(3)		[3] 5,990	5,990	1,629	27.2	5,990	1,629	27.2	3,521

For footnotes, see end of table.

92512—54—57

TABLE 12.—Industrial consumption of natural gas in the United States in 1950–51, by State and use—Continued

State	Field (drilling, pumping, and operating gasoline-recovery plants)		Carbon-black manufacture			Fuel							Total industrial			Fuel at electric utility plants [1] (million cubic feet)
				Value at point of consumption		Million cubic feet					Value at point of consumption			Value at point of consumption		
	Million cubic feet (estimated)	Value at point of consumption (thousand dollars)	Million cubic feet	Total (thousand dollars)	Average (cents per M cubic feet)	Petroleum refineries	Portland-cement plants	Natural-gas-pipelines	Other industrial	Total	Total (thousand dollars)	Average (cents per M cubic feet)	Million cubic feet	Total (thousand dollars)	Average (cents per M cubic feet)	
1951—Continued																
Ohio	817	167	------	------	------	357	------	3,509	120,125	123,991	50,169	40.5	124,808	50,336	40.3	2,453
Oklahoma	126,756	6,276	(4)	(4)	(4)	36,656	(3)	6,262	[3] [4] 70,693	[4] 113,611	[4] 13,432	[4] 11.8	240,367	19,708	8.2	41,153
Pennsylvania	4,277	1,314	------	------	------	9,932	------	3,701	137,565	151,198	59,653	39.5	155,475	60,967	39.2	9,742
Tennessee	------	------	------	------	------	------	------	7,465	57,887	65,352	11,224	17.2	65,352	11,224	17.2	7,500
Texas	774,443	40,359	322,287	16,341	5.1	270,123	25,492	41,511	556,713	893,839	86,444	9.7	1,990,569	143,144	7.2	193,616
Utah and Wyoming	18,145	1,329	------	------	------	5,046	(3)	508	[3] 21,238	26,792	5,361	20.0	44,937	6,690	14.9	830
Virginia	25	6	------	------	------	------	------	1,570	2,897	4,467	1,361	30.5	4,492	1,367	30.4	150
West Virginia	23,100	4,741	------	------	------	1,607	------	5,139	59,751	66,497	19,164	28.8	89,597	23,905	26.7	95
Wisconsin	------	------	------	------	------	------	------	683	7,682	8,365	5,030	60.1	8,365	5,030	60.1	79
Unclassified by States	------	------	[4] 81,944	[4] 4,756	[4] 5.8	------	[3] 22,685	------	------	------	------	------	------	------	------	------
Total: 1951	1,441,870	97,470	426,423	22,213	5.2	537,774	102,508	192,496	2,462,457	3,295,235	632,564	19.2	5,163,528	752,247	14.6	763,898

[1] Federal Power Commission. These figures include some manufactured gas and are therefore shown separately. The natural-gas component in these figures is included with "Other industrial."

[2] Less than $500.

[3] Gas used in portland-cement plants included under "Unclassified by States" for United States total and under "Other industrial" for State totals to avoid disclosing figures of individual operators.

[4] Gas used in carbon-black manufacture included under "Unclassified by States" for United States total and under "Other industrial" for State totals to avoid disclosing figures of individual operators.

[5] Not separately reported. Included with "Other industrial."

Petroleum Refineries.—The use of natural gas as fuel at petroleum refineries increased 8 percent in 1950 and 18 percent in 1951. California and Texas showed the largest increases, California in 1951 returning to the 1948 level of consumption after dropping in 1949. Natural gas was used for the first time at refineries in Tennessee and New Jersey, and a large increase in the use by Pennsylvania refineries was reported. Natural gas supplied 36.9 percent of total refinery fuel in the United States in 1951 and 34.7 percent in 1950 compared with 33.2 percent in 1949.

Electric Utility Plants.—The use of natural gas as fuel at electric-utility plants increased 14 percent in 1950 and 21 percent in 1951. Electric generation (excluding hydroelectric generation) increased by 16 percent in each of these years. Increases in gas used took place in most States; there were especially large relative increases in Georgia, Mississippi, New Jersey, New York, and Pennsylvania.

Portland-Cement Plants.—The use of natural gas as fuel at portland-cement plants increased 15 percent in 1950 and 6 percent in 1951. The production of portland cement correspondingly increased 8 and 9 percent. The use of gas was reported for the first time by plants in Arizona, Mississippi, and Montana.

Natural-Gas Pipelines.—Starting in 1950, data were collected on the use of natural gas as a fuel at natural-gas-pipeline compressor stations. Previously this gas was reported under "Other industrial." Because 1950 was the first year such figures were reported, this figure for 1950 may not be entirely comparable with that for 1951. In 1951 the quantity of gas used for this purpose was 192 billion cubic feet—about 6 percent of the industrial use exclusive of field and carbon black.

Other Industrial.—In 1951, "Other industrial" use increased 14 percent. This is a smaller rate of increase than was shown by most of the other classes of consumers for 1951. Texas, with a 10-percent increase, was below the national average.

Mixed Gas.—The overall volume of natural gas distributed as mixed gas did not increase significantly in 1950, but there was a sharp shift in the location and number of consumers receiving mixed gas. Missouri in 1950 had no distribution of mixed gas, all distributors having converted to straight natural by the end of 1949. In 1951 the volume of natural gas used with manufactured gas increased sharply, primarily as the result of completion of a pipeline to the New York City area. Iowa, Kentucky, and Nebraska reported no natural used in mixed gas in 1951.

The consumers and the volumes reported in table 13 are included in the general-consumption tables (tables 8–12) for natural gas.

TABLE 13.—Consumption of natural gas used with manufactured gas in the United States in 1950–51, by States [1]

State	Residential		Commercial		Industrial (million cubic feet)	Total	
	Number of consumers	Million cubic feet	Number of consumers	Million cubic feet		Million cubic feet	Value at point of consumption (thousand dollars)
1950							
Delaware and Maryland	45,598	722	2,617	147	166	1,035	1,034
Illinois	1,257,021	27,037	62,479	9,548	14,484	51,069	33,605
Indiana	182,901	3,572	10,898	962	7,758	12,292	10,008
Iowa	28,702	2,035	4,066	918	4,336	7,289	3,587
Kentucky	100,033	3,316	9,670	1,078	2,404	6,798	3,192
Nebraska	1,641	130	227	50	40	220	156
New Jersey	689,549	1,943	47,698	455	305	2,703	758
New York	384,749	16,916	24,055	2,967	2,052	21,935	16,799
Pennsylvania	879,055	27,366	56,223	3,940	4,568	35,874	29,196
Tennessee	1,278	7	93	8	----------	15	23
Virginia	690	3	198	5	----------	8	12
Total	3,571,217	83,047	218,224	20,078	36,113	139,238	98,370
1951							
Delaware and Maryland	45,611	1,206	2,617	245	258	1,709	2,962
Illinois	904,820	26,986	43,048	9,342	15,175	51,503	32,830
Indiana	303,261	5,741	17,216	1,596	10,347	17,684	14,719
Massachusetts	65,659	137	2,776	30	23	190	548
New Jersey	917,360	12,401	63,924	2,381	8,943	23,725	43,226
New York	2,835,654	49,265	116,071	9,146	6,322	64,733	93,773
Pennsylvania	826,081	31,572	52,132	4,229	6,018	41,819	55,640
Tennessee	1,240	6	90	7	----------	13	19
Virginia	650	2	196	4	----------	6	9
Total	5,900,336	127,316	298,070	26,980	47,086	201,382	243,726

[1] Included in tables for the consumption of natural gas (tables 8–12).

PRICES

The average value at wells for natural gas in the United States in 1950 was 6.5 cents per thousand cubic feet, an increase of 0.2 cent from 1949. Most of the larger producing States recorded increases of from 0.1 to 0.2 cent per thousand. Kansas showed the largest gain, from 5.4 to 6.6 cents per thousand, partly as a result of enforcement of a minimum-price ruling upheld by the United States Supreme Court in 1950.

In 1951 the average wellhead value of natural gas increased 0.8 cent to 7.3 cents per thousand cubic feet. This was the sharpest increase yet recorded in 1 year. Increases were general through all the producing States. Increases in the major producing States of the Southwest (Mississippi excepted) ranged from 0.4 to 1.5 cents per thousand cubic feet compared with 0.1 to 0.2 cent in 1950. In Illinois, Indiana, Michigan, and Pennsylvania, which showed declines in 1950, the rise in 1951 was even larger.

Residential average values showed scattered plus and minus changes by States in 1950, and in 1951 the majority of the changes were declines. Industrial average values, on the other hand, while showing

a predominance of negative changes in 1950, showed increases in most States in 1951. The increases in average value at point of consumption then must be attributed more to the increasing proportion of high-value sales—that is, residential and commercial—than to the increase in unit price of a particular sale. Also, the increased volume of gas distributed after long-distance transmission in regions where the unit value was high tended to raise the national-average value at points of consumption.

TABLE 14.—Average value of natural gas in the United States, 1950–51, by States, in cents per thousand cubic feet

State	At wells (estimated)		At point of consumption		State	At wells (estimated)		At point of consumption	
	1950	1951	1950	1951		1950	1951	1950	1951
Alabama	5.0	5.0	27.5	29.1	Nebraska	11.8	12.8	36.9	38.6
Arizona	------	------	28.6	29.9	New Hampshire	------	------	------	300.0
Arkansas	3.5	4.0	14.8	15.7	New Jersey	------	------	53.6	178.8
California	11.9	14.6	33.7	35.1	New Mexico	3.0	3.8	10.8	11.0
Colorado	3.9	4.3	29.5	29.7	New York	25.1	25.1	82.8	105.8
Delaware	------	------	99.5	174.1	North Carolina	------	------	------	18.0
District of Columbia	------	------	127.5	123.0	North Dakota	5.1	5.2	46.9	57.2
Florida	5.2	7.3	19.7	20.9	Ohio	19.4	20.2	52.7	53.0
Georgia	------	------	31.9	30.7	Oklahoma	4.9	5.3	14.5	15.1
Illinois	10.1	15.3	45.3	48.2	Pennsylvania	25.3	27.7	50.7	58.4
Indiana	7.0	9.8	60.4	64.3	South Carolina	------	------	------	14.1
Iowa	------	------	37.5	41.7	South Dakota	------	5.0	42.1	45.4
Kansas	6.6	8.1	20.3	21.3	Tennessee	10.0	9.4	30.7	30.1
Kentucky	19.7	21.7	40.8	42.4	Texas	4.7	5.4	9.8	10.4
Louisiana	5.3	5.8	11.4	12.1	Utah	6.0	6.6	31.3	34.8
Maryland	19.8	20.0	126.7	124.8	Virginia	8.7	15.6	95.1	99.6
Massachusetts	------	------	------	262.2	West Virginia	16.8	18.6	30.3	32.1
Michigan	13.2	14.8	73.0	74.5	Wisconsin	------	------	131.9	112.5
Minnesota	------	------	43.5	42.8	Wyoming	6.0	7.5	18.7	19.0
Mississippi	6.3	6.3	22.0	21.6					
Missouri	14.3	14.3	40.0	43.0	Total	6.5	7.3	26.6	29.8
Montana	5.3	5.5	28.7	31.3					

WORLD REVIEW

Canada.—Gross production of natural gas in the Province of Alberta in 1951 was 85.4 billion cubic feet compared with 75.6 billion in 1950.

The Petroleum and Natural Gas Conservation Board of Alberta reported that Alberta's proved reserves of natural gas at the end of 1951 were 6.8 trillion cubic feet. The board estimated that 6.5 trillion cubic feet would be required to meet the needs of Alberta for the next 30 years and expected new reserves to be found at the rate of 1 trillion cubic feet per year for 8 to 10 years.

Italy.—The production of natural gas in Italy again doubled in 1951, reaching 34 billion cubic feet. Domestic consumers used about 4 percent of the production, 12 percent was used for motor-vehicle fuel, and 81 percent went to industrial consumers. At the end of 1951, there were 950 miles of natural-gas pipeline in Italy.

Mexico.—Gross production of natural gas in Mexico in 1951 was approximately 80 billion cubic feet. The Poza Rica field produced most of this gas. Pending completion of repressuring facilities here large quantities of gas were being flared.

TABLE 15.—Consumption of natural gas, 1945–50, by countries, in million cubic meters

[United Nations Statistical Yearbook]

Country	1945	1946	1947	1948	1949	1950 [1]
Western Hemisphere:						
Argentina	609	562	(2)	(2)	(2)	(2)
Canada	1,371	1,356	1,491	1,660	1,712	1,994
Ecuador	70	66	87	(2)	(2)	(2)
Mexico	762	768	997	1,066	1,188	1,677
United States	114,457	117,594	129,753	145,776	153,471	177,889
Venezuela	7,257	9,381	11,402	13,319	14,066	15,776
Europe:						
Austria	(2)	(2)	(2)	(2)	(2)	(2)
Czechoslovakia	2	3	(2)	(2)	(2)	(2)
Denmark	4	3	3	(2)	(2)	(2)
France	85	110	147	174	228	246
Germany [3]	71	109	78	67	54	68
Hungary	77	91	101	(2)	(2)	(2)
Italy	42	64	94	117	234	504
Poland	[4] 102	149	148	[5] 81	(2)	(2)
Rumania	1,304	1,332	[1] 1,176	(2)	(2)	(2)
Yugoslavia	3	6	12	9	8	16
Asia:						
Brunei	(2)	[1] 28	25	562	580	754
China [6]	(7)	61	55	(2)	(2)	(2)
Indonesia	(2)	(2)	24	369	591	621
Japan	41	36	35	51	58	69
Total [8]	127,000	132,000	147,000	[9] 166,000	176,000	(2)

[1] Preliminary or estimated figures.
[2] Data not available.
[3] American and British Zones.
[4] April–December.
[5] January–June.
[6] Beginning 1945, industries under control of the National Resources Commission.
[7] Less than 500,000 cubic meters.
[8] Excluding U. S. S .R., where natural-gas consumption was last reported as 1,400 million cubic meters in 1936.
[9] Revised.

Venezuela.—Gross production of natural gas in Venezuela in 1951 was approximately 600 billion cubic feet. Only 1 percent of this was utilized away from the producing fields.

The natural-gas pipeline from Las Mercedes and Tucupido to Caracas was completed, and a line was started from Anaco to Puerto La Cruz.

Natural-Gas Liquids

By D. S. Colby, E. M. Seeley, A. T. Coumbe, and I. F. Avery

GENERAL SUMMARY

PRODUCTION of natural-gas liquids in 1951 increased 13 percent over 1950 to 205 million barrels. In 1950 production had increased 16 percent over 1949. The LP-gas [1] portion of this output showed the highest rate of increase in 1951—20 percent. Production of natural gasoline and of finished gasoline and naphtha also increased, while that of "other products" (condensate, kerosine, distillate fuel, etc.) declined.

In 1951, 6,203 billion cubic feet of gas was treated, and the average recovery of all liquids was 1.39 gallons per thousand cubic feet. At the end of 1951 operable plant capacity totaled 812 thousand barrels per day at 521 plants.

Total demand for natural-gas liquids in 1951 was 206 million barrels—13 percent above the previous year. Shipments to refineries increased 8 percent; LP-gas sales for fuel increased 17 percent, and a 42-percent increase took place in the use of LP-gases for chemical production.

Total stocks at plants, terminals, and refineries increased 831 thousand barrels during 1951, as a slight decrease in stocks of LP-gases was more than counterbalanced by increases for natural gasoline and other products.

The total value of natural-gas liquids produced increased from $420 millions in 1950 to $508 millions in 1951. The average value per gallon rose in 1951 to 5.9 cents after dropping from 6.1 cents in 1949 to 5.5 cents in 1950.

Exports of natural gasoline and liquefied gases (LP-gases and LR-gases) increased in 1951 and together totaled 3,718 thousand barrels compared with 2,612 thousand barrels in 1950.

RESERVES

The American Gas Association Reserves Committee estimated proved recoverable reserves of natural-gas liquids in the United States at the end of 1951 to be 4,725 million barrels. The estimated increase in reserves during the year was the second largest for any year since the committee began estimating reserves in 1947. The percentage of reserves existing in dissolved gases increased from 26 percent in 1947 to 34 in 1951, that is, the major additions to reserves were of liquids in dissolved gases. In 1951 the major additions to reserves took place in Texas, Louisiana, New Mexico, Oklahoma, and West Virginia. California showed the largest decrease in reserves for any State during the year owing to revision of reserve estimates. States whose reserves of natural-gas liquids had declined during each of the years 1949, 1950, and 1951 were Arkansas, Colorado, Kentucky, Mississippi, Montana, Pennsylvania, and Utah.

[1] Liquefied petroleum gas. Does not include LR- (liquefied refinery) gases except where indicated.

TABLE 1.—Salient statistics of natural-gas liquids in the United States, 1947–51, in thousands of barrels

	1947	1948	1949	1950	1951
Production:					
Natural gasoline and natural-gasoline mixtures	65,327	70,938	71,640	76,873	83,880
LP-gases:					
Isobutane	4,909	4,675	4,181	4,667	5,509
Other LP-gases	40,134	47,922	53,688	67,615	80,868
Finished gasoline and naphtha	10,280	12,594	16,681	20,981	23,048
Other products	11,523	10,592	10,896	11,825	11,449
Total	132,173	146,721	157,086	181,961	204,754
Receipts from outside sources (refineries)	2,922	4,103	4,316	1,727	1,600
Total new supply	135,095	150,824	161,402	183,688	206,354
Stock change at plants and terminals	−630	1,188	850	190	457
For motor fuel:					
Shipments to refineries:					
Natural gasoline and natural-gasoline mixtures	60,821	65,659	65,941	72,246	77,943
LP-gases	9,695	10,284	12,226	13,188	15,430
Finished gasoline and naphtha	1,874	3,462	3,392	4,401	5,304
Other products	9,483	8,229	7,760	8,597	7,731
Shipments to jobbers and trade outlets:					
Natural gasoline	4,234	4,109	4,370	3,897	5,368
Finished gasoline and naphtha	8,600	8,841	12,904	17,602	17,599
Other products	170	200	211	113	182
Exports	3,717	3,649	4,142	1,217	2,029
Losses	785	890	1,488	1,483	1,099
Transfers to non-motor-fuel uses:					
LP-gases for fuel	28,873	35,609	38,855	49,228	57,571
LP-gases for chemical manufacture	5,769	6,790	6,793	8,599	12,230
Other products	1,704	1,914	2,470	2,927	3,411
Total demand at plants and terminals	135,725	149,636	160,552	183,498	205,897
Stocks at plants, terminals, and refineries:					
Natural gasoline	2,818	3,609	4,100	4,187	4,909
LP-gases	720	1,051	1,172	1,661	1,547
Other products	758	919	1,559	1,507	1,730
Total	4,296	5,579	6,831	7,355	8,186
Value at plants:					
Natural gasoline...thousands of dollars	171,057	257,125	211,487	213,810	254,319
LP-gases.....do	66,820	117,823	99,054	97,773	138,443
Finished gasoline and naphtha...do	57,117	52,414	60,551	75,044	83,062
Other products.....do		31,615	31,098	32,978	32,337
Average per gallon.....cents	5.3	7.4	6.1	5.5	5.9
Natural gas treated...millions of cubic feet	4,070,150	4,393,500	4,656,142	5,341,804	6,203,070
Average yield, natural-gas liquids except LP-gases per M cubic feet.....gallons	0.90	0.90	0.89	0.86	0.80
Average yield, all natural-gas liquids gallons	1.36	1.40	1.42	1.43	1.39
Sales to consumers for fuel and chemical uses:					
LP-gases	34,495	42,048	45,649	57,643	69,152
LR-gases	18,119	23,114	21,889	25,275	31,497
Total	52,614	65,162	67,538	82,918	100,649
Exports of natural gasoline, LP-gases and LR-gases	6,099	5,150	5,635	2,612	3,718

PRODUCTION

The production of natural-gas liquids in 1951 totaled 204,754,000 barrels, an increase of 13 percent over 1950 compared with a 16-percent increase in 1950 over 1949. Natural gasoline and LP-gases continued the rapid increases recorded in 1950; the increase in production of finished gasoline and naphtha was less than that in 1950, and the output of "other products" declined from the 1950 figure. The percentage changes in production for the various products in 1951 compared with 1950 were: Natural gasoline, +9 percent; LP-gases, +20 percent; finished gasoline and naphtha, +10 percent; other products, −3 percent.

TABLE 2.—Estimated proved recoverable reserves of natural-gas liquids [1] in the United States, 1950–51, in thousands of barrels

[Committee on Natural Gas Reserves, American Gas Association]

State	Reserves as of Dec. 31, 1950	Changes in reserves during 1951			Reserves as of Dec. 31, 1951			
		Extensions and revisions	Discoveries of new fields and new pools in old fields	Net production	Nonassociated with oil	Associated with oil	Dissolved in oil	Total
Arkansas	52,938	−110	80	1,858	30,326	7,167	13,557	51,050
California	363,387	−4,596	----------	29,475	0	112,854	216,462	329,316
Colorado	12,921	−521	----------	490	301	0	11,609	11,910
Illinois	26,259	2,006	28	3,721	22	50	24,500	24,572
Indiana	152	13	17	33	18	22	109	149
Kansas	163,578	−14	330	4,325	155,367	1,430	2,772	159,569
Kentucky	11,927	369	185	2,003	[2] 10,478	0	0	10,478
Louisiana	643,512	64,775	9,294	32,808	540,276	99,303	45,194	684,773
Michigan	1,018	89	1	99	595	0	414	1,009
Mississippi	55,897	47	995	4,649	25,750	20,912	5,628	52,290
Montana	3,547	79	----------	285	3,341	0	0	3,341
Nebraska	235	1,808	666	123	2,314	169	103	2,586
New Mexico	93,897	44,221	661	8,160	47,842	32,580	50,197	130,619
Ohio	1,688	94	11	83	[2] 1,710	0	0	1,710
Oklahoma	279,903	52,715	4,319	25,812	120,293	27,993	162,839	311,125
Pennsylvania	2,599	119	59	214	[2] 2,563	0	0	2,563
Texas	2,496,039	470,160	55,702	144,560	1,398,327	391,917	1,087,097	2,877,341
Utah	194	−128	----------	5	61	0	0	61
West Virginia	8,976	20,845	282	6,182	[2] 23,921	0	0	23,921
Wyoming	48,987	−3,478	2,543	2,166	40,623	5,263	0	45,886
Alabama, Florida and North Dakota	9	4	321	1	0	0	333	333
Total	4,267,663	648,497	75,494	267,052	2,404,128	699,660	1,620,814	4,724,602

[1] Comprises natural gasoline, LP-gases, and condensate.
[2] Not allocated by types, but occurring principally in column shown.

The production of LP-gases exceeded that of natural gasoline for the first time in 1951.

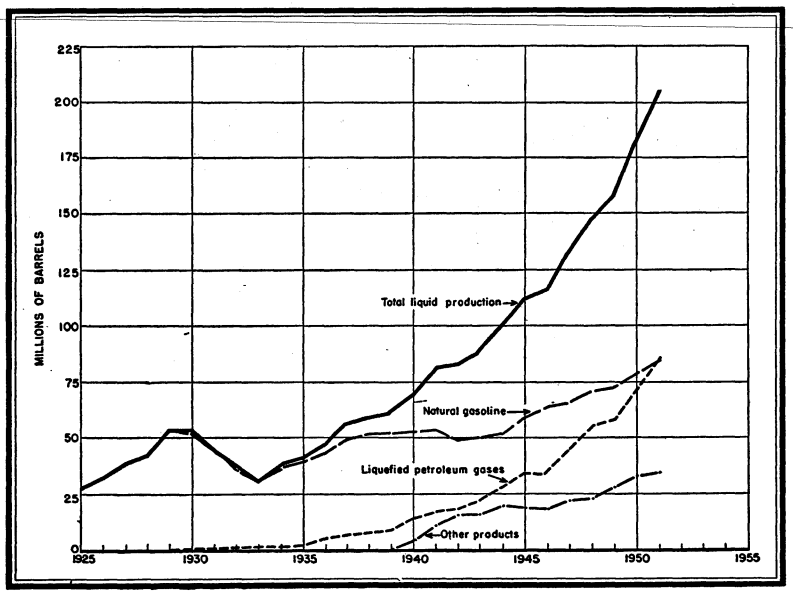

FIGURE 1.—Production of natural-gas liquids in the United States, 1925–51.

TABLE 3.—Natural-gas liquids produced and natural gas treated in the United States, 1950–51, by States

State	Number of operators [2]	Production										Natural gas treated		
		Natural gasoline		LP-gases		Finished gasoline and naphtha		Other products [1]		Total			Average yield (gallons per M cubic feet)	
		Thousand barrels	Thousand dollars	Thousand barrels	Thousand dollars	Thousand barrels	Thousand dollars	Thousand barrels	Thousand dollars	Thousand barrels	Thousand dollars	Million cubic feet	Natural-gas liquids except LP-gases	All natural-gas liquids
1950														
Arkansas	8	1,276	3,498	938	1,197	69	288	50	140	2,333	5,123	64,237	.91	1.53
California	30	17,664	54,488	7,081	14,497			3,583	11,039	28,328	80,024	509,796	1.75	2.33
Colorado	1	217	584	169	289					386	873	7,785	1.17	2.08
Illinois	8	989	3,019	2,118	3,436					3,107	6,455	13,333	3.12	9.79
Kansas	12	2,572	6,146	1,115	1,487					3,687	7,633	361,744	.30	.43
Kentucky	3	244	687	1,535	1,658					1,779	2,345	47,660	.21	1.57
Louisiana	25	5,110	14,056	6,165	7,991	6,362	22,338	3,131	8,154	20,768	52,539	534,550	1.15	1.63
Michigan	3	79	161							79	161	1,173	2.83	2.83
Mississippi	1	722	2,122	532	864			58	152	1,312	3,138	45,145	.73	1.22
Montana	1	98	350	153	450					251	800	15,017	.27	.70
New Mexico	9	3,021	8,886	1,998	2,061	(3)	1	(3)	11	5,019	10,959	185,138	.69	1.14
New York	1	(3)	(3)							(3)	13		.19	.19
Ohio	3	103	344							103	344	20,764	.21	.21
Oklahoma	34	7,592	19,851	6,753	8,393	253	1,397	135	331	14,733	29,972	332,764	1.01	1.86
Pennsylvania	10	232	702	14	55					246	757	41,406	.24	.25
Texas	101	34,979	92,995	39,643	50,266	14,240	50,862	4,788	12,929	93,650	207,052	2,938,158	.77	1.34
Utah		6	20							6	20			
West Virginia	14	975	2,709	3,575	4,195	57	158	16	32	4,623	7,094	183,957	.24	1.06
Wyoming	6	994	3,192	493	934			64	190	1,551	4,316	39,164	1.13	1.66
Total	207	76,873	213,810	72,282	97,773	20,981	75,044	11,825	32,978	181,961	419,605	5,341,804	.86	1.43

1951

Arkansas	8	1,281	3,873	962	1,606	68	270	37	104	2,348	5,853	71,145	.82	1.39
California	28	18,670	58,619	8,401	15,528	12	38	2,450	7,266	29,533	81,451	553,821	1.60	2.24
Colorado	1	[4]	[4]	[4]	[4]					[4]	[4]	[4]	[4]	[4]
Illinois	7	[5] 900	[5] 2,839	2,071	4,727					[5] 2,971	[5] 7,566	[5] 12,238	[5] 3.09	[5] 10.20
Kansas	13	2,645	6,931	1,621	2,445					4,266	9,376	397,294	.28	.45
Kentucky	4	265	799	1,901	2,129					2,166	2,928	[6] 86,950	.13	1.05
Louisiana	25	4,860	14,653	6,839	15,374	6,963	23,657	3,820	10,892	22,482	64,576	598,420	1.10	1.58
Michigan	2	[5]	[5]							[5]	[5]	[5]	[5]	[5]
Mississippi	1	655	2,296	473	852			74	207	1,202	3,355	46,468	.66	1.09
Montana	1	113	392	164	481					277	873	17,000	.28	.68
Nebraska	1	[4]	[4]	[4]	[4]					[4]	[4]	[4]	[4]	[4]
New Mexico	9	3,306	10,496	2,281	3,170			1	11	5,588	13,677	242,759	.57	.97
New York	1	[7]	[7]							[7]	[7]	[7]	[7]	[7]
Ohio	3	107	399							107	399	23,837	.19	.19
Oklahoma	35	9,016	25,571	8,084	12,436	269	1,498	173	429	17,542	39,934	419,868	.95	1.75
Pennsylvania	8	[7] 192	[7] 656	18	71					[7] 210	[7] 727	[7] 37,406	[7] .22	[7] .24
Texas	99	39,437	119,147	48,624	71,943	15,697	57,471	4,773	13,355	108,531	261,916	3,406,670	.74	1.34
Utah		[4]	[4]							[4]	[4]			
West Virginia	10	1,056	3,170	3,844	5,568	39	128	12	39	4,951	8,905	229,654	.20	.91
Wyoming	6	1,067	3,477	784	1,634			109	34	1,960	5,145	45,139	1.09	1.82
Undistributed		310	1,001	310	479					620	1,480	14,401	.90	1.81
Total	199	83,880	254,319	86,377	138,443	23,048	83,062	11,449	32,337	204,754	508,161	6,203,070	.80	1.39

[1] Includes condensate, kerosine, distillate fuel, etc.
[2] A producer operating in more than 1 State is counted but once in arriving at total for United States.
[3] Less than 500 barrels or $500.
[4] Colorado, Utah, and Nebraska combined under "Undistributed," to avoid disclosure of individual operations.
[5] Michigan included with Illinois.
[6] Includes 36,627 million cubic feet from transmission lines previously treated in another State.
[7] New York included with Pennsylvania.

TABLE 4.—Monthly production of natural-gas liquids in the United States, 1950–51, by State and district,[1] in thousands of barrels

State and district	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1950													
West New York and West Pennsylvania	28	24	25	24	18	16	16	15	15	17	24	24	246
West Virginia	365	327	359	342	327	404	377	394	419	434	415	460	4,623
Ohio	10	9	9	10	10	8	7	7	7	9	8	9	103
Illinois	265	233	254	250	265	260	255	275	264	266	261	259	3,107
Kentucky	163	148	168	150	137	111	129	129	135	157	171	181	1,779
Michigan	6	6	6	7	7	7	7	8	7	8	6	4	79
Kansas	350	321	294	288	283	274	258	254	278	318	362	407	3,687
Oklahoma	1,207	1,128	1,200	1,157	1,154	1,127	1,179	1,258	1,263	1,342	1,316	1,402	14,733
Texas:													
Gulf	1,826	1,721	1,753	1,656	1,670	1,617	1,737	1,818	1,803	1,932	1,910	2,070	21,513
East Texas	791	696	807	791	799	844	898	896	946	1,013	935	924	10,340
Panhandle	1,529	1,266	1,352	1,339	1,331	1,241	1,100	1,228	1,234	1,389	1,398	1,579	15,986
West Texas, Rest of State	3,546	3,262	3,457	3,479	3,542	3,639	4,054	4,028	4,050	4,234	4,149	4,371	45,811
Total Texas	7,692	6,945	7,369	7,265	7,342	7,341	7,789	7,970	8,033	8,568	8,392	8,944	93,650
Arkansas	220	199	211	201	193	185	188	190	183	193	192	178	2,333
Louisiana:													
Gulf	758	615	736	520	533	584	620	681	691	712	727	763	7,940
Inland	1,082	1,029	1,099	1,027	1,009	987	1,028	1,039	1,008	1,117	1,162	1,241	12,828
Total Louisiana	1,840	1,644	1,835	1,547	1,542	1,571	1,648	1,720	1,699	1,829	1,889	2,004	20,768
Mississippi	114	102	109	106	110	107	106	114	106	111	113	114	1,312
New Mexico	399	358	409	404	424	410	412	464	445	440	419	435	5,019
Montana	27	24	26	22	18	15	15	15	17	20	24	28	251
Colorado, Utah, Wyoming	141	132	142	139	158	152	165	167	177	189	187	194	1,943
California	2,408	2,119	2,253	2,135	2,290	2,297	2,415	2,443	2,392	2,549	2,453	2,574	28,328
Total United States	15,235	13,719	14,669	14,047	14,278	14,285	14,966	15,423	15,440	16,450	16,232	17,217	181,961
Daily average	491	490	473	468	461	476	483	498	515	531	541	555	499
1951													
West New York and West Pennsylvania	23	22	23	19	15	16	11	13	11	15	22	20	210
West Virginia	461	384	446	436	408	408	407	381	405	428	425	362	4,951
Ohio	11	9	11	9	9	9	9	9	8	8	8	7	107
Illinois and Michigan	251	214	248	240	264	255	256	247	246	265	244	241	2,971
Kentucky	178	152	173	169	158	146	139	133	145	165	257	351	2,166
Kansas	411	393	388	359	317	301	278	290	311	359	406	453	4,266
Oklahoma	1,437	1,360	1,590	1,468	1,431	1,315	1,355	1,381	1,447	1,540	1,579	1,639	17,542
Texas:													
Gulf	2,099	1,930	2,101	1,944	1,950	1,878	1,926	1,980	2,056	2,302	2,357	2,440	24,963
East Texas	909	806	940	887	918	917	937	980	983	976	932	923	11,108
Panhandle	1,520	1,391	1,798	1,500	1,383	1,295	1,222	1,449	1,503	1,589	1,536	1,697	17,883
West Texas	1,630	1,495	1,760	1,772	1,860	1,828	2,040	2,181	2,194	2,189	2,046	2,081	23,076
Rest of State	2,819	2,474	2,701	2,585	2,545	2,441	2,503	2,560	2,548	2,705	2,749	2,871	31,501
Total Texas	8,977	8,096	9,300	8,688	8,656	8,359	8,628	9,150	9,284	9,761	9,620	10,012	108,531
Arkansas	172	156	175	191	217	206	213	211	196	216	188	207	2,348
Louisiana:													
Gulf	766	686	781	746	724	706	672	736	687	700	809	778	8,791
Inland	1,201	1,079	1,196	1,137	1,121	1,059	1,119	1,097	1,075	1,208	1,187	1,212	13,691
Total Louisiana	1,967	1,765	1,977	1,883	1,845	1,765	1,791	1,833	1,762	1,908	1,996	1,990	22,482
Mississippi	110	94	106	98	98	97	100	94	94	105	104	102	1,202
New Mexico	442	395	471	486	470	447	481	517	439	494	460	486	5,588
Montana	30	28	24	24	24	20	17	13	18	23	27	29	277
Colorado, Nebraska, Utah, and Wyoming	202	197	209	196	200	189	204	219	225	251	242	246	2,580
California	2,575	2,305	2,575	2,380	2,469	2,331	2,409	2,419	2,382	2,502	2,488	2,698	29,533
Total United States	17,247	15,570	17,716	16,646	16,581	15,864	16,298	16,910	16,973	18,040	18,066	18,843	204,754
Daily average	556	556	571	555	535	529	526	545	566	582	602	608	561

[1] West New York and West Pennsylvania separated from east part of States to allow grouping either according to Bureau of Mines refinery districts or according to Petroleum Administration for War districts. Districts shown for Texas and Louisiana are Bureau of Mines production districts.

REVIEW BY STATES

California.—The total production of natural-gas liquids in California increased 4 percent in 1951, the same rate of increase as in 1950. LP-gas production increased considerably, but the output of "other products" declined.

Louisiana.—The production of natural-gas liquids in Louisiana increased 8 percent in 1951 to 22,482,000 barrels. Output in the Gulf coast area of Louisiana, which had been declining slowly for several years, increased 10 percent in 1951. Natural-gasoline production in that area decreased but was more than offset by increases in production of LP-gases, finished gasoline and naphtha, and other products.

Oklahoma.—The production of natural gasoline and LP-gases in 1951 increased by 19 and 20 percent respectively, maintaining the rapid rise of recent years. The output of finished gasoline and naphtha and of other products also increased, but these only accounted for about 2 percent of the total production of natural-gas liquids.

Texas.—Bureau of Mines production district boundaries were revised in 1951 to coincide with Texas Railroad Commission districts and to provide a separate breakdown of West Texas. The Gulf coast comprises Railroad Commission districts 2 and 3; West Texas—districts 7c and 8; East Proper (East Texas field)—part of district 6; and Panhandle—district 10.

The percentage increase in the production of natural-gas liquids in Texas was less in 1951 than in 1950 but still exceeded the national average. The output of natural gasoline increased 13 percent and of LP-gases, 23 percent. Texas in 1951 provided 53 percent of the natural-gas liquids produced in the United States compared with 52 percent in 1950.

Other States.—As in 1950, Illinois, Michigan, and New York reported decreased production of natural-gas liquids. In addition, in 1951, output declined in Mississippi. Nebraska produced for the first time in 1951. Wyoming showed an above-average gain, and opening of the extraction plant on the Tennessee Gas Transmission Co. pipeline in Kentucky sharply increased that State's output at the end of 1951.

YIELDS, PROCESSES, AND NUMBER OF PLANTS

Cycle Plants.—In 1950, 1,216,405 million cubic feet of gas was treated at cycle plants to recover 42,730 thousand barrels of liquid products. In 1951, 1,223,459 million cubic feet was treated to recover 43,911 thousand barrels. The average yields for these 2 years were 1.48 gallons per thousand cubic feet in 1950 and 1.51 gallons in 1951.

Yields.—The average yield of all natural-gas liquids, after rising slowly since 1943, declined 0.04 gallon per thousand cubic feet in 1951 to 1.39 gallons per thousand cubic feet. The yield of LP-gases, however, continued its steady increase; the yield of natural gasoline

and other products declined more sharply than in previous years. This indicated that a rising proportion of the drier gases was being treated. The yield of LP-gases in 1951 was 0.59 gallon per thousand cubic feet, up 0.02 gallon from 1950.

TABLE 5.—Natural-gas liquids produced in the United States in 1950–51, by State and method of manufacture

State	Number of plants operating				Production (thousands of barrels)			
	Compression [1]	Absorption [2]	Cycling [3]	Total	Compression [1]	Absorption [2]	Cycling [3]	Total
1950								
Arkansas		8		8		2,333		2,333
California	2	75	2	79	5	22,675	5,648	[4] 28,328
Colorado		1		1		386		386
Illinois	5	6		11	5	3,102		3,107
Kansas	2	[5] 15		17	19	3,668		3,687
Kentucky	1	3		4	16	1,763		1,779
Louisiana	5	31	7	43	583	8,502	11,683	20,768
Michigan	2	1		3	55	24		79
Mississippi			2	2		[5] 58	1,254	1,312
Montana		1		1		251		251
New Mexico	2	10		12	213	4,806		5,019
New York	1			1	([6])			([6])
Ohio		6		6		103		103
Oklahoma	10	66		76	289	14,444		14,733
Pennsylvania	14	6		20	[6] 17	229		[6] 246
Texas	22	150	36	208	4,188	65,317	24,145	93,650
Utah						[5] 6		6
West Virginia	32	18		50	2,702	1,921		4,623
Wyoming	2	6		8	88	1,463		1,551
Total	100	403	47	550	8,180	131,051	42,730	181,961
1951								
Arkansas		8		8		2,348		2,348
California	2	70	2	74	7	24,793	4,733	29,533
Colorado		1		1		([7])		([7])
Illinois	4	6		10	[8] 44	2,927		[8] 2,971
Kansas	2	16		18	14	4,252		4,266
Kentucky	2	3		5	280	1,886		2,166
Louisiana	2	33	7	42	303	9,903	12,276	22,482
Michigan	2			2	([8])			([8])
Mississippi			2	2		[5] 75	1,127	1,202
Montana		1		1		277		277
Nebraska		1		1		([7])		([7])
New Mexico	1	12		13	61	5,527		5,588
New York	1			1	([6])			([6])
Ohio		5		5		107		107
Oklahoma	8	70		78	182	17,360		17,542
Pennsylvania	10	6		16	[6] 14	196		[6] 210
Texas	14	152	30	196	2,387	80,369	25,775	108,531
Utah						([7])		([7])
West Virginia	28	12		40	2,951	2,000		4,951
Wyoming	2	6		8	81	1,879		1,960
Undistributed						620		620
Total	78	402	41	521	6,324	154,519	43,911	204,754

[1] Includes 21 plants manufacturing LP-gases in 1950 and 9 plants in 1951.
[2] Includes combination of absorption process with compression and charcoal processes. Includes 262 plants manufacturing LP-gases in 1950 and 279 plants in 1951; 3 charcoal plants in West Virginia and Ohio producing 13,000 barrels in 1950 and 2 charcoal plants producing 45,000 barrels in 1951.
[3] Includes 37 plants manufacturing LP-gases in 1950 and 35 in 1951.
[4] Includes 962,000 barrels of field condensate.
[5] Drip gasoline.
[6] New York included with Pennsylvania.
[7] Included under "Undistributed" to avoid disclosure of individual operations.
[8] Michigan included with Illinois.

The average value of liquid products recovered increased from 7.9 cents per thousand cubic feet treated to 8.2 cents in 1951. The rise was due almost entirely to higher prices and not to changes in yield.

Production by Processes.—The number of plants operating in 1950 remained unchanged from 1949 at 550, the reduction in the number of operating compression plants being offset by an increase in the number of absorption and cycling plants. The production of natural-gas liquids at each of the three major types of plants was greater in 1950 than in 1949.

In 1951 the number of operating plants declined to 521, primarily because of further reduction in the number of operating compression-type plants. Production from compression-type plants declined in 1951, but that from absorption and cycle plants increased.

MARKET DEMAND—SHIPMENTS

Total demand for natural-gas liquids at plants and terminals was 206 million barrels in 1951, 12 percent more than in 1950. Demand exceeded 1950 for all products except condensate.

Shipments to Refineries.—Shipments of natural-gas liquids to refineries increased 8 percent in 1951. The largest gains percentage-wise were made in the shipments of isopentane and of "other LP-gas mixtures." Regionally, the Texas Gulf and the Indiana-Illinois-Kentucky districts showed the largest increases in the utilization of natural-gas liquids at refineries. East Coast and California showed large declines. The average natural-gas liquid content of refinery gasoline declined to 9.0 percent in 1951 from 9.5 percent in 1950.

TABLE 6.—Percentage of natural-gas liquids in refinery gasoline in the United States, 1947–51, by Bureau of Mines refinery district

Year	East Coast	Appalachian	Indiana, Illinois, Kentucky	Oklahoma, Kansas, Missouri	Texas Inland	Texas Gulf Coast	Louisiana Gulf Coast	Arkansas, Louisiana Inland	Rocky Mountain	California	Total
1947	0.8	2.0	5.5	7.7	22.6	8.8	5.3	10.3	3.9	17.4	8.7
1948	.8	2.4	5.0	8.9	25.0	8.3	4.8	7.1	3.8	17.2	8.5
1949	1.5	2.0	5.3	9.5	27.6	8.5	6.0	7.5	4.5	18.4	9.1
1950	3.5	1.7	5.0	8.3	26.0	10.7	5.9	13.8	4.1	19.0	9.5
1951	2.6	1.7	5.1	8.9	23.1	11.1	5.3	12.4	4.3	16.1	9.0

"Direct" Sales.—Direct sales from plants increased more rapidly than sales to refineries. The largest gain was in sales of LP-gases for chemical use, which increased 42 percent to 12,230,000 barrels. Sales of LP-gases for fuel increased 17 percent, and sales of natural gasoline to jobbers rose by 38 percent.

In the period 1949–51 tank trucks grew in importance as a mode of transport of natural gasoline and allied products at the expense of rail tank car. The percentage of total output transported by tank truck rose from 21 percent in 1949 to 24 percent in 1951, while tank cars handled 24 percent in 1949 and 21 percent in 1951. Pipelines and barges held their position virtually unchanged at 51 and 2 percent, respectively, for 1951.

TABLE 7.—Supply and distribution at plants and terminals [1] of natural-gas liquids in the United States, 1950–51, by months, in thousands of barrels

	January	February	March	April	May	June	July	August	September	October	November	December	Total
1950													
Production:													
Natural gasoline and natural-gasoline mixtures	6,128	5,433	5,994	6,038	6,316	6,533	6,751	6,803	6,629	6,910	6,544	6,793	76,872
LP-gases:													
Butane, normal	1,499	1,292	1,359	1,243	1,204	1,213	1,265	1,290	1,391	1,501	1,523	1,457	16,237
Isobutane	371	309	361	324	350	352	340	416	434	488	463	459	4,667
Propane	2,665	2,470	2,394	2,250	2,182	1,914	2,050	2,180	2,385	2,676	2,786	3,186	29,138
Butane-propane mixture	1,368	1,215	1,266	1,243	1,109	1,053	1,093	1,353	1,187	1,295	1,362	1,599	15,143
Other LP-gas mixtures	414	376	407	385	450	565	580	548	588	617	562	584	6,076
Isopentane	98	77	116	42	90	56	67	73	83	100	108	111	1,021
Finished gasoline and naphtha	1,732	1,569	1,786	1,702	1,688	1,688	1,801	1,678	1,743	1,833	1,855	1,906	20,981
Condensate	722	757	739	590	656	679	759	844	758	780	771	821	8,876
Other products	238	221	247	230	233	232	260	238	242	250	258	301	2,950
Total	15,235	13,719	14,669	14,047	14,278	14,285	14,966	15,423	15,440	16,450	16,232	17,217	181,961
Receipts from outside sources [2]	386	231	94	90	18	17	11	164	136	148	155	277	1,727
Total new supply	15,621	13,950	14,763	14,137	14,296	14,302	14,977	15,587	15,576	16,598	16,387	17,494	183,688
Stock change at plants and terminals	419	816	−207	−64	−550	134	425	53	−18	−72	−512	−234	190
For motor fuel:													
Shipments to refineries:													
Natural gasoline and natural-gasoline mixtures	5,780	5,133	5,460	5,751	6,120	5,750	5,956	6,062	6,236	6,722	6,524	6,752	72,246
Butane, normal	498	468	479	449	381	415	486	555	564	677	748	657	6,377
Isobutane	282	254	281	254	277	268	253	293	297	372	336	333	3,500
Isopentane	92	71	87	63	68	51	61	58	84	105	105	73	918
Other LP-gases	150	165	163	143	215	249	226	182	214	244	209	233	2,393
Finished gasoline and naphtha	288	272	281	295	277	258	437	469	455	437	453	479	4,401
Condensate	703	651	736	547	631	714	768	784	749	757	769	788	8,597
Shipments to jobbers and trade outlets:													
Natural gasoline	296	239	312	247	348	318	317	345	348	398	394	335	3,897
Finished gasoline and naphtha	1,320	995	1,783	1,572	1,825	1,654	1,420	1,469	1,337	1,376	1,447	1,404	17,602
Condensate	12	9	12	9	11	16	9	7	7	6	7	8	113
Exports and losses [3]	117	74	167	161	243	230	258	193	426	191	154	129	2,343
Transfers to non-motor-fuel uses:													
LP-gases:													
For fuel [3]	4,795	3,999	4,308	3,861	3,578	3,298	3,327	4,151	3,832	4,369	4,732	5,335	49,585
For chemical manufacture	577	552	660	636	651	740	776	757	838	794	751	867	8,599
Other products	292	252	241	213	221	207	258	209	207	222	270	335	2,927
Total demand at plants and terminals	15,202	13,134	14,970	14,201	14,846	14,168	14,552	15,534	15,594	16,670	16,899	17,728	183,498

1951													
Production:													
Natural gasoline and natural-gasoline mixtures	6,503	5,937	7,093	6,825	7,197	7,161	7,269	7,316	7,163	7,446	6,934	7,036	83,880
LP-gases:													
Butane, normal	1,588	1,410	1,484	1,577	1,383	1,303	1,238	1,323	1,440	1,564	1,600	1,721	17,631
Isobutane	456	410	466	463	461	390	407	442	447	472	515	580	5,509
Propane	3,361	2,952	3,400	2,860	2,669	2,442	2,451	2,619	2,979	3,359	3,551	3,893	36,536
Butane-propane mixture	1,534	1,450	1,545	1,667	1,309	1,140	1,298	1,561	1,368	1,395	1,470	1,478	17,215
Other (LP-gas) mixtures	654	579	692	347	694	673	666	653	669	724	768	802	7,921
Isopentane	91	83	117	124	98	129	133	144	147	151	174	174	1,565
Finished gasoline and naphtha	2,013	1,805	1,890	1,884	1,818	1,727	1,933	1,924	1,914	2,027	2,035	2,078	23,048
Condensate	735	650	720	627	659	638	626	659	592	635	704	747	7,992
Other products	312	294	309	272	293	261	277	269	254	267	315	334	3,457
Total	17,247	15,570	17,716	16,646	16,581	15,864	16,298	16,910	16,973	18,040	18,066	18,843	204,754
Receipts from outside sources [2]	176	200	171	159	106	28	62	149	140	112	157	140	1,600
Total new supply	17,423	15,770	17,887	16,805	16,687	15,892	16,360	17,059	17,113	18,152	18,223	18,983	206,354
Stock change at plants and terminals	−75	226	95	473	226	272	56	59	−127	−420	−294	−34	457
For motor fuel:													
Shipments to refineries:													
Natural gasoline and natural-gasoline mixtures	6,092	5,398	6,775	5,877	6,593	6,222	6,553	6,733	6,877	7,347	6,646	6,830	77,943
Butane, normal	706	565	594	457	457	428	430	412	535	752	670	599	6,605
Isobutane	334	299	350	326	323	261	286	332	313	339	361	373	3,897
Isopentane	87	81	120	106	128	117	107	144	122	148	155	162	1,477
Other LP-gases	264	249	302	260	293	284	249	277	303	318	300	352	3,451
Finished gasoline and naphtha	461	395	482	420	456	421	430	438	431	471	451	448	5,304
Condensate	705	645	659	631	648	635	593	621	593	627	668	706	7,731
Shipments to jobbers and trade outlets:													
Natural gasoline	444	417	496	478	512	515	621	339	381	390	422	353	5,368
Finished gasoline and naphtha	1,482	1,324	1,508	1,575	1,446	1,370	1,309	1,503	1,440	1,557	1,491	1,594	17,599
Condensate	19	22	23	15	15	11	12	10	12	10	16	17	182
Exports and losses [3]	123	90	115	139	238	329	312	311	443	204	213	71	2,588
Transfers to non-motor-fuel uses:													
LP-gases:													
For fuel [3]	5,461	4,831	5,035	4,841	4,079	3,783	4,117	4,657	4,649	5,065	5,644	5,949	58,111
For chemical manufacture	965	904	1,022	953	1,031	1,004	1,041	968	920	1,118	1,147	1,157	12,230
Other products	355	324	311	254	242	240	244	255	221	226	333	406	3,411
Total demand at plants and terminals	17,498	15,544	17,792	16,332	16,461	15,620	16,304	17,000	17,240	18,572	18,517	19,017	205,897

[1] Terminals owned by producers.
[2] Mainly straight-run gasoline from refineries.
[3] Exports from plants and terminals totaling 357,000 barrels in 1950 and 540,000 barrels in 1951 are included with shipments of LP-gases for fuel and are excluded from "Exports and losses." This portion of the exports is not separable by months.

TABLE 8.—Natural-gas liquids utilized at refineries in the United States, 1950–51, by Bureau of Mines refinery district and month, in thousands of barrels

District	January	February	March	April	May	June	July	August	September	October	November	December	Total
1950													
East Coast	101	372	250	220	296	496	495	594	399	548	493	451	4,715
Appalachian	53	43	43	42	36	32	37	37	32	38	33	44	470
Indiana, Illinois, Kentucky, etc	730	672	793	793	827	916	811	894	738	919	947	812	9,852
Oklahoma, Kansas, Missouri	730	587	651	675	682	530	438	615	722	907	824	770	8,131
Texas:													
Gulf Coast	1,838	1,624	1,910	1,676	1,474	1,674	1,786	2,348	2,372	2,361	2,306	2,485	23,854
Inland	1,233	993	1,263	1,158	1,074	858	902	920	1,260	1,295	1,245	1,193	13,394
Total Texas	3,071	2,617	3,173	2,834	2,548	2,532	2,688	3,268	3,632	3,656	3,551	3,678	37,248
Louisiana-Arkansas:													
Louisiana Gulf Coast	498	440	346	364	398	341	370	354	423	432	463	439	4,868
Arkansas, Louisiana Inland	88	79	126	128	116	128	145	122	89	100	100	140	1,361
Total Louisiana-Arkansas	586	519	472	492	514	469	515	476	512	532	563	579	6,229
Rocky Mountain	124	113	101	89	99	88	80	92	119	157	178	153	1,393
California	1,884	1,850	1,869	1,839	2,111	2,258	2,442	2,534	2,366	2,545	2,379	2,524	26,601
Total United States	7,279	6,773	7,352	6,984	7,113	7,321	7,506	8,510	8,520	9,302	8,968	9,011	94,639
1951													
East Coast	586	294	402	308	325	263	183	332	241	189	357	229	3,709
Appalachian	49	30	35	52	27	45	46	47	44	46	37	34	492
Indiana, Illinois, Kentucky, etc	894	840	817	1,013	1,085	948	968	937	937	1,050	1,005	1,078	11,572
Oklahoma, Kansas, Missouri	780	593	668	571	643	640	574	856	932	1,030	882	880	9,049
Texas:													
Gulf Coast	2,060	1,955	2,403	2,195	2,247	2,446	2,491	2,493	2,611	2,623	2,637	2,590	28,751
Inland	1,007	899	1,040	952	1,261	850	1,071	1,167	1,364	1,481	1,232	1,274	13,598
Total Texas	3,067	2,854	3,443	3,147	3,508	3,296	3,562	3,660	3,975	4,104	3,869	3,864	42,349
Louisiana-Arkansas:													
Louisiana Gulf Coast	436	360	351	335	348	346	381	392	364	403	414	418	4,548
Arkansas, Louisiana Inland	113	107	130	119	107	94	109	112	148	133	110	124	1,406
Total Louisiana-Arkansas	549	467	481	454	455	440	490	504	512	536	524	542	5,954
Rocky Mountain	149	132	145	136	130	101	120	134	147	166	192	183	1,735
California	1,971	1,818	2,006	2,122	2,101	1,853	2,039	2,188	2,016	2,197	2,051	2,028	24,390
Total United States	8,045	7,028	7,997	7,803	8,274	7,586	7,982	8,658	8,804	9,318	8,917	8,838	99,250

SALES OF LP-GASES [2]

A sharp upward trend in sales of LP-gases, evident in 1950, continued into 1951, when deliveries to consumers were 21 percent over the 1950 total, which in turn had been 23 percent above 1949 requirements. The market for this liquid fuel virtually doubled in 4 years, as its advantages for both domestic and industrial uses, as well as for fueling internal-combustion engines, became more widely known. Furthermore, its rapidly growing use as raw material by both synthetic-rubber and chemical-manufacturing plants also helped to rapidly expand the demand. Exports of LP-gases had likewise mounted sharply with increases over the preceding year of 17 percent in 1949, 27 percent in 1950, and 29 percent in 1951, according to records of the Bureau of the Census, United States Department of Commerce.

TABLE 9.—Sales of LP-gases [1] in the United States, 1947–51, by type of gas

Year	Butane		Propane		Butane-propane mixture		Total	
	Thousand gallons	Percent of total	Thousand gallons	Percent of total	Thousand gallons	Percent of total	Thousand gallons	Increase over previous year, percent
1947	398,635	18.0	863,686	39.1	947,476	42.9	2,209,797	29.8
1948	512,615	18.7	1,279,744	46.8	944,442	34.5	2,736,801	23.6
1949	488,801	17.2	1,403,359	49.5	944,439	33.3	2,836,599	3.8
1950	568,038	16.3	1,938,301	55.7	976,228	28.0	3,482,567	22.4
1951	708,989	16.8	2,418,790	57.2	1,099,496	26.0	4,227,275	21.7

[1] Data include LR-gases.

TABLE 10.—Sales of LP-gases [1] in the United States, 1947–51, by uses, in thousands of gallons

Year	Domestic and commercial	Chemical	Synthetic rubber	Industrial	Gas manufacturing	Internal combustion	All other	Total
1947	1,150,538	414,267	201,535	173,601	169,332	99,786	738	2,209,797
1948	1,473,289	524,350	225,641	180,518	237,638	92,941	2,424	2,736,801
1949	1,627,550	544,886	177,850	162,197	239,210	77,981	6,925	2,836,599
1950	[2] 2,022,464	[2] 624,468	228,485	217,078	251,694	129,818	8,560	3,482,567
1951	2,166,813	844,507	374,864	262,102	281,692	289,991	7,306	4,227,275

[1] Data include LR-gases. [2] Revised.

A survey of sales of LP-gases by States, first attempted for 1950, was repeated for 1951, so that a more detailed review of State markets on a comparative basis, is now available.

The market for LP-gases showed important increases in all parts of the country in 1951, except in district 1. Most of the liquid gases sold in that area are consumed for domestic and commercial fuel and that particular use registered only a nominal gain in 1951 over the 1950 total. Over 40 percent of the 1951 sales were reported from district 3, and there the expansion in the demand was outstanding—35 percent over the 1950 total—due mostly to much greater requirements for

[2] LP-gases, as used in this section, include LR-(liquid refinery) gases as well. E. T. Knudsen, Chief, Petroleum Statistics Branch, Bureau of Mines, Region III, Los Angeles, Calif., made the survey and compiled the sales statistics for district 5. Districts are those of the Petroleum Administration for War.

TABLE 11.—Sales of LP-gases [1] in the United States, 1950–51, by State and use, in thousands of gallons

PAW district and State	Domestic and commercial		Gas manufacturing		Industrial		Synthetic rubber	
	1950 [2]	1951	1950	1951	1950	1951	1950	1951
District 1:								
Connecticut	16,531	16,612	7,186	6,056	13,684	13,527		11
Delaware	6,770	5,031	783	2,176	315	352		
Florida	54,241	59,333	4,515	6,658	436	1,059		
Georgia	48,835	51,775	6,569	9,900	2,254	3,116		
Maine	12,516	11,349	734	461	182	491		
Maryland & D. C	21,640	20,239	3,684	3,059	1,705	1,458		
Massachusetts	21,967	22,854	14,616	10,947	1,614	2,126		
New Hampshire	9,177	9,529	382	1,165	179	109		
New Jersey	31,017	30,691	12,880	7,926	23,446	26,263		31
New York	52,806	52,866	7,914	6,178	3,277	3,022		
North Carolina	42,531	44,614	12,455	16,702	1,579	1,950		
Pennsylvania	38,471	38,403	10,403	17,633	19,740	20,502	71	134
Rhode Island	4,918	5,150		4	320	556		
South Carolina	26,712	29,817	3,133	6,650	3,142	3,231		
Vermont	5,115	6,098	1,156	2,009	110	374		
Virginia	22,450	25,069	6,448	4,482	2,095	1,938	282	
West Virginia	6,706	6,299	582	1,560	8,188	4,077		
Total	422,403	435,729	93,440	103,566	82,266	84,151	353	176
District 2:								
Illinois	94,815	96,800	17,368	17,388	15,810	22,342		11
Indiana	43,727	45,283	17,701	20,445	5,435	7,028		105
Iowa	46,677	49,781	10,092	9,741	5,701	5,358		
Kansas	69,186	79,567	454	92	293	6,272		
Kentucky	26,028	26,489	1,633	1,508	1,861	1,364	410	1,443
Michigan	42,781	42,892	27,294	27,814	22,018	23,302		189
Minnesota	53,433	55,279	7,060	7,812	3,874	5,072		
Missouri	62,468	68,501	2,740	4,466	2,510	4,270		
Nebraska	38,995	42,375	1,844	2,225	1,215	1,484		
North Dakota	17,808	20,516	1,485	2,166	156	528		
Ohio	28,457	31,447	5,478	6,012	3,696	4,909		1,098
Oklahoma	98,313	105,131	1,913	2,239	2,485	5,672		76
South Dakota	30,576	32,158	2,421	3,839	1,294	1,216		
Tennessee	22,229	22,554	4,682	4,102	753	543		29
Wisconsin	38,125	41,853	10,916	9,481	32.550	30,122		
Total	713,618	760,626	113,081	119,320	99,651	119,482	410	2,951
District 3:								
Alabama	33,256	41,892	2,962	2,934	2,111	3,864		
Arkansas	71,584	73,946	302	489	1,031	2,856		
Louisiana	128,781	128,913	320	688	4,334	4,794	40,840	66,264
Mississippi	51,277	53,903	24	73	462	1,282		
New Mexico	42,040	44,698	4,869	5,444	632	332		
Texas	309,226	347,269	3,432	3,665	16,460	28,752	174,379	273,987
Total	636,164	690,621	11,909	13,293	25,030	41,880	215,219	340,251
District 4:								
Colorado	31,887	37,322	1,121	1,538	599	706		
Idaho	3,526	5,540	4,433	4,930	60	427		
Montana	8,179	9,681	84	508	400	620		
Utah	2,162	3,030	278	200	217	200		
Wyoming	18,741	19,536				1,565		2
Total	64,495	75,109	5,916	7,176	1,276	3,518		2
District 5:								
Arizona	19,066	19,137	785	510	18	149		
California	139,305	142,998	7,762	12,708	5,218	7,367	12,503	31,484
Nevada	2,144	4,475	4,085	5,039	9	484		
Oregon	16,437	26,252	9,001	11,081	2,067	2,389		
Washington	8,832	11,866	5,715	8,999	1,543	2,682		
Total	185,784	204,728	27,348	38,337	8,855	13,071	12,503	31,484
Total United States	2,022,464	2,166,813	251,694	281,692	217,078	262,102	228,485	374,864

For footnotes, see end of table.

TABLE 11.—Sales of LP-gases [1] in the United States, 1950–51, by State and use, in thousands of gallons—Continued

PAW district and State	Chemical		Internal combustion		All other		Total		Percent of total	
	1950 [2]	1951	1950	1951	1950	1951	1950 [2]	1951	1950 [2]	1951
District 1:										
Connecticut	-------	-------	590	620	-------	232	37,991	37,058	5.0	4.7
Delaware	-------	933	-------	25	-------	-------	7,868	8,517	1.0	1.1
Florida	-------	-------	347	341	22	4	59,561	67,395	7.9	8.6
Georgia	4	175	520	1,215	20	209	58,202	66,390	7.7	8.4
Maine	-------	-------	55	76	-------	-------	13,487	12,377	1.8	1.6
Maryland &D. C	-------	-------	-------	-------	-------	125	27,029	24,881	3.6	3.2
Massachusetts	-------	-------	-------	-------	1	39	38,198	35,966	5.1	4.6
New Hampshire	-------	-------	-------	-------	-------	-------	9,738	10,803	1.3	1.4
New Jersey	2,787	3,179	-------	19	-------	281	70,130	68,390	9.3	8.7
New York	1,517	1,231	-------	9	10	13	65,524	63,319	8.7	8.0
North Carolina	-------	21	243	1,047	12	197	56,820	64,531	7.5	8.2
Pennsylvania	10,979	10,542	21	278	10	38	79,695	87,530	10.6	11.1
Rhode Island	-------	-------	-------	-------	-------	-------	5,238	5,710	.7	.7
South Carolina	-------	-------	13	64	-------	110	33,000	39,872	4.4	5.1
Vermont	-------	-------	-------	-------	-------	-------	6,381	8,481	.8	1.1
Virginia	-------	62	19	32	-------	-------	31,294	31,583	4.1	4.0
West Virginia	138,496	140,562	530	620	-------	-------	154,502	153,118	20.5	19.5
Total	153,783	156,705	2,338	4,346	75	1,248	754,658	785,921	100.0	100.0
District 2:										
Illinois	137	1,318	10,069	17,072	1,691	379	139,890	155,310	13.6	13.3
Indiana	7,978	36,295	1,477	2,688	-------	688	76,318	112,532	7.4	9.7
Iowa	-------	-------	471	581	-------	9	62,941	65,470	6.1	5.6
Kansas	-------	911	5,267	12,730	-------	122	75,200	99,694	7.3	8.6
Kentucky	50,587	50,062	1,443	1,064	-------	62	81,962	81,992	7.9	7.1
Michigan	1,416	2,456	1,075	2,011	-------	15	94,584	98,679	9.2	8.5
Minnesota	-------	-------	3,326	4,144	-------	44	67,693	72,351	6.6	6.2
Missouri	-------	-------	878	1,434	4,100	22	72,696	78,693	7.0	6.7
Nebraska	-------	-------	1,180	1,591	-------	220	43,234	47,895	4.2	4.1
North Dakota	-------	-------	1,764	1,486	1	130	21,214	24,816	2.0	2.1
Ohio	-------	34	1,136	1,372	-------	38	38,767	44,910	3.8	3.8
Oklahoma	336	299	5,169	19,105	-------	207	108,216	132,729	10.5	11.4
South Dakota	-------	-------	1,710	2,006	6	240	36,007	39,459	3.5	3.4
Tennessee	196	15	912	224	-------	85	28,772	27,552	2.8	2.4
Wisconsin	-------	-------	1,700	1,599	4	49	83,295	83,104	8.1	7.1
Total	60,650	91,390	37,577	69,107	5,802	2,310	1,030,789	1,165,186	100.0	100.0
District 3:										
Alabama	-------	-------	455	1,007	-------	11	38,784	49,708	2.9	2.8
Arkansas	-------	-------	1,973	4,338	1,453	745	76,343	82,374	5.8	4.6
Louisiana	53,552	104,617	5,775	15,907	1	62	233,603	321,245	17.7	18.0
Mississippi	-------	-------	3,281	8,009	100	9	55,144	63,276	4.2	3.5
New Mexico	-------	-------	6,081	7,091	180	1,295	53,802	58,860	4.0	3.3
Texas	334,109	438,303	26,177	120,382	538	242	864,321	1,212,600	65.4	67.8
Total	387,661	542,920	43,742	156,734	2,272	2,364	1,321,997	1,788,063	100.0	100.0
District 4:										
Colorado	-------	-------	996	1,640	200	132	34,803	41,338	46.6	44.8
Idaho	-------	-------	24	43	-------	-------	8,043	10,940	10.8	11.8
Montana	-------	-------	219	719	-------	20	8,882	11,548	11.9	12.5
Utah	-------	-------	26	582	-------	39	2,683	4,051	3.6	4.4
Wyoming	-------	-------	1,508	3,388	-------	-------	20,249	24,491	27.1	26.5
Total	-------	-------	2,773	6,372	200	191	74,660	92,368	100.0	100.0
District 5:										
Arizona	-------	-------	2,022	3,527	-------	-------	21,891	23,323	7.3	5.9
California	22,374	53,492	41,215	49,592	211	1,001	228,588	298,642	76.1	75.5
Nevada	-------	-------	-------	108	-------	-------	6,238	10,106	2.1	2.5
Oregon	-------	-------	12	187	-------	178	27,517	40,087	9.1	10.1
Washington	-------	-------	139	18	-------	14	16,229	23,579	5.4	6.0
Total	22,374	53,492	43,388	53,432	211	1,193	300,463	395,737	100.0	100.0
Total United States	624,468	844,507	129,818	289,991	8,560	7,306	3,482,567	4,227,275	------	------

[1] Data include LR-gases.
[2] Revised.

TABLE 12.—Sales of LP-gases [1] in the United States, 1950–51, by State and type of gas, in thousands of gallons

PAW district and State	Butane		Propane		Butane and propane mixture		Total		Per cent increase, 1950 to 1951
	1950	1951	1950 [2]	1951	1950 [2]	1951	1950 [2]	1951	
District 1:									
Connecticut	1,212	1,349	35,737	35,436	1,042	273	37,991	37,058	−2.5
Delaware		7	7,868	8,510			7,868	8,517	8.2
Florida	1,078	5,772	31,693	34,068	26,790	27,555	59,561	67,395	13.2
Georgia	2,342	4,294	35,089	43,047	20,771	19,049	58,202	66,390	14.1
Maine			13,363	12,367	124	10	13,487	12,377	−8.2
Maryland & D. C.	848	581	26,181	24,300			27,029	24,881	−7.9
Massachusetts	7,739	5,245	26,956	28,082	3,503	2,639	38,198	35,966	−5.8
New Hampshire			9,738	10,732		71	9,738	10,803	10.9
New Jersey	9,248	9,282	60,830	59,094	52	14	70,130	68,390	−2.5
New York	6,669	2,180	57,810	60,283	1,045	856	65,524	63,319	−3.4
North Carolina	445	2,755	47,119	56,175	9,256	5,601	56,820	64,531	13.6
Pennsylvania	3,399	2,090	73,765	80,352	2,531	5,088	79,695	87,530	9.8
Rhode Island			5,238	5,710			5,238	5,710	9.0
South Carolina	1,000	1,768	23,759	27,951	8,241	10,153	33,000	39,872	20.8
Vermont			6,381	8,481			6,381	8,481	32.9
Virginia	836	1,112	30,391	30,410	67	61	31,294	31,583	.9
West Virginia	4,715	1,917	41,678	18,316	108,109	132,885	154,502	153,118	−.9
Total	39,531	38,352	533,596	543,314	181,531	204,255	754,658	785,921	4.1
District 2:									
Illinois	25,209	16,009	103,306	122,655	11,375	16,646	139,890	155,310	11.0
Indiana	13,490	6,773	61,234	71,094	1,594	34,665	76,318	112,532	47.5
Iowa	4,779	2,654	55,919	61,779	2,243	1,037	62,941	65,470	4.0
Kansas	1,904	12,215	48,668	57,853	24,628	29,626	75,200	99,694	32.6
Kentucky	602	2,362	26,702	26,205	54,658	53,425	81,962	81,992	
Michigan	25,809	9,979	66,688	87,659	2,087	1,041	94,584	98,679	4.3
Minnesota	2,937	2,440	63,076	67,503	1,680	2,408	67,693	72,351	6.9
Missouri	6,040	2,991	56,866	64,961	9,790	10,741	72,696	78,693	8.2
Nebraska	465	1,072	40,069	43,085	2,700	3,738	43,234	47,895	10.8
North Dakota	80	666	19,138	22,813	1,996	1,337	21,214	24,816	17.0
Ohio	541	1,779	38,205	43,059	21	72	38,767	44,910	15.8
Oklahoma	11,327	14,049	46,031	60,957	50,858	57,723	108,216	132,729	22.7
South Dakota	213	792	33,414	37,857	2,380	810	36,007	39,459	9.6
Tennessee	930	1,134	20,077	21,439	7,765	4,979	28,772	27,552	−4.2
Wisconsin	17,717	17,742	63,676	63,122	1,902	2,240	83,295	83,104	−.2
Total	112,043	92,657	743,069	852,041	175,677	220,488	1,030,789	1,165,186	13.0
District 3:									
Alabama	2,241	5,604	20,046	19,671	16,497	24,433	38,784	49,708	28.2
Arkansas	3,104	3,770	20,760	23,888	52,479	54,716	76,343	82,374	7.9
Louisiana	94,536	86,287	66,512	141,427	72,555	93,531	233,603	321,245	37.5
Mississippi	5,918	4,937	15,945	19,312	33,281	39,027	55,144	63,276	14.7
New Mexico	11,455	5,972	24,400	35,400	17,947	17,488	53,802	58,860	9.4
Texas	284,706	409,469	270,783	467,867	308,832	335,264	864,321	1,212,600	40.3
Total	401,960	516,039	418,446	707,565	501,591	564,459	1,321,997	1,788,063	35.3
District 4:									
Colorado	3,148	2,557	30,417	36,289	1,238	2,492	34,803	41,338	18.8
Idaho	366	595	7,524	10,203	153	142	8,043	10,940	36.0
Montana	331	3,205	8,551	8,343			8,882	11,548	30.0
Utah	14	46	2,644	3,793	25	212	2,683	4,051	51.0
Wyoming	3,825	6,068	16,000	17,082	424	1,341	20,249	24,491	20.9
Total	7,684	12,471	65,136	75,710	1,840	4,187	74,660	92,368	23.7
District 5:									
Arizona	38	16	10,775	13,483	11,078	9,824	21,891	23,323	6.5
California	2,039	44,953	128,949	166,521	97,600	87,168	228,588	298,642	30.6
Nevada			5,298	8,606	940	1,500	6,238	10,106	62.0
Oregon	2,008		21,888	36,081	3,621	4,006	27,517	40,087	45.7
Washington	2,735	4,501	11,144	15,469	2,350	3,609	16,229	23,579	45.3
Total	6,820	49,470	178,054	240,160	115,589	106,107	300,463	395,737	31.7
Total United States	568,038	708,989	1,938,301	2,418,790	976,228	1,099,496	3,482,567	4,227,275	21.4
Exports	[3]	[3]	[3]	[3]	[3]	[3]	67,763	87,244	28.7
Grand total	[3]	[3]	[3]	[3]	[3]	[3]	3,550,330	4,314,519	21.5

[1] Data include LR-gases.
[2] Revised.
[3] Not available by type of gas.

raw materials and solvents going to synthetic rubber and chemical manufacturing plants. District 2 was the second most important market for these liquid gases, and sales in the area in 1951 were 13 percent above 1950. Districts 4 and 5 reported relatively small proportions of the LP-gas sales in 1951, with increases of 24 and 32 percent, respectively, over the 1950 demand.

Over half of the LP-gases were sold for domestic and commercial fuel, and this use increased by 7 percent in 1951 over 1950, compared with a 24-percent gain in 1950 over 1949. This indicated lower rate of growth in the domestic market in 1951 was largely due to the fact that sales reports were received for 1951 from a far greater number of dealers throughout the country, who were in closer contact than producers and wholesalers with small consumers, especially those on farms, and therefore were in a better position to "break out" the proportion of deliveries used for fuel in tractors and other farm equipment and to enter such quantities under "internal-combustion-engine fuel." The result of this more detailed reporting of sales as to end-use was to divert quantities, which in prior years had been included under domestic consumption, to the "internal-combustion-engine fuel" total.

The fast-growing chemical manufacturing industry bought 35 percent more LP-gases for use as raw material and solvents in 1951 than in 1950, and the quantity credited to these plants represented 20 percent of the LP-gas market compared with an 18-percent proportion in 1950. The effort of the Government to stockpile rubber in anticipation of any interruption in international trade was reflected in the large gain—64 percent—in sales of LP-gases for synthetic-rubber components in 1951. LP-gases delivered to synthetic-rubber plants accounted for 9 percent of all sales in 1951 and 7 percent in 1950.

The volume of LP-gases reported as sold for internal-combustion-engine fuel more than doubled in 1951 compared with 1950 and totaled about 7 percent of all requirements compared with a 4 percent share in 1950. The unusual gain in this use in 1951 was due partly to more detailed reporting by a greater number of dealers; but it also resulted from the fact that the "item" for reporting internal-combustion-engine fuel was more clearly defined in the 1951 schedule, by adding that quantities sold for trucks, buses, tractors, pumping equipment, etc., should be included. It is believed that at least part of such sales, especially quantities used in farm equipment, were entered under the "domestic" classification in previous years. The change in the wording in the 1951 schedule also evidently diverted LP-gases consumed as fuel in the petroleum industry which were formerly included under "industrial uses" to "internal-combustion-engine fuel."

Manufactured-gas companies bought 12 percent more LP-gases in 1951 than in 1950 to use for standby purposes, for enriching their manufactured gas, and for direct distribution through their mains to consumers. The quantity required by the manufactured-gas industry was about 7 percent of the LP-gas demand in both 1950 and 1951.

The American Gas Association reported that an average of 309,300 customers, of which 283,300 were residential, received liquefied petroleum gas from utilities during 1951.

Distributors reported a 21-percent gain in sales of LP-gases to industrial plants for fuel and other uses in 1951 compared to a 34-

percent rise in this demand in 1950 over 1949. It is believed that some quantities used by petroleum companies in their internal-combustion-engine equipment were formerly included under "industrial uses," which reporting overstated the latter item.

STOCKS

Total stocks of natural-gas liquids at plants and terminals and at refineries increased in 1951 from 7,355 thousand barrels to 8,186 thousand. Stocks of natural gasoline increased 722 thousand barrels, most of the rise taking place at refineries. LP-gas stocks remained substantially unchanged at plants and terminals and declined 153 thousand barrels at refineries. Stocks of "other products" increased at plants and terminals and remained virtually unchanged at refineries.

TABLE 13.—Stocks of natural-gas liquids in the United States, 1947–50, and 1951, by months, in thousands of barrels

Date	Natural gasoline		LP-gases		Other products		Total		
	At plants and terminals	At refineries	At plants and terminals	At refineries	At plants and terminals	At refineries	At plants and terminals	At refineries	Grand total
Dec. 31:									
1947	1,794	1,024	589	131	475	283	2,858	1,438	4,296
1948	2,538	1,071	748	303	760	159	4,046	1,533	5,579
1949	2,919	1,181	803	369	1,175	384	4,897	1,934	6,831
1950	2,461	1,726	1,229	432	1,397	110	5,087	2,268	7,355
1951									
Jan. 31	2,498	1,908	1,055	390	1,459	164	5,012	2,462	7,474
Feb. 28	2,716	2,019	980	344	1,542	241	5,238	2,604	7,842
Mar. 31	2,624	2,337	1,227	312	1,482	127	5,333	2,776	8,109
Apr. 30	3,192	2,236	1,281	359	1,333	121	5,806	2,716	8,522
May 31	3,235	2,522	1,518	321	1,279	204	6,032	3,047	9,079
June 30	3,463	3,105	1,626	418	1,215	216	6,304	3,739	10,043
July 31	3,410	3,028	1,508	411	1,442	266	6,360	3,705	10,065
Aug. 31	3,569	2,815	1,387	411	1,463	238	6,419	3,464	9,883
Sept. 30	3,262	2,780	1,540	364	1,490	142	6,292	3,286	9,578
Oct. 31	2,929	2,582	1,431	353	1,512	196	5,872	3,131	9,003
Nov. 30	2,739	2,294	1,237	361	1,602	146	5,578	2,801	8,379
Dec. 31	2,653	2,256	1,268	279	1,623	107	5,544	2,642	8,186

PRICES

The average price of grade 26–70 natural gasoline to blenders, f. o. b. group 3 (Oklahoma), was 6.18 cents per gallon in 1951, 0.62 cent per gallon above the 1950 average. The increase in the 1951 average over 1950 was due to the fact that prices, after rising during the last 9 months of 1950, held steady during 1951 (except for the normal seasonal weakening during the summer months) at the high level attained by the end of 1950. The average price in January 1951 was 6.88 cents per gallon. It dropped to 5.50 cents from May through August and returned to 6.88 cents in November.

The average refinery price of Regular grade (80 octane) gasoline f. o. b. Oklahoma (group 3) in 1951 was 10.49 cents per gallon, 0.37 cent above the 1950 average. The price was steady at 10.50 cents per gallon through most of 1951, with slight weakening in November and December.

The price of commercial propane f. o. b. refineries at New York Harbor held steady at 7.00 cents per gallon in 1951 from January 21 to December 12. The January average price was 7.64 cents. A price rise in December raised the average for that month to 7.16 cents. The average price for 1951 was 7.07 cents per gallon. Due to the rise in prices during the last 9 months of 1950 and the maintenance of these prices in 1951, the 1951 average was 0.73 cent per gallon above 1950.

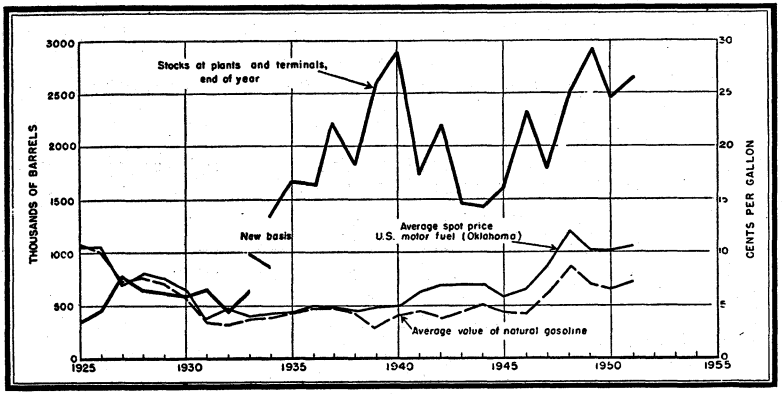

FIGURE 2.—Average value of natural gasoline, spot price of gasoline, and stocks of natural gasoline, 1925–51.

TECHNOLOGY

A plant was placed in operation by the Tennessee Gas Transmission Co. in 1951 for extracting natural-gas liquids from the gas transported through its high-pressure transmission line. This gas had previously been treated in the field to remove enough condensables to make it suitable for pipeline transmission. The plant, by using a refrigeration process that cools the gas stream to −96° F., removes about 15 percent of the ethane and most of the heavier hydrocarbons from the gas stream. The primary purpose of the plant was to recover light hydrocarbons for use in the manufacture of chemicals. By constructing the plant along the pipeline close to the marketing area for the finished products, advantage was taken of the low cost of pipeline transportation.

The first adoption to natural-gasoline-plant use of the deethanizing absorber or rectified absorber was made in 1951 at the Snyder, Tex., plant operated by Sunray Oil Corp. The richness of the inlet-gas stream to this plant made practical use of this type of equipment, heretofore employed only in refineries. A deethanizing absorber produces in one column a deethanized rich oil that requires no further processing, except removal of the absorbed liquids. Lean oil enters the top of the column and contacts the feed gas stream entering midway up the column. The rich oil passing to the lower section of the column is stripped of ethane by vapors produced by a reboiler at the bottom of the column.

FOREIGN TRADE [3]

Exports of LP-gases [4] in 1951 (2,077 thousand barrels) represented a 29-percent gain in the volume of this foreign trade. The value of these shipments increased from $5,748,000 or 8.5 cents a gallon in 1950 to $7,820,000 or 9 cents a gallon in 1951. As in previous years, Canada and Mexico continued to be the most important buyers of LP-gases.

Exports of natural gasoline rose in 1951 mainly because of the sizable shipments made to Australia. Shipments totaled 1,641 thousand barrels, of which 715 thousand went to Canada, 711 thousand to Australia, and 102 thousand to the Netherlands Antilles. The total value of natural gasoline exported in 1951 was $6,963,807 or 10.1 cents per gallon.

TABLE 14.—LP-gases [1] exported from the United States, 1947–51, by countries, in thousands of barrels [2]

[U. S. Department of Commerce]

Country	1947	1948	1949	1950	1951
Argentina	(3)	7	13	1	
Bermuda	5	6	7	8	10
Brazil	38	41	81	112	152
Canada	752	635	743	810	1,031
Cuba	1	6	11	30	53
France	49	(3)	(3)	15	30
Mexico	392	369	384	605	761
Philippines, Republic of	10	14	21	18	19
Other countries	20	6	11	14	21
Total	1,267	1,084	1,271	1,613	2,077

[1] Includes LR-gases.
[2] Converted from pounds to gallons at 189 pounds per barrel.
[3] Less than 500 barrels.

TABLE 15.—Natural gasoline exported from the United States, 1947–51, by countries, in thousands of barrels

[U. S. Department of Commerce]

Country	1947	1948	1949	1950	1951
Australia	83	268	408		711
Canada	1,600	1,356	1,412	846	715
Netherlands Antilles	512	591	882	92	102
Trinidad			324		
United Kingdom	2,451	1,815	1,065	61	
France	125				
Sweden	25	33			
Other countries	36	3	273	(1)	113
Total	4,832	4,066	4,364	999	1,641

[1] Less than 500 barrels.

[3] Figures on exports compiled by M. B. Price and E. D. Page, of the Bureau of Mines, from records of the U. S. Department of Commerce.
[4] Includes LR-gases.

Nickel

By Hubert W. Davis

GENERAL SUMMARY

ALLOCATION, prohibition or restriction on use in all nonessential items, inadequate supplies, higher prices, smaller consumption in the United States, and an increase in output in Canada were important features of the nickel situation in 1951.

Despite the fact that the supply of new nickel for the United States in 1951 was 2 percent larger than in 1950, it was inadequate for industry requirements and stockpile commitments. Consequently, consumption and procurement of nickel were subject to NPA Order M–14, effective January 1, 1951, and effective August 15 nickel was placed under complete allocation under Order M–80. Total reported consumption of nickel in the United States in 1951 was 13 percent less than in 1950, which, however, was a peacetime record. Deliveries of nickel to the National Stockpile increased. Stocks of nickel held by consumers in the United States declined 5 percent.

Output of nickel in Canada in 1951 was 11 percent greater than in 1950. In July 1951 the International Nickel Co. of Canada, Ltd., announced that it had achieved its objective of increasing refined-nickel production by 1,000,000 pounds a month. This expansion was completed about 5 months ahead of the target date. Falconbridge Nickel Mines, Ltd., continued its expansion and modernization program. Production of nickel ore in New Caledonia was the largest since 1942 and 60 percent greater than in 1950, but the combined output of matte and ferronickel declined 23 percent. The Government-owned nickel facilities in Oriente Province, Cuba, were being rehabilitated in 1951, and four furnaces were put into operation on January 31, 1952. Domestic output of nickel was, as heretofore, small in 1951. Imports of nickel from Canada were 1 percent greater than in 1950, but those from Norway were up 33 percent. Receipts of refined nickel from France, however, declined 20 percent.

TABLE 1.—Salient statistics for nickel, 1947–51

	1947	1948	1949	1950	1951
United States:					
Production:					
Primary—short tons	646	883	790	913	756
Secondary—do	9,541	8,850	5,680	8,795	8,602
Imports (gross weight) [1]—do	88,408	106,939	97,144	[2] 97,333	102,325
Exports (gross weight) [3]—do	12,037	8,184	4,471	3,645	4,622
Consumption—do	80,757	93,558	68,326	98,904	86,416
Price per pound [4]—cents	35	33¾–40	40	40–50½	50½–56½
Canada:					
Production—short tons	118,627	131,740	128,690	[2] 123,659	137,268
Exports—do	117,056	131,840	127,141	[2] 119,984	130,239
World production—do	154,000	166,000	161,000	160,000	177,000

[1] Excludes "All other manufactures of nickel," weight of which is not recorded; also nickel bars, etc., scrap, and residues.
[2] Revised figure.
[3] Excludes "Manufactures," weight of which is not recorded.
[4] Price quoted to United States buyers by International Nickel Co., Inc., for electrolytic nickel in carlots f.o.b. Port Colborne, Ontario; price includes duty of 2½ cents a pound in 1947 and 1¼ cents, 1948–51.

The steel industry continued to be the chief consumer of nickel in the United States; 44 percent of all nickel used in 1951 was in stainless and other steels. Consumption in stainless steel was 4 percent larger but that for other steels was 8 percent less. Utilization of nickel in high-temperature and electrical-resistance alloys was up 30 percent, but use for anodes, nonferrous alloys, and cast irons declined 66, 6, and 24 percent, respectively. Most of the nickel consumed in 1951 was in the form of metal, but the proportion of oxide and oxide sinter used was appreciably less in 1951 than in 1950.

Effective June 1, 1951, the contract price to United States buyers for electrolytic nickel in carlots, f. o. b. Port Colborne, Ontario, was advanced to 56½ cents a pound, including duty of 1¼ cents a pound, and for nickel oxide sinter (on which there is no duty) was increased to 52¾ cents a pound (nickel content) f. o. b. Copper Cliff, Ontario. The former prices (50½ and 46¾ cents, respectively) had been in effect since December 13, 1950.

The Geological Survey published a report on the Cle Elum River nickeliferous iron deposits in Washington.[1] According to this report:

> Drilling shows a reserve of 6,250,000 tons of ferruginous material containing 40.86 percent Fe, 0.84 percent Ni, and 2.40 percent Cr_2O_3, underlain by serpentine containing 0.63 percent Ni to an average depth of 21 feet. The iron deposits are subdivided into 3,200,000 tons of measured material, 650,000 tons of indicated material, and 2,400,000 tons of inferred material. The better grades of material generally are in the lower 60 percent of the iron deposits. Much of the material could be recovered only by underground mining, although as much as 1,000,000 tons might be removed by open-pit methods.

The M. A. Hanna Co. began an exploration of the nickel deposit at Riddle in Douglas County, Oreg., during August.

Allocation of nickel metal, oxide, and salts to the free-world countries in the fourth quarter 1951 was announced on October 11 by the International Materials Conference. The United States was allocated 19,690 metric tons, or 63 percent of the total.

PRODUCTION

Domestic production of nickel (other than from imported matte and oxide) is small and comprises metal recovered from scrap (nickel anodes and nickel-silver and copper-nickel alloys, including Monel metal) and primary nickel recovered in copper mining. There has been no output of nickel from ore or as a byproduct of talc production since 1945.

A total of 1,513,000 pounds of nickel, in the form of both crude and refined nickel sulfate, was recovered as a byproduct of copper refining at Baltimore, Md.; Carteret and Perth Amboy, N. J.; Laurel Hill, N. Y.; and Tacoma, Wash. Shipments were 1,551,000 pounds, the bulk of which was crude nickel sulfate sold to refiners for use as an

[1] Lamey, C. A., and Hotz, P. E., The Cle Elum River Nickeliferous Iron Deposits, Kittitas County, Wash.: Geol. Survey Bull. 978-B, 1951, 67 pp.

intermediate in the manufacture of refined nickel salts. Although all the nickel recovered as a byproduct of copper refining is credited to domestic production, some is actually recovered from imported blister copper.

In addition to the nickel recovered as a byproduct of copper refining in 1951, 3,443,000 pounds (nickel content) of refined nickel salt (chiefly sulfate) was produced in the United States from domestic crude nickel sulfate and from nickel shot and nickel scrap.

The total production of refined nickel salts in the United States was 3,946,000 pounds (nickel content) in 1951; shipments to consumers for electroplating, catalysts, and ceramics totaled 3,935,000 pounds.

TABLE 2.—Nickel produced in the United States, 1947–51

Year	Primary (short tons) [1]	Secondary	
		Short tons	Value
1947	646	9,541	$7,188,189
1948	883	8,850	6,966,720
1949	790	5,680	4,877,984
1950	913	8,795	8,408,020
1951	756	8,602	9,252,311

[1] Byproduct of copper refining. Value withheld to avoid disclosing individual company operations.

CONSUMPTION AND CONSUMERS' STOCKS

Tables 3 and 4 give data on consumption and consumers' stocks of nickel, as determined by a Bureau of Mines survey. The data cover all known consumers of nickel in the form of new metal, oxide, and matte. The figures for nickel salts, however, fall short of the total and probably represent only 52 and 59 percent of the total in 1951 and 1950, respectively.

TABLE 3.—Nickel (exclusive of scrap) consumed and in stock in the United States, 1950–51, by forms, in pounds of nickel

Form	1950			1951		
	Consumption	Stocks at consumers' plants Dec. 31	In transit to consumers' plants Dec. 31	Consumption	Stocks at consumers' plants Dec. 31	In transit to consumers' plants Dec. 31
Metal [1]	148,508,734	9,425,850	429,732	135,919,818	8,075,814	379,777
Oxide and oxide sinter	28,840,556	575,309	54,761	17,492,609	1,365,801	1,083
Matte	17,843,880	1,295,198		17,481,384	1,197,296	
Salts	2,614,529	516,809	3,723	1,938,621	592,690	30,542
Total	197,807,699	11,813,166	488,216	172,832,432	11,231,601	411,402

[1] Includes a relatively small but undetermined quantity of secondary nickel (ingot or shot remelted from scrap nickel and scrap-nickel alloys.)

TABLE 4.—Nickel (exclusive of scrap) consumed in the United States, 1947–51, by uses, in pounds of nickel

Use	1947	1948	1949	1950	1951
Ferrous:					
Stainless steels	30,700,270	32,487,815	23,817,187	41,822,486	43,584,274
Other steels	34,758,963	43,564,600	26,948,418	35,554,167	32,850,461
Cast iron	7,905,576	8,431,667	6,792,472	9,761,622	7,430,972
Nonferrous [1]	54,747,667	56,067,736	37,942,549	56,277,952	52,675,585
High-temperature and electrical-resistance alloys	10,249,545	12,336,123	8,107,918	11,407,174	14,815,616
Electroplating:					
Anodes	17,975,335	28,425,717	27,620,766	34,847,601	11,967,184
Solutions [2]	1,218,268	1,327,396	1,448,584	1,481,215	562,033
Catalysts [3]	878,664	1,190,851	994,206	2,015,234	2,768,905
Ceramics [4]	385,112	370,708	299,246	604,766	495,355
Magnets	2,694,459	2,913,905	2,680,882	1,946,971	1,291,856
Other				2,088,511	4,390,191
Total	161,513,859	187,116,518	136,652,228	197,807,699	172,832,432

[1] Comprises copper-nickel alloys, nickel-silver, brass, bronze, beryllium alloys, magnesium and aluminum alloys, Monel, Inconel, and malleable nickel.

[2] Figures for solutions for 1947, 1948, 1949, 1950, and 1951 represent about 25, 40, 50, 55, and 48 percent, respectively, of total.

[3] Figures for catalysts for 1947, 1948, 1949, and 1950 represent about 37, 37, 42, and 84 percent, respectively, of total.

[4] Figures for ceramics for 1947–50 represent about 50 percent of total.

FOREIGN TRADE [2]

The quantity of new nickel imported into the United States in 1951 was 2 percent more than in 1950. Imports comprised chiefly metal, oxide, and matte. As heretofore, Canada was the chief source of the imports. At the plant of the International Nickel Co., Inc., Huntington, W. Va., the roasted and sintered matte was refined to Monel metal and other products.

TABLE 5.—Nickel products imported for consumption in the United States in 1951, by countries, gross weight in pounds [1]

[U. S. Department of Commerce]

Country	Metal [2]	Ore and matte	Oxide and oxide sinter	Nickel bars, rods, etc.	Nickel scrap [2]	Nickel silver [3]	Nickel residues [4]
Australia					44,288		
Austria					25,991		
Belgium-Luxembourg	10,011			4,367	4,050		
Canal Zone				10,090	650		
Canada [5]	143,166,541	25,655,526	23,972,556	30,928	162,157	3,458	564,246
Cuba					6,165		
France	432,430			7,821	470,453		
Germany				8,203		33	
Japan		2,134			15,719		
Mexico				2,256			
Netherlands					47,333		
Norway	9,607,810						
Portugal					6,241		
Sweden	100		22	55			
Union of South Africa					35,840		
United Kingdom	143,410			11,334	762,855		
Total	153,360,302	25,657,660	23,972,578	75,054	1,581,742	3,491	564,246

[1] In the corresponding table in Minerals Yearbook, 1950, imports of metal from Belgium-Luxembourg should read 135,581 pounds and total metal 138,397,272 pounds (revised figures).

[2] Separation of metal from scrap is on basis of unpublished tabulations.

[3] Contains 10–30 percent nickel; balance mostly copper.

[4] Reported to Bureau of Mines by importers.

[5] According to reports by importers to the Bureau of Mines, the roasted and sintered matte averages about 68.5 percent nickel, the oxide and oxide sinter about 75 percent, and the nickel residues about 29 percent nickel.

[2] Figures on imports and exports compiled by M. B. Price and E. D. Page, of the Bureau of Mines, from records of the U. S. Department of Commerce.

The nickel content of refined metal, matte, oxide, and residues imported into the United States is estimated at 186,231,000 pounds in 1951, compared with 182,562,000 pounds (revised figure) in 1950 and 182,146,000 pounds (revised figure) in 1949.

Since January 1, 1948, the rate of duty on refined nickel imported into the United States has been 1¼ cents a pound. Nickel ore, matte, and oxide enter the United States duty free.

Exports of nickel comprise largely products manufactured from imported raw materials. Exports of alloy and scrap in 1951 were 41 percent over 1950; but those of metal, nickel-chrome electric-resistance wire, and nickel-silver were smaller by 43, 8, and 11 percent, respectively.

The United Kingdom (4,821,471 pounds), Canada (2,247,391 pounds), Japan (577,575 pounds), Germany (201,342 pounds), and Netherlands (183,149 pounds) were the chief foreign markets for nickel, Monel metal, alloys, and scrap in 1951.

TABLE 6.—Nickel products (excluding residues) imported for consumption in the United States, 1949–51, by classes

[U. S. Department of Commerce]

Class	1949		1950		1951	
	Pounds	Value	Pounds	Value	Pounds	Value
Unmanufactured:						
Nickel ore and matte	22,256,644	$4,598,335	22,270,886	$7,610,011	25,657,660	$5,561,034
Nickel pigs, ingot, shot, cathodes, etc.[1]	144,680,899	54,427,004	[2] 138,397,272	[2] 58,685,369	153,360,302	81,383,518
Nickel scrap [1]	2,857,478	389,118	1,250,663	274,981	1,581,742	150,898
Nickel bars, rods, tubes, etc.	8,862	17,069	73,907	59,395	75,054	75,978
Nickel oxide	24,483,602	6,584,951	32,612,122	[2] 10,477,405	23,972,578	8,793,383
Manufactured:						
Nickel-silver or German silver in sheets, strips, rods, and wire			61,964	7,271	3,491	935
All other manufactures of nickel	[3]	5,489	[3]	4,648	[3]	52,367
Total		66,021,966		[2] 77,119,080		96,018,113

[1] Separation of metal from scrap is on basis of unpublished tabulations.
[2] Revised figure.
[3] Quantity not recorded.

TABLE 7.—Nickel products exported from the United States, 1949–51, by classes

[U. S. Department of Commerce]

Class	1949		1950		1951	
	Pounds	Value	Pounds	Value	Pounds	Value
Ore, concentrates, and matte	52,000	$3,906	12,826	$2,110	35,578	$2,000
Alloys and scrap containing nickel (including Monel metal)	5,568,949	2,881,834	5,675,191	2,805,872	7,984,503	4,783,015
Metal in ingots, bars, sheets, etc.	1,610,329	959,725	676,169	413,541	386,310	376,946
Manufactures	[1]	922,352	[1]	876,872	[1]	1,044,485
Nickel-chrome electric resistance wire	686,270	979,813	428,885	606,189	393,599	712,186
Nickel-silver or German silver, crude, scrap, or bars, rods, etc.	1,024,613	442,775	496,598	236,193	443,175	185,089
Total		6,190,405		4,940,777		7,103,721

[1] Quantity not recorded.

WORLD REVIEW

Table 8 shows world production of nickel by countries, 1944–51, insofar as statistics are available. Despite the fact that nickel is produced in many countries, one country—Canada—has supplied about 77 percent of the world output since 1944.

TABLE 8.—World mine production of nickel, 1944–51, by countries, in metric tons of contained metal

[Compiled by Berenice B. Mitchell]

Country	1944	1945	1946	1947	1948	1949	1950	1951
Brazil	6	60				7	(1)	(1)
Canada	124,555	111,189	87,146	107,616	119,512	116,745	[2]112,181	124,527
Cuba (content of oxide)	4,679	10,900	11,241	2,014				
Finland	313	900	622	540				(1)
French Morocco	47							
Germany	(1)	(1)						
Indonesia	(1)	(1)						
Italy	14	12						
Japan [3]	1,720	650	(4)					
New Caledonia	8,115	4,328	2,779	3,345	4,882	3,371	6,300	9,200
Norway	529	516	55					
Sweden	698	390						
Union of South Africa	481	499	497	529	458	567	843	1,138
U. S. S. R. [5]	13,000	13,400	20,000	25,000	25,000	25,000	25,000	25,000
United States [6]	896	1,048	319	586	801	717	828	686
Total (estimate)	157,000	145,000	123,000	140,000	151,000	146,000	145,000	161,000

[1] Data not available; estimate by author of chapter included in total.
[2] Revised figure.
[3] Preliminary data for year ended Mar. 31 of year following that stated.
[4] Less than 0.5 ton.
[5] Estimate.
[6] Byproduct in electrolytic refining of copper. In 1944 and 1945 includes also production from ore.

Canada.—Virtually all the Canadian output is derived from copper-nickel ores of the Sudbury district, Ontario. Some nickel is also recovered as a byproduct from silver-cobalt ores of Cobalt, Ontario. Two companies—International Nickel Co. of Canada, Ltd., and Falconbridge Nickel Mines, Ltd.—are the principal producers. Nickel production in Canada was 137,268 short tons in 1951 compared with 123,659 tons in 1950. Exports of nickel from Canada were 130,239 short tons in 1951 compared with 119,984 tons in 1950.

Sales of nickel in all forms by the International Nickel Co. of Canada, Ltd., were 243,865,030 pounds in 1951 compared with 256,410,543 pounds in 1950.[3] Sales in 1950 included withdrawals from stocks of refined nickel accumulated from operations in 1949, when demand was slack and governments were limiting their purchases for stockpiling.

During 1951 underground mining was increased substantially beyond that achieved in any previous year. Underground ore mined was 7,780,143 short tons compared with 5,733,269 tons in 1950 and 5,015,318 tons in 1949, reflecting the rapid progress in the program of conversion to exclusively underground mining. Open-pit ore mined was 4,019,177 tons compared with 4,115,755 tons in 1950 and 4,969,573 tons in 1949. Accordingly, total ore mined was 11,799,320 tons in 1951 compared with 9,849,024 tons in 1950 and 9,984,891 tons in 1949. According to the company, proved ore reserves at the end

[3] International Nickel Co. of Canada, Ltd., Annual Report: 1951, 28 pp.

of 1951 were 253,705,000 short tons containing 7,693,000 tons of nickel-copper compared with 252,860,000 tons containing 7,669,000 tons of nickel-copper at the end of 1950. Underground development in the producing mines advanced 89,269 feet (17 miles) in 1951, bringing the total footage to 1,585,546 or over 300 miles.

Concerning developments and exploration in 1951 the company reported as follows: [4]

Mining of the Stobie open pit was completed early in August to the depth planned. The Frood open pit was continued in production throughout the year at a rate calculated to preserve a flow of ore from this source until the expanded underground mining facilities which we have under construction are ready to be operated at full capacity.

All three of the new major mining operations involved in our program to replace the open pit ores, namely, the Creighton project for mining lower-grade ores by low-cost caving methods, the mining of the Stobie section of the Frood-Stobie Mine, and the Murray Mine project, produced ore from regular operations during the year.

The new No. 7 Creighton shaft, the related underground ore bins and crusher station, the permanent hoist house on the surface, the new crushing plant and concentrator, and the pipe lines for transporting the bulk concentrate 7½ miles to Copper Cliff, were all completed during the year. Regular production from the first area of the Creighton caving project was delivered through this new shaft in July, in time to replace the tonnage which theretofore had been obtained from the Stobie open pit. By the year-end the daily mine rate had been lifted to 10,000 tons of ore from the caving area and operations in the new crushing plant and concentrator had been brought to full scale and integrated into the milling operations at Copper Cliff.

Additional areas are being developed in the Creighton caving area to bring this mine project to a condition of stabilized production. Ore-passes and slusher-ways are being advanced to serve the extension of caving area and work is also progressing on the elaborate ventilation system required to maintain satisfactory working conditions. A second underground crusher installation is under way to handle ore from the new caving areas. Plans have now been completed further to increase the daily capacity of the new concentrator by 2,000 tons, bringing the daily capacity to 12,000 tons.

At the Stobie section of the Frood-Stobie Mine we commenced ore shipments to the concentrator at Copper Cliff at a daily rate of 3,000 tons. The large underground crusher installations at the 600- and 1,000-foot levels, along with the necessary ore-passes, were completed and put into operation. Preparation of stopes is under way to bring the area served by these installations into regular ore production as soon as possible. Preliminary work is in progress also on the 1,400 foot level crusher and ore-pass system.

Work continued on the sinking and equipping of the new No. 8 shaft at Stobie required to provide additional ore hoisting capacity and flexibility in the Stobie phase of the conversion program.

At the Frood section of the Frood-Stobie Mine alterations were completed, increasing the ore handling capacity of the main Frood shaft and improving the operating efficiency of the No. 3 rock house.

Production from the Murray Mine, which had been put on a regular production basis of 4,500 tons daily at the start of the year, was increased to 5,000 tons daily. More stoping area is being developed to meet the requirements of the complete conversion program. The deepening of the Murray Mine shaft was completed during the year, making way for the exploring and developing of the lower level ores.

At Levack Mine, work proceeded on the deepening of the existing main shaft and the sinking also of the new internal shaft. The new shaft will allow the exploiting of the lower level ores that are not now accessible. Both of these shaft projects will be completed in 1952.

Large scale development for future mining was continued throughout the year of the deeper levels of the Creighton Mine; at the Frood section of the Frood-Stobie Mine, where the mining, by low-cost blasthole methods, of levels immediately below the open pit reached scheduled production; and at Garson Mine in

[4] Work cited in footnote 3; pp. 8–9, 12.

the area of the existing main shaft. The deepening of the Garson main shaft continued on schedule.

The company's program of exploration in search for new sources of nickel for future needs was further expanded during the year. The program has involved continuous geological work on our known deposits, extensive studies of the geology of other parts of the Sudbury Basin and property examinations or prospecting elsewhere in Canada and throughout the world.

The cost of the entire exploration program during the year was $2,593,908 compared with $1,682,436 in 1950 and $1,554,373 in 1949. The number of feet of exploration drilled in Canada was 289,677 compared with 260,127 in 1950 and 149,399 in 1949.

Major exploration camps were operated in Ontario, Manitoba, and the Northwest Territories, and projects were carried on also in Saskatchewan and Quebec. Outside of Canada, exploration was started in Tanganyika and property examinations were made in seven other countries.

Comprehensive exploration to determine the ore possibilities of our Crean Hill Mine also has been proceeding, following the dewatering and shaft reconditioning which was completed in April. This mine was closed as an operating unit in 1919.

The metallurgical plants of Falconbridge Nickel Mines, Ltd., at Falconbridge treated 1,083,670 short tons in 1951, a new record, compared with 928,650 tons in 1950. The new record was achieved by operating the ore-dressing plant 363 days on a two-shift basis and the concentrator and two blast furnaces 99.7 and 99.4 percent, respectively, of the total yearly hours. Production of matte was 17 percent greater than in 1950 and the highest in company history. Ore hoisted at the Falconbridge Mine was 930,164 tons in 1951 (881,838 tons in 1950), and output at the McKim mine was 155,961 tons (46,997 tons in 1950).

Concerning developments at its mines in 1951, the company reports as follows: [5]

Falconbridge Mine.—The exploratory drive at the 2,625 horizon was driven a further 1,242 feet during the year, and four short ore shoots were exposed which will be explored further on one of the deeper levels. The westerly drive on the 2,800 level was advanced 698 feet and confirmed the ore zone mentioned in last year's report. Other major development work included opening up the 2,975 level east and west of No. 5 shaft and driving east on the 3,150 level. These drives showed ore of mine average grade with better than average widths to the east.

Below the 3,150 level, considerable waste rock was carried out from the internal shaft including driving shaft raises for extending the main No. 5 shaft to the 4,200 horizon. On the 3,850 level the orebody was reached and opened up for a length of 129 feet while on the 4,025 level the east and west drifts were extended a total of 1,787 feet. These drives showed ore of average mine width and grade, but unexpected difficulty was experienced on the 4,025 east drift in driving through an area where a low angle shear zone intersects the contact shear zone. This local condition has been overcome in the drift.

Extension of the ore pass system to the 4,025 level was started.

Work on the "Southwall" orebody was confined to 700 feet of drifting on the 2,450 level and diamond drilling on the 2,975 and 4,025 levels. Results on the two upper levels were as expected, but on the 4,025 level drilling to date has indicated several areas of dissemination but only one notable ore shoot. Continuation of deep drilling has confirmed the presence of "Southwall" ore to the 5,700 horizon in the main shaft section but as yet this deep drilling has been confined to the one section, pending the driving of the required hanging wall crosscuts on the 4,025 level.

East Falconbridge Mine.—A new three compartment shaft, No. 8, was collared some 4,500 feet easterly from Falconbridge No. 5 shaft and reached a depth of 245 feet by the year end with one station established. This shaft is being sunk to explore and prepare for mining the eastern section of the property. As part of this program, the 802 drift was extended 2,039 feet east from No. 5 shaft and is now east of No. 8 shaft location. Low grade ore intersections shown by this

[5] Falconbridge Nickel Mines, Ltd., 23d Annual Report: 1951, 24 pp.

drive confirm previous diamond drill results from surface. This shaft will ultimately connect with the 1,750 and 2,800 drifts already driven to the eastern property boundary from the main ore zone.

McKim Mine.—Stoping was carried out from three levels with preparation work proceeding on two more levels. Stoping on the upper levels reveals the ore to be much wider than expected, but lower level drifts indicate a narrower and shorter ore body, particularly on the 1,175 and 1,350 levels, the latter being the lowest level presently opened. For the year McKim exceeded its rated production capacity of 500 tons a day, and should do substantially better in 1952. Because of its massive nature and good grade, McKim ore has proven to be a beneficial addition to the Falconbridge blast furnaces.

An exploratory drive was made 1,099 feet east on the 1,350 level along the norite-greenstone contact, but failed to find anything of importance. The west drive on this level was advanced 351 feet, mostly in medium grade ore. On the 1,175 level the west drift was extended 1,101 feet along the ore zone and through the diabase dyke. The ventilation escapement raise was extended to the 1,175 level.

The problem of McKim ore freezing in winter months during its transportation by rail to the Falconbridge smelter has been solved by the construction of a thaw shed.

Hardy Mine.—Shaft sinking was started during February and reached a depth of 1,028 feet at year end. Stations were established at 125 feet intervals from the 250 to 1,000 level, inclusive, and crosscuts commenced on each level. Development of the Hardy Mine will be proceeded with as rapidly as the availability of machinery, equipment, and power permit.

Expansion of the milling and smelting facilities continued throughout 1951, and a further expansion program of these units was under way at the year end.

According to Falconbridge Nickel Mines, Ltd., ore reserves totaled 19,116,500 short tons on December 31, 1951, and comprised 10,102,500 tons of developed ore averaging 1.64 percent nickel and 0.87 percent copper in the Falconbridge and McKim mines and 9,014,000 tons of indicated ore averaging 1.85 percent nickel and 1.14 percent copper in Sudbury-district holdings. A net increase of 3,236,000 tons in indicated ore reserves results from inclusion of an ore body found at depth under Fecunis Lake, some 2½ miles east of the Hardy Mine. Five diamond-drill intersections have been obtained from this deep-ore zone, but the limits of mineralization have not been determined.

The Sherritt Gordon Mines, Ltd., made much progress toward its construction program designed to bring its mines at Lynn Lake into production by the end of 1953. This program involves the development of the "A" and "EL" mines, transplanting the mining plants, concentrator and employees' houses from Sherridon to Lynn Lake, development of hydroelectric power on the Laurie River, extension of the railroad from Sherridon to Lynn Lake, and construction of a chemical metallurgical plant in Alberta.[6] The railroad extension, which is being built by the Canadian National Railways, is reported to be up to schedule.

After a thorough study of various locations in Alberta, Sherritt Gordon Mines, Ltd., has decided to locate its chemical metallurgical plant at Fort Saskatchewan, 15 miles northeast of Edmonton. Fort Saskatchewan is on the Canadian National Railways and has adequate supply of water and natural gas. Work on the design of this plant was in progress in 1951, and construction will start during the second quarter 1952.

The work of deepening the "A" shaft, begun at the end of 1950, continued to June 1951, when the shaft reached a depth of 1,628 feet.

[6] Sherritt Gordon Mines, Ltd., Annual Report: 1951, 16 pp.

Lateral development followed on the 14th and 16th levels in preparation for production. The 14th level is to open a scram system underneath the lower "A" ore body. The underground crushing installation will be on the 16th level. No exploratory development was undertaken except some diamond drilling to outline known ore on the new levels so that the drives could be located. The small amount of exploration done confirmed all previous ore indications, and the ore reserve remains at 14,055,000 tons assaying 1.223 percent nickel and 0.618 percent copper. Major permanent construction at the "A" shaft area was begun in 1951. Foundations were completed for the hoist house, main hoist, main substation, powerhouse, shops, and warehouse. Structural steel was erected at the main substation, and three-fifths of the steel work was erected and sheeted at the powerhouse. Excavation work for the ore bins and the crusher house was completed and a start made on the bin foundations. The concentrator area was completely stripped of overburden, and some rock excavation was started. Piers were poured for the fire tower. Foundations were ready for transformers in both the 2,300 and 500 substations; all substation poles were erected, and some of the main distribution poles were placed. A power line was cut from the "A" plant to the townsite and on to the "EL" plant. The right-of-way for the "EL" narrow-gage railway was cleared. In December 1951 the first house was moved from Sherridon to Lynn Lake. At the "EL" mine the former Sherridon East shaft steel headframe was erected. The hoist and powerhouse building was also completed, and the hoist was partly assembled. Foundation work and steel erection were completed for the change house, and sheeting was in progress.

Work on development of hydroelectric power for the permanent Lynn Lake plant was begun in the spring of 1951 on the Laurie River at Mile 18. This site will generate 7,000 horsepower and requires a concrete dam 900 feet long at the top, with an operating head of 55 feet.

During the first part of the year the pilot plant was operated to demonstrate the complete process, treating 600 pounds of nickel concentrate per day. Results of this work, along with improved control features and new techniques developed in the research laboratory, were used as the basis to expand the pilot-plant capacity to 3,000 pounds a day. The leaching section of this enlarged pilot plant was operated for demonstration during December. Subsequent metal reduction and ammonium sulfate-recovery processes were to be demonstrated during the first quarter of 1952. Development work on the acid-oxidation process, which was being demonstrated for Chemical Construction Corp., was carried out intermittently from July to December.

The Sherritt Gordon property at Lynn Lake was described in a trade magazine.[7]

Cuba.—Rehabilitation of the nickel facilities at Nicaro, Cuba, proceeded throughout 1951 and four furnaces were put into operation on January 31, 1952—60 days ahead of schedule. The eight additional

[7] Waldron, H. L., Sherritt Gordon Develops Lynn Lake Nickel-Copper: Eng. and Min. Jour., vol. 152, No. 11, November 1951, pp. 72–78.

furnaces were scheduled for reactivation by mid-1952. The Nicaro plant was to have an annual production of 30 million pounds of nickel as oxide. A majority interest in Nickel Processing Corp., operator of the Government-owned nickel plant at Nicaro, was acquired by the National Lead Co. National Lead Co. and Fomento de Minerales Cubanos S. A. purchased N. V. Billiton Maatschappij's interest in the corporation and rights to certain processes which may further expand output of the plant.

Japan.—Some 8,000 tons of nickel ore from New Caledonia arrived in Japan in August 1951. It was destined for treatment at the Saganeseki refinery of the Nippon Mining Co. for ferronickel manufacture.[8]

New Caledonia.—Production of nickel ore in New Caledonia in 1951 was the highest since 1942—252,335 metric tons compared with 157,645 tons in 1950.. Production in 1951, by mines, is shown in table 9.

TABLE 9.—Production of nickel ore in New Caledonia in 1951, by mines

Mine	Metric tons	Nickel, percent	Operator
Thio	195,500	3.25	Société le Nickel.
Pin Pin	47,060	5.25	Do.
Tao V	5,001	4.00	M. Henri LaFleur.
Medona	1,974	6.00	Do.
Tunney 10	1,800	2.80	M. Paul Videault.
André	1,000	4.50	Do.

The ore produced at the Tao V and Medona mines was processed to matte at the Doniambo plant of Société le Nickel for export to France to customers other than those of Société le Nickel. The ore produced at the Tunney 10 and André mines was for export to Japan.

Production of nickel matte and ferronickel by Société le Nickel declined substantially in 1951 from 1950, mainly because of delay in delivery of Australian coal. During the last several months of 1951 operations were disrupted by the necessary dismantling of one of the two water-jacket furnaces for rebricking, at which time one of the two operating electric furnaces exploded, putting all electric furnaces out of operation.

TABLE 10.—Production of nickel matte and ferronickel by Société le Nickel in 1950 and 1951, in metric tons

Product	1950		1951	
	Gross weight	Nickel content	Gross weight	Nickel content
Matte	6,290	4,859	3,614	2,796
Ferronickel (electric furnace)	4,192	1,450	2,547	856
Ferronickel (water-jacket furnace)			1,885	602
	10,482	6,309	8,046	4,254

[8] Metal Bulletin (London), No. 3638, Oct. 30, 1951, p. 17.

Exports of nickel by Société le Nickel comprised 4,142 metric tons of matte containing 3,287 tons of nickel and 3,694 tons of ferronickel containing 1,222 tons of nickel in 1951 compared with 5,790 tons of matte containing 4,480 tons of nickel and 1,118 tons of ferronickel containing 440 tons of nickel in 1950.

Norway.—Production of refined nickel and copper at the refinery of Falconbridge Nickel Mines, Ltd., at Kristiansand in 1951 was the highest in company history.[9] By year end, construction work of the new plant facilities was practically completed for an annual capacity of 30 million pounds of nickel, and the new equipment was being tested before the process change scheduled for the first quarter of 1952. Present plans include a further increase in refining capacity to a minimum of 35,000,000 pounds of nickel per year. This can be accomplished by extension of the tank houses and other relatively minor changes. Production of nickel sulfate from the newly installed facilities was continuous during the latter part of 1951, although at a rate less than anticipated capacity. The new roaster and anode furnace unit was placed in operation early in 1951 and performed satisfactorily.

United Kingdom.—The nickel refinery of Mond Nickel Co. at Clydach, Wales, was operated at maximum capacity in 1951 and output of nickel was the highest on record.

[9] Falconbridge Nickel Mines, Ltd., 23d Annual Report: 1951, p. 8.

Nitrogen Compounds

By E. Robert Ruhlman

GENERAL SUMMARY

DURING 1951, nitrogen supplies were less than demand in the United States. Increased agricultural requirements and the rearmament program utilized all the nitrogenous material that industry was capable of producing. The shortage of nitrogenous materials and estimated future government requirements were causing the nitrogen industry in the United States to plan substantial expansion.

Ammonium nitrate exports were controlled throughout 1951 by the Office of International Trade, and after November 20 exports of all fertilizer nitrogen materials required export licenses.

Ammonia solutions, ammonium sulfate, ammonium nitrate, and synthetic sodium nitrate continued to be the principal nitrogen compounds produced domestically. Imports of fertilizer nitrogen materials increased in 1951, but exports of both industrial and fertilizer nitrogen were lower than in 1950.

DOMESTIC PRODUCTION

Ammonium Compounds.—Domestic production of synthetic anhydrous ammonia in 1951 (1,767,000 short tons) was 13 percent more than in 1950 and broke all previous records. The only anhydrous ammonia plant still in the Army's possession—The Morgantown Ordnance Works, Morgantown, W. Va.—was leased to the Mathieson Chemical Corp.

Total production of ammonium sulfate in 1951 decreased over 23 percent, with synthetic plants producing only 622,000 short tons compared to 1,138,000 tons in 1950. This decrease reflected cessation of the Army's purchasing program to supply fertilizer nitrogen to Germany, Japan, and Korea. The sulfur shortage contributed to the smaller supply of ammonium sulfate. Byproduct coking plants increased their production 8 percent to 898,000 tons in 1951 compared to 831,000 tons in 1950.

Ammonium nitrate production reached another alltime high in in 1951—1,346,000 tons. As usual, agriculture consumed the largest proportion of ammonium nitrate.

The Daniels process for direct oxidation of atmospheric nitrogen to produce nitric oxide reached the production stage after several years of research by Wisconsin Alumni Research Foundation and

Food Machinery & Chemical Corp. A large plant utilizing this process was being constructed at the Sunflower Ordnance Works, De Soto, Kans.

The numerous companies announcing expansion programs in 1951 included the Solvay Process Division, Allied Chemical & Dye Corp., at its Hopewell, Va., and South Point, Ohio, plants, with a combined expansion of 100,000 tons of nitrogen annually, using natural gas in place of coke as the source of hydrogen. Other companies announcing expansion programs or construction of new plants were: Commercial Solvents Corp., Sterlington, La.; Consumers Cooperative Association, Lawrence, Kans.; Illinois Anhydrous Ammonia Co., Farmer City, Ill.; Mississippi Chemical Corp., Yazoo City, Miss.; Shell Chemical Corp., Pittsburg, Calif.; and the Spencer Chemical Co., Jayhawk Works, Pittsburg, Kans., and Vicksburg, La.

TABLE 1.—Principal nitrogen compounds produced in the United States, 1948–51, in short tons

Commodity	1948	1949	1950	1951
Ammonia (NH_3):				
Synthetic plants: Anhydrous ammonia [1]	1,089,786	1,294,057	1,565,569	1,767,043
Byproduct coking plants (NH_3 content):				
Aqua ammonia	24,753	22,750	23,387	24,878
Ammonium sulfate	207,671	189,202	207,754	224,566
Subtotal	232,424	211,952	231,141	249,444
Grand total	1,322,210	1,506,009	1,796,710	2,016,487
Principal ammonium compounds:				
Ammonium sulfate:				
Synthetic plants [1]	264,476	846,195	1,137,721	622,084
Byproduct coking plants [2]	830,683	756,807	831,016	898,263
Total	1,095,159	1,603,002	1,968,737	1,520,347
Ammonium nitrate, basis solution, 100 percent NH_4NO_3 [1]	988,342	1,018,706	1,213,911	1,346,443

[1] Data from Bureau of Census Monthly Facts for Industry series.
[2] Does not include ammonium sulfate produced at byproduct coking plants from purchased anhydrous ammonia as follows: 1948—30,749 short tons; 1949—58,826 short tons; 1950—14,699 short tons; and 1951—none.

The Missouri Ordnance Works at Louisiana, Mo., operated during World War II by the Army to produce synthetic ammonia and since the end of the war by the Bureau of Mines as a demonstration synthetic liquid fuels plant, was transferred to the Bureau of Mines in 1951.

Sodium Nitrate.—The synthetic nitrate of soda consumed in the United States in 1951 was produced domestically; none was imported. Only two companies were in production—Solvay Process Division, Allied Chemical & Dye Corp., Hopewell, Va., and Mathieson Chemical Corp., Lake Charles, La.

CONSUMPTION AND USES

As in the past, the major part of the nitrogen supply was consumed by agriculture, with smaller quantities used by industry. A small quantity of elemental nitrogen is used for industrial purposes, but most nitrogen enters both agriculture and industry in various chemical

compounds. According to the United States Department of Agriculture more than 1.2 million short tons of nitrogen was consumed by agriculture during the fiscal year ended June 30, 1951. The principal chemical nitrogen materials, in order of importance, were (1) ammonium nitrate and ammonium nitrate-limestone mixtures, (2) sodium nitrate, (3) ammonium sulfate, (4) anhydrous ammonium and solutions, (5) calcium cyanamide, and (6) calcium nitrate.

According to the United States Department of Agriculture, consumption of ammonium nitrate in the year ended June 30, 1951, was 638,176 tons, a 10-percent increase over the preceding 12 months. Consumption of other fertilizer nitrogen materials increased as follows: Ammonium sulfate, 97 percent; ammonium nitrate-limestone mixtures, 87 percent; and sodium nitrate, 9 percent. Demand for anhydrous ammonia continued to grow during the year, with over 118,000 tons reported consumed.

PRICES

Prices for nitrogen compounds were frozen on January 26 by GCPR (General Ceiling Price Regulation) at the highest price charged during the base period of December 19, 1950–January 25, 1951. The manufacturers' regulation (CPR 22) issued April 25, 1951, permitted minor price adjustments to correct inequalities caused by GCPR if so desired by the manufacturer. Numerous supplementary regulations and amendments were issued during the year, permitting price increases. The prices for various nitrogen compounds in effect at the opening, middle and end of 1951, as quoted in the Oil, Paint and Drug Reporter, are shown in table 2.

TABLE 2.—Prices of major nitrogen compounds in 1951, per short ton [1]

Commodity	Jan. 1, 1951	July 9, 1951	Dec. 31, 1951
Chilean nitrate, port warehouse, bulk	$48.00	$50.00	$53.50
Sodium nitrate, synthetic domestic, c. l. works, crude, bulk	45.00	45.00	47.50
Ammonium sulfate, coke ovens, bulk	32.00–45.00	40.00–45.00	40.00–45.00
Cyanamide, fertilizer-mixing grade, 20% N, granular, Niagara Falls, Ont.:			
Bulk	54.00		
Bagged		65.45	65.45
Ammonium nitrate, fertilizer grade:			
Canadian eastern, 32.5% N, c. l., shipping point, bags	69.50	69.50	69.50
Western, domestic, works, bags	61.00–63.00	61.00–63.00	61.00–63.00
Anhydrous ammonia, fertilizer, tanks, works	74.00–80.00	79.00–80.00	79.00–80.00
Ammonium nitrate-dolomite compound, 20.5% N, Hopewell, Va., bags	46.00	48.50	51.00

[1] Quotations from Oil, Paint and Drug Reporter of the dates listed.

FOREIGN TRADE [1]

As in previous years, imports of natural Chilean nitrate greatly exceeded the imports of any other nitrogenous material. The tonnage of Chilean sodium nitrate imported increased more than 17 percent compared with 1950, to 725,800 tons, the highest since 1945. The value of these imports rose in 1951 to $27,016,000.

Chilean potassium-sodium nitrate imports dropped to 5,566 tons valued at $244,300.

[1] Figures on imports and exports compiled by M. B. Price and E. D. Page, of the Bureau of Mines, from records of the U. S. Department of Commerce.

TABLE 3.—Major nitrogen compounds imported for consumption into and exported from the United States, 1948–51, in short tons

[U. S. Department of Commerce]

	1948	1949	1950	1951
Imports for consumption:				
Industrial chemicals:				
Ammonium nitrate	80	1	----------	4
Anhydrous ammonia	209	----------	----------	----------
Fertilizer materials:				
Ammonium nitrate mixtures:				
Containing less than 20 percent nitrogen	250	2,290	1,523	361
Containing 20 percent or more nitrogen	100,314	136,405	221,299	342,757
Ammonium phosphates	108,228	126,274	[1] 107,695	134,962
Ammonium sulfate	105,887	105,498	[1] 144,732	216,106
Calcium cyanamide	116,504	115,885	97,725	68,231
Nitrogenous materials, n. s. p. f.	5,304	4,829	23,830	26,023
Potassium nitrate, crude	(2)	1	20	6,453
Sodium nitrate	709,573	675,54 :	[1] 618,018	725,980
Potassium-sodium nitrate	----------	6,80 :	20,409	8,249
Exports:				
Industrial chemicals:				
Anhydrous ammonia	3,407	3,477	10,202	5,907
Ammonium nitrate	5,087	17,004	3,336	5,049
Fertilizer materials:				
Ammonium nitrate	(3)	470,443	94,169	1,256
Ammonium sulfate	136,648	660,733	[1] 819,285	134,100
Nitrogenous chemical materials, n. e. s.	701,450	23,510	41,363	63,768
Sodium nitrate	17,100	3,714	[1] 32,862	43,669

[1] Revised figure.
[2] Less than 0.5 ton.
[3] Not separately classified; included in nitrogenous chemical materials, n. e. s.

TABLE 4.—Sodium nitrate and potassium-sodium nitrate imported for consumption in the United States, 1947–51, in short tons, by countries

[U. S. Department of Commerce]

	1947		1948		1949		1950		1951	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Sodium nitrate:										
Canada	42	$2,542	199	$11,057	8	$416	[1] 8	[1] $1,137	84	$4,622
Chile	556,483	15,151,347	709,374	23,031,245	675,535	26,005,637	[1] 617,999	[1] 22,387,123	725,844	27,015,854
France	----------	----------	----------	----------	----------	----------	----------	----------	33	3,213
Germany	----------	----------	----------	----------	----------	----------	11	1,330	5	576
Poland	----------	----------	----------	----------	----------	----------	----------	----------	14	968
Total	556,525	15,153,889	709,573	23,042,302	675,543	26,006,053	[1] 618,018	[1] 22,389,590	725,980	27,025,233
Potassium-sodium nitrate, mixtures:										
Canada	----------	----------	----------	----------	----------	----------	----------	----------	3	148
Chile	2,500	64,968	----------	----------	6,802	310,343	20,409	882,582	5,566	244,341
Germany	----------	----------	----------	----------	----------	----------	----------	----------	2,680	92,294
Total	2,500	64,968	----------	----------	6,802	310,343	20,409	882,582	8,249	336,783

[1] Revised figure.

WORLD REVIEW

World demand for nitrogen continued to increase during 1951, resulting in new records in both production and consumption. Although

estimates of production and consumption by the United Nations Food and Agriculture Organization and by Aikman (London), Ltd., differ, they both show an apparent production surplus for 1951–52. According to the Aikman Co., for the period July 1, 1949, through June 30, 1952, there was an apparent surplus of over 650,000 metric tons of nitrogen for agriculture. Details of world production and consumption are shown in tables 5 and 6.

Expansion of world nitrogen facilities was taking place rapidly because of the increased demand throughout the world for more fertilizers. A new plant was being constructed at Oulu, Finland, to produce about 16,000 metric tons of fertilizer nitrogen compounds annually. Bamag-Meguin of Germany developed a new process for the manufacture of nitric acid reported to be of lower unit cost than other methods.[2] Other new plants for various nitrogen compounds were either being constructed or planned in Brazil, Canada, Colombia, Egypt, Iceland, India, Spain, Sweden and many other countries.

The Anglo Chilean Nitrate Corp. and Lautaro Nitrate Co., Ltd., representing a large share of the nitrate industry in Chile, completed plans to merge under the new name of Anglo Lautaro Nitrate Co.

TABLE 5.—World production and consumption of fertilizer nitrogen compounds, fiscal years ended June 30, 1950–52, by principal country, in metric tons of contained nitrogen

[United Nations Food and Agriculture Organization]

Country	Production			Consumption		
	1949–50	1950–51 [1]	1951–52 [2]	1949–50	1950–51	1951–52 [2]
Austria	67,820	74,900	94,750	17,620	22,542	25,000
Belgium	174,985	173,357	214,269	78,345	78,000	77,500
Canada	143,676	149,208	149,208	31,240	32,659	32,659
Chile	241,823	242,583	234,660	7,042	8,369	9,000
Czechoslovakia	30,000	30,000	30,300	35,000	40,000	40,000
Denmark				59,588	70,000	73,000
Egypt			27,900	93,000	42,533	130,118
France	214,000	259,030	285,000	[3] 225,000	262,100	280,000
Germany:						
Federal Republic	431,405	464,677	500,000	327,641	361,562	380,000
Soviet Zone	130,000	205,000	205,000	130,000	184,000	191,000
Greece				25,000	22,000	35,000
India	9,200	8,417	37,998	64,234	46,650	62,998
Italy	136,905	177,301	186,000	119,882	156,500	158,000
Japan	378,481	414,595	456,770	303,063	442,000	442,000
Korea, South			306	98,857	14,598	48,189
Netherlands	112,557	189,053	226,500	143,187	165,978	160,000
Norway	150,040	160,747	159,404	36,864	30,699	32,000
Peru	34,159	35,440	36,000	36,399	37,680	39,630
Poland	60,000	65,000	65,000	70,000	75,000	75,000
Portugal [3]				23,000	31,870	33,000
Spain	2,500	6,600	7,000	38,500	56,600	60,000
Sweden	23,397	25,426	16,028	59,642	67,999	72,542
Taiwan (Formosa)	3,510	6,112	13,849	42,570	61,279	76,215
United Kingdom	275,282	275,000	278,900	209,221	218,800	175,000
United States [3]	1,048,000	996,000	1,099,000	935,000	1,166,000	1,275,000
World total [4]	[5] 3,707,000	4,011,103	4,379,654	3,404,694	3,930,054	4,268,353

[1] Revised.
[2] Preliminary figures.
[3] Figures for consumption include overseas territories.
[4] Exclusive of U. S. S. R.; includes amounts for minor producing and consuming countries not listed above.
[5] Revised by Bureau of Mines.

[2] Oil, Paint and Drug Reporter, vol. 160, No. 13, September 24, 1951, p. 48.

TABLE 6.—Estimates of world production and consumption of nitrogen, years ended June 30, 1949–52, in thousands of metric tons [1]

	Estimated production		Estimated consumption	
	For agriculture	For industry	In agriculture	In industry
1948–49 [2]	3,399	550	3,300	550
1949–50 [2]	3,865	610	3,497	610
1950–51 [2]	4,039	735	3,989	735
1951–52	4,425	810	4,290	810

[1] Exclusive of U. S. S. R. Source: Aikman (London), Ltd., Annual Report on the Nitrogen Industry, Nov. 10, 1952.
[2] Revised figures.

Peat

By J. A. Corgan and Golden V. Chiriaco

GENERAL SUMMARY

PRODUCTION of peat in the United States in 1951 increased about 49 percent in tonnage and 30 percent in value over 1950. The output is used entirely within the United States, none being exported. Imports increased about 16 percent over 1950 and accounted for about 43 percent of the 338,947 tons consumed in this country in 1951.

TABLE 1.—Salient statistics of the peat industry in the United States, 1947–51

	1947	1948	1949	1950	1951
SHORT TONS					
Production	136,232	129,581	129,532	130,723	194,416
Imports	79,567	91,073	94,747	[1] 124,382	144,531
Available supply	215,799	220,654	224,279	[1] 255,105	338,947
World production	52,000,000	49,000,000	50,000,000	57,000,000	59,000,000
VALUE					
Production	$868,979	$929,560	$1,020,014	$1,142,566	$1,489,225
Average per ton	$6.38	$7.17	$7.87	$8.74	$7.66

[1] Revised figure.

RESERVES

There were no new developments during 1951 with regard to reserves of peat which remained at slightly less than 13,827,000,000 short tons (*see* Peat Chapter, Minerals Yearbook, 1950, p. 869).

PRODUCTION

Sixty-three producers operating in 17 States contributed to the 1951 production of 194,416 short tons of peat reported to the Bureau of Mines, as compared with 48 producers operating in 17 States in 1950. Although the industry in general showed a substantial increase over 1950, part of the rise in production in 1951 can be attributed to the output of a number of operations reporting to the Bureau for the first time. The total value of peat produced in 1951, $1,489,225, represents a 30-percent increase over the 1950 value of $1,142,566, whereas the average value per ton in 1951, $7.66, was a decrease of 12.4 percent from the 1950 value of $8.74. The overall decline in the average per-ton value and, particularly, the sharp decline in the average value in moss peat can be attributed principally to the low value reported by several large producers of moss peat.

More peat was produced in Washington in 1951 than in any other State. The output of Washington together with that of the next three leading States—New Jersey, Florida, and Ohio—accounted for

about 62 percent of the United States total. Other producing States, in order of output, were Michigan, Iowa, Pennsylvania, California, Indiana, Connecticut, Illinois, Georgia, Colorado, Maine, Texas, Wisconsin, and Massachusetts.

Peat humus, produced in 14 States in 1951, constituted about 64 percent of total peat production; reed, or sedge, produced in 8 States, about 24 percent; and moss peat and other, produced in 9 States, about 12 percent.

TABLE 2.—Peat produced in the United States, 1949–51, by States

State	1949		1950		1951	
	Short tons	Value	Short tons	Value	Short tons	Value
California	5,670	$35,193	6,399	$37,192	6,432	$42,016
Colorado	2,800	24,504	3,210	28,088	2,241	19,611
Connecticut	5,974	33,011	6,294	35,145	5,586	33,702
Florida	11,800	69,000	23,022	151,270	25,748	161,417
Georgia	1,870	56,000	1,750	41,000	2,250	41,000
Indiana	7,949	28,537	5,793	18,966	5,699	22,824
Iowa	(1)	(1)	3,000	19,500	13,545	107,909
Maine	3,312	79,360	2,912	61,600	1,805	36,870
Massachusetts	595	7,415	650	7,575	(1)	(1)
Michigan	(1)	(1)	12,750	174,000	20,180	320,100
Minnesota	12,820	54,255	400	13,100		
New Hampshire	15	296				
New Jersey	25,500	180,750	26,466	186,338	27,678	213,500
Ohio	20,372	181,117	22,145	245,379	21,378	261,891
Pennsylvania	6,663	30,035	(1)	(1)	8,591	46,568
Texas	1,531	12,000	977	10,566	1,238	10,750
Washington	(1)	(1)			45,304	98,955
Wisconsin	(1)	(1)	2,293	9,536	(1)	(1)
Other States	[2] 22,661	[2] 228,541	[2] 12,662	[2] 103,311	[2] 6,741	[2] 72,112
Total	129,532	1,020,014	130,723	1,142,566	194,416	1,489,225

[1] Reported under "Other States" to avoid disclosure of individual company operations.
[2] Includes data for Illinois and States indicated by footnote 1.

TABLE 3.—Peat produced in the United States, 1950–51, by kinds

Kind	1950			1951		
	Short tons	Value		Short tons	Value	
		Total	Per ton		Total	Per ton
Moss peat	9,139	$109,196	$11.95	[1] 24,001	[1] $140,870	[1] $5.87
Reed or sedge	35,791	328,365	9.17	46,643	463,131	9.93
Peat humus	85,243	704,332	8.26	123,772	885,224	7.15
Other	550	673	1.22	(2)	(2)	(2)
Total	130,723	1,142,566	8.74	194,416	1,489,225	7.66

[1] Includes negligible quantity of "Other" types of peat.
[2] Reported under "Moss peat" to avoid disclosure of individual company operations.

USES

For many years peat has been used in this country primarily for soil improvement. Of the total sales reported for 1951 about 73 percent was so used, about 19 percent was sold for mixed fertilizers, and about 8 percent was consumed in other uses.

United States Government Specifications.—The Federal Government purchases a certain amount of peat, principally for horticultural purposes, provided the peat meets required specifications. These specifications may be obtained from the Federal Supply Service, General Services Administration, Washington 25, D. C.

TABLE 4.—Peat sold in the United States, 1947–51, by uses

Year	Soil improvement		Mixed fertilizers		Other uses		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1947	105,796	$584,012	28,354	$266,359	1,561	$17,593	135,711	$867,964
1948	86,991	578,615	36,012	309,259	6,000	36,000	129,003	923,874
1949	76,963	546,062	40,897	385,015	11,672	89,237	129,532	1,020,314
1950	87,090	704,200	36,433	391,174	7,198	47,345	130,721	1,142,719
1951	138,712	962,002	37,233	364,164	14,800	141,268	190,745	1,467,434

IMPORTS [2]

The quantity of moss peat imported into the United States in 1951 reached an alltime high of 144,531 short tons, an increase of 16 percent over the 124,382 tons (revised figure) imported in 1950 and about 84 percent over the 1939 prewar figure of 78,611 tons. In 1951, as in past years, no exports of peat were reported.

TABLE 5.—Peat moss imported for consumption in the United States, 1949–51, by kind and by country

[U. S. Department of Commerce]

Country	Poultry and stable grade					
	1949		1950		1951	
	Short tons	Value	Short tons	Value	Short tons	Value
Canada	25,473	$890,230	[1] 20,807	$828,966	17,963	$734,549
Denmark	32	838	50	1,254		
Germany	1,646	43,177	[1] 8,252	[1] 219,766	11,539	343,769
Ireland	434	19,680	682	21,546	97	3,320
Netherlands	474	12,622	923	17,128	1,083	43,916
Poland-Danzig	122	3,900				
Sweden	16	464	63	2,221	65	2,008
United Kingdom			34	812	18	790
Total	28,197	970,911	[1] 30,811	[1] 1,091,693	30,765	1,128,352

Country	Fertilizer grade					
	1949		1950		1951	
	Short tons	Value	Short tons	Value	Short tons	Value
Belgium-Luxembourg	55	$710				
Canada	48,162	1,651,913	46,762	$1,610,988	56,101	$2,196,367
Denmark	1,145	31,909	1,051	24,550	325	6,507
Germany	5,306	136,045	[1] 30,902	[1] 780,265	47,700	1,230,544
Ireland	2,800	112,545	2,171	74,126	1,139	40,921
Netherlands	5,894	154,593	7,673	149,011	6,485	189,331
Norway	2	51				
Poland-Danzig	2,735	106,351	3,823	106,325	1,846	53,815
Sweden	367	17,541	432	12,482	22	556
United Kingdom	84	1,840	757	17,487	148	4,143
Total	66,550	2,213,498	[1] 93,571	[1] 2,775,234	113,766	3,722,184

[1] Revised figure.

[2] Figures on imports compiled by M. B. Price and E. D. Page of the Bureau of Mines from records of the United States Department of Commerce.

WORLD PRODUCTION

As indicated in table 6, the estimated world production of peat in 1951 increased slightly over 1950. Because of the lack of specific data, it has been necessary to estimate production in many countries from the most reliable information available.

TABLE 6.—World production of peat, 1946–51, by countries, in metric tons

[Compiled by Pauline Roberts]

Country	1946	1947	1948	1949	1950	1951
Austria [1]	50,000	50,000	50,000	50,000	50,000	50,000
Canada:						
Agricultural use	87,850	72,592	81,465	72,800	[2] 68,215	71,538
Fuel	132	86	77	51	[2] 53	18
Denmark	3,705,180	5,168,139	3,616,860	1,416,406	901,802	2,013,932
Finland:						
Agricultural use	6,846	14,231	17,188	[1] 18,650	7,000	224,000
Fuel	176,509	153,164	197,659	178,538	197,000	
France	84,621	57,995	37,344	[1] 60,000	[1] 60,000	[1] 60,000
Germany:						
East Germany [1]	500,000	500,000	500,000	500,000	500,000	500,000
West Germany	[1] 500,000	1,800,000	2,038,000	1,203,266	[1] 1,200,000	[3] 423,400
Hungary	3,720	8,550	[1] 8,000	[1] 8,000	[1] 8,000	[1] 8,000
Iceland	[1] 10,500	3,200	3,400	[1] 2,500	[1] 3,000	[1] 2,000
Ireland	4,826,238	4,850,512	[1] 3,846,800	[1] 4,079,400	[1] 2,680,300	[1] 4,000,000
Italy	52,332	20,698				
Netherlands	701,600	715,000	966,000	779,000	[2] 527,600	641,900
Norway:						
Agriculture use	9,200	[1] 20,000	[1] 20,000	[1] 20,000	24,500	25,300
Fuel	467,908	378,600	343,130	381,659	360,743	[2] 329,616
Portugal	2,456	2,715	1,529	266	402	
Spain	2,226	3,033	1,267	869	4,952	4,410
Sweden:						
Agricultural use	79,339	88,205	108,533	106,269	[1] 100,000	[1] 100,000
Fuel	770,230	436,249	363,794	94,191	[1] 100,000	[1] 250,000
Switzerland	100,000	40,000	(4)	(4)	(4)	(4)
U. S. S. R. [1]	26,000,000	32,000,000	32,000,000	36,000,000	44,000,000	44,000,000
United States	127,647	123,587	117,553	117,509	118,589	176,370
Total (estimate)	38,000,000	47,000,000	44,000,000	45,000,000	[2] 51,000,000	53,000,000

[1] Estimate.
[2] Revised figure.
[3] Including 280,959 tons for agricultural use.
[4] Negligible.

Petroleum and Petroleum Products

By A. G. White, A. T. Coumbe, and A. L. Clapp

GENERAL SUMMARY

THE SHUTDOWN of the Abadan refinery in Iran during the last half of 1951 had a major effect on oil operations and total oil demand in the United States.[1]

The volume of crude oil refined in Iran averaged only 272,000 barrels daily in 1951, compared with 524,000 barrels daily in 1950. Runs to stills in the first half of 1951 averaged 507,000 barrels daily compared with 43,000 barrels daily in the last half. Although this loss in refinery output was more than offset by the rise in total crude runs in Western Europe (1,100,000 barrels daily in 1951 compared with 793,000 barrels daily in 1950), the situation outside the United States changed abruptly from an expectation of ample supplies of crude petroleum and products to one of shortages in meeting the large increase in demand abroad.

The most direct effect in the United States was an increase in the exports of refined products to 126 million barrels, a gain of 49 million compared with 1950, when a further decline might have been expected. Exports of refined products by quarters in 1951, compared with 1950, gained 3 percent in the first quarter, 55 percent in the second, 126 percent in the third, and 66 percent in the fourth. Part of the increase of 13 million barrels in the amount of heavy fuel oil used to bunker ships engaged in the foreign trade in 1951 can be attributed to the shortage in supplies abroad. These figures seem to warrant a rough estimate that the total demand for all oils in the United States was increased by about 2 percent above normal expectations in 1951. Furthermore, the gain of only 1 percent in crude-oil imports and the decline of 3 percent in the imports of refined products in 1951 can be attributed to this situation.

The total demand for all oils in the United States amounted to 2,726 million barrels in 1951, including total exports and shipments to Territories of about 155 million barrels and a domestic demand of 2,571 million in continental United States. Compared with 1950, total demand increased 9.6 percent, exports were 39 percent higher, and domestic demand was 8.3 percent greater.

Exports of refined products increased 65 percent, whereas crude exports declined 18 percent. The decline in crude exports was due

[1] Certain terms, as utilized in this chapter, are more or less unique to the petroleum industry. Principal terms, and their meaning, are as follows:

Total demand.—A derived figure representing total new supply plus decreases or minus increases in reported stocks. Because there are substantial secondary and consumers' stocks that are not reported to the Bureau of Mines, this figure varies considerably from consumption.

Domestic demand.—Total demand less exports.

New supply of all oils.—The sum of crude-oil production, plus production of natural-gas liquids, plus benzol (coke-oven) used for motor fuel, plus imports of crude oil and petroleum products.

Transfers.—Crude oil conveyed to fuel-oil stocks without processing or reclassification of products from one product category to another.

All oils.—Crude petroleum, natural-gas liquids, and their derivatives.

Principal products.—Gasoline, kerosine, distillate fuel oil, and residual fuel oil.

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primarily to the increased deliveries of Canadian crude oil via pipeline to Lake Superior and Lake tankers to refineries in Ontario.

Domestic demand includes all oil delivered to the Armed Forces in the United States, both for use at home and for shipment abroad in military custody. Data collected by the Bureau of Mines show a gain of 25 million barrels in the military deliveries of distillate fuel. residual fuel, and aviation gasoline in 1951 as compared to 1950. Of the total gain of 8.3 percent in domestic demand, less than 7 percent, represents the increase in civilian demand after all military deliveries were deducted.

The new supply of all oils (production plus imports) gained about 12 percent in 1951 compared with 1950. The larger relative gain in supply, as compared with total demand, resulted from the addition of over 32 million barrels to total stocks in 1951, whereas total stocks were reduced by 20 million barrels in 1950. The increase of 24 million barrels in stocks of refined products compared with the decline of 16 million barrels in 1950 was an important factor in the gain of over 13 percent in total crude runs in 1951. The principal changes in total stocks in 1951 were gains of 7.3 million barrels in crude-oil stocks, 0.8 million in natural-gas liquids stocks, and 24.3 million barrels

TABLE 1.—Salient statistics of crude petroleum, refined products, and natural-gas liquids in the United States, 1947–51 [1]

	1947	1948	1949	1950	1951 [2]
Crude petroleum:					
Domestic production—thousands of barrels [3]	1,856,987	2,020,185	1,841,940	1,973,574	2,244,529
World production—do	3,022,139	3,433,226	3,404,019	3,802,907	4,282,874
United States proportion of world production—percent	61	59	54	52	52
Imports [4]—thousands of barrels [3]	97,532	129,093	153,686	177,714	179,073
Exports [5]—do	46,355	39,736	33,069	34,823	28,604
Stocks, end of year:					
Gasoline-bearing crude—do	224,929	246,572	253,356	248,463	255,783
California heavy crude—do	5,725	10,055			
Runs to stills—do	1,852,246	2,031,041	1,944,221	2,094,867	2,370,404
Total value of domestic production at wells—thousands of dollars	3,577,890	5,245,080	4,674,770	4,963,380	5,681,710
Average price per barrel at wells	$1.93	$2.60	$2.54	$2.51	$2.53
Total producing oil wells in the United States, Dec. 31	426,280	437,880	448,680	465,870	474,990
Total oil wells completed in the United States during year	17,999	22,585	22,042	24,430	23,453
Refined products:					
Imports [5]—thousands of barrels [3]	61,857	59,051	81,873	132,547	128,648
Exports [5]—do	118,122	94,938	86,307	76,483	125,824
Stocks, end of year—do	[6] 265,850	[7] 343,537	[8] 342,932	326,892	351,146
Output of motor fuel—do	839,998	921,923	962,417	1,024,462	1,139,511
Yield of gasoline—percent	40.2	40.3	43.7	43.0	42.4
Completed refineries, end of year	390	375	367	357	350
Daily crude oil capacity of refineries—thousands of barrels [3]	6,034	6,439	6,696	6,964	7,333
Average dealers' net price (excluding tax) of gasoline in 50 United States cities—cents per gallon [9]	12.33	14.55	15.05	15.10	15.33
Natural-gas liquids:					
Production—thousands of barrels [3]	132,173	146,721	157,086	181,961	205,512
Stocks, end of year—do	4,296	5,579	6,831	7,355	8,186

[1] Data, including imports and exports, are for continental United States.
[2] Preliminary figures, except that all stock figures are final.
[3] 42 gallons per barrel.
[4] Bureau of Mines data.
[5] U. S. Department of Commerce, except Alaska and Hawaii, which are Bureau of Mines data, 1948–51.
[6] Figure on new basis and comparable with succeeding year. Figure for 1947 on old basis and comparable with preceding years—267,103,000 barrels.
[7] Figure on new basis and comparable with succeeding year. Figure for 1948 on old basis and comparable with preceding year—345,650,000 barrels.
[8] Figure on new basis and comparable with succeeding year. Figure for 1949 on old basis and comparable with preceding year—342,704,000 barrels.
[9] American Petroleum Institute.

in product stocks. Since product stocks declined about 12 million barrels in the California district, the increase in the districts east of California amounted to 36 million barrels.

As total imports declined about 1 percent, the increase in new supply in 1951 came from increased production. The production of crude oil set a new record in 1951, averaging 6,149,000 barrels daily, a gain of 742,000 barrels daily or almost 14 percent compared with 1950. Texas supplied 180 million barrels of the total increase of 271 million barrels in crude production.

The production of light oils from natural gas and other sources averaged 564,000 barrels daily in 1951, a gain of 13 percent. About 60 percent of these light oils are included in the output of motor fuel, and most of the remainder are sold as liquefied gases for fuel and chemical uses and are supplemented by the similar products recovered from still gas at refineries.[2]

DEMAND

The domestic demand for all oils[3] in continental United States averaged 7,044,000 barrels daily, or a gain of 8.3 percent compared with 1950. The relative gains of principal products were 9.7 percent for motor fuel, 1.8 percent for residual fuel oil, 13.8 percent for distillate, 4.9 percent for kerosine, and 9.5 percent for all other products. A brief review of the trends in demand for the major oil products follows.

Motor Fuel (Gasoline and Naphtha).—The total demand for motor fuel rose from 1,019 million barrels in 1950 to 1,131 million in 1951, an increase of 112 million barrels or 11 percent. Exports increased from 24.7 million barrels to 40.4 million barrels, a gain of 15.7 million or 63 percent. Domestic demand rose from 994 million barrels to 1,090 million, an increase of 96 million barrels or 10 percent.

The downward trend in exports since 1949, caused by expanding refinery capacity abroad, was reversed in 1951, since a major part of the increasing foreign production was needed to offset the loss in Iran output and was not sufficient to cover the increases in demand. Exports of aviation gasoline, included in the total, rose from 7.1 million barrels in 1950 to 12.2 million in 1951.

The domestic demand for motor fuel continued a steady upward trend with the rapid growth in motor transport and the gain in aviation requirements. The rapid increase in the number of trucks powered by diesel engines, using either diesel oil or liquefied gases, accounted for over 1 percent of the total highway use of fuel in 1951. The domestic demand for aviation gasoline, included in the total, increased from 39.5 million barrels in 1950 to 53.1 million in 1951, the major part of the increase being in deliveries to the Armed Forces. The aviation-gasoline figures do not include jet fuel, a mixture of low-grade gasoline with either light distillate fuel oil or kerosine.

Residual Fuel Oil.—The total demand for residual fuel oil rose from 570 million barrels in 1950 to 593 million in 1951, a 4-percent gain. Exports increased from 16.2 million barrels to 29.1 million, a 79-percent increase. Domestic demand amounted to 554 million barrels in 1950 and 564 million in 1951, a gain of less than 2 percent.

[2] The term "motor fuel" as used in this chapter includes gasoline and naphtha but does not include liquefied gases or distillate fuel oil used subsequently in internal-combustion engines.

[3] For definition, *see* footnote 1 at beginning of this chapter.

TABLE 2.—Supply and demand of all oils [1] in continental United States, 1949 (total) and 1950–51, by months

[Thousands of barrels]

	1950													1949 (total)
	January	February	March	April	May	June	July	August	September	October	November	December	Total	
New supply:														
Domestic production:														
Crude petroleum	152,935	139,127	151,301	149,147	159,558	161,305	170,058	176,192	176,698	183,011	176,782	177,460	1,973,574	1,841,940
Natural-gas liquids	15,235	13,719	14,669	14,047	14,278	14,285	14,966	15,423	15,440	16,450	16,232	17,217	181,961	157,086
Benzol, etc	21	21	17	17	17	17	17	7	7	7	5	5	158	189
Total production	168,191	152,867	165,987	163,211	173,853	175,607	185,041	191,622	192,145	199,468	193,019	194,682	2,155,693	1,999,215
Imports:														
Crude petroleum [2]	15,102	11,499	14,614	15,336	13,618	14,931	15,076	15,539	15,760	15,809	13,992	16,438	177,714	153,686
Refined products [3]	11,062	7,765	12,406	11,426	10,135	10,203	10,004	10,622	10,147	12,295	12,736	13,746	132,547	81,873
Total new supply	194,355	172,131	193,007	189,973	197,606	200,741	210,121	217,783	218,052	227,572	219,747	224,866	2,465,954	2,234,774
Increase (+) or decrease (−) in stocks	−10,662	−17,639	−23,747	−2,362	−404	+10,690	+8,481	+1,316	+16,320	+13,054	+4,773	−20,229	−20,409	−2,852
Demand:														
Total demand	205,017	189,770	216,754	192,335	198,010	190,051	201,640	216,467	201,732	214,518	214,974	245,095	2,486,363	2,237,626
Exports: [3]														
Crude petroleum	2,130	2,328	2,153	2,968	2,946	3,095	3,274	3,096	2,654	4,033	3,229	2,917	34,823	33,069
Refined products	5,168	5,979	6,270	6,468	6,327	6,109	6,447	5,953	6,956	6,617	6,725	7,464	76,483	86,307
Domestic demand:														
Motor fuel	66,981	63,274	78,780	80,350	89,035	90,174	91,677	94,507	86,725	89,067	82,688	81,032	994,290	913,713
Kerosine	13,906	11,413	12,939	8,371	5,700	4,629	6,892	7,035	7,920	9,486	12,737	16,816	117,844	102,672
Distillate fuel oil	43,406	39,484	42,604	28,806	25,163	19,705	23,779	26,785	24,965	29,434	35,411	55,343	394,885	329,278
Residual fuel oil	51,437	47,382	52,159	43,017	41,915	39,055	40,847	44,908	42,704	46,194	47,977	56,198	553,793	496,021
Lubricants	2,846	2,370	3,271	2,544	3,346	3,588	3,314	3,822	3,511	3,906	3,322	3,013	38,853	33,101
Miscellaneous	19,143	17,540	18,578	19,811	23,578	23,696	25,410	30,361	26,297	25,781	22,885	22,312	275,392	243,465
Total domestic demand	197,719	181,463	208,331	182,899	188,737	180,847	191,919	207,418	192,122	203,868	205,020	234,714	2,375,057	2,118,250
Stocks:														
Crude petroleum	246,610	243,750	241,230	244,605	239,877	242,287	240,270	237,393	242,311	246,424	249,525	248,463	248,463	253,356
Natural-gas liquids	7,363	8,098	7,708	7,950	8,163	8,151	8,730	8,667	8,581	8,226	7,636	7,355	7,355	6,831
Refined products	338,484	322,970	302,133	296,154	300,265	308,557	318,476	322,732	334,220	343,516	345,778	326,892	326,892	342,932
Total stocks	592,457	574,818	551,071	548,709	548,305	558,995	567,476	568,792	585,112	598,166	602,939	582,710	582,710	603,119

	1951 [4]													1950 (total)
	January	February	March	April	May	June	July	August	September	October	November	December	Total	
New supply:														
Domestic production:														
Crude petroleum	183,110	166,041	187,624	183,800	191,268	183,898	190,362	193,201	187,816	197,610	188,149	191,650	2,244,529	1,973,574
Natural-gas liquids	17,305	15,622	17,774	16,702	16,640	15,920	16,357	16,969	17,029	18,123	18,146	18,925	205,512	181,961
Benzol, etc	9	9	6	6	6	12	10	8	40	44	45	16	211	158
Total production	200,424	181,672	205,404	200,508	207,914	199,830	206,729	210,178	204,885	215,777	206,340	210,591	2,450,252	2,155,693
Imports:														
Crude petroleum [2]	15,472	13,096	14,971	15,319	16,051	16,889	16,940	16,404	15,000	13,054	12,760	13,117	179,073	177,714
Refined products [3]	14,958	13,143	11,688	10,978	11,097	9,385	7,500	7,783	7,318	10,778	11,297	12,723	128,648	132,547
Total new supply	230,854	207,911	232,063	226,805	235,062	226,104	231,169	234,365	227,203	239,609	230,397	236,431	2,757,973	2,465,954
Increase (+) or decrease (−) in stocks	−12,793	−11,174	−1,523	+13,433	+16,556	+15,260	+12,146	+8,109	+12,952	+7,040	−11,902	−15,699	+32,405	−20,409
Demand:														
Total demand	243,647	219,085	233,586	213,372	218,506	210,844	219,023	226,256	214,251	232,569	242,299	252,130	2,725,568	2,486,363
Exports: [3]														
Crude petroleum	2,913	2,471	2,640	3,615	1,791	2,342	2,320	2,361	2,199	1,947	1,858	2,147	28,604	34,823
Refined products	5,413	5,290	7,299	7,940	11,143	10,319	13,506	15,397	14,919	12,413	11,276	10,909	125,824	76,483
Domestic demand:														
Motor fuel	80,554	72,717	86,846	87,430	100,188	96,093	100,476	101,206	91,803	99,945	88,702	84,394	1,090,354	994,290
Kerosine	15,633	14,789	11,788	8,678	5,877	5,494	6,490	6,455	6,640	10,171	14,960	16,744	123,719	117,844
Distillate fuel oil	57,331	50,085	45,046	32,185	25,519	24,132	24,277	27,185	27,271	31,655	47,221	57,233	449,140	394,885
Residual fuel oil	56,223	51,101	53,568	46,841	44,104	42,153	39,400	40,454	39,547	45,016	50,982	54,382	563,771	553,793
Lubricants	3,539	3,115	3,691	3,550	3,850	3,632	3,348	3,592	3,313	4,090	3,421	3,163	42,304	38,853
Miscellaneous	22,041	19,517	22,708	23,133	26,034	26,679	29,206	29,606	28,559	27,332	23,879	23,158	301,852	275,392
Total domestic demand	235,321	211,324	223,647	201,817	205,572	198,183	203,197	208,498	197,133	218,209	229,165	239,074	2,571,140	2,375,057
Stocks:														
Crude petroleum	243,107	235,247	233,824	243,180	248,418	248,170	250,847	254,276	254,900	262,266	261,100	255,783	255,783	248,463
Natural-gas liquids	7,474	7,842	8,109	8,522	9,079	10,043	10,065	9,883	9,578	9,003	8,379	8,186	8,186	7,355
Refined products	319,336	315,654	315,287	318,951	329,712	344,256	353,703	358,565	371,198	371,447	361,335	351,146	351,146	326,892
Total stocks	569,917	558,743	557,220	570,653	587,209	602,469	614,615	622,724	635,676	642,716	630,814	615,115	615,115	582,710

[1] For definition of this and other terms used in the petroleum industry, *see* text footnote 1 at the beginning of this chapter.
[2] Bureau of Mines data.
[3] Source: U. S. Department of Commerce, except Alaska and Hawaii, which are Bureau of Mines data.
[4] Preliminary figures except stock figures are final.

TABLE 3.—Demand for all oils [1] in continental United States, 1942–51

[Millions of barrels]

Year	Domestic demand	Exports	Total demand	Year	Domestic demand	Exports	Total demand
1942	1,449.9	116.9	1,566.8	1947	1,989.8	164.5	2,154.3
1943	1,521.4	150.0	1,671.4	1948	2,113.7	134.7	2,248.4
1944	1,671.3	207.6	1,878.9	1949	2,118.2	119.4	2,237.6
1945	1,772.7	183.0	1,955.7	1950	2,375.1	111.3	2,486.4
1946	1,792.8	153.1	1,945.9	1951 [2]	2,571.1	154.4	2,725.5

[1] *See* text footnote 1 at beginning of this chapter.
[2] Preliminary figures.

Exports to Asia and Oceania increased 8.1 million barrels in 1951, to Europe 2.2 million, and to Canada 1.3 million barrels. A major part of the gain in exports was from California and was due to shortages caused by the closing of the refinery in Iran and to a shift in shipments to Japan from our military custody to commercial shipments that are recorded as exports.

The small increase in domestic demand resulted from a combination of diverse factors. The principal gains were about 13 million barrels in residual fuel oil used for bunkering ships engaged in foreign trade, 10 million barrels in deliveries to our Armed Forces, and 9 million barrels in deliveries to mines and industrial plants. The largest declines were 22 million barrels used by manufactured-gas and electric public-utility plants resulting from shifts to coal or natural gas, and 6 million barrels in deliveries to railroads resulting from the further shift to diesel locomotives.

Distillate Fuel Oil.—The total demand for distillate fuel rose from 408 million barrels in 1950 to 472 million in 1951—a gain of 64 million or almost 16 percent. Domestic demand increased 54 million barrels or almost 14 percent, and exports were up 10 million barrels or 79 percent. The principal gains in exports were 3.7 million barrels to other North American countries, 3.0 million to Europe, and 2.3 million to Asia and Oceania. A considerable part of this increase resulted from the shortage outside the United States after closing of the Iran refinery. The largest gains in domestic demand were 28.3 million for heating and 11.3 million for railroad use. The only decline was 3.6 million barrels in deliveries to gas and electric plants.

Kerosine.—The total demand for kerosine rose from 120 million barrels in 1950 to 131 million in 1951—a gain of 11 million or about 9 percent. Domestic demand increased 5.9 million barrels or 5 percent, whereas exports gained 4.7 million or 228 percent. The major increases in exports were to the United Kingdom, Egypt, and India, and resulted from the reduction in normal supply from Iran. Kerosine, as reported by refineries, is a product that meets the specifications for "lamp oil" as to color and flashpoint and goes back to the period when kerosine lamps were in general use. The increased demand has been for such uses as range oil, small space heating, tractor fuel, and one of the constituents of jet fuel. For these purposes it competes with No. 1 distillate.

Other Products.—The total demand for other products includes exports of these products, export of crude oil, and domestic demand for the products, including crude oil used as fuel and losses. The exports of crude oil declined from 34.8 million barrels in 1950 to 28.6

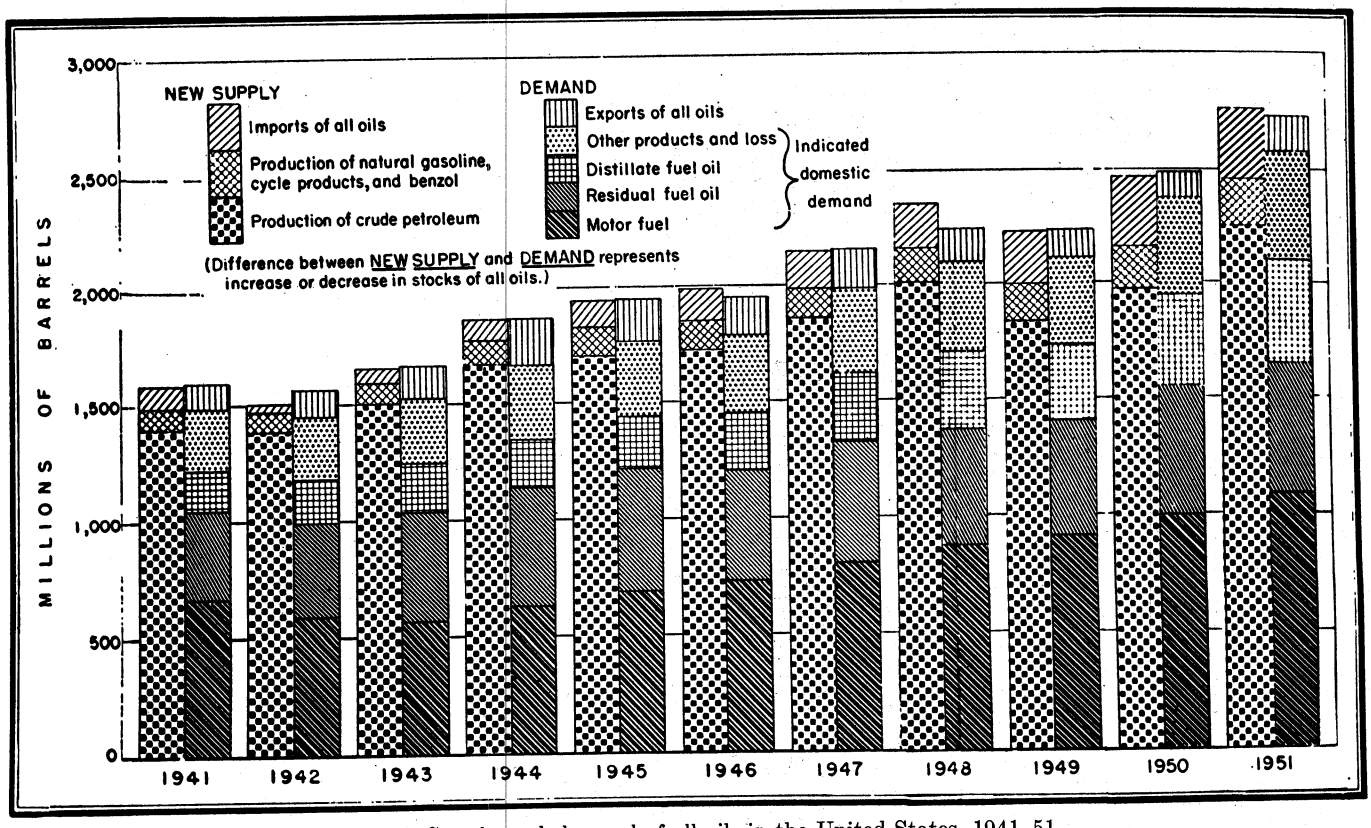

FIGURE 1.—Supply and demand of all oils in the United States, 1941–51.

million in 1951. The exports of other refined products rose from 20.8 million in 1950 to 26.9 million in 1951. The domestic demand for other products increased from 314.2 million barrels to 344.2 million in 1951, a gain of 10 percent. The domestic demand for liquefied gases increased almost 21 percent to 103.3 million barrels in 1951; the production of still gas increased 15 percent to 96.3 million barrels; asphalt demand rose to 66.2 million barrels, a gain of 13 percent; and the demand for lubricants and greases amounted to 42.3 million barrels in 1951, an increase of over 9 percent. Total losses, crude oil and refinery shortage, declined from 17.9 million barrels in 1950 to 5.8 million in 1951.

Demand in United States Territories.—In computing domestic demand in continental United States, shipments from the United States to the Territories (and possessions) are included with exports and any imports from foreign countries into the Territories are deleted from total imports. The major part of such shipments from the United States goes to Hawaii, Alaska, and Puerto Rico, whereas Puerto Rico is normally the chief importer of foreign oils.

Table 4, in addition to giving imports and exports of continental United States, shows the receipts of oil products within the Territories and these receipts, less some minor reexports, indicate their total demand. The figures do not include oil moved in the custody of the Armed Forces. Total oil receipts in the Territories rose from 17.1 million barrels in 1950 to the record level of 20.0 million in 1951, a gain of about 24 percent compared with 1946. The indicated demand, after deducting reexports, amounted to about 16.8 million barrels in 1950 and 19.7 million in 1951.

WORLD OIL SUPPLY

World production of crude petroleum increased 12.6 percent, from 3,803 million barrels in 1950 to 4,283 million in 1951. The total increase of 480 million barrels included a gain of 271 million for the United States and an increase of 209 million for the rest of the world. The largest gains in production outside the United States were: Kuwait, 79 million barrels; Saudi Arabia, 78 million; Venezuela, 75 million; Canada, 19 million; U.S.S.R., 19 million; and Iraq, 15 million. The principal decline was 115 million barrels for Iran. The United States produced 51.9 percent of the world total in 1950 and 52.4 percent in 1951.

Total imports of crude oil and products into continental United States exceeded total exports by 199.0 million barrels in 1950 and 153.3 million in 1951. The net import of crude oil rose from 142.9 million barrels in 1950 to 150.5 million in 1951, whereas the net import of oil products declined from 56.1 million barrels in 1950 to 2.8 million in 1951. The increase in exports of refined products from 76.5 million barrels in 1950 to 125.8 million in 1951, due to the refinery shutdown in Iran in the last half of 1951, was the main reason for the decline in net product imports.

The Caribbean countries and Mexico furnished about 86 percent of the total imports into continental United States and the Territories in 1951, including about 77 percent of total crude imports and 98 percent of total product imports.

TABLE 4.—Imports and exports of crude petroleum and petroleum products, 1950–51 [1]

[Thousands of barrels]

Product	Imports					
	1950			1951 [2]		
	Continental United States	United States Territories	Total	Continental United States	United States Territories	Total
Gasoline	156	74	230	418	16	434
Kerosine	245	25	270			
Distillate fuel oil	2,602	435	3,037	1,924	1,139	3,063
Residual fuel oil	120,036	2,674	122,710	118,675	2,802	121,477
Asphalt	1,795	17	1,812	2,368	7	2,375
Other unfinished oils	7,713		7,713	5,263		5,263
Total	132,547	3,225	135,772	128,648	3,964	132,612
Crude petroleum [3]	177,714		177,714	179,073		179,073

Product	Exports					
	1950			1951 [2]		
	Foreign	United States Territories	Total	Foreign	United States Territories	Total
Motor fuel	18,785	5,936	24,721	33,475	6,881	40,356
Kerosine	1,303	775	2,078	5,987	831	6,818
Distillate fuel oil	10,275	2,378	12,653	19,794	2,880	22,674
Residual fuel oil	11,888	4,340	16,228	24,139	4,919	29,058
Lubricants: Grease	381	2	383	445	3	448
Oil	13,678	191	13,869	16,763	206	16,969
Wax	1,193		1,193	1,349	2	1,351
Coke	2,445	48	2,493	4,425	46	4,471
Asphalt	787	196	983	1,007	178	1,185
Liquefied gases	1,605	27	1,632	2,064	57	2,121
Miscellaneous	250		250	373		373
Total	62,590	13,893	76,483	109,821	16,003	125,824
Crude petroleum [1]	34,823		34,823	28,604		28,604

[1] Source: U. S. Department of Commerce, except Alaska and Hawaii, which are Bureau of Mines data.
[2] Preliminary figures.
[3] Bureau of Mines data.

RESERVES

The Committee on Petroleum Reserves, American Petroleum Institute, estimated proved reserves of crude oil in the United States on December 31, 1951, at 27,468 million barrels, compared with 25,268 million on December 31, 1950. These estimates refer solely to blocked-out reserves, including only oil recoverable under existing economic and operating conditions.

The increase in net crude reserves in 1951 was 2,200 million barrels (8.7 percent). Estimated new reserves added in 1951 were 4,414 million barrels, including an upward revision of 4,025 million, due to extensions of old pools and revisions of previous estimates, and an estimate of 389 million for new reserves discovered in 1951 in new fields and in new pools in old fields. Deduction of an estimated production in 1951 of 2,214 million barrels, exclusive of lease condensate mixed with crude, results in the indicated net gain in total reserves.

TABLE 5.—Estimates of proved oil reserves in the United States, on Dec. 31, 1945–51, by States [1]

[Millions of barrels]

State	1945 [2]	1945	1946	1947	1948	1949	1950	1951
Eastern States:								
Illinois	350	350	351	355	393	468	564	646
Indiana	41	41	44	46	49	50	57	51
Kentucky	57	57	59	65	59	56	56	59
Michigan	64	64	69	70	69	66	79	64
New York	81	81	76	71	67	63	59	57
Ohio	30	30	29	29	29	28	27	26
Pennsylvania	110	110	98	123	110	103	106	95
West Virginia	39	39	36	36	37	38	39	39
Total	772	772	762	795	813	872	987	1,037
Central and Southern States:								
Arkansas	304	288	267	297	300	297	342	337
Kansas	542	542	545	563	674	738	732	792
Louisiana	1,690	1,559	1,652	1,791	1,869	1,910	2,185	2,285
Mississippi	267	257	270	304	365	403	386	385
New Mexico	512	512	544	530	552	592	592	612
Oklahoma	890	889	898	953	1,250	1,330	1,397	1,476
Texas	11,470	10,835	11,647	11,777	12,484	13,510	13,582	15,315
Total	15,675	14,882	15,823	16,215	17,494	18,780	19,216	21,202
Mountain States:								
Colorado	260	260	300	382	366	345	339	325
Montana	108	108	104	115	119	112	111	108
Utah					1	16	22	30
Wyoming	600	600	589	679	716	692	841	973
Total	968	968	993	1,176	1,202	1,165	1,313	1,436
Pacific Coast States: California	3,410	3,318	3,294	3,295	3,764	3,823	3,734	3,761
Other States	2	2	2	7	7	9	18	32
Total United States	20,827	19,942	20,874	21,488	23,280	24,649	25,268	27,468

[1] From reports of Committee on Petroleum Reserves, American Petroleum Institute, of the amount of crude oil that may be extracted by present methods from fields completely developed or sufficiently explored to permit reasonably accurate calculations. The change in reserves during any year represents total new discoveries, extensions, and revisions, minus production.
[2] Old basis; includes condensate.

The principal changes in net crude-oil reserves in 1951 were gains of 1,733 million barrels for Texas, 132 million for Wyoming, 100 million for Louisiana, 82 million for Illinois, 80 million for Oklahoma, 60 million for Kansas, 27 million for California, and 20 million for New Mexico. The principal declines were 15 million barrels for Michigan, 14 million for Colorado, and 11 million for Pennsylvania.

As of December 31, 1951, Texas had 55.8 percent of the total crude reserves, California 13.7 percent, Louisiana 8.3 percent, Oklahoma 5.4 percent, and Wyoming 3.5 percent.

The total proved reserves of natural-gas liquids, not included in the crude-oil reserves, rose from 4,268 million barrels on December 31, 1950, to 4,725 million at the end of 1951.

CRUDE PETROLEUM

SUPPLY AND DEMAND

The new supply of crude petroleum in the United States averaged 6,640,000 barrels daily in 1951, a gain of 746,000 barrels daily or 12.7 percent compared with 1950. The domestic production of crude oil increased 13.7 percent, whereas crude imports gained only 0.8 percent. The supply of crude oil proved to be more than was required in 1951, as measured by an increase in total crude stocks of 7 million barrels

during the year and a gain of 24 million barrels in stocks of refined products.

The total indicated demand for crude oil (new supply plus decreases or minus increases in crude stocks) increased from 2,156 million barrels in 1950 to 2,416 million in 1951, a gain of 260 million or 12 percent. Total crude run to stills at refineries increased from 2,095 million barrels to 2,370 million, a gain of 275 million in 1951 or 13 percent. Crude for all other purposes (export, direct fuel use, and loss) declined 15 million barrels from 61 million to 46 million.

TABLE 6.—Supply and demand [1] for crude petroleum in continental United States, 1947–51

[Thousands of barrels]

	1947	1948	1948 [2]	1949	1950	1951 [3]
Production	1,856,987	2,020,185	2,020,185	1,841,940	1,973,574	2,244,529
Imports [4]	97,532	129,093	129,093	153,686	177,714	179,073
Total new supply	1,954,519	2,149,278	2,149,278	1,995,626	2,151,288	2,423,602
Increase (+) or decrease (−) in stocks [5]	+478	+25,973	+25,973	−3,271	−4,893	+7,320
Demand:						
Domestic crude	1,856,479	1,998,357	1,998,357	1,844,173	1,979,764	2,234,123
Foreign crude	97,562	124,948	124,948	154,724	176,417	182,159
Total demand	1,954,041	2,123,305	2,123,305	1,998,897	2,156,181	2,416,282
Runs to stills:						
Domestic	1,754,987	1,907,027	1,924,335	1,789,756	1,918,854	2,188,677
Foreign	97,259	124,014	124,014	154,465	176,013	181,727
Exports [6]	46,355	39,736	39,736	33,069	34,823	28,604
Transfers to fuel oil: [1]						
Distillate	3,263	3,543	3,543	2,701	2,537	2,863
Residual	27,091	23,847	6,699	4,750	5,325	6,006
Other fuel and losses	25,086	25,138	24,978	14,156	18,629	8,405
Total demand	1,954,041	2,123,305	2,123,305	1,998,897	2,156,181	2,416,282

[1] For definition, *see* text footnote 1 at the beginning of this chapter.
[2] Includes California data on a new basis to compare with subsequent years.
[3] Preliminary figures.
[4] Bureau of Mines data.
[5] Inclusive of heavy crude in California, separately reported, 1947–48; separation discontinued in 1949.
[6] U. S. Department of Commerce.

PRODUCTION

GENERAL

The production of crude oil set a new record in 1951 as the result of a gain of 13.7 percent compared with 1950. The increase of 271.0 million barrels in production was distributed very irregularly among the States. The largest gains were 180.3 million barrels for Texas, 26.9 million for California, 23.2 million for Oklahoma, and 22.9 million for Louisiana. There were declines in 8 States, including 3.8 million barrels for Illinois, 1.9 million for Michigan, 1.3 million for Arkansas, and 1.2 million for Mississippi.

Five States produced over 100 million barrels each and accounted for 83.0 percent of the total in 1950 and 84.6 percent in 1951. There has been no change in the order of importance of these States since 1946. Texas, producing 45.0 percent of the national total in 1951, has the widest markets for crude oil and has been most affected by the increasing imports of crude oil.

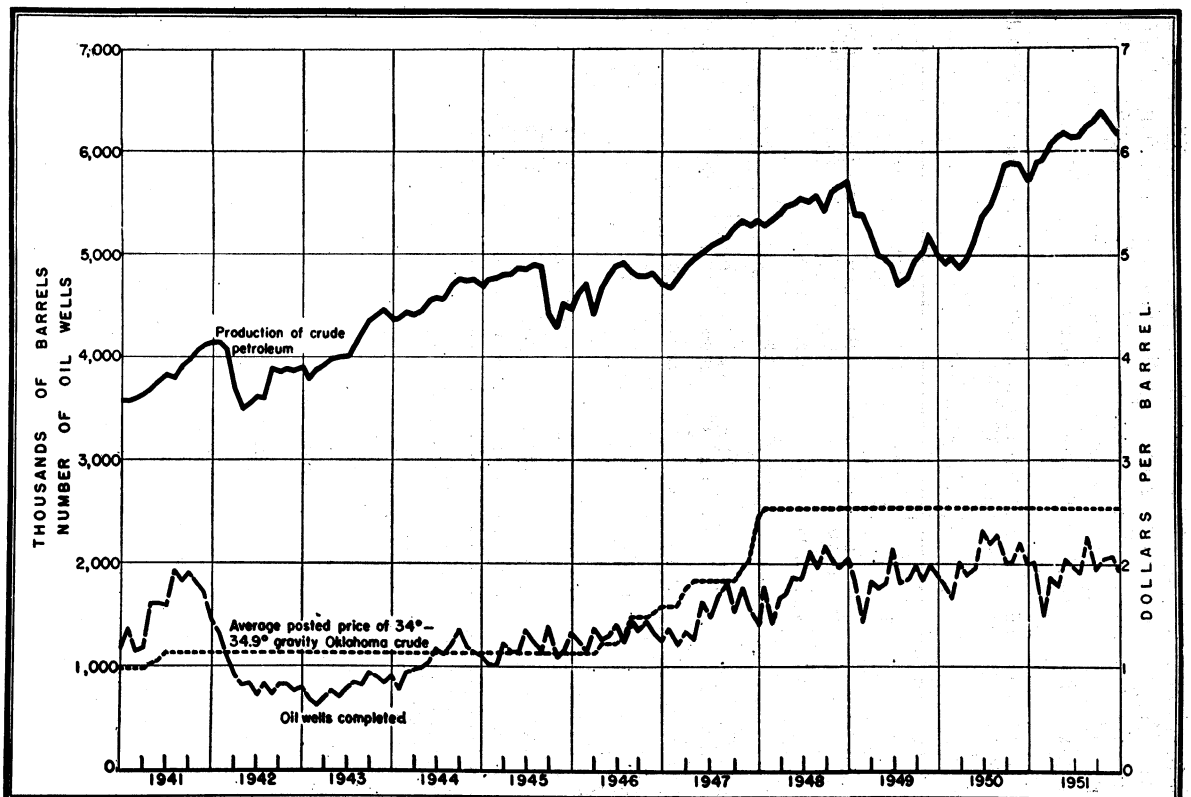

FIGURE 2.—Daily average production of crude petroleum, total number of oil wells completed, and average posted price per barrel of selected grade of Oklahoma crude petroleum in the United States, 1941–51, by months.

The next 6 States in importance produced more than 20 million and less than 100 million barrels each. This group produced 13.4 percent of the national total in 1950 and 12.2 percent in 1951. Wyoming replaced Illinois as the sixth State in importance in 1951, and New Mexico, Mississippi, Arkansas, and Colorado followed in order.

The 11 States in the above groups accounted for 96.4 percent of the total production in 1950 and 96.8 percent in 1951. Six of these States—Texas, Louisiana, Oklahoma, Kansas, New Mexico, and Arkansas—issue monthly proration orders under State conservation laws to adjust production to market demand. These States supplied 70.4 percent of national production in 1950 and 72.5 percent in 1951.

TABLE 7.—Crude petroleum produced in the United States, 1947–51, and total, 1859–1951, by States [1]

[Thousands of barrels]

	1947	1948	1949	1950	1951 [2]	1859–1951 (total)
Production:						
Alabama	396	466	462	735	1,020	3,683
Arkansas	29,948	31,682	29,986	31,108	29,770	825,872
California	333,132	340,074	332,942	327,607	354,467	8,974,065
Colorado	15,702	17,862	23,587	23,303	27,225	174,219
Florida	259	290	441	487	596	2,176
Illinois	66,459	64,808	64,501	62,028	58,207	1,564,523
Indiana	6,095	6,974	9,696	10,699	10,597	211,320
Kansas	105,132	110,908	101,868	107,586	115,218	[3] 2,241,096
Kentucky	9,397	8,801	8,803	10,381	11,622	[4] 263,868
Louisiana	160,128	181,458	190,826	208,965	231,838	2,792,854
Michigan	16,215	16,871	16,517	15,826	13,923	[5] 336,170
Mississippi	34,925	45,761	37,966	38,236	37,039	321,098
Montana	8,742	9,382	9,118	8,109	8,922	177,173
Nebraska	229	215	330	1,547	2,408	9,792
New Mexico	40,926	47,969	47,645	47,367	53,082	[6] 735,477
New York	4,762	4,621	4,425	4,143	4,254	[7] 170,855
Ohio	3,108	3,600	3,483	3,383	3,097	624,096
Oklahoma	141,019	154,455	151,660	164,599	187,789	[8] 6,422,898
Pennsylvania	12,690	12,667	11,374	11,859	11,150	[7] 1,146,723
Texas	820,210	903,498	744,834	829,874	1,010,128	14,732,987
Utah		16	637	1,228	1,425	[8] 3,306
West Virginia	2,617	2,692	2,839	2,808	2,743	443,703
Wyoming	44,772	55,032	47,890	61,631	67,932	983,730
Other States [9]	124	83	110	65	77	1,933
Total	1,856,987	2,020,185	1,841,940	1,973,574	2,244,529	43,163,617
Value at wells:						
Total (thousands of dollars)	3,577,890	5,245,080	4,674,770	4,963,380	5,681,710	63,972,568
Average per barrel	$1.93	$2.60	$2.54	$2.51	$2.53	$1.48

[1] For detailed figures by States, 1859–1935, *see* Minerals Yearbook, 1937, p. 1008.
[2] Preliminary figures.
[3] Oklahoma included with Kansas in 1905 and 1906.
[4] Includes Tennessee, 1883–1907.
[5] Figures represent 1925–51 production only; earlier years included under "Other States."
[6] Figures represent 1924–51 production only; earlier years included under "Other States."
[7] Early production in New York included with Pennsylvania.
[8] Figures represent 1948–51 production only; earlier years included under "Other States."
[9] Includes Alaska, 1912–33; Arkansas, 1920; Michigan 1900–19; Missouri, 1899–1911, 1913–16, 1919–23, 1932–51; Mississippi, 1933–35; New Mexico, 1913, 1919–23; North Dakota, 1951; Tennessee, 1916–1951; Utah, 1907–11, 1920, 1924–41; Virginia 1943–51.

TABLE 8.—Production of crude petroleum in the United States in 1950–51, by State and month

[Thousands of barrels]

State	January	February	March	April	May	June	July	August	September	October	November	December	Total
1950 [1]													
Alabama	49	44	46	49	52	58	60	75	67	75	76	84	735
Arkansas	2,668	2,413	2,649	2,566	2,654	2,580	2,635	2,678	2,564	2,644	2,493	2,564	31,108
California [2]	26,877	24,188	26,591	25,723	27,034	26,433	27,341	27,875	27,657	29,457	28,710	29,721	327,607
Colorado	1,890	1,694	1,850	1,835	1,871	1,782	1,882	1,872	1,916	2,173	2,232	2,306	23,303
Florida	32	28	31	31	29	47	46	51	48	46	52	46	487
Illinois	5,120	4,696	5,365	5,015	5,322	5,151	5,207	5,449	5,240	5,353	5,010	5,100	62,028
Indiana	813	775	930	905	929	879	935	948	882	959	858	886	10,699
Kansas	8,381	7,832	9,004	8,470	9,042	9,051	9,412	9,352	9,212	9,343	9,137	9,350	107,586
Kentucky	708	668	840	803	914	857	887	925	919	1,021	916	923	10,381
Louisiana	17,370	15,864	16,534	15,548	16,717	17,019	18,169	18,126	17,875	18,582	18,322	18,839	208,965
Michigan [3]	1,391	1,255	1,396	1,309	1,415	1,331	1,333	1,357	1,268	1,310	1,219	1,242	15,826
Mississippi	3,031	2,755	3,091	2,929	3,193	3,284	3,405	3,411	3,305	3,364	3,220	3,248	38,236
Montana [4]	610	623	690	645	695	683	687	697	670	693	681	735	8,109
Nebraska	56	54	64	72	84	96	124	135	171	227	215	249	1,547
New Mexico	4,030	3,601	3,836	3,721	3,879	3,844	4,010	4,124	4,028	4,131	4,000	4,163	47,367
New York	365	305	362	320	372	351	338	362	341	354	331	342	4,143
Ohio	282	250	292	274	290	305	298	310	282	303	238	259	3,383
Oklahoma	12,209	11,614	12,405	12,524	13,235	13,621	14,312	14,833	14,561	15,154	14,769	15,362	164,599
Pennsylvania	949	846	971	953	1,034	1,010	1,022	1,041	1,011	1,041	980	1,001	11,859
Texas	60,852	54,806	58,959	60,430	65,586	67,665	72,448	76,786	79,035	80,874	77,618	74,815	829,874
Utah	87	88	93	101	102	105	108	107	103	112	108	114	1,228
West Virginia	240	220	246	234	245	238	230	249	232	248	209	217	2,808
Wyoming	4,918	4,504	5,050	4,685	4,858	4,910	5,163	5,423	5,307	5,541	5,384	5,888	61,631
Other States	7	4	6	5	6	5	6	6	4	6	4	6	[5] 65
Total: 1950	152,935	139,127	151,301	149,147	159,558	161,305	170,058	176,192	176,698	183,011	176,782	177,460	1,973,574
1949	167,016	150,682	162,399	150,343	154,250	147,283	145,530	148,356	148,286	155,469	156,496	155,830	1,841,940
Daily average, 1950	4,933	4,969	4,881	4,972	5,147	5,377	5,486	5,684	5,890	5,904	5,893	5,725	5,407
Pennsylvania Grade (included above)	1,718	1,515	1,750	1,660	1,811	1,758	1,757	1,825	1,737	1,804	1,642	1,695	20,672
1951 [6]													
Alabama	84	69	82	92	90	95	92	85	83	84	77	87	1,020
Arkansas	2,520	2,317	2,558	2,376	2,546	2,454	2,541	2,492	2,459	2,588	2,413	2,506	29,770
California [2]	29,729	26,933	29,812	28,875	29,951	29,264	30,085	30,229	29,431	30,372	29,484	30,302	354,467
Colorado	2,312	2,091	2,363	2,274	2,276	2,110	2,140	2,324	2,269	2,396	2,306	2,364	27,225
Florida	47	44	49	49	50	50	54	50	50	52	50	51	596
Illinois	5,164	4,311	4,977	4,868	5,188	4,757	4,957	4,929	4,646	5,029	4,718	4,663	58,207
Indiana	805	629	829	819	884	854	939	997	973	1,008	934	926	10,597
Kansas	9,358	8,642	9,784	9,489	9,756	9,264	9,588	9,994	9,670	10,176	9,769	9,728	115,218
Kentucky	913	739	873	864	940	925	993	1,037	1,084	1,148	1,060	1,046	11,622
Louisiana	19,494	17,417	19,616	19,302	19,805	18,841	19,516	19,723	19,027	20,125	19,182	19,790	231,838

Michigan [3]	1,242	1,100	1,215	1,176	1,209	1,163	1,174	1,174	1,110	1,173	1,096	1,091	13,923
Mississippi	3,237	2,905	3,146	3,042	3,165	3,035	3,120	3,113	3,005	3,159	3,012	3,100	37,039
Montana [4]	742	692	717	702	787	767	780	773	757	760	731	714	8,922
Nebraska	289	229	250	203	205	186	182	187	170	167	169	171	2,408
New Mexico	4,222	3,859	4,402	4,320	4,479	4,312	4,458	4,484	4,462	4,714	4,692	4,678	53,082
New York	363	316	356	341	368	355	365	376	336	386	350	342	4,254
Ohio	272	215	275	258	291	263	274	277	237	280	243	212	3,097
Oklahoma	15,350	13,984	15,778	15,329	15,908	15,362	15,884	16,057	15,479	16,372	16,013	16,273	187,789
Pennsylvania	1,017	886	976	947	977	945	928	963	866	989	887	769	11,150
Texas	79,700	73,015	83,286	82,610	86,223	82,996	86,253	87,710	85,740	90,528	85,124	86,943	1,010,128
Utah	105	98	108	108	119	130	112	123	115	121	135	151	1,425
West Virginia	238	204	229	227	235	222	243	244	223	244	223	211	2,743
Wyoming	5,902	5,342	5,938	5,522	5,811	5,543	5,680	5,848	5,616	5,730	5,474	5,526	67,932
Other States	5	4	5	7	5	5	4	12	8	9	7	6	[7] 77
Total: 1951	183,110	166,041	187,624	183,800	191,268	183,898	190,362	193,201	187,816	197,610	188,149	191,650	2,244,529
1950	152,935	139,127	151,301	149,147	159,558	161,305	170,058	176,192	176,698	183,011	176,782	177,460	1,973,574
Daily average, 1951	5,907	5,930	6,052	6,127	6,170	6,130	6,141	6,232	6,261	6,375	6,272	6,182	6,149
Pennsylvania Grade (included above)	1,760	1,518	1,707	1,648	1,729	1,653	1,672	1,719	1,537	1,764	1,571	1,422	19,700

[1] Final figures.
[2] American Petroleum Institute.
[3] Department of Conservation, Michigan.
[4] Montana Oil Conservation Board.
[5] Missouri (32), Tennessee (12), and Virginia (21).
[6] Preliminary figures.
[7] Missouri (29), North Dakota (22), Tennessee (14), and Virginia (12).

TABLE 9.—Supply of and demand[1] for crude petroleum in continental United States, 1950–51, by months

[Thousands of barrels]

Year	January	February	March	April	May	June	July	August	September	October	November	December	Total
1950													
Supply:													
Production	152,935	139,127	151,301	149,147	159,558	161,305	170,058	176,192	176,698	183,011	176,782	177,460	1,973,574
Imports[2]	15,102	11,499	14,614	15,336	13,618	14,931	15,076	15,539	15,760	15,809	13,992	16,438	177,714
Total new supply	168,037	150,626	165,915	164,483	173,176	176,236	185,134	191,731	192,458	198,820	190,774	193,898	2,151,288
Stock changes:													
Domestic crude	−7,122	−2,094	−2,348	+1,889	−3,946	+2,258	−2,662	−1,981	+5,204	+3,369	+3,300	−2,057	−6,190
Foreign crude	+376	−766	−172	+1,486	−782	+152	+645	−896	−286	+744	−199	+995	+1,297
Total demand:													
Domestic crude	160,057	141,221	153,649	147,258	163,504	159,047	172,720	178,173	171,494	179,642	173,482	179,517	1,979,764
Foreign crude	14,726	12,265	14,786	13,850	14,400	14,779	14,431	16,435	16,046	15,065	14,191	15,443	176,417
Runs to stills:													
Domestic crude	155,283	136,591	150,682	141,969	157,228	154,901	167,907	171,662	165,804	173,340	168,417	175,070	1,918,854
Foreign crude	14,704	12,246	14,736	13,828	14,371	14,762	14,423	16,416	15,974	15,053	14,122	15,378	176,013
Exports[3]	2,130	2,328	2,153	2,968	2,946	3,095	3,274	3,096	2,654	4,033	3,229	2,917	34,823
Total transfers	764	565	551	576	628	643	624	748	649	746	669	699	7,862
Losses	1,902	1,756	313	1,767	2,731	425	923	2,686	2,459	1,535	1,236	896	18,629
1951[4]													
Supply:													
Production	183,110	166,041	187,624	183,800	191,268	183,898	190,362	193,201	187,816	197,610	188,149	191,650	2,244,529
Imports[2]	15,472	13,096	14,971	15,319	16,051	16,889	16,940	16,404	15,000	13,054	12,760	13,117	179,073
Total new supply	198,582	179,137	202,595	199,119	207,319	200,787	207,302	209,605	202,816	210,664	200,909	204,767	2,423,602
Stock changes:													
Domestic crude	−3,832	−7,225	−1,705	+7,801	+5,799	−989	+2,926	+3,259	+1,411	+8,064	−115	−4,988	+10,406
Foreign crude	−1,524	−635	+282	+1,555	−561	+741	−249	+170	−787	−698	−1,051	−329	−3,086
Total demand:													
Domestic crude	186,942	173,266	189,329	175,999	185,469	184,887	187,436	189,942	186,405	189,546	188,264	196,638	2,234,123
Foreign crude	16,996	13,731	14,689	13,764	16,612	16,148	17,189	16,234	15,787	13,752	13,811	13,446	182,159
Runs to stills:													
Domestic crude	183,032	170,040	185,981	171,747	182,937	181,105	183,156	186,516	180,979	186,093	184,470	192,621	2,188,677
Foreign crude	16,926	13,705	14,554	13,741	16,584	16,141	17,166	16,205	15,773	13,733	13,788	13,411	181,727
Exports[3]	2,913	2,471	2,640	3,615	1,791	2,342	2,320	2,361	2,199	1,947	1,858	2,147	28,604
Total transfers	726	642	690	629	711	637	715	878	829	795	803	814	8,869
Losses	341	139	153	31	58	810	1,268	216	2,412	730	1,156	1,091	8,405

[1] *See* text footnote 1 at beginning of this chapter.
[2] Bureau of Mines.
[3] U. S. Department of Commerce, except Alaska and Hawaii, which are Bureau of Mines data.
[4] Preliminary figures.

TABLE 10.—Percentage of total crude petroleum produced in the United States, 1942–51, by States

State	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951 [1]
Texas	34.8	39.5	44.5	44.0	43.8	44.2	44.7	40.4	42.1	45.0
California	17.9	18.9	18.6	19.1	18.2	17.9	16.8	18.1	16.6	15.8
Louisiana	8.3	8.2	7.7	7.7	8.3	8.6	9.0	10.4	10.6	10.3
Oklahoma	10.2	8.2	7.4	8.1	7.8	7.6	7.7	8.2	8.3	8.4
Kansas	7.0	7.0	5.9	5.6	5.6	5.7	5.5	5.5	5.5	5.1
Wyoming	2.4	2.3	2.0	2.1	2.2	2.4	2.7	2.6	3.1	3.0
Illinois	7.7	5.5	4.6	4.4	4.3	3.6	3.2	3.5	3.1	2.6
New Mexico	2.3	2.6	2.4	2.2	2.1	2.2	2.4	2.6	2.4	2.4
Mississippi	2.1	1.2	1.0	1.1	1.4	1.9	2.3	2.1	1.9	1.7
Arkansas	1.9	1.8	1.8	1.7	1.6	1.6	1.6	1.6	1.6	1.3
Colorado	.1	.2	.2	.3	.7	.8	.9	1.3	1.2	1.2
Michigan	1.6	1.4	1.1	1.0	1.0	.9	.8	.9	.8	.6
Kentucky	.3	.5	.5	.6	.6	.5	.4	.5	.5	.5
Pennsylvania	1.3	1.0	.8	.7	.8	.7	.6	.6	.6	.5
Other States	2.1	1.7	1.5	1.4	1.6	1.4	1.4	1.7	1.7	1.6
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

[1] Preliminary figures.

TABLE 11.—Production of crude petroleum in leading fields in the United States, 1950–51, and total production since discovery, in thousands of barrels

[Oil and Gas Journal] [1]

Field	State	1950	1951	Total since discovery [2]
East Texas	Texas	97,609	99,646	2,877,058
Wilmington	California	46,353	51,057	557,879
Coalinga	do	23,260	25,417	668,518
Ventura Avenue	do	20,944	23,302	420,893
Huntington Beach	do	20,558	22,511	481,231
Wasson	Texas	18,546	22,465	238,541
Rangely	Colorado	18,806	22,071	97,530
Goldsmith	Texas	11,998	21,221	134,442
Hastings	do	13,243	16,789	213,246
Velma	Oklahoma	10,227	16,089	69,516
Slaughter	Texas	12,866	15,197	191,671
Webster	do	11,235	15,179	165,196
T-X-L	do	13,532	14,673	91,415
Seeligson	do	9,372	14,511	90,956
Conroe	do	11,991	14,270	307,471
Yates	do	10,835	14,162	386,806
Cuyama-South	California	8,465	14,106	23,759
Bradford-Allegany [3]	Pennsylvania-New York	13,423	13,503	613,148
Hawkins	Texas	10,440	13,333	131,617
Keystone	do	11,246	13,031	100,699
Thompson	do	10,198	13,020	165,937
Levelland	do	10,923	12,683	42,615
Midway-Sunset	California	11,414	12,563	772,759
Buena Vista	do	12,033	11,174	401,114
Fullerton	Texas	11,707	10,855	83,248
Sholem-Alechem	Oklahoma	8,545	10,557	73,424
Cowden	Texas	9,246	10,542	114,208
Van	do	7,345	9,792	220,911
Diamond M	do	6,904	9,175	16,757
Kettleman-North Dome	California	10,480	9,100	381,473
Long Beach	do	8,450	8,511	759,884
Elk Basin	Wyoming-Montana	6,485	8,505	64,078
McElroy	Texas	7,507	8,447	209,636
Coles Levee	California	8,420	8,344	81,967
Dollarhide	Texas	6,432	8,316	23,593
Weeks Island	Louisiana	5,154	8,112	16,700
Kern	California	6,488	8,000	392,928
Katy	Texas	5,359	7,936	37,220
Anahuac	do	6,785	7,816	108,852
Trapp	Kansas	8,645	7,686	130,852
West Ranch	Texas	5,463	7,635	72,469
Elk City	Oklahoma	5,066	7,426	13,274
Seminole	Texas	5,846	7,213	66,416
Delta Farms	Louisiana	7,653	7,194	46,417
Russell Ranch	California	7,959	7,118	22,796
Clay City	Illinois	7,876	7,031	140,547
Lake St. John	Louisiana	7,514	6,800	44,042
Talco	Texas	5,615	6,738	129,175

For footnotes, see end of table.

TABLE 11.—Production of crude petroleum in leading fields in the United States, 1950–51, and total production since discovery, in thousands of barrels—Con.

[Oil and Gas Journal][1]

Field	State	1950	1951	Total since discovery[2]
Caillou Island	Louisiana	5,240	6,509	63,702
Baxterville	Mississippi	4,895	6,381	27,569
Old Ocean	Texas	5,305	6,322	65,728
Oklahoma City	Oklahoma	6,785	6,303	681,570
Midland Farms	Texas	2,876	6,210	13,614
Cat Canyon-West	California	4,607	6,140	52,089
Louden	Illinois	7,436	6,127	163,130
Sharon Ridge	Texas	3,983	5,972	16,460
Coyote	California	5,711	5,899	234,867
Foster	Texas	5,447	5,457	69,233
Tex-Harvey	do	400	5,455	5,855
La Gloria	do	5,748	5,355	38,322
Erath	Louisiana	5,071	5,245	46,950
Santa Fe Springs	California	5,288	5,146	538,646
Tinsley	Mississippi	5,189	5,117	122,900
Chocolate Bayou	Texas	3,980	5,107	15,691
Bayou Sale	Louisiana	4,746	5,088	38,537
Drinkard	New Mexico	5,538	5,037	28,085

[1] The classification of fields and data may differ from other sources used in the State summaries.
[2] Includes revisions.
[3] Bureau of Mines data.

CRUDE PRODUCTION BY STATES

Alabama.—Although oil production for the State is relatively unimportant, it has gained substantially—from 462,000 barrels in 1949 to 735,000 in 1950 and to 1,020,000 barrels in 1951. There were 50 wells drilled in 1951, of which 17 were rated as oil producers. This compares with 43 for 1950, when 18 were proved for oil and 1 for gas.

Arkansas.—Crude-oil production of 29,770,000 barrels during 1951 was 1,338,000 barrels or 4.3 percent less than in the previous year, with output declining in almost all fields. Only the Fouke and Wesson fields showed slight increases over 1950. The decline in production in Arkansas, in conjunction with the increase in total United States production, reduced Arkansas' share of the total from 1.6 percent in 1950 to 1.3 percent in 1951—the lowest it has been since 1937.

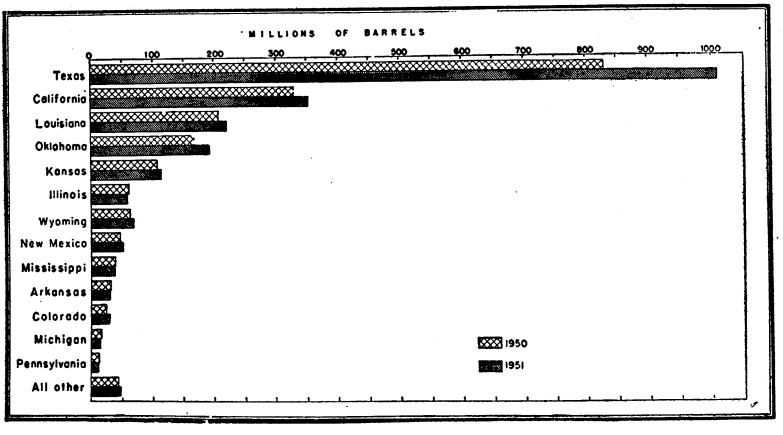

FIGURE 3.—Production of crude petroleum in the United States, 1950–51, by States.

Of the 99 wildcat wells drilled during 1951, 13 produced oil, and 1 produced gas, as compared with 10 oil producers out of 100 wildcats in 1950. There was a moderate increase in developmental drilling, with 330 wells completed during 1951 compared with 307 in the preceding year, but the number of successful oil wells fell from 232 to 222 and the percentage of producers from 76 to 67 percent.

Six new pools were discovered in Arkansas during 1951, but none appeared to be especially promising, and only 1 discovery well had an initial production rate over 100 barrels per day. Ten new producing zones in old fields were discovered, and 6 of these had initial production of over 100 barrels per day. The largest producer (320 barrels daily), was in the Travis formation of the old El Dorado field.

TABLE 12.—Production of crude petroleum in Arkansas, 1947–51, by fields

[Thousands of barrels]

Field	1947	1948	1949	1950	1951 [1]
Atlanta	1,472	1,383	1,080	999	841
Buckner	654	861	778	798	719
Dorcheat-Macedonia	1,503	1,263	930	983	875
Fouke	985	1,037	945	894	929
McKamie	1,175	1,084	1,156	1,179	1,175
Magnolia	4,648	4,622	4,292	4,547	4,407
Midway	2,703	2,851	2,685	2,786	2,684
Schuler	4,022	3,820	3,140	2,854	2,626
Smackover	3,983	3,901	3,900	3,991	3,910
Stephens	1,475	1,278	1,611	1,774	1,476
Village	1,791	2,086	1,850	1,677	1,247
Wesson	1,793	3,084	3,053	3,452	3,597
Other fields [2]	3,744	4,412	4,566	5,174	5,284
Total Arkansas	29,948	31,682	29,986	31,108	29,770

[1] Preliminary figures.
[2] Includes oil consumed on leases and net change in stocks held on leases for entire State.

California.—Although the 354,467,000 barrels of crude oil produced during 1951 represented an increase of 8 percent over 1950, this rate failed to equal that for the country as a whole, and California's contribution to the total fell from 16.6 to 15.8 percent. This decrease in the share of total production was a continuation of the trend that has been evident since 1948. It is notable that, in spite of the 8-percent increase in California's production, the self-sufficiency of the west coast in the matter of crude oil declined sharply; and receipts from outside sources, both domestic and foreign, rose to 5,246,000 barrels in 1951 compared to 1,448,000 in 1950.

Of the larger fields (those producing over 10,000,000 barrels), all except Buena Vista and Kettleman North Dome increased their output during 1950. Both in quantity (4,726,000 barrels) and percentage (28.6) the Cuyama-Russell Ranch field showed the greatest increase. However, the Wilmington field easily maintained its position as the greatest producing field in the State, increasing its output by 4,572,000 barrels (10 percent) to a total of 50,806,000 barrels. Production in several smaller fields increased substantially, during 1951 with Tejon Ranch, Lompoc, and Zaca Creek more than doubling their 1950 rate and Sansinena almost doubling. Although not generally of large magnitude, there were decreases in production in a great many of the smaller fields.

TABLE 13.—Production of crude petroleum in California, 1947–51, by district and field, in thousands of barrels

[American Petroleum Institute]

District and field	1947	1948	1949	1950	1951 [1]
San Joaquin Valley:					
Belridge	4,488	4,019	2,920	2,931	3,516
Buena Vista	17,265	16,596	13,907	12,032	11,168
Coalinga	33,754	35,818	33,266	31,210	31,957
Coles Levee [2]	7,225	6,591	7,239	7,207	7,224
Cuyama-Russell Ranch		842	8,066	16,504	21,230
Edison	4,124	4,107	4,126	3,914	4,867
Elk Hills	2,334	2,118	3,057	2,700	2,459
Fruitvale	2,391	2,383	2,720	2,827	3,312
Gosford-East		4	382	680	831
Greeley	4,288	5,100	4,750	4,061	4,615
Helm	1,553	1,264	979	819	728
Kern River-Kern Front	6,979	8,240	6,934	6,461	7,984
Kettleman North Dome	13,480	12,832	11,739	10,467	9,090
Lost Hills	1,922	2,750	2,383	2,019	2,084
McKettrick	9,941	10,606	6,509	5,774	6,309
Midway-Sunset	15,660	15,165	12,758	11,431	12,619
Mountain View	1,894	1,307	1,199	1,240	1,173
Mount Poso	5,151	4,567	4,216	3,809	3,451
Poso Creek	1,325	1,286	785	830	1,196
Raisin City	962	1,093	1,356	1,613	1,749
Rio Bravo	4,576	4,430	4,229	3,748	4,089
Riverdale	1,546	1,155	966	780	781
Round Mountain	3,085	2,700	2,438	2,167	2,056
Tejon Ranch	1,187	1,133	861	[3] 795	[3] 2,078
Ten Section	2,829	2,379	2,351	2,076	1,877
Other San Joaquin Valley	7,955	8,360	8,692	8,002	7,999
Total San Joaquin Valley	155,914	156,845	148,828	146,097	156,442
Coastal district:					
Aliso Canyon	1,219	1,226	1,275	1,455	1,986
Cat Canyon	4,424	5,897	5,175	4,632	6,324
Del Valle	3,069	3,516	3,283	1,261	1,677
Elwood	2,576	2,681	2,681	2,313	1,920
Gato Ridge	1,314	1,279	1,150	933	1,030
Lompoc	1,660	2,320	203	988	2,482
Newhall-Petrere	2,397	2,726	3,185	2,995	2,865
Orcutt	1,636	1,667	1,717	1,362	1,476
Padre Canyon	1,179	2,092	2,655	2,462	2,242
Rincon	1,344	1,158	1,264	1,304	1,319
San Miguelito	1,874	1,832	2,350	2,895	4,464
Santa Maria Valley	9,518	7,269	5,667	4,509	4,479
South Mountain	1,844	2,072	2,463	2,382	2,207
Ventura Avenue	17,754	17,738	21,040	20,985	23,301
Zaca Creek	179	612	658	556	1,648
Other Coastal	4,144	5,315	10,311	11,797	13,185
Total Coastal	56,131	59,400	65,077	62,829	72,605
Los Angeles Basin:					
Brea Olinda	4,449	5,286	5,213	4,533	5,402
Coyote	7,277	7,381	6,450	5,717	5,895
Dominguez	5,436	4,818	4,743	4,602	4,286
Huntington Beach	18,291	20,821	21,035	20,568	22,465
Inglewood	4,330	4,420	5,064	4,879	4,951
Long Beach	8,596	8,159	8,349	8,432	8,498
Montebello	2,696	2,467	2,346	2,185	2,014
Newport	2,630	2,412	2,242	1,785	1,575
Richfield	2,413	2,272	2,347	2,364	2,425
Rosecrans	1,684	1,695	[4] 2,247	[4] 1,991	[4] 1,640
Sansinena	22	19	125	531	1,037
Santa Fe Springs	5,914	5,512	5,327	5,288	5,131
Seal Beach	4,042	4,150	4,381	4,286	4,118
Torrance	2,938	2,862	2,762	2,615	2,522
Wilmington	47,674	48,317	43,509	46,234	50,806
Other Los Angeles Basin	2,695	3,238	2,897	2,671	2,655
Total Los Angeles Basin	121,087	123,829	119,037	118,681	125,420
Total California	333,132	340,074	332,942	327,607	354,467

[1] Preliminary figures.
[2] Includes Tupman.
[3] Includes Willow Springs.
[4] Includes Athens.

The need for an effort to provide increased crude-oil productive capacity in California were reflected in the higher rate of drilling activity during 1951. The number of wildcat wells drilled was up 22 percent to a total of 551, and the number of development wells rose 31 percent to 1,810. Somewhat greater success in finding oil was also achieved, with 12 percent of the wildcats resulting in producers during 1951 versus 10 percent in 1950; comparable percentages for developmental wells are 92 and 90.

Colorado.—Production of crude oil during 1951 resumed a relatively sharp rate of increase that was interrupted temporarily in 1950. Total output of 27,225,000 barrels was 17 percent greater than in 1950 and represented a new record for the State. Of the total increase of 3,922,000 barrels, 2,982,000 was concentrated in the Rangely field. The rate of increase over 1950, 17 percent, was greater than that for the entire country. Colorado maintained its position as the eleventh most important producing State and supplied 1.2 percent of total production. Other changes in individual fields were minor and varied, except that the addition of eight new fields of as yet unknown potential resulted in a sharp rise in the "other fields" category.

Wildcat completions during 1951 totaled 143, but only 9 were oil producers and 6 were gas wells. These figures compare with 56 wildcats, 6 producers, and 3 gas wells in 1950. Of development wells, 146 were drilled in 1951 against 43 in the preceding year, and the number of oil producers rose even more sharply—from 16 to 94—and gas wells dropped from 9 to 6.

TABLE 14.—Production of crude petroleum in Colorado, 1947–51, by fields

[Thousands of barrels]

Year	Fort Collins-Wellington	Hiawatha	Iles	Maudlin Gulch	Moffat	Price	Powder Wash	Rangely	Walden	Wilson Creek	Other fields [1]	Total
1947	133	51	541	--------	91	195	29	11,600	179	2,705	178	15,702
1948	127	62	534	1	112	164	35	13,881	129	2,602	215	17,862
1949	99	63	531	51	85	164	63	19,632	120	2,586	193	23,587
1950	115	64	503	174	81	181	91	18,956	115	2,796	227	23,303
1951 [2]	100	119	447	223	76	189	123	21,938	106	2,795	1,109	27,225

[1] Includes crude oil consumed on leases and net change in stocks held on leases for entire State.
[2] Preliminary figures.

Florida.—The production of oil, of small volume, increased from 441,000 barrels in 1949 to 487,000 in 1950 and 596,000 barrels in 1951. Drilling fell off sharply from 13 completions (10 of them wildcats), resulting in 1 oil well in 1950 to 2 wildcats in 1951, both of which proved dry.

Illinois.—Crude-oil production continued the decline that began in 1947, and total output of 59,827,000 barrels (Oil and Gas Journal data) during 1951 was 4 percent less than the 1950 total. Although the great majority of the individual fields showed fairly substantial decreases during 1951, there were notable exceptions. Output of the Benton field (2,205,000 barrels) was more than 5 times the 1950 figure, Dale's output about doubled, and New Harmony's production increased almost 50 percent. Albion and Phillipstown fields showed more moderate increases.

There was a moderate increase in the number of wildcat wells drilled during 1951 to 873 from 810 in 1950, but the number of oil producers completed fell to 103 from 104. The number of development wells drilled declined sharply from 2,013 in 1950 to 1,551 in 1951, and the number resulting in oil producers showed an even greater relative decrease from 1,176 to 815.

TABLE 15.—Production of crude petroleum in Illinois, 1947–51, by fields, in thousands of barrels

[Oil and Gas Journal]

Field	1947	1948	1949	1950	1951
Albion	663	595	979	1,187	1,231
Benton	773	664	532	436	2,205
Boyd	1,313	1,210	1,062	887	687
Bridgeport	2,267	1,905	1,943	2,012	1,936
Centralia	1,456	1,251	1,712	1,250	946
Clay City-Noble	5,833	8,585	8,347	8,142	[1] 7,031
Dale-Hoodville	1,341	1,323	1,300	1,187	[2] 2,215
East Inman	343	1,102	1,905	1,050	837
Johnsonville	936	1,173	941	829	664
Louden	7,385	6,715	6,077	7,436	6,127
Marine	1,057	1,080	988	872	787
New Harmony-Keensburg	3,217	2,918	2,783	2,376	[3] 3,504
Phillipstown	829	1,032	861	829	1,092
Robinson	1,100	1,236	1,381	1,532	1,530
Sailor Springs	688	1,320	2,371	1,833	1,445
Salem	5,239	4,706	4,106	3,726	3,404
Other fields	31,020	27,217	26,798	26,519	24,186
Total Illinois	65,460	64,032	64,086	62,103	59,827

[1] Clay City only.
[2] Dale only.
[3] New Harmony only.

Indiana.—Production of crude oil during 1951 totaled 10,597,000 barrels, only a slight change from the preceding year's total of 10,699,000 barrels. Of some significance is the fact that production accelerated during the latter half of the year. There was also little change in exploratory drilling, with 559 wildcats completed compared with 570 in 1950. Developmental drilling was off sharply; however, the 810 wells completed in 1951 represented a decrease of 154 from 1950, and the 370 oil producers completed showed a decrease of 132.

TABLE 16.—Production of crude petroleum in Indiana, 1947–51, by months

[Thousands of barrels]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1947	538	476	532	522	520	501	516	503	492	504	484	507	6,095
1948	504	476	528	520	547	550	570	577	635	679	663	725	6,974
1949	667	620	735	734	855	792	804	864	845	941	915	924	9,696
1950	813	775	930	905	929	879	935	948	882	959	858	886	10,699
1951 [1]	805	629	829	819	884	854	939	997	973	1,008	934	926	10,597

[1] Preliminary figures.

Kansas.—The 114,094,000 barrels (Oil and Gas Journal data) of crude oil produced during 1951 was an increase of 6.4 percent over 1950 and an alltime record for the State. In spite of this record rate of output, Kansas' share of total United States production fell from 5.5 percent in 1950 to 5.1 percent. Most of the increase in production

was achieved in the smaller fields included in the "Other" classification, although the production in the Gorham and Morel fields each increased approximately 1 million barrels.

There was a substantial increase in drilling activity during 1951; 4,501 wells were completed compared to 4,010 in 1950. Wildcat completions rose from 816 to 1,006, and the number of development wells was up from 3,194 to 3,495. However, the degree of success reached in drilling remained unchanged for development wells with about 58 percent of the total number drilled resulting in oil wells in both years, whereas for exploratory wells the proportion of producers fell from 15.7 percent in 1950 to 13.8 percent in 1951.

TABLE 17.—Production of crude petroleum in Kansas, 1947–51, by fields, in thousands of barrels

[Oil and Gas Journal]

Field	1947	1948	1949	1950	1951
Bemis-Shutts	6,057	5,748	4,560	4,681	4,287
Bloomer	3,045	3,161	2,492	2,716	2,782
Burnett	3,120	4,996	3,497	2,747	3,044
Burrton-Haury	1,073	1,024	1,211	1,127	1,026
Chase	2,644	2,583	3,258	3,078	2,786
El Dorado	2,764	3,026	3,084	3,019	3,202
Fairport	735	801	908	1,243	1,135
Geneseo-Edwards	3,733	3,519	2,803	2,960	3,001
Gorham	1,880	1,667	1,445	1,406	2,452
Hall-Gurney	3,414	3,485	3,433	3,159	3,637
Kraft-Prusa	6,425	6,871	5,463	5,870	6,326
Morel	1,641	1,717	1,399	1,337	2,301
Ray	1,397	1,390	1,246	1,484	1,822
Silica	5,195	4,824	4,597	5,147	4,950
Stoltenberg	2,804	2,483	2,098	1,962	1,760
Trapp	11,371	10,404	8,905	8,645	7,686
Other fields	47,030	50,114	49,733	56,639	61,897
Total Kansas	104,328	107,813	100,132	107,220	114,094

Kentucky.—During 1951 crude-oil production reached a new record high of 11,622,000 barrels, 1,241,000 barrels or 12 percent greater than in 1950. There was a nominal increase in the number of wells drilled from 1,150 in 1950 to 1,309 in 1951, and the number of successful wells showed an almost parallel increase from 516 to 524.

TABLE 18.—Production of crude petroleum in Kentucky, 1947–51, by months

[Thousands of barrels]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1947	800	679	774	787	781	752	814	777	803	842	772	816	9,397
1948	748	706	801	663	736	732	738	728	726	746	730	747	8,801
1949	711	628	743	699	739	688	722	723	755	806	799	790	8,803
1950	708	668	840	803	914	857	887	925	919	1,021	916	923	10,381
1951 [1]	913	739	873	864	940	925	993	1,037	1,084	1,148	1,060	1,046	11,622

[1] Preliminary figures.

Louisiana.—Production of 231,838,000 barrels of crude in 1951, a new record quantity, was 11 percent above the 1950 total of 208,965,000 barrels, which in turn was about 10 percent over the 1949 output. Crude credited to the Gulf Coast area, about 80 percent of the State total, increased by 15 percent from 164,755,000 barrels in

TABLE 19.—Production of crude petroleum in Louisiana, 1947–51, by district and field

[Thousands of barrels]

District and field	1947	1948	1949	1950	1951 [1]
Gulf Coast:					
Anse la Butte	2,423	2,385	2,160	2,194	2,442
Avery Island	1,601	2,137	2,376	2,649	3,018
Barataria	1,932	3,255	3,468	3,450	3,294
Bay Marchand			376	1,986	2,428
Bay St. Elaine	817	1,495	2,055	2,230	2,672
Bayou Blue	618	682	805	1,071	1,122
Bayou Mallett	442	500	711	874	1,253
Bayou Sale	4,445	5,221	4,996	4,737	5,139
Caillou Island	2,699	3,549	4,135	5,335	6,499
Charenton	1,580	1,514	1,512	1,361	1,136
David Haas	27	662	1,084	1,170	1,128
Delta Farms	5,539	6,818	7,581	7,648	7,190
Dog Lake	691	604	556	901	1,320
East White Lake	1,357	1,333	1,217	1,321	1,443
Egan	2,054	2,441	2,381	2,136	2,083
Erath	1,194	1,233	1,246	1,214	1,178
Garden Island	1,295	1,353	1,509	1,614	1,583
Gibson	2,161	2,089	1,717	1,539	1,460
Golden Meadows	2,666	3,493	4,156	5,020	4,864
Good Hope	2,178	2,351	2,177	2,240	2,434
Grand Bay	3,433	3,729	3,590	3,766	3,853
Gueydan	2,008	2,072	2,115	2,217	2,325
Hackberry	4,000	4,264	3,626	3,519	3,621
Horseshoe Bayou	677	878	1,178	1,246	1,346
Iowa	2,489	2,478	2,212	1,947	2,382
Jeanerette	514	587	867	947	1,067
Jennings	1,809	1,492	1,207	1,104	893
Lafitte	4,362	4,107	4,017	4,332	4,489
Lake Chicot	1,349	1,201	1,083	1,031	1,105
Lake Pelto	1,429	1,558	1,584	1,625	2,173
Lake Salvador	1,623	1,665	1,842	1,972	2,086
Leeville	1,580	1,811	1,910	2,112	2,205
Main Pass		16	306	1,331	2,057
New Iberia	1,526	1,548	1,577	1,462	1,470
North Crowley	1,521	1,696	1,753	1,767	1,659
Paradis	3,728	3,936	3,698	3,649	3,626
Pine Prairie	1,546	1,409	1,416	1,168	1,048
Point-a-La-Hache		3	304	1,603	2,484
Port Barre	1,375	1,636	1,456	1,470	1,438
Quarantine Bay	3,421	3,745	3,445	3,725	3,960
Romre Pass				606	2,315
St. Gabriel	1,786	1,709	1,629	1,577	1,793
Section 28	364	518	1,103	1,296	1,117
Sunshine		2	152	771	1,257
Tepetate	3,402	3,935	3,977	3,788	3,321
University	1,976	2,097	2,844	2,840	2,203
Venice	3,638	4,174	4,614	5,001	5,742
Ville Platte	2,238	2,106	1,969	1,888	1,462
Vinton	3,654	3,578	3,740	3,872	3,960
Weeks Island	678	1,642	2,922	5,183	8,199
West Bay	1,691	2,108	2,281	2,404	2,936
West Cote Blanche	1,040	1,280	1,827	1,704	2,392
West Lake Verrett	1,357	1,379	1,393	1,472	1,782
White Castle	1,229	1,597	1,594	1,692	1,672
Other Gulf Coast [2]	26,546	28,919	30,984	37,978	49,632
Total Gulf Coast	123,708	137,990	146,433	164,755	188,756
Northern:					
Big Creek	1,892	1,963	1,664	1,443	1,468
Caddo	2,328	3,392	4,969	5,689	4,972
Delhi	8,041	8,576	7,545	6,733	6,679
Haynesville	3,500	4,405	5,339	5,444	5,480
Lake St. John	5,544	7,357	7,300	6,695	5,871
Lisbon	653	978	1,703	2,216	1,481
Nebo [3]	2,798	2,623	2,438	2,328	2,302
Olla [4]	2,921	2,794	2,625	2,490	2,294
Ora	674	2,997	1,896	1,085	656
Rodessa	1,727	1,509	1,302	1,186	1,043
Saline Lake		83	400	558	723
Other Northern [2]	6,342	6,791	7,212	8,343	10,113
Total Northern	36,420	43,468	44,393	44,210	43,082
Total Louisiana	160,128	181,458	190,826	208,965	231,838

[1] Preliminary figures.
[2] Includes crude oil consumed on leases and net change in stocks held on leases for entire district.
[3] Includes Hemphill, Trout Creek, and Jena.
[4] Includes Little Creek and Summerville.

1950 to 188,756,000 in 1951, whereas, conversely, the quantity produced in Northern Louisiana registered a small decline from 44,210,000 barrels in 1950 to 43,082,000 in 1951.

Gulf Coast fields that reported important percentage gains in crude production in 1951 over 1950 were the Caillou Island, Iowa, Lake Pelto Main Pass, Point-A-La-Hache, Romre Pass, Sunshine, Weeks Island, West Bay, and West Cote Blanche. In addition, various small fields, taken together, accounted for an increased production of 11,650,000 barrels, a gain of 31 percent over the 1950 total for this group. Main Pass, Point-A-La-Hache, and Sunshine, first reported in 1948, developed into fairly important producing fields in 1950 and 1951. Romre Pass, with first production in 1950, had a large increase in 1951.

In the Gulf Coast area, 991 wells were completed in 1951 compared with 1,126 in 1950. The proved oil wells totaled 583 in 1951 and 720 in 1950. The number of wildcat wells drilled in the same area increased from 166—49 of them oil wells—in 1950, to 169—41 oil wells—in 1951. New pools discovered totaled 24 in 1951 and 32 in 1950. Shell 1 Gonsulin, 41–14s–7e, in Iberia Parish was drilled to a record depth of 15,336 feet in 1951 to produce oil in the Miocene formation.

Only 3 of the 11 major fields in Northern Louisiana showed increases in production in 1951 over 1950, and the gains for 2 of these were trivial. Various small fields grouped together were credited with a gain of 21 percent in 1951 over 1950, an increase that counteracted the net decline in the main producing areas.

There were 1,249 wells drilled in Northern Louisiana in 1951 compared with 1,327 in 1950. The number proved for oil also declined from 773 in 1950 to 635 in 1951. Wells drilled in wildcat areas increased from 136 in 1950 to 210 in 1951, and this exploratory drilling resulted in 17 oil wells in both years. New pools discovered in the area declined from 17 in 1950 to 12 in 1951.

Michigan.—The decline in crude-oil production evident since 1948 continued in 1951, when the total (13,923,000 barrels) was 12 percent below the 1950 output of 15,826,000 barrels. All fields in the State reported lower production in 1951 except East Norwich and St. Helen, where gains were only moderate. The 746 wells completed in the State in 1951 were somewhat below the 1950 total of 897. Those proved for oil totaled 223 in 1951, a number well below the 348 reported in 1950. Wildcat wells declined from 338—29 of them oil wells—in 1950 to 332, of which 19 proved to be oil producers in 1951.

TABLE 20.—Production of crude petroleum in Michigan, 1947–51, by fields, in thousands of barrels

[Michigan Department of Conservation]

Year	Beaver Creek	Cold-water	Deep River	East Norwich	Kawkawlin	Kimball Lake	Pentwater	Reed City	St. Helen	Stony Lake	Other fields	Total
1947	15	1,746	2,872	358	725	868	-------	2,209	50	419	6,953	16,215
1948	370	2,212	2,885	336	804	1,614	392	1,282	59	849	6,068	16,871
1949	904	1,673	2,396	322	755	1,119	1,333	944	157	861	6,053	16,517
1950	794	1,635	2,080	331	722	847	1,410	752	354	998	5,903	15,826
1951 [1]	641	1,488	2,029	384	631	569	718	646	388	881	5,548	13,923

[1] Preliminary figures.

Mississippi.—Crude-oil production during 1951—37,039,000 barrels—represented a decrease of 1,197,000 barrels or 3 percent from the preceding year. The first 4 months showed increases, compared with 1950; thereafter each month showed a decrease.

A moderate increase occurred in drilling activity during 1951, with 374 wells drilled compared to 313 wells in 1950. The number of oil wells completed increased from 124 to 137.

TABLE 21.—Production of crude petroleum in Mississippi, 1947–51, by months

[Thousands of barrels]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1947	2,720	2,352	2,655	2,613	2,829	2,832	2,976	3,073	3,082	3,326	3,158	3,309	34,925
1948	3,526	3,419	3,702	3,652	3,817	3,760	4,027	4,021	3,856	4,069	3,956	3,956	45,761
1949	3,580	3,028	3,383	3,286	3,376	2,990	3,073	3,124	2,990	3,069	3,017	3,050	37,966
1950	3,031	2,755	3,091	2,929	3,193	3,284	3,405	3,411	3,305	3,364	3,220	3,248	38,236
1951 [1]	3,237	2,905	3,146	3,042	3,165	3,035	3,120	3,113	3,005	3,159	3,012	3,100	37,039

[1] Preliminary figures.

Montana.—During 1951 crude-oil production rose somewhat from the low rate of the preceding year, but the total (8,922,000 barrels) was less than in 1948 and 1949. Changes in the rate of well completions were minor, with 262 wells completed in 1951 compared to 270 in 1950.

TABLE 22.—Production of crude petroleum in Montana, 1947–51, by fields, in thousands of barrels

[Montana Oil Conservation Board]

Year	Big Wall	Bowes	Cat Creek	Cut Bank	Elk Basin	Kevin-Sunburst	Melstone	Pondera	Reagan	Other fields [1]	Total
1947	-------	-------	586	4,246	1,728	1,625	-------	317	10	230	8,742
1948	2	-------	510	4,074	2,415	1,623	14	361	61	322	9,382
1949	225	-------	459	3,437	2,331	1,559	70	515	226	296	9,118
1950	460	61	398	2,931	1,569	1,486	164	544	182	314	8,109
1951 [2]	716	427	325	2,724	1,821	1,449	179	792	215	274	8,922

[1] Includes crude oil consumed on leases and net change in stocks held on leases for entire State.
[2] Preliminary figures.

Nebraska.—Although total crude-oil production during 1951 reached a new peak of 2,408,000 barrels—56 percent over 1950—the trend was downward during the year, and for each month after August output was less than in the comparable month of 1950.

Drilling activity was up sharply during 1951, with 241 wells completed compared to 171 in 1950. The increased exploratory activity was even more marked, with 134 wildcat wells drilled compared with 82 in 1950.

TABLE 23.—Production of crude petroleum in Nebraska, 1947–51, by months

[Thousands of barrels]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1947	23	18	18	17	17	18	19	17	21	20	20	21	229
1948	17	14	18	17	18	20	21	20	16	18	17	19	215
1949	21	18	20	20	17	18	28	23	25	49	41	50	330
1950	56	54	64	72	84	96	124	135	171	227	215	249	1,547
1951 [1]	289	229	250	203	205	186	182	187	170	167	169	171	2,408

[1] Preliminary figures.

New Mexico.—Crude-oil production during 1951 rose to a new record of 52,729,000 barrels (Oil and Gas Journal data), about 11 percent above the rate that had prevailed for the preceding 3 years. Almost all the increase is attributable to the "other" fields, that is, fields that are too small to be significant individually but that, in New Mexico, contribute one-third of the total production.

The number of wells completed rose to 773 in 1951 from 607 the preceding year, but this increase is attributable to the large number of gas wells drilled in the Northwest section of the State. The number of oil wells completed actually fell from 396 to 350.

There was great activity in wildcat drilling, expecially in the Southeast part of the State, where the important Permian Basin extends over from Texas. Wildcat wells totaled 105 in 1951, compared with 79 in 1950, and 90 were in the Southeast area, most of them in Eddy and Lea Counties.

TABLE 24.—Production of crude petroleum in New Mexico, 1947–51, by district and field, in thousands of barrels

[Oil and Gas Journal]

District and field	1947	1948	1949	1950	1951
Southeast:					
Arrowhead	1,547	1,460	1,289	1,059	988
Brunson	1,360	2,660	3,015	2,143	2,515
Drinkard	3,332	6,236	6,742	5,538	5,037
Eunice	5,796	5,360	4,414	3,898	[1] 10,590
Grayburg-Jackson	1,935	1,869	1,763	1,750	1,545
Hobbs	3,562	3,841	3,732	3,924	4,380
Langlie-Mattix	1,122	1,075	1,126	1,546	1,700
Maljamar	2,119	2,033	2,042	2,011	1,829
Monument	6,541	6,902	6,488	6,168	([1])
Paddock	1,298	1,584	1,568	1,378	1,178
Vacuum	4,099	4,504	4,449	4,546	4,865
Other	7,854	9,708	10,714	13,023	17,835
Northwest [2]	405	375	335	331	267
Total New Mexico	40,970	47,607	47,677	47,315	52,729

[1] Monument included with Eunice.
[2] Bureau of Mines data.

New York.—Crude output during 1951 was 4,254,000 barrels, 111,000 barrels greater than in 1950. The increase, although slight, represents the first such change since 1946 and probably reflects the more general application of improved methods of secondary recovery.

Drilling activity showed little change during 1951, with 627 wells completed (320 oil wells) compared to 657 (337 oil wells) in 1950.

TABLE 25.—Production of crude petroleum in New York, 1947–51, by months

[Thousands of barrels]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1947	419	349	384	395	400	400	424	393	402	416	359	421	4,762
1948	375	351	410	387	386	397	396	390	389	368	386	386	4,621
1949	371	362	392	371	363	373	362	388	366	361	350	366	4,425
1950	365	305	362	320	372	351	338	362	341	354	331	342	4,143
1951 [1]	363	316	356	341	368	355	365	376	336	386	350	342	4,254

[1] Preliminary figures.

Ohio.—The downward trend in crude-oil production continued for the third successive year, and 1951 output (3,097,000 barrels) was the lowest since 1946. Drilling activity also decreased, with 971 wells completed in 1951 compared to 1,027 in 1950.

TABLE 26.—Production of crude petroleum in Ohio, 1947–51, by months

[Thousands of barrels]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1947	236	201	244	266	256	264	282	259	274	291	250	285	3,108
1948	259	251	309	302	303	312	317	324	309	305	298	311	3,600
1949	263	267	304	287	288	321	281	315	293	293	288	283	3,483
1950	282	250	292	274	290	305	298	310	282	303	238	259	3,383
1951 [1]	272	215	275	258	291	263	274	277	237	280	243	212	3,097

[1] Preliminary figures.

Oklahoma.—Crude-oil production during 1951 increased 14 percent over the preceding year to a total of 186,866,000 barrels (Oil and Gas Journal data), the highest since 1937. Of the total increase of 23,023,000 barrels, the smaller fields, reported collectively, contributed 11,704,000 barrels, Sholem-Alechem 2,012,000 barrels, Fox-Graham 2,273,000 barrels, Elk City 2,360,000 barrels, and Velma 5,862,000 barrels.

Although wells completed in Oklahoma increased from 5,459 in 1950 to 5,626 in 1951, those producing oil declined by 6 percent from 3,304 in 1950 to 3,109 in 1951. Wildcat wells declined slightly from 840 in 1950 (163 producing oil) to 830 in 1951, of which 124 were oil wells.

TABLE 27.—Production of crude petroleum in Oklahoma, 1947–51, by fields, in thousands of barrels

[Oil and Gas Journal]

Field	1947	1948	1949	1950	1951
Allen	1,075	1,129	1,317	1,359	1,447
Apache	1,803	2,181	1,749	1,337	1,470
Beebee	619	601	740	1,272	1,073
Brock-West	239	536	858	1,114	982
Burbank	2,615	2,432	2,338	2,124	2,318
Cache Creek	2,328	1,945	1,780	1,511	1,289
Cement	4,442	4,552	4,207	4,091	4,127
Coon Creek	1,652	1,731	1,539	1,363	1,432

TABLE 27.—Production of crude petroleum in Oklahoma, 1947–51, by fields, in thousands of barrels—Continued

Field	1947	1948	1949	1950	1951
Cumberland	3,948	3,955	3,275	3,628	3,475
Cushing	2,839	2,862	2,726	2,759	2,816
Edmond	545	470	434	392	359
Elk City	----------	63	788	5,066	7,426
Eola	----------	----------	370	595	891
Fitts	1,287	1,141	1,076	1,026	938
Fox-Graham	(1)	(1)	414	923	3,196
Glenn	2,568	2,610	2,587	2,551	2,502
Healdton	2,431	2,629	2,527	2,382	2,267
Hewitt	1,672	1,633	[2] 2,716	4,320	3,694
Hoover-Northwest	439	434	766	1,034	887
Knox	522	1,758	2,250	1,886	1,725
Lone Grove	1,497	1,199	1,023	834	934
Lucien	694	625	589	670	978
Oklahoma City	9,670	8,543	7,703	6,785	6,303
Pauls Valley	2,399	2,162	1,488	1,091	957
Ramsey	839	689	712	767	728
Ringwood	20	87	260	1,927	2,288
Seminole district:					
Bowlegs	1,172	1,262	1,176	1,201	1,178
Little River	1,432	1,416	1,194	1,016	945
St. Louis	1,356	1,330	1,283	1,405	1,560
Seminole City	1,271	1,086	1,441	1,164	1,207
Sholem-Alechem	723	5,196	6,497	8,545	10,557
South Burbank	1,455	1,076	901	860	776
Tatums	638	1,119	3,795	3,456	3,378
Velma	8,153	13,225	10,134	10,227	16,089
West Edmond	14,936	9,322	5,478	3,914	3,482
Witcher	30	1,497	2,094	1,942	1,655
Yale-Quay	772	828	796	825	1,352
Other fields	64,013	71,356	68,982	76,481	88,185
Total Oklahoma	142,094	154,680	150,003	163,843	186,866

[1] Included with "Other fields."
[2] Includes Bayou.

Pennsylvania.—After a slight increase in 1950 over 1949, the downward trend in crude-oil production was again evident in 1951, when the total of 11,150,000 barrels was 6 percent below the 1950 output of 11,859,000 barrels. There were 1,738 wells completed in 1951 compared with 1,581 in 1950. The 1951 developments resulted in 776 oil wells, 239 gas wells, and 70 dry holes.

TABLE 28.—Production of crude petroleum in Pennsylvania, 1947–51, by months

[Thousands of barrels]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1947	1,110	920	1,017	1,069	1,081	1,057	1,110	1,056	1,072	1,120	994	1,084	12,690
1948	1,021	961	1,115	1,089	1,071	1,093	1,083	1,073	1,048	1,047	1,046	1,020	12,667
1949	983	916	1,029	970	956	959	919	980	922	940	884	916	11,374
1950	949	846	971	953	1,034	1,010	1,022	1,041	1,011	1,041	980	1,001	11,859
1951[1]	1,017	886	976	947	977	945	928	963	866	989	887	769	11,150

[1] Preliminary figures.

Texas.—The State was credited with nearly half (45 percent) the total crude-oil production in 1951, when the total of 1,010,128,000 barrels was 22 percent over the 1950 output of 829,874,000 barrels. Important increases in crude output were reported for all districts except the Panhandle, where there was a 6-percent decline. The production gain in West Texas in 1951 was outstanding—33 percent—followed by South Texas with a 23-percent increase and the Gulf

Coast with an expansion of 20 percent. Central Texas showed an 18-percent gain, and production in both the East and North Texas districts were up by 13 percent.

There was only a nominal gain in the number of wells drilled in Texas in 1951, with a total of 16,615 compared with 16,509 in 1950. All areas except the North Central and the Panhandle showed small gains in wells drilled in 1951 over 1950. Oil-producing wells drilled declined from 10,665 in 1950 to 10,086 in 1951, whereas proved gas wells increased from 647 in 1950 to 726 in 1951. There was a 12-percent gain in dry holes in 1951—5,803 compared with 5,197 in 1950. The average footage for all wells increased from 4,340 to 4,601 feet in 1951.

Gulf Coast.—This district, which accounts for about a fourth of the Texas crude, was credited with a production of 239,104,000 barrels in 1951, or a fifth more than the 1950 total (199,263,000 barrels). Of the numerous fields in the district only nine of them showed losses in 1951 compared with 1950. These declines were all trivial except in the Bay City, down 17 percent, South Liberty, lower by 19 percent, and West Columbia, a drop of 11 percent. Fields, showing largest gains in 1951 over 1950 and which produced relatively important quantities were: Anahuac, 14 percent; Chocolate Bayou, 21 percent; Conroe, 18 percent; Friendswood, 32 percent; Hastings, 25 percent; Old Ocean, 13 percent; Thompson, 26 percent; and West Ranch, 38 percent. Numerous small fields grouped together, which accounted for about 28 percent of the district total in both 1950 and 1951, reported a gain of 21 percent in crude production in 1951 over 1950.

Wells completed in 1951 totaled 2,312 compared with 2,303 in 1950. Completions in 1951 were reported as 1,267 oil wells, 209 gas wells, and 836 dry holes; the 1950 breakdown was 1,390 oil wells, 153 gas wells, and 760 failures. Exploration activities resulted in the discovery of 110 new pools in the Gulf Coast area in 1951 compared with 92 in 1950; and new pays reported totaled 69 in 1951 and 61 in 1950. Records show that 7 wells were drilled below 12,500 feet in 1951 and 6 in 1950.

East Texas.—Fields in the area produced 162,764,000 barrels of crude petroleum in 1951, a gain of 13 percent over the 1950 total of 144,191,000 barrels, comprising about 16 percent of the Texas 1951 production. Three fields in East Texas—Cayuga, Merigale and Rodessa—showed a lower output in 1951 than in 1950, whereas all others reported a gain. More than three-fifths of the crude was credited to East Texas proper, where the gain was about 3 percent in 1951 over 1950. Secondary fields showing important gains in production in 1951 were: Hawkins, 31 percent; Talco, 14 percent; and Van, 32 percent. Various small fields grouped together reported a total of 19,160,000 barrels in 1951, a gain of 68 percent.

The number of wells drilled in East Texas fields increased from 1,152 in 1950 to 1,173 in 1951. Oil wells declined from 801 to 739, and the gas wells dropped from 51 to 30, whereas the dry holes rose from 300 in 1950 to 404 in 1951. Drilling activities resulted in the discovery of 20 new pools and 9 new pay sands in 1951 compared with 13 new pools and 5 pay sands in 1950. Two wells were drilled below 12,500 feet in 1951 and 1 in 1950.

Central Texas.—Only a small proportion—about 1 percent—of the Texas crude production comes from this area; however, the 1951 total

of 11,517,000 barrels was 18 percent above the previous year. All fields reported gains, with the Luling field largest—21 percent.

The number of wells drilled in the area dropped slightly from 5,012 in 1950 to 4,990 in 1951. The 1951 explorations resulted in the discovery of 2,424 oil and 50 gas wells. Dry holes totaled 2,516. In 1950, 2,590 oil and 71 gas wells were brought in, and the dry holes numbered 2,351. There were 219 new pools and 19 new pays discovered in 1951, compared with 132 and 14, respectively, in 1950.

North Texas.—Although crude production increased from 79,998,000 barrels in 1950 to 90,208,000 in 1951—a 13-percent gain—the output for the area declined from about 10 percent of the State total in 1950 to less than 9 percent in 1951. Wells completed declined from 2,982—1,637 oil wells, 22 gas wells, and 1,323 dry holes—in 1950 to 2,667—1,378 oil wells, 11 gas wells, and 1,278 dry holes—in 1951. Wildcat drilling, however, increased from 607 wells in 1950 to 862 in 1951. The larger share of the exploratory drilling in 1951 was confined to Archer, Young, Jack, and Cooke Counties, in the order named.

Panhandle.—This was the only producing area to show a decline in 1951, when the output of 31,287,000 barrels was 6 percent below the 1950 total of 33,131,000 barrels.

There was also a decline in drilling activities, as the 727 wells completed were 18 percent below the 889 reported for 1950. A total of 350 wells were proved for oil in 1951, 294 for gas, and 83 were dry. These results compare with 582 oil and 232 gas wells found in 1950 and 75 dry holes. Thirty-six wildcat wells were drilled in 1951, and these proved only 2 oil wells. This record compares with 24 wildcats in 1950, which brought in 1 oil and 2 gas wells.

Five wells were drilled below 10,000 feet in 1950; however, none below this depth were reported during 1951.

South Texas.—Crude-oil production of 94,119,000 barrels in 1951 was about 23 percent over the 1950 output of 76,826,000 barrels, and the quantity in each year represented approximately 9 percent of the State total.

Wells completed in 1951, totaling 2,301, proved 1,253 for oil and 118 for gas; the remaining 930 were dry holes. The comparative totals for 1950 were 2,155 completions, resulting in 1,185 oil and 124 gas wells and 846 dry holes. Three were wells sunk to over 12,500 feet in 1951 compared with 1 in 1950.

Wildcat drilling increased from 628 wells—97 proving oil, 97 gas, and 502 dry holes—in 1950 to 730—101 oil, 40 gas, and 589 dry holes—in 1951. Most of these exploratory activities were centered in Duval, Jim Hogg, Nueces, San Patricio, Starr, and Webb Counties.

West Texas.—About 38 percent of the crude produced in the State came from this area in 1951, and the total (381,129,000 barrels) was a third above the 1950 quantity (286,696,000 barrels). Outstanding gains in production in 1951 were reported for Ector and Scurry Counties. The output credited to Ector County, which makes up part of the Spraberry trend of the Permian Basin, one of the richest known oil deposits in the country, increased by a third from 57,096,000 barrels in 1950 to 75,918,000 in 1951. A similar gain was reported for Scurry County, the center of another important group of fields discovered in recent years, where the output has "skyrocketed" from a minor quantity in 1949 to 36,529,000 barrels in 1950 and to 48,478,000 in 1951. Other counties and districts that showed important gains in

crude production in 1951 were Andrews, Crane-Upton, Gaines-Yoakum, Hockley, Pecos, and Winkler.

In this area 5,112 wells were completed in 1951 compared with 4,998 in 1950. Drilling activities proved 4,053 oil and 25 gas wells in 1951, and 1,034 were dry holes. The comparative record in 1950 was 4,117 oil and 16 gas wells and 865 dry holes. Wells classed as wildcats numbered 669 (110 proving oil and 6 gas wells) in 1950 and 844 (189 proving oil and 9 gas wells) in 1951. There were 64 wells drilled below 12,500 feet in 1951 compared with 37 in 1950 and 12 in 1949. One well in Pecos County, a dry hole, was sunk to 15,468 feet in 1951; however, another in Upton County drilled to 13,400 feet struck oil.

TABLE 29.—Production of crude petroleum in Texas, 1947–51, by district and field

[Thousands of barrels]

District and field [1]	1947	1948	1949	1950	1951 [2]
Gulf Coast:					
Amelia	1,581	1,581	1,080	715	1,073
Anahuac	10,663	10,832	7,103	6,801	7,727
Barbers Hill	1,969	1,944	1,964	2,110	2,038
Bay City	1,546	1,903	1,044	1,510	1,260
Bloomington	249	1,337	1,794	1,775	1,934
Bonnie View	1,178	1,299	856	832	965
Chocolate Bayou	1,613	2,863	3,529	4,272	5,166
Conroe	21,950	20,519	11,638	11,943	14,081
Dickinson-Gillock	2,000	2,287	2,368	3,493	4,090
Dyersdale	953	1,171	1,393	1,550	1,449
Esperson	1,016	1,029	1,220	1,508	1,496
Fairbanks	2,232	2,272	1,905	1,696	2,053
Falls City	1,509	1,571	1,048	1,101	1,341
Fannette	2,770	2,484	1,529	1,425	1,948
Fig Ridge	1,800	1,236	860	783	937
Friendswood	20,997	20,745	13,178	11,386	14,989
Goose Creek	562	913	1,766	2,451	2,873
Greta	4,028	4,338	3,053	2,858	3,512
Hastings	21,279	21,643	14,317	13,247	16,536
Heyser	1,984	1,891	1,109	1,288	1,671
High Island	1,136	1,315	1,893	2,380	2,384
Hull	1,286	1,520	1,781	3,534	4,612
Humble	762	1,138	1,272	1,257	1,246
La Rosa	1,374	1,052	812	716	827
Livingston	1,895	1,898	1,353	1,373	1,395
Lolita	2,229	2,193	1,482	1,502	1,803
Lovell's Lake	1,556	1,595	1,113	1,220	1,418
McFaddin	1,925	1,955	1,254	1,126	1,339
Manvel	2,725	2,913	2,108	2,011	2,393
Markham	1,783	1,468	1,047	1,139	2,045
Old Ocean	5,473	5,983	5,096	5,521	6,247
Oyster Bayou	2,936	4,218	2,913	2,418	3,519
Pierce Junction	531	840	1,285	1,444	1,782
Placedo	2,222	2,281	1,675	1,944	2,291
Racoon Bend	2,722	2,492	1,785	1,657	1,874
Refugio	3,203	3,119	2,355	2,442	2,708
Segno	1,276	1,161	850	772	817
Silsbee	1,064	1,114	1,176	1,223	1,364
Sour Lake	969	1,180	1,400	1,883	2,009
South Houston	1,592	1,641	1,417	1,193	1,192
South Liberty	145	442	1,339	2,064	1,665
Stowell	4,590	3,762	2,645	2,288	2,836
Sugarland	1,691	1,859	1,186	1,059	1,380
Sugar Valley	1,479	2,421	2,079	2,056	1,943
Swan Lake				331	1,052
Thompson	15,621	16,927	11,763	10,187	12,840
Tomball	3,388	3,518	2,394	2,212	2,444
Village Mills	38	77	366	2,291	3,300
West Columbia	2,394	2,591	2,654	2,619	2,331
West Ranch	7,043	7,031	5,066	5,456	7,525
Withers-Magnet	5,655	5,850	4,160	3,718	4,345
Other Gulf Coast [3]	51,957	60,221	49,119	55,483	67,039
Total Gulf Coast	234,539	249,633	189,592	199,263	239,104

For footnotes, see end of table.

TABLE 29.—Production of crude petroleum in Texas, 1947–51, by district and field—Continued

[Thousands of barrels]

District and field [1]	1947	1948	1949	1950	1951 [2]
East Texas:					
East Texas proper	117,112	112,284	93,951	97,825	100,995
Cayuga	2,285	2,098	1,991	1,808	1,568
Hawkins	17,045	17,609	11,464	10,439	13,638
Long Lake	2,122	2,223	1,491	1,415	1,619
Merigale	687	1,614	1,036	1,088	992
Mexia-Powell	1,124	1,038	977	829	1,398
New Hope	1,481	1,617	1,894	1,836	2,355
Quitman	2,933	3,715	2,886	2,740	3,078
Rodessa	1,179	1,204	1,005	848	802
Sulphur Bluff	1,175	1,167	735	708	769
Talco	8,849	8,804	6,188	5,891	6,692
Van	10,443	12,110	8,313	7,358	9,698
Other East Texas	7,762	8,899	9,686	11,406	19,160
Total East Texas	174,197	174,382	141,617	144,191	162,764
Central Texas:					
Charlotte	582	1,879	2,032	2,223	2,434
Darst Creek	2,541	2,574	2,521	2,534	2,830
Luling	1,455	1,401	1,387	1,608	1,951
Other Central Texas	3,061	3,345	2,952	3,404	4,302
Total Central Texas	7,639	9,199	8,892	9,769	11,517
North Texas [4 5]	62,093	70,257	69,543	79,998	90,208
Panhandle [6]	29,589	31,725	33,076	33,131	31,287
South Texas:					
Aqua Dulce	4,227	4,097	2,082	2,094	2,232
Fulton Beach		361	743	1,202	1,819
Garcia	1,421	1,393	1,009	1,064	1,321
Hoffman	791	1,052	1,049	1,069	1,386
Kelsey	2,085	2,629	2,056	2,284	3,017
London Gin			52	974	1,330
Midway	1,597	1,663	1,449	1,652	1,219
Saxet-Saxet Frio	2,595	2,519	1,794	1,499	1,480
Stratton	4,344	4,625	3,233	3,150	3,680
Sun	1,879	1,861	1,231	1,260	1,293
Taft	1,032	1,381	1,148	1,096	1,542
White Point	4,563	4,496	2,684	2,674	3,658
Willamar	4,817	4,029	2,397	2,092	2,205
Other South Texas	60,302	64,165	52,627	54,716	67,937
Total South Texas	89,653	94,271	73,554	76,826	94,119
West Texas:					
Andrews	22,781	31,417	28,043	31,860	35,308
Borden				2,978	8,981
Crane-Upton	20,339	21,875	19,345	22,973	30,215
Coke	160	1,056	1,971	3,852	8,155
Crockett	7,050	8,496	6,931	7,078	8,574
Dawson	1,210	1,550	1,112	1,534	2,305
Ector [7]	50,392	67,518	53,814	57,096	75,918
Gaines-Yoakum	35,915	41,417	29,098	28,703	35,742
Garza	1,631	2,586	2,605	3,364	4,199
Glasscock-Howard-Mitchell	[8] 8,276	[8] 9,002	[8] 12,455	8,977	9,598
Hockley	19,950	29,697	26,503	27,597	31,338
Kent	36	16	10	3,525	6,121
King	1,138	1,088	759	863	1,090
Midland	10	3	20	873	9,598
Pecos	20,122	22,771	17,036	17,862	22,305
Reagan	2,798	2,669	2,389	2,372	2,631
Reeves		461	784	1,090	1,295
Runnels	35	90	860	1,063	4,338
Scurry	[8]	[8]	[8]	36,529	48,478
Terry	65	150	303	1,172	3,260
Tom Green			262	1,152	1,911
Ward	6,631	6,739	4,833	5,380	8,281
Winkler	22,626	24,325	18,506	17,961	19,228
Other West Texas [3]	1,335	1,105	921	842	2,860
Total West Texas	222,500	274,031	228,560	286,696	381,129
Total Texas	820,210	903,498	744,834	829,874	1,010,128

[1] The breakdown of Texas districts was changed to agree with the Texas Railroad Commission divisions beginning with 1946.
[2] Preliminary figures.
[3] Includes crude oil consumed on the leases and net change in stocks held on leases for entire district.
[4] Includes fields in and between Hardeman, Wilbarger, Wichita, Clay, Montague, and Cook Counties on the north, and San Saba, Lampasas, and Coryell on the south.
[5] Includes crude oil consumed on the leases and net change in stocks held on leases for East (exclusive of East Texas proper), Central, North, and South Texas.
[6] Carson, Gray, Hutchinson, Moore, Sherman, and Wheeler Counties.
[7] Includes the part of Jordan pool in Crane County.
[8] Scurry included with Glasscock-Howard-Mitchell before 1950.

Utah.—Crude production of 1,228,000 barrels in 1950 was about double—93 percent—the 1949 total. However this unusual gain was not repeated in 1951, as the output of 1,425,000 barrels was only 16 percent over 1950. There were 39 wells drilled in 1951, resulting in 8 oil wells, 1 gas well, and 30 dry holes. Wildcat drilling (32 wells) proved 3 new pools, 2 oil and 1 gas: 1 for 143 barrels of oil daily in the Basal Green River formation in Duchesne County; a second for 392 barrels of oil daily in the same formation in Uintah County; and a gas well rated at 10,000 M c. f. daily in the Ferron sand of Carbon County.

West Virginia.—A slight decline in crude-oil production was continued for a second year; the 1951 total of 2,743,000 barrels was 2 percent below the 1950 output of 2,808,000 barrels. The 622 wells completed in 1951 (which resulted in 79 oil wells, 419 gas wells, and 124 dry holes) compares with 652 completions in 1950, with 132 oil wells, 384 gas wells, and 136 dry holes. Seventeen wildcats in 1951 brought in 11 gas wells, which compares with 23 gas wells in 1950, the result of 43 exploratory drillings.

TABLE 30.—Production of crude petroleum in West Virginia, 1947–51, by months

[Thousands of barrels]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1947	227	183	220	202	211	209	218	219	229	253	208	238	2,617
1948	210	199	234	230	222	224	230	231	225	230	232	225	2,692
1949	212	209	233	226	235	238	236	254	247	260	247	242	2,839
1950	240	220	246	234	245	238	230	249	232	248	209	217	2,808
1951 [1]	238	204	229	227	235	222	243	244	223	244	223	211	2,743

[1] Preliminary figures.

Wyoming.—Crude production, which declined 13 percent in 1949, has since turned upward. The 1951 output of 67,932,000 barrels was 10 percent over the 1950 total of 61,631,000 barrels, which in turn was 29 percent above the 1949 quantity. The net gain in production in

TABLE 31.—Production of crude petroleum in Wyoming, 1947–51, by fields

[Thousands of barrels]

Year	Big Sand Draw	Byron-Garland	Cole Creek	Elk Basin	Fiddler Creek	Frannie	Grass Creek	Hamilton Dome	Lance Creek	Little Buffalo
1947	1,462	4,653	490	4,696	-------	1,711	1,042	2,196	4,294	982
1948	2,590	4,546	570	6,039	12	1,746	1,137	3,138	3,290	1,264
1949	2,250	2,628	515	5,325	1,246	1,305	899	1,493	2,862	598
1950	2,077	4,849	837	5,583	3,696	2,968	1,317	3,531	2,669	1,285
1951 [1]	2,185	5,552	1,347	7,492	2,126	3,653	1,926	3,453	3,139	1,001

Year	Lost Soldier-Wertz, etc.	Mush Creek	Oregon Basin	Salt Creek	Steamboat Butte	Sussex-Meadow Creek	Winkleman	Worland	Other fields [2]	Total
1947	4,003	179	4,009	4,566	2,800	-------	507	313	6,869	44,772
1948	5,466	1,020	3,491	4,655	3,822	25	796	1,577	9,848	55,032
1949	5,322	1,085	1,604	3,937	2,247	262	471	3,076	10,765	47,890
1950	5,362	934	2,839	4,165	2,410	2,010	828	2,173	12,098	61,631
1951 [1]	5,325	947	3,717	4,063	2,731	3,043	817	1,786	13,629	67,932

[1] Preliminary figures.
[2] Includes crude oil consumed on leases and net change in stocks held on leases for entire State.

1951—6,301,000 barrels over 1950—was due to important increases in the Elk Basin, Sussex-Meadow Creek, Oregon Basin, Byron-Garland, and numerous small fields grouped as 1 unit. Fiddler Creek was the only field to report a large decline in 1951 compared with 1950.

There were 745 wells completed in 1951, which resulted in 442 oil wells, 21 gas wells, and 282 dry holes. This compares with 615 completions in 1950, which brought in 365 oil wells, 18 gas wells, and 232 dry holes. Fourteen new pools were discovered in both 1950 and 1951.

Other States.—In 1951 there was a total production of 77,000 barrels of crude petroleum in other States, including North Dakota, Missouri, Tennessee, and Virginia.

WELLS

The total number of wells drilled in the United States, including oil and gas wells and dry holes, set another new record, rising from 42,030 in 1950 to 43,136 in 1951, a gain of 1,106 compared with a gain of 4,374 wells in 1950. The number of oil wells completed declined from 24,430 in 1950 to 23,453 in 1951, although the number of gas wells and dry holes increased. The program for increased drilling has been stimulated by the recently expanded demand for crude oil and the effort to increase total reserves.

The principal gains in the total number of wells drilled (comparing 1951 with 1950) were 527 in California, 489 in Kansas, 190 in Colorado, 166 in New Mexico, and 161 in Kentucky. The largest declines were 396 in Illinois, 210 in Louisiana, 169 in Indiana, and 137 in Michigan.

The total number of producing oil wells in the United States rose from 465,870 on December 31, 1950, to 474,990 at the end of 1951, and the average production per well increased from 11.8 barrels per day to 13.1.

TABLE 32.—Wells drilled for oil and gas in the United States, 1950–51, by months

[Oil and Gas Journal]

Wells	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	
													Number	Percent
1950														
Oil	1,808	1,664	2,017	1,896	1,974	2,334	2,200	2,276	2,023	2,019	2,211	2,008	24,430	58.1
Gas	227	187	229	174	252	282	240	262	258	275	230	227	2,843	6.8
Dry	951	954	1,113	1,087	1,136	1,324	1,397	1,436	1,379	1,347	1,435	1,198	14,757	35.1
Total	2,986	2,805	3,359	3,157	3,362	3,940	3,837	3,974	3,660	3,641	3,876	3,433	42,030	100.0
1951														
Oil	2,021	1,499	1,883	1,775	2,058	1,979	1,914	2,286	1,940	2,062	2,089	1,947	23,453	54.4
Gas	239	217	239	169	258	251	258	320	231	276	294	278	3,030	7.0
Dry	1,307	933	1,240	1,224	1,486	1,373	1,477	1,667	1,440	1,455	1,632	1,419	16,653	38.6
Total	3,567	2,649	3,362	3,168	3,802	3,603	3,649	4,273	3,611	3,793	4,015	3,644	43,136	100.0

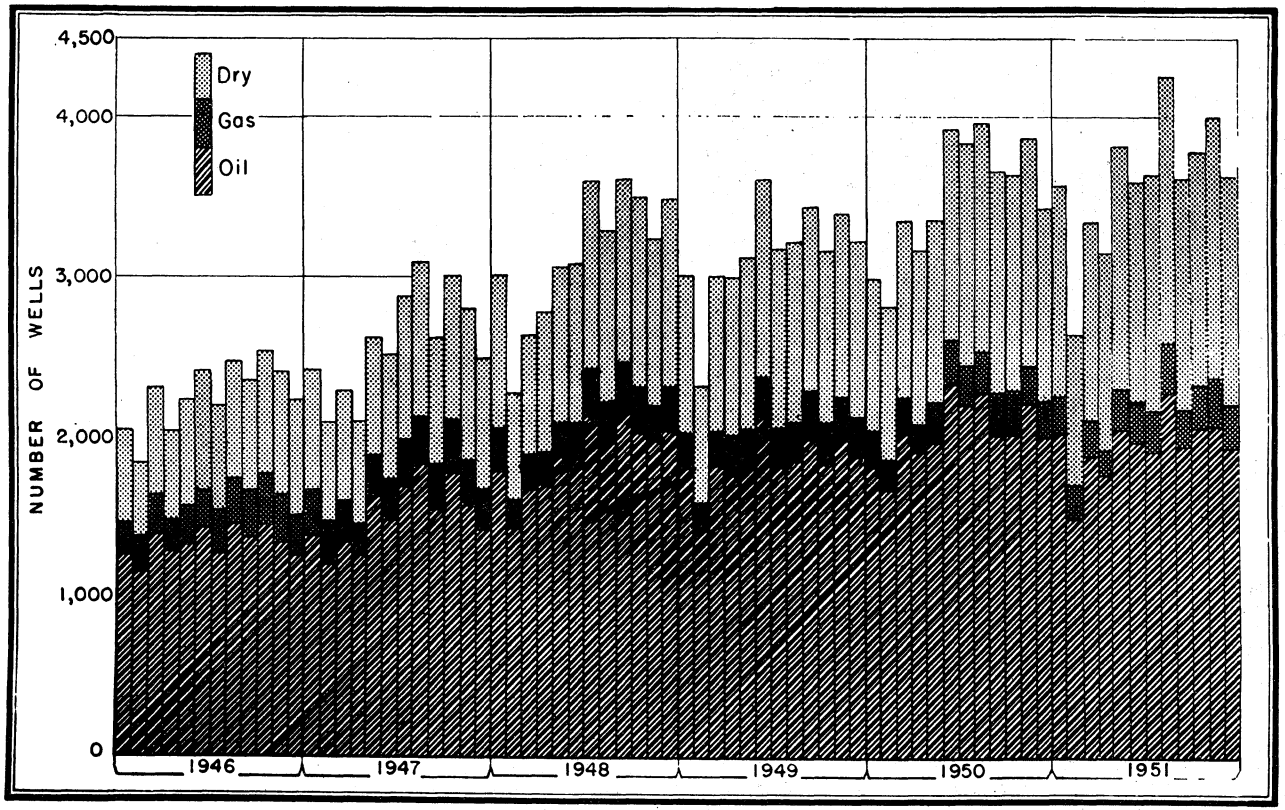

FIGURE 4.—Wells drilled in the United States, 1946–51, by months.

TABLE 33.—Wells drilled for oil and gas in the United States, 1950–51, by State and district

[Oil and Gas Journal]

State and district	1950				1951			
	Oil	Gas	Dry	Total	Oil	Gas	Dry	Total
Alabama	18	1	24	43	17	--------	33	50
Arkansas	242	2	153	397	235	10	184	429
California	1,278	51	499	1,828	1,735	40	580	2,355
Colorado	22	12	65	99	103	12	174	289
Illinois	1,280	17	1,511	2,808	918	10	1,484	2,412
Indiana	576	51	906	1,533	434	18	912	1,364
Kansas	1,985	400	1,565	3,950	2,177	376	1,886	4,439
Kentucky	516	157	474	1,147	524	155	629	1,308
Louisiana:								
Gulf Coast	720	42	362	1,124	583	36	370	989
Northern	773	154	396	1,323	635	140	473	1,248
Total Louisiana	1,493	196	758	2,447	1,218	176	843	2,237
Michigan	348	30	459	837	223	20	457	700
Mississippi	124	9	180	313	137	9	228	374
Montana	154	20	96	270	144	8	110	262
Nebraska, Missouri	78	20	100	198	77	15	167	259
New Mexico	396	88	123	607	350	254	169	773
Oklahoma	3,304	249	1,812	5,365	3,109	265	2,075	5,449
Pennsylvania, New York, Ohio, West Virginia	1,579	872	543	2,994	1,509	884	538	2,931
Texas:								
Gulf Coast	1,390	153	760	2,303	1,267	209	836	2,312
West Texas	4,117	16	865	4,998	4,053	25	1,034	5,112
East Texas	801	51	300	1,152	739	30	404	1,173
Other districts	4,357	427	3,272	8,056	4,027	462	3,529	8,018
Total Texas	10,665	647	5,197	16,509	10,086	726	5,803	16,615
Wyoming	365	18	232	615	442	21	282	745
Other States	7	3	60	70	15	31	99	145
Total United States	24,430	2,843	14,757	42,030	23,453	3,030	16,653	43,136

TABLE 34.—Producing oil wells in the United States and average production per well per day in 1950–51, by State and district

State and district	1950		1951 [1]	
	Approximate number, Dec. 31	Average production per well per day (barrels)	Approximate number, Dec. 31	Average production per well per day (barrels)
Arkansas	3,700	23.2	3,800	21.7
California	28,080	34.2	29,630	33.7
Colorado	770	84.0	840	92.7
Illinois	27,500	6.2	27,420	5.8
Indiana	3,410	9.2	3,600	8.3
Kansas	31,000	9.7	32,460	9.9
Kentucky	15,650	1.8	16,900	2.0
Louisiana:				
Gulf Coast	5,060	92.6	5,420	98.7
Northern	6,800	18.6	7,070	17.0
Total Louisiana	11,860	50.3	12,490	52.2
Michigan	3,950	11.2	3,800	9.8
Mississippi	1,670	68.2	1,760	59.2
Montana	3,300	6.9	3,380	7.3
Nebraska	140	42.4	260	33.0
New Mexico	6,020	22.4	6,350	23.5
New York	23,200	.5	23,200	.5
Ohio	18,580	.5	17,650	.5
Oklahoma	56,800	8.1	57,600	9.0
Pennsylvania	81,190	.4	78,800	.4
Texas: [2]				
Gulf Coast	17,100	32.3	18,260	37.1
West Texas	30,400	27.8	34,600	32.1
East Texas proper	23,200	11.6	22,950	12.0
Other districts	57,800	12.1	58,860	13.6
Total Texas	128,500	18.3	134,670	21.0
West Virginia	15,000	.5	14,500	.5
Wyoming	5,320	32.9	5,610	34.1
Other States [3]	230	32.8	270	34.2
Total United States	465,870	11.8	474,990	13.1

[1] Preliminary figures.
[2] The breakdown of Texas districts was changed to agree with the Texas Railroad Commission divisions.
[3] Alabama, Florida, Missouri, North Dakota, Tennessee, Utah, and Virginia.

CONSUMPTION AND DISTRIBUTION

The indicated total demand [4] for crude oil set a new record in 1951 and amounted to 2,416.3 million barrels—a gain of 12.1 percent compared with 1950. The demand for domestic crude oil increased 12.9 percent to 2,234.1 million barrels and resulted from a production of 2,244.5 million barrels and an increase of 10.4 million barrels in stocks of domestic crude oil. The demand for foreign crude oil increased 3.3 percent to 182.2 million barrels, with imports of 179.1 million barrels and a reduction of 3.1 million barrels in stocks of foreign crude. The demand for foreign crude oil represented 8.2 percent of total crude demand in 1950 and 7.5 percent in 1951.

The total demand for crude oil in 1951 included 2,370.4 million barrels of crude runs to stills at refineries or 98.1 percent of the total. Other demands for crude oil totaled 45.9 million barrels, compared with 61.3 million in 1950. Crude exports declined 6.2 million barrels,

[4] For definition, *see* text footnote 1 at the beginning of this chapter.

owing primarily to completion of a new Canadian pipeline to Lake Superior that supplied crude to refineries along the way and began tanker shipments to Ontario in May. Reported transfers of crude for direct use as fuel oil increased from 7.9 million barrels in 1950 to 8.9 million in 1951. Other crude, representing fuel use and losses, decreased from 18.6 million barrels in 1950 to 8.4 million in 1951.

Runs to Stills.—Total crude runs to stills increased from 5,739,000 barrels daily in 1950 to 6,494,000 in 1951, a gain of 13.2 percent. The total increase in runs amounted to 275.5 million barrels, including a gain of 269.8 million in runs of domestic crude and an increase of 5.7 million in runs of foreign crude. Runs of foreign crude increased to 3.6 million barrels in the California district compared with no runs in 1950 and the first trial runs of 1.1 million in 1949. Foreign crude was run for the first time in the Indiana-Illinois district with the beginning of Lake shipments of Canadian crude.

Distribution.—The Bureau of Mines collects data relating to receipts of domestic and foreign crude petroleum at refineries in the United States. These receipts include the crude for total runs to stills at refineries, a small amount of crude used as refinery fuel, and any increase in crude stocks at refineries. Classification of the receipts by States of origin shows the amount received from local production (intrastate), the receipts from other States (interstate), and receipts of imported crude. The classification of receipts by methods of transportation indicates the mode of final delivery—boat, pipeline, or tank cars and trucks. The receipts of domestic crude by boat were, in most instances, originally moved by pipeline from the point of production to the point of shipment by boat.

Receipts of domestic and foreign crude petroleum at refineries amounted to 2,372.0 million barrels in 1951 and—supplemented by a decrease of 1.0 million barrels in crude stocks at refineries—provided for total crude runs of 2,370.4 million barrels and crude used as fuel and losses of 2.6 million barrels. Receipts of foreign crude oil amounted to 179.1 million barrels (7.6 percent of the total), interstate receipts of domestic crude were 901.7 million barrels (38.0 percent of the total), and intrastate receipts of 1,291.2 million barrels represented 54.4 percent of the total.

Of the total refinery receipts of crude petroleum in 1951, 74.1 percent was delivered by pipeline, 24.5 percent by boat, and 1.4 by tank cars and trucks.

Deliveries to refineries by boat totaled 581.5 million barrels in 1951. The delivery of foreign crude oil totaled 178.7 million barrels, including 171.9 million to the East Coast, 3.1 million to the Gulf Coast, 3.6 million to the California district, and 0.1 million to Michigan refineries. The interstate movement of domestic crude oil by boat amounted to 256.9 million barrels, including 191.5 million shipped from the Gulf Coast to the East Coast district, 52.8 million of exchanges by boat between the Texas Gulf and Louisiana Gulf districts, 12.0 million barrels representing river shipments to Kentucky refineries, and 0.6 million barrels to Illinois, Minnesota, and Wisconsin

TABLE 35.—Runs to stills of crude petroleum in the United States in 1951, by district and month [1]

[Thousands of barrels]

District [2]	January	February	March	April	May	June	July	August	September	October	November	December	Total
East Coast:													
Domestic	15,084	14,956	17,092	15,807	16,333	15,691	13,980	16,199	16,605	17,054	17,440	19,883	196,124
Foreign	16,048	13,276	13,903	13,056	15,938	15,572	16,661	15,619	15,095	13,157	13,203	12,742	174,270
Total East Coast	31,132	28,232	30,995	28,863	32,271	31,263	30,641	31,818	31,700	30,211	30,643	32,625	370,394
Appalachian	5,363	4,987	5,536	5,434	5,603	5,471	5,618	5,486	5,211	5,516	5,442	5,788	65,455
Indiana, Illinois, Kentucky, etc.:													
Domestic	37,046	35,159	37,833	33,497	36,509	36,303	37,556	37,246	35,148	35,609	37,367	38,767	438,040
Foreign								48	62	94	114	69	387
Total Indiana, Illinois, Kentucky, etc	37,046	35,159	37,833	33,497	36,509	36,303	37,556	37,294	35,210	35,703	37,481	38,836	438,427
Oklahoma, Kansas, etc	17,217	15,197	16,396	14,819	15,670	16,367	14,823	14,949	15,552	16,725	15,252	16,732	189,699
Texas Inland	6,958	6,454	7,353	7,147	7,482	7,700	8,015	7,930	7,598	8,074	7,246	7,554	89,511
Texas Gulf Coast:													
Domestic	48,508	42,772	48,354	44,292	48,217	46,954	48,152	49,113	47,412	48,652	47,089	50,377	569,892
Foreign	609	309	377	221	251	55	77	69			1	130	2,099
Total Texas Gulf Coast	49,117	43,081	48,731	44,513	48,468	47,009	48,229	49,182	47,412	48,652	47,090	50,507	571,991
Louisiana Gulf Coast:													
Domestic	15,107	14,164	14,968	14,363	14,841	14,815	15,469	15,386	15,249	15,944	15,783	15,591	181,680
Foreign	57	43	88	67	168	202	154	152	156	137	111	50	1,385
Total Louisiana Gulf Coast	15,164	14,207	15,056	14,430	15,009	15,017	15,623	15,538	15,405	16,081	15,894	15,641	183,065
Arkansas, Louisiana Inland, etc	2,503	2,235	2,116	2,519	2,535	2,271	2,642	2,640	2,249	2,501	2,407	2,271	28,889
Rocky Mountain	6,856	6,588	7,303	6,001	6,887	7,530	7,571	7,510	6,973	6,283	7,063	7,278	83,843
California:													
Domestic	28,390	27,528	29,030	27,868	28,860	28,003	29,330	30,057	28,982	29,735	29,381	28,380	345,544
Foreign	212	77	186	397	227	312	274	317	460	345	359	420	3,586
Total California	28,602	27,605	29,216	28,265	29,087	28,315	29,604	30,374	29,442	30,080	29,740	28,800	349,130
Total United States: Domestic	183,032	170,040	185,981	171,747	182,937	181,105	183,156	186,516	180,979	186,093	184,470	192,621	2,188,677
Foreign	16,926	13,705	14,554	13,741	16,584	16,141	17,166	16,205	15,773	13,733	13,788	13,411	181,727
Grand total: 1951	199,958	183,745	200,535	185,488	199,521	197,246	200,322	202,721	196,752	199,826	198,258	206,032	2,370,404
1950	169,987	148,837	165,418	155,797	171,599	169,663	182,330	188,078	181,778	188,393	182,539	190,448	2,094,867
Daily average 1951	6,450	6,562	6,469	6,183	6,436	6,575	6,462	6,539	6,558	6,446	6,609	6,646	6,494

[1] Preliminary figures.
[2] Where no breakdown is shown, runs were all of domestic crude.

refineries. Intrastate deliveries by boat amounted to 145.9 million barrels, including 57.3 million barrels in California, 42.0 million in the Louisiana Gulf district, 37.6 million in Texas, and 9.0 million in Kentucky.

TABLE 36.—Receipts of crude petroleum at refineries in the United States, 1947–51, by method of transportation

[Millions of barrels]

Method of transportation	1947	1948	1949	1950	1951 [1]
By boat:					
Intrastate	108.5	120.9	112.2	128.6	145.9
Interstate	241.0	265.1	211.8	221.2	256.9
Foreign	97.5	129.1	154.9	177.7	178.7
Total by boat	447.0	515.1	478.9	527.5	581.5
By pipelines:					
Intrastate	912.9	984.7	938.1	998.7	1,127.0
Interstate	449.7	490.0	495.7	542.6	629.4
Foreign					.4
Total by pipelines	1,362.6	1,474.7	1,433.8	1,541.3	1,756.8
By tank car and truck:					
Intrastate	19.9	24.0	17.4	16.2	18.3
Interstate	26.1	32.8	15.4	15.4	15.4
Total by tank car and truck	46.0	56.8	32.8	31.6	33.7
Grand total	1,855.6	2,046.6	1,945.5	2,100.4	2,372.0

[1] Preliminary figures.

Demand by States of Origin.—The demand for domestic crude oil increased 254 million barrels in 1951 to a total of 2,234 million. It exceeded 50 million barrels in 8 States. The total demand in these States for crude oil amounted to 2,070 million barrels, or 92.6 percent of the national total in 1951, compared with 91.6 percent in 1950.

Texas, the leading State in supplying the market demand for crude oil, contributed 41.6 percent of the total in 1950 and 45.1 percent in 1951. The demand for Texas crude oil increased about 184 million barrels in 1951, a gain of over 22 percent. Receipts of Texas crude oil at refineries rose from 812.5 million barrels in 1950 to 997.6 million in 1951, an increase of 185.1 million. The principal changes in receipts compared with 1950, were increases of 100.7 million in intrastate receipts at Texas refineries, a gain of 40.6 million in receipts of Texas crude oil at refineries in the Indiana-Illinois district, and an increase of 34.5 million barrels to East Coast refineries due partly to the small gain in receipts of foreign crude.

California ranked second in the demand for domestic crude oil and supplied 16.9 percent of the total in 1950, compared with 15.9 percent in 1951. Demand for California crude increased 21.8 million barrels in 1951, a gain of 6.5 percent, whereas intrastate receipts by refiners in California and Washington increased 23.8 million barrels. Receipts of foreign crude at California refineries amounted to 3.6 million barrels compared with no imports in 1950.

TABLE 37.—Daily average demand for total crude petroleum in the United States in 1950–51, by State of origin and month

[Thousands of barrels]

State	January	February	March	April	May	June	July	August	September	October	November	December	Year
1950													
Alabama	0.9	1.6	2.1	1.4	1.7	1.7	2.1	1.5	2.3	2.1	2.5	1.9	1.8
Arkansas	85.5	92.3	85.0	93.6	94.2	83.7	85.4	89.3	80.7	92.7	89.3	81.7	87.8
California	890.7	861.2	848.6	891.2	901.9	918.1	911.7	962.0	955.0	962.4	964.2	920.6	915.9
Colorado	64.3	62.4	60.8	57.8	60.4	57.7	66.0	56.3	61.4	75.5	78.0	76.9	64.8
Florida	1.3	1.8	.3	1.8	.9	.1	.5	3.4	4.0	.1	1.5	1.9	1.5
Illinois	193.4	190.1	165.5	213.6	189.0	176.4	154.7	179.1	176.4	173.2	152.0	168.4	177.5
Indiana	27.2	26.1	27.4	30.2	30.6	29.2	31.9	29.4	29.4	30.0	30.0	26.9	29.0
Kansas	275.8	262.6	284.1	274.1	314.3	276.8	312.3	319.6	299.4	273.3	292.7	298.4	290.6
Kentucky	24.6	25.8	26.7	28.6	32.4	26.5	29.1	31.5	29.3	35.7	34.5	22.7	29.0
Louisiana	535.6	529.7	545.8	511.7	538.0	549.0	611.3	591.9	620.5	591.5	616.5	642.8	574.0
Michigan	50.4	47.3	44.6	45.1	45.9	34.3	51.7	45.0	45.1	38.9	42.1	43.3	44.5
Mississippi	95.2	98.3	89.1	106.0	110.6	105.5	104.4	111.7	104.9	117.9	93.2	102.0	103.3
Missouri, Tennessee, Virginia	.2	.1	.2	.2	.2	.2	.2	.2	.1	.2	.1	.2	.2
Montana	22.4	23.7	23.5	17.4	18.8	22.7	23.1	25.1	21.1	15.9	23.7	25.4	21.9
Nebraska	2.1	1.8	2.1	1.4	2.8	2.9	2.9	5.6	5.9	7.7	6.8	7.9	4.2
New Mexico	137.1	145.6	136.6	145.5	152.1	138.1	112.0	128.6	106.7	116.7	148.9	126.1	132.7
New York	12.2	8.7	12.0	10.3	11.4	9.9	9.7	13.1	12.0	12.5	11.6	11.9	11.3
Ohio	12.1	9.7	8.5	6.1	5.7	8.7	11.6	9.5	8.7	7.4	11.7	10.3	9.2
Oklahoma	430.5	436.7	436.1	388.1	457.0	480.6	502.3	429.9	435.5	444.7	493.8	472.0	450.7
Pennsylvania	32.1	33.5	28.9	35.9	34.1	32.3	35.1	34.8	42.0	36.0	32.5	33.8	34.2
Texas	2,094.6	2,008.5	1,964.9	1,878.5	2,102.2	2,139.4	2,312.2	2,461.9	2,486.8	2,601.6	2,470.7	2,506.3	2,254.4
Utah	2.5	3.0	3.4	3.4	3.3	3.5	3.5	3.5	3.5	3.7	3.8	3.6	3.4
West Virginia	7.1	7.9	8.0	6.7	7.2	8.3	9.5	9.1	7.8	8.4	7.5	7.7	7.9
Wyoming	165.4	165.2	152.2	160.0	159.6	196.0	188.4	205.5	177.9	146.8	175.2	198.1	174.2
Total domestic crude	5,163.2	5,043.6	4,956.4	4,908.6	5,274.3	5,301.6	5,571.6	5,747.5	5,716.4	5,794.9	5,782.8	5,790.8	5,424.0
Foreign crude	475.0	438.0	477.0	461.7	464.5	492.6	465.5	530.2	534.9	486.0	473.0	498.2	483.3
Grand total, 1950	5,638.2	5,481.6	5,433.4	5,370.3	5,738.8	5,794.2	6,037.1	6,277.7	6,251.3	6,280.9	6,255.8	6,289.0	5,907.3
Pennsylvania Grade (included above)	58.0	56.5	52.5	56.1	56.2	53.7	61.0	62.7	66.6	62.2	57.2	59.2	58.5
1951 [1]													
Alabama	2.9	2.9	2.5	3.9	2.7	2.4	2.1	3.2	2.8	3.0	2.6	2.6	2.8
Arkansas	74.6	98.7	70.8	81.0	82.2	74.5	86.9	80.3	82.4	78.4	87.6	72.1	80.6
California	950.2	1,011.5	972.1	961.1	956.7	964.1	971.0	995.1	1,002.1	983.7	1,000.6	943.3	975.6
Colorado	67.4	79.6	76.9	66.6	69.5	79.2	68.7	74.8	72.5	68.0	84.9	75.3	73.5
Florida	2.4	1.2	1.0	2.5	.1	3.5	.2	2.8	.8	3.5	.2	3.5	1.8
Illinois	157.5	200.6	150.3	128.5	126.5	150.3	165.2	149.3	152.9	148.1	148.0	168.8	153.6
Indiana	28.0	20.4	25.8	27.7	29.5	27.5	29.7	31.9	30.0	31.8	32.0	28.8	28.7
Kansas	317.4	314.1	331.1	297.0	295.9	310.0	292.3	287.6	333.3	341.4	319.5	334.2	314.5
Kentucky	39.3	20.1	28.6	21.2	29.0	37.6	30.3	26.4	32.0	35.1	45.4	26.4	31.0
Louisiana	615.2	624.2	625.8	651.8	631.7	642.1	600.5	631.6	620.0	663.1	667.0	628.1	633.4

Michigan	34.0	42.2	40.3	35.1	37.9	35.7	40.1	37.7	38.2	37.5	37.7	37.5	37.8
Mississippi	86.8	121.4	102.5	90.9	100.6	104.8	105.0	100.6	85.6	98.8	106.1	94.1	99.6
Missouri, North Dakota, Tennessee, Virginia	.2	.2	.2	.2	.1	.2	.1	.3	.3	.3	.2	.1	.2
Montana	24.8	24.9	22.7	20.6	24.4	28.0	29.5	25.0	28.7	22.1	26.8	26.6	25.3
Nebraska	8.8	8.8	8.7	5.5	6.7	5.9	6.0	5.6	5.1	.6	4.1	6.8	6.0
New Mexico	153.1	125.7	129.8	159.8	140.3	151.3	147.6	138.8	143.6	136.9	171.3	130.0	144.0
New York	12.0	11.4	11.4	11.3	10.3	11.7	12.0	12.0	11.0	14.6	11.9	12.2	11.8
Ohio	8.7	11.1	12.6	7.7	7.0	9.3	7.8	6.9	9.0	8.8	8.0	9.1	8.8
Oklahoma	512.5	491.6	537.9	502.8	523.0	529.3	513.3	516.9	498.0	481.0	515.1	527.9	512.6
Pennsylvania	33.4	32.4	31.8	33.2	31.6	30.2	27.4	28.5	33.8	31.3	31.8	26.1	30.9
Texas	2,720.3	2,756.7	2,743.7	2,592.4	2,690.3	2,760.1	2,704.8	2,760.5	2,831.7	2,742.7	2,788.4	2,997.0	2,757.6
Utah	2.9	3.5	3.7	3.4	3.8	4.3	3.6	3.9	3.7	4.0	4.4	4.7	3.9
West Virginia	6.6	6.5	7.2	7.2	8.8	6.2	8.1	8.4	8.4	7.9	6.2	8.2	7.5
Wyoming	171.4	178.4	170.0	155.2	174.3	194.7	194.1	199.0	187.6	171.8	175.7	179.8	179.4
Total domestic crude	6,030.4	6,188.1	6,107.4	5,866.6	5,982.9	6,162.9	6,046.3	6,127.1	6,213.5	6,114.4	6,275.5	6,343.2	6,120.9
Foreign crude	548.3	490.4	473.8	458.8	535.8	538.3	554.5	523.7	526.2	443.6	460.3	433.7	499.1
Grand total, 1951	6,578.7	6,678.5	6,581.2	6,325.4	6,518.7	6,701.2	6,600.8	6,650.8	6,739.7	6,558.0	6,735.8	6,776.9	6,620.0
Pennsylvania Grade (included above)	58.0	55.7	56.9	48.9	61.5	52.7	55.1	49.3	57.1	59.0	52.6	49.8	54.7

[1] Preliminary figures.

TABLE 38.—Demand for total crude petroleum in the United States, 1950–51, by State of origin and month

[Thousands of barrels]

State	January	February	March	April	May	June	July	August	September	October	November	December	Year
1950													
Alabama	28	45	67	41	54	51	64	46	68	64	76	60	664
Arkansas	2,649	2,584	2,634	2,810	2,919	2,511	2,649	2,769	2,420	2,874	2,679	2,532	32,030
California	27,612	24,114	26,307	26,734	27,960	27,544	28,264	29,822	28,651	29,834	28,927	28,539	334,308
Colorado	1,994	1,748	1,886	1,736	1,872	1,729	2,045	1,746	1,842	2,340	2,341	2,385	23,664
Florida	41	50	10	54	27	4	16	104	119	4	45	60	534
Illinois	5,995	5,324	5,129	6,409	5,859	5,293	4,796	5,552	5,291	5,368	4,559	5,220	64,795
Indiana	844	730	850	907	950	875	990	912	882	929	901	835	10,605
Kansas	8,550	7,353	8,808	8,224	9,742	8,303	9,682	9,907	8,983	8,472	8,782	9,251	106,057
Kentucky	761	722	827	858	1,005	796	901	976	880	1,107	1,035	704	10,572
Louisiana	16,604	14,830	16,920	15,350	16,679	16,469	18,951	18,349	18,616	18,338	18,494	19,927	209,527
Michigan	1,562	1,323	1,383	1,352	1,424	1,030	1,603	1,396	1,354	1,205	1,264	1,343	16,239
Mississippi	2,951	2,753	2,762	3,180	3,427	3,164	3,235	3,462	3,146	3,654	2,795	3,161	37,690
Missouri, Tennessee, Virginia	7	4	6	5	6	5	6	6	4	6	4	6	[1] 65
Montana	695	662	728	523	583	681	715	779	632	495	710	787	7,990
Nebraska	65	49	66	43	86	88	89	174	178	238	204	244	1,524
New Mexico	4,249	4,078	4,233	4,364	4,716	4,143	3,471	3,986	3,201	3,619	4,468	3,908	48,436
New York	377	245	372	310	354	295	300	405	361	388	349	369	4,125
Ohio	375	271	265	184	177	260	361	296	261	231	350	320	3,351
Oklahoma	13,346	12,229	13,519	11,642	14,166	14,419	15,571	13,326	13,065	13,787	14,813	14,633	164,516
Pennsylvania	996	938	895	1,076	1,058	969	1,087	1,078	1,259	1,115	974	1,046	12,491
Texas	64,932	56,239	60,910	56,355	65,169	64,183	71,678	76,320	74,605	80,650	74,120	77,696	822,857
Utah	77	84	105	101	103	107	110	109	105	114	114	112	1,241
West Virginia	221	220	249	200	222	249	295	281	235	259	224	237	2,892
Wyoming	5,126	4,626	4,718	4,800	4,946	5,879	5,841	6,372	5,336	4,551	5,254	6,142	63,591
Total domestic crude	160,057	141,221	153,649	147,258	163,504	159,047	172,720	178,173	171,494	179,642	173,482	179,517	1,979,764
Foreign crude	14,726	12,265	14,786	13,850	14,400	14,779	14,431	16,435	16,046	15,065	14,191	15,443	176,417
Grand total, 1950	174,783	153,486	168,435	161,108	177,904	173,826	187,151	194,608	187,540	194,707	187,673	194,960	2,156,181
Daily average:													
Domestic crude	5,163	5,044	4,956	4,909	5,274	5,302	5,572	5,748	5,716	5,795	5,783	5,791	5,424
Domestic and foreign crude	5,638	5,482	5,433	5,370	5,739	5,794	6,037	6,278	6,251	6,281	6,256	6,289	5,907
Pennsylvania Grade (included above)	1,797	1,583	1,628	1,683	1,741	1,610	1,891	1,944	1,997	1,927	1,716	1,834	21,351
1951 [2]													
Alabama	90	81	76	118	85	73	65	99	84	93	78	82	1,024
Arkansas	2,313	2,764	2,196	2,431	2,550	2,234	2,695	2,489	2,471	2,429	2,626	2,235	29,433
California	29,455	28,323	30,133	28,832	29,656	28,924	30,102	30,847	30,064	30,495	30,017	29,243	356,091
Colorado	2,090	2,227	2,383	1,997	2,154	2,376	2,130	2,320	2,175	2,107	2,548	2,335	26,842
Florida	76	34	32	77	2	106	6	87	24	109	6	107	666
Illinois	4,882	5,617	4,660	3,856	3,922	4,509	5,122	4,628	4,588	4,591	4,439	5,234	56,048

Indiana	869	570	801	832	914	824	922	990	899	986	961	893	10,461
Kansas	9,838	8,794	10,265	8,910	9,172	9,301	9,061	8,916	9,998	10,583	9,585	10,359	114,782
Kentucky	1,217	564	886	635	899	1,129	940	818	960	1,087	1,362	817	11,314
Louisiana	19,070	17,477	19,399	19,553	19,582	19,262	18,614	19,581	18,601	20,556	20,011	19,471	231,177
Michigan	1,055	1,181	1,250	1,053	1,176	1,071	1,242	1,169	1,145	1,162	1,131	1,161	13,796
Mississippi	2,692	3,400	3,177	2,727	3,118	3,145	3,256	3,120	2,567	3,063	3,184	2,916	36,365
Missouri, North Dakota, Tennessee, Virginia	5	4	5	6	5	5	4	11	9	8	8	5	[3] 75
Montana	768	698	704	617	756	839	913	773	862	685	803	825	9,243
Nebraska	273	248	268	164	206	177	186	173	153	19	124	211	2,202
New Mexico	4,746	3,519	4,025	4,794	4,349	4,540	4,575	4,302	4,308	4,244	5,138	4,030	52,570
New York	372	320	352	339	321	351	373	373	329	454	356	378	4,318
Ohio	270	310	389	231	218	279	242	214	272	274	239	282	3,220
Oklahoma	15,887	13,764	16,676	15,085	16,212	15,877	15,911	16,024	14,940	14,910	15,451	16,365	187,102
Pennsylvania	1,036	908	987	995	979	906	850	883	1,014	970	953	809	11,290
Texas	84,329	77,186	85,056	77,772	83,398	82,801	83,848	85,575	84,952	85,025	83,653	92,907	1,006,502
Utah	89	99	114	103	118	130	113	122	110	126	132	147	1,403
West Virginia	206	182	223	215	273	187	250	259	253	244	187	254	2,733
Wyoming	5,314	4,996	5,272	4,657	5,404	5,841	6,016	6,169	5,627	5,326	5,272	5,572	65,466
Total domestic crude	186,942	173,266	189,329	175,999	185,469	184,887	187,436	189,942	186,405	189,546	188,264	196,638	2,234,123
Foreign crude	16,996	13,731	14,689	13,764	16,612	16,148	17,189	16,234	15,787	13,752	13,811	13,446	182,159
Grand total, 1951	203,938	186,997	204,018	189,763	202,081	201,035	204,625	206,176	202,192	203,298	202,075	210,084	2,416,282
Daily average:													
Domestic crude	6,030	6,188	6,107	5,867	5,983	6,163	6,046	6,127	6,214	6,114	6,276	6,343	6,121
Domestic and foreign crude	6,579	6,679	6,581	6,325	6,519	6,701	6,601	6,651	6,740	6,558	6,736	6,777	6,620
Pennsylvania Grade (included above)	1,797	1,560	1,765	1,466	1,908	1,582	1,708	1,529	1,713	1,828	1,578	1,543	19,977

[1] Missouri (32), Tennessee (12), and Virginia (21).
[2] Preliminary figures.
[3] Missouri (29), North Dakota (20), Tennessee (14), and Virginia (12).

Louisiana ranked third in importance, supplying 10.6 percent of the total demand for domestic crude in 1950 and 10.3 percent in 1951. The demand for Louisiana crude increased 21.7 million barrels in 1951 or 10.3 percent. Total receipts of Louisiana crude at refineries amounted to 229.5 million barrels in 1951, an increase of 26.9 million, including increases of 8.9 million at Louisiana refineries, 11.7 million at refineries in the Indiana-Illinois district, and 10.1 million at Texas refineries; receipts of Louisiana crude in the East Coast district declined 3.3 million.

Oklahoma was fourth in importance, furnishing 8.3 percent of the total demand for domestic crude in 1950 and 8.4 percent in 1951. The demand for Oklahoma crude oil increased 22.6 million barrels or 13.7 percent in 1951. Total receipts of Oklahoma crude at refineries increased 17.8 million barrels in 1951, including gains of 4.5 million at Oklahoma refineries, 6.0 million at refineries in the Indiana-Illinois district, and 4.1 million at refineries in the Appalachian district.

Kansas, fifth in rank, supplied 5.4 percent of the total demand for domestic crude in 1950 and 5.1 percent in 1951. The demand for Kansas crude oil increased 8.7 million barrels or 8.2 percent in 1951. Total receipts of Kansas crude oil at refineries were 112.2 million barrels in 1951, including 60.6 million at Kansas refineries and 51.6 million at refineries in other States. Intrastate receipts increased 1.3 million barrels. Receipts of Kansas crude in the Indiana-Illinois district rose from 35.4 to 37.8 million barrels and those at Oklahoma refineries rose from 10.4 to 11.9 million barrels in 1951.

Wyoming, the sixth State, outranked Illinois in 1951; it supplied 3.2 percent of the demand for domestic crude in 1950 and 2.9 percent in 1951. The demand for Wyoming crude amounted to 65.5 million barrels in 1951, an increase of 1.9 million or a gain of 3 percent. Receipts of Wyoming crude at refineries totaled 65.4 million barrels in 1951, a gain of 4.1 million barrels. Intrastate receipts totaled 27.9 million barrels, an increase of 2.5 million. Receipts of Wyoming

TABLE 39.—Receipts of domestic crude oil in 1951, by States [1]

[Thousands of barrels]

Receiving State	Total domestic receipts	Intrastate receipts	Interstate receipts from															
			Arkansas	Colorado	Florida and New York	Illinois	Indiana	Kansas, Nebraska, and North Dakota	Kentucky and Ohio	Louisiana	Alabama and Mississippi	New Mexico	Oklahoma	Pennsylvania	Texas	West Virginia	Montana and Wyoming	Total
Arkansas	21,667	20,588	------	------	------	------	------	------	------	1,079	------	------	------	------	------	------	------	1,079
California, Washington	344,983	343,344	------	38	------	------	------	------	------	------	------	------	------	------	------	------	1,601	1,639
Colorado	7,421	1,701	------	------	------	------	------	------	------	------	------	------	------	------	------	------	5,720	5,720
Georgia, South Carolina	115	------	------	------	------	------	------	------	------	115	------	------	------	------	------	------	------	115
Illinois, Minnesota, Wisconsin	153,962	28,778	------	704	------	62	1,349	19,152	30	384	------	10,326	26,585	------	58,854	------	7,738	125,184
Indiana	134,610	538	------	1,810	------	4,220	------	17,274	------	96	------	5,160	18,440	------	80,792	------	6,280	134,072
Kansas, Nebraska, South Dakota	76,984	61,125	------	194	------	------	------	618	------	------	------	------	11,171	------	3,015	------	861	15,859
Kentucky, Tennessee	28,654	10,565	1,288	------	------	1,141	3,748	------	------	7,898	3,363	------	------	------	651	------	------	18,089
Louisiana, Alabama, Mississippi	189,463	119,260	8,118	------	------	------	------	------	------	------	24,343	------	------	------	37,742	------	------	70,203
Maryland	14,260	------	------	------	------	------	------	------	------	1,001	105	------	------	------	13,154	------	------	14,260
Massachusetts, Rhode Island	5,847	------	------	------	------	------	------	------	------	1,667	267	------	------	------	3,913	------	------	5,847
Michigan	38,426	15,827	------	------	------	3,830	------	167	------	------	------	------	2,324	------	13,566	------	2,712	22,599
Missouri	14,544	------	------	------	------	------	------	293	------	------	------	------	837	------	12,008	------	1,406	14,544
Montana	17,735	6,734	------	------	------	------	------	------	------	------	------	------	------	------	------	------	11,001	11,001
New Jersey, Florida	83,685	------	------	------	661	------	------	75	------	11,928	2,493	2,048	903	2,069	63,508	------	------	83,685
New Mexico	5,502	4,496	------	------	------	------	------	------	------	------	------	------	------	------	1,006	------	------	1,006
New York: East	4,716	------	------	------	------	------	------	------	------	------	4,269	------	------	------	447	------	------	4,716
West	16,211	2,813	------	------	------	4,965	------	969	------	------	------	------	------	536	6,928	------	------	13,398
Ohio: East	27,769	2,311	236	------	------	15,662	------	593	2,251	112	85	------	5,196	------	1,323	------	------	25,458
West	83,902	42	1,202	------	------	7,906	------	2,374	74	14,306	1,339	------	16,924	------	39,735	------	------	83,860
Oklahoma	99,109	68,887	------	------	------	------	------	11,909	------	------	------	621	------	------	17,692	------	------	30,222
Pennsylvania: East	88,794	------	------	------	------	147	------	------	------	9,761	------	------	------	------	78,886	------	------	88,794
West	17,022	10,628	------	------	64	682	------	------	941	------	------	------	2,319	------	2,034	354	------	6,394
Texas	659,797	562,338	30	------	------	------	------	------	------	65,719	------	27,937	3,773	------	------	------	------	97,459
Utah	21,210	1,294	------	19,122	------	------	------	------	------	------	------	------	------	------	------	------	794	19,916
West Virginia	4,462	2,023	------	------	------	154	------	------	441	------	------	------	1,844	------	------	------	------	2,439
Wyoming, Idaho	32,106	27,910	------	3,769	------	------	------	90	------	------	------	------	------	------	------	------	337	4,196
United States total	2,192,956	1,291,202	10,874	25,637	725	38,769	5,097	53,514	3,737	114,066	36,264	46,092	90,316	2,605	435,254	354	38,450	901,754
Daily average	6,008	3,538	30	70	2	106	14	147	10	313	99	126	248	7	1,192	1	105	2,470

[1] Preliminary figures.

TABLE 40.—Crude runs to stills and refinery receipts of crude oil by method of transportation in the United States in 1951, by State and district

[Thousands of barrels]

Receiving State and district	Crude runs to stills	Fuel and losses [1]	Receipts of domestic crude [2]	Change in refinery stocks	Total receipts by method of transportation						
					Intrastate			Interstate			Foreign boats
					Pipelines	Tank cars and trucks	Boats	Pipelines	Tank cars and trucks	Boats	
Georgia, South Carolina	3,963	−10		1						115	3,839
Maryland	23,241	−58		34						14,260	8,957
Massachusetts, Rhode Island	12,144	2		141						5,847	6,440
New Jersey, Florida	150,219	244	661	−1,322				3,623		80,062	65,456
New York: East	11,432	41		−296						4,716	6,461
West	16,232	55	2,877	−76	2,813			12,429	969		
Pennsylvania: East	169,395	288		−148				2,308		86,486	80,741
West	16,989	−3	13,233	36	10,562	66		6,310	84		
West Virginia	4,453	1	2,377	8	1,981	42		2,439			
District 1	408,068	560	19,148	−1,622	15,356	108		27,109	1,053	191,486	171,894
Illinois, Minnesota, Wisconsin	153,490	−31	67,547	868	28,743	35		122,118	2,407	659	[3] 365
Indiana	134,570	4	5,635	36	235	303		133,756	316		
Kansas, Nebraska, North Dakota, South Dakota	76,668	152	114,639	164	59,860	1,265		15,349	510		
Kentucky, Tennessee	28,253	7	12,920	394	1,436	165	8,964	5,471	663	11,955	
Michigan	38,171	439	15,827	−86	15,187	640		21,934	665		98
Missouri	14,543			1				14,544			
Ohio: East	27,781	2	3,735	−14	2,292	19		25,458			
West	83,943	10		−51	28	14		83,860			
Oklahoma	98,488	233	159,203	388	68,333	554		30,213	9		
District 2	655,907	816	379,506	1,700	176,114	2,995	8,964	452,703	4,570	12,614	463
Arkansas	21,530	5	31,462	132	20,348	240		719	360		
Louisiana, Alabama, Mississippi	190,424	388	269,590	−110	75,686	1,567	42,007	55,859	6,090	8,254	1,239
New Mexico	5,476	3	50,588	23	4,421	75		1,006			
Texas	661,502	158	997,592	5	519,866	4,881	37,591	52,649	239	44,571	1,868
District 3	878,932	554	1,349,232	50	620,321	6,763	79,598	110,233	6,689	52,825	3,107
Colorado	7,379	11	27,338	31	1,342	359		5,501	219		
Montana	17,890	56	7,715	−211	5,561	1,173		10,912	89		
Utah	21,035	62	1,294	113	1,028	266		19,916			
Wyoming, Idaho	32,063	20	65,379	23	26,932	978		3,007	1,189		
District 4	78,367	149	101,726	−44	34,863	2,776		39,336	1,497		
California, Washington, district 5	349,130	563	343,344	−1,101	280,348	5,686	57,310		1,639		3,609
United States total	2,370,404	2,642	2,192,956	−1,017	1,127,002	18,328	145,872	629,381	15,448	256,925	179,073
Daily average	6,494	7	6,008	−3	3,088	50	400	1,724	42	704	491

[1] Negative figure represents average. [2] Represents a total movement of crude oil to refineries within the State (intrastate) and in other States (interstate). [3] Pipeline.

crude at refineries in other Mountain States were 17.9 million barrels, a gain of 2.4 million. Receipts in the Indiana-Illinois district and the Oklahoma-Kansas district were 18.8 million barrels, a decline of 0.4 million compared with 1950.

Illinois dropped to seventh place in supplying the demand for domestic crude oil, dropping from 3.3 percent of the total in 1950 to 2.5 percent in 1951. The demand for Illinois crude oil declined 13.6 percent from 64.8 million barrels in 1950 to 56.0 million in 1951 as the result of a downward trend in production. The primary markets for Illinois crude oil are in the Indiana-Illinois and Appalachian refinery districts.

New Mexico, ranking eighth, supplied 2.4 percent of the total demand for domestic crude oil in both 1950 and 1951. The demand for New Mexico crude amounted to 52.6 million barrels in 1951, a gain of 4.1 million or 8.5 percent. Receipts of New Mexico crude at refineries in 1951 totaled 50.6 million barrels, an increase of 1.9 million. Intrastate receipts amounted to 4.5 million barrels; receipts in Texas were 27.9 million, in the Indiana-Illinois district 15.5 million, in the East Coast 2.1 million, and in Oklahoma 0.6 million. The principal increase was 1.9 million barrels in the Indiana-Illinois district.

STOCKS

Stocks of all oils rose from 582.7 million barrels on the first of the year to 615.1 million at the end of the year, an increase of 32.4 million barrels during 1951, including gains of 7.3 million for crude oil, 0.8 million for natural-gas liquids, and 24.3 million barrels for refined stocks.

The principal changes in domestic crude-oil stocks, by origin, in 1951 were gains of 3.6 million barrels for Texas, 2.5 million for Wyoming, 2.1 million for Illinois, and 0.7 million each for Oklahoma, Louisiana, and Mississippi. The chief decline was 1.6 million barrels for California.

The increase in refined stocks indicated that crude production and refinery runs were substantially in excess of demand. The increase of 24.3 million barrels in refined stocks included a gain of 36.3 million barrels in districts east of California and a decline of 12.0 million barrels in the California district.

TABLE 41.—Stocks of crude petroleum, natural-gas liquids, and refined products in continental United States at end of year, 1947–51

[Thousands of barrels]

Product	1947	1948	1949	1950	1951 [1]
Crude petroleum (refinable):					
At refineries	52,864	60,969	60,405	63,328	62,311
Pipeline and tank-farm	156,726	169,508	177,049	167,941	175,481
Producers	15,339	16,095	15,902	17,194	17,991
Total refinable	224,929	246,572	[2] 253,356	[2] 248,463	[2] 255,783
California heavy crude	5,725	10,055			
Total crude petroleum	230,654	256,627	253,356	248,463	255,783
Natural-gas liquids	4,296	5,579	6,831	7,355	8,186
Refined products	267,103	345,650	342,704	326,892	351,146
	[3] 265,850	[3] 343,537	[3] 342,932	[3] 341,300	
Grand total	502,053	607,856	602,891	582,710	615,115
	[3] 500,800	[3] 605,743	[3] 603,119	[3] 597,118	

[1] Final figures.
[2] Separation between "gasoline-bearing" and "heavy" in California discontinued in 1949.
[3] New basis, for comparison with subsequent year.

TABLE 42.—Stocks of crude petroleum in continental United States in 1951, by State of origin and month [1]

[Thousands of barrels]

State of origin	Jan. 1	Jan. 31	Feb. 28	Mar. 31	Apr. 30	May 31	June 30	July 31	Aug. 31	Sept. 30	Oct. 31	Nov. 30	Dec. 31
Alabama	92	86	74	80	54	59	81	108	94	93	84	83	88
Arkansas	2,268	2,475	2,028	2,390	2,335	2,331	2,551	2,397	2,400	2,388	2,547	2,334	2,605
California	31,240	31,514	30,124	29,803	29,846	30,141	30,481	30,464	29,846	29,213	29,090	28,557	29,616
Colorado	1,555	1,777	1,641	1,621	1,898	2,020	1,754	1,764	1,768	1,862	2,151	1,909	1,938
Florida	121	92	102	119	91	139	83	131	94	120	63	107	51
Illinois	9,197	9,479	8,173	8,490	9,502	10,768	11,016	10,851	11,152	11,210	11,648	11,927	11,356
Indiana	283	219	278	306	293	263	293	310	317	391	413	386	419
Kansas	10,132	9,652	9,500	9,019	9,598	10,182	10,145	10,672	11,750	11,422	11,015	11,199	10,568
Kentucky	1,359	1,055	1,230	1,217	1,446	1,487	1,283	1,336	1,555	1,679	1,740	1,438	1,667
Louisiana	14,229	14,653	14,593	14,810	14,559	14,782	14,361	15,263	15,405	15,831	15,400	14,571	14,890
Michigan	643	830	749	714	837	870	962	894	899	864	875	840	770
Mississippi	2,668	3,213	2,718	2,687	3,002	3,049	2,939	2,803	2,796	3,234	3,330	3,158	3,342
Missouri, Nebraska, North Dakota	60	76	57	39	79	78	87	83	98	114	263	307	268
Montana	1,270	1,244	1,238	1,251	1,336	1,367	1,295	1,162	1,162	1,057	1,132	1,060	949
New Mexico	6,449	5,925	6,265	6,642	6,168	6,298	6,070	5,953	6,135	6,289	6,759	6,313	6,961
New York	197	188	184	188	190	237	241	233	236	243	175	169	133
Ohio	763	765	670	556	583	656	640	672	735	700	706	710	640
Oklahoma	28,549	28,012	28,232	27,334	27,578	27,274	26,759	26,732	26,765	27,304	28,766	29,328	29,236
Pennsylvania	1,176	1,157	1,135	1,124	1,076	1,074	1,113	1,191	1,271	1,123	1,142	1,076	1,036
Texas	118,389	113,760	109,589	107,819	112,657	115,482	115,677	118,082	120,217	121,005	126,508	127,979	122,015
Utah	14	30	29	23	28	29	29	28	29	34	29	32	36
West Virginia	425	457	479	485	497	459	494	487	472	442	442	478	435
Wyoming	8,995	9,583	9,929	10,595	11,460	11,867	11,569	11,233	10,912	10,901	11,305	11,507	11,461
Total domestic crude	240,074	236,242	229,017	227,312	235,113	240,912	239,923	242,849	246,108	247,519	255,583	255,468	250,480
Foreign crude	8,389	6,865	6,230	6,512	8,067	7,506	8,247	7,998	8,168	7,381	6,683	5,632	5,303
Grand total	248,463	243,107	235,247	233,824	243,180	248,418	248,170	250,847	254,276	254,900	262,266	261,100	255,783
Pennsylvania Grade (included above)	2,134	2,097	2,055	1,997	2,179	2,000	2,071	2,035	2,225	2,049	1,985	1,978	1,857

[1] Final figures.

TABLE 43.—Stocks of crude petroleum in continental United States in 1951, by location and month [1]

[Thousands of barrels]

State	Jan. 1	Jan. 31	Feb. 28	Mar. 31	Apr. 30	May 31	June 30	July 31	Aug. 31	Sept. 30	Oct. 31	Nov. 30	Dec. 31
Arkansas	2,138	2,256	2,027	2,128	1,919	1,891	2,129	2,127	1,979	2,076	2,092	2,040	2,299
California, Washington	31,240	31,600	30,221	30,062	29,992	30,377	30,594	30,676	30,016	29,365	29,313	28,631	29,723
Colorado	721	745	671	935	871	891	851	859	846	746	837	789	775
Georgia, Delaware, Florida, South Carolina, Virginia	336	286	362	383	395	290	382	370	411	334	236	420	263
Illinois, Minnesota, Wisconsin	16,811	17,073	15,372	15,378	16,566	17,818	18,609	18,661	18,924	19,675	20,271	20,597	20,250
Indiana	4,534	4,279	3,792	3,833	4,241	4,374	4,238	4,045	4,061	4,515	4,726	4,188	4,008
Kansas, Nebraska, North Dakota	10,052	9,614	9,611	9,594	10,838	10,785	10,283	10,907	11,315	11,298	12,132	12,344	11,820
Kentucky, Tennessee	2,151	2,698	2,559	2,644	2,882	2,897	2,626	2,267	2,953	2,640	3,033	3,125	3,185
Louisiana, Alabama	12,895	13,063	12,641	12,785	12,804	13,507	13,198	12,698	13,322	13,327	13,316	12,946	13,785
Maryland	1,043	1,212	1,055	1,039	1,107	1,060	1,138	1,383	1,037	1,129	1,060	991	1,077
Massachusetts, Rhode Island	699	530	727	602	659	640	379	683	766	830	681	712	840
Michigan	1,604	1,476	1,261	1,287	1,388	1,531	1,642	1,554	1,681	1,635	1,577	1,620	1,632
Mississippi	1,130	1,575	1,493	1,481	1,810	1,935	1,837	1,628	1,738	1,709	1,713	1,688	1,878
Missouri, Iowa	6,339	6,339	6,315	6,509	6,596	6,718	6,458	6,481	6,595	6,751	6,507	6,652	6,339
Montana	1,742	1,699	1,742	1,722	1,971	1,897	1,764	1,581	1,559	1,541	1,613	1,376	1,352
New Jersey	7,043	6,213	5,247	6,482	7,489	7,224	7,400	7,239	8,132	6,685	7,390	6,923	5,761
New Mexico	1,689	1,734	1,795	1,933	1,821	1,729	1,669	1,604	1,637	1,749	1,840	2,196	1,718
New York	1,201	1,176	1,046	1,026	1,137	1,163	1,168	1,364	1,133	1,313	1,379	1,353	845
Ohio	7,407	7,017	6,885	6,256	6,644	7,933	7,658	7,389	8,029	8,336	8,337	7,995	8,118
Oklahoma	28,493	27,187	26,544	26,760	27,245	27,544	27,621	27,735	29,301	29,143	29,979	30,839	29,957
Pennsylvania	7,888	6,940	7,499	7,583	7,385	7,789	7,984	8,830	7,841	8,542	8,100	7,862	7,931
Texas	93,516	89,877	87,539	84,543	87,407	87,881	88,424	90,822	91,366	91,738	95,427	94,895	91,488
Utah	542	645	670	620	780	755	621	614	616	602	663	689	690
West Virginia	583	602	669	640	615	618	654	768	706	705	726	773	742
Wyoming, Idaho	6,666	7,271	7,504	7,599	8,618	9,171	8,843	8,562	8,312	8,516	9,318	9,456	9,307
Total	248,463	243,107	235,247	233,824	243,180	248,418	248,170	250,847	254,276	254,900	262,266	261,100	255,783

[1] Final figures.

TABLE 44.—Stocks of crude petroleum in continental United States in 1951, by classification and location [1]

[Thousands of barrels]

Classification and location	Jan. 1	Jan. 31	Feb. 28	Mar. 31	Apr. 30	May 31	June 30	July 31	Aug. 31	Sept. 30	Oct. 31	Nov 30	Dec. 31
At refineries:													
Arkansas	550	426	380	490	366	343	530	465	395	501	472	494	682
California, Washington	9,645	9,469	8,440	8,986	8,523	8,993	8,801	9,096	8,237	8,803	8,140	8,416	8,544
Colorado	221	194	165	213	281	320	262	287	267	211	285	227	252
Georgia, Delaware, South Carolina	215	229	260	341	304	261	302	239	340	214	179	313	216
Illinois, Minnesota, Wisconsin	4,172	4,286	3,608	3,627	3,704	4,476	4,833	5,111	4,691	4,649	4,859	4,948	5,040
Indiana	1,820	1,885	1,573	1,825	1,913	1,796	1,947	1,733	1,662	1,871	1,849	1,708	1,856
Kansas, Nebraska	2,253	2,096	2,002	1,931	2,584	2,699	2,465	2,671	2,545	2,506	2,700	2,776	2,417
Kentucky, Tennessee	991	1,057	905	1,065	1,251	1,198	934	882	1,228	985	1,275	1,398	1,385
Louisiana	3,823	4,131	3,640	3,935	4,125	4,503	4,417	4,426	4,371	4,114	3,887	3,968	3,699
Maryland	1,043	1,212	1,055	1,039	1,107	1,060	1,138	1,383	1,037	1,129	1,060	991	1,077
Massachusetts, Rhode Island	699	530	727	602	659	640	379	683	766	830	681	712	840
Michigan	767	655	357	479	462	584	739	656	679	637	601	654	681
Mississippi	12	12	13	14	17	14	11	13	15	14	20	24	26
Missouri	218	210	211	228	232	244	217	220	208	235	237	223	219
Montana	868	819	796	758	940	941	915	777	804	804	814	741	657
New Jersey	6,912	5,977	5,139	6,387	7,285	7,009	7,301	7,045	7,878	6,479	7,209	6,482	5,590
New Mexico	83	86	71	89	63	76	96	84	87	110	117	121	106
New York	984	967	828	809	939	959	1,023	1,174	961	1,131	1,142	1,127	612
Ohio	1,481	1,378	1,436	1,385	1,315	1,605	1,378	1,360	1,434	1,476	1,341	1,311	1,416
Oklahoma	3,146	2,990	2,940	3,035	3,163	3,261	3,346	3,254	3,328	3,608	3,337	3,492	3,534
Pennsylvania	6,244	5,223	5,827	5,886	5,651	6,172	6,397	7,147	6,031	6,747	6,369	6,119	6,132
Texas	15,781	15,004	14,349	14,036	16,750	16,346	16,513	16,873	17,103	16,470	17,121	17,476	15,786
Utah	412	515	538	490	632	599	484	468	475	464	506	520	525
West Virginia	31	45	32	39	36	36	34	40	36	34	56	53	39
Wyoming, Idaho	957	981	968	982	1,064	1,230	1,074	959	923	894	1,131	1,003	980
Total at refineries	63,328	60,377	56,260	58,671	63,366	65,365	65,536	67,046	65,501	64,916	65,388	65,297	62,311
Pipeline and tank-farm stocks:													
Arkansas	1,213	1,445	1,267	1,253	1,168	1,173	1,219	1,287	1,209	1,190	1,240	1,171	1,237
California	17,152	17,685	17,309	16,633	17,038	16,768	17,101	16,937	17,034	15,809	16,612	15,615	16,499
Colorado	380	411	376	587	440	421	429	422	424	385	397	412	373
Illinois	12,034	12,192	11,159	11,176	12,272	12,767	13,196	12,975	13,678	14,441	14,837	15,064	14,625
Indiana	2,644	2,329	2,154	1,943	2,263	2,513	2,226	2,247	2,334	2,564	2,807	2,415	2,082
Kansas, Nebraska, North Dakota	6,814	6,548	6,674	6,663	7,278	7,115	6,847	7,245	7,768	7,756	8,425	8,567	8,396
Kentucky, Tennessee	1,090	1,576	1,589	1,514	1,566	1,639	1,632	1,325	1,660	1,585	1,683	1,657	1,730
Louisiana, Alabama	7,654	7,358	7,487	7,405	7,256	7,543	7,331	6,856	7,492	7,805	7,986	7,568	8,658
Michigan	642	626	674	613	731	757	718	708	822	808	791	781	761
Mississippi	753	1,158	1,085	1,062	1,403	1,546	1,431	1,215	1,358	1,285	1,313	1,269	1,452
Missouri, Iowa	6,121	6,129	6,104	6,281	6,364	6,474	6,241	6,261	6,387	6,516	6,270	6,429	6,120
Montana	689	700	761	774	841	781	674	639	585	557	619	465	520
New Jersey, Florida	239	282	198	127	284	233	166	311	312	313	225	535	205

New Mexico	1,001	1,043	1,144	1,279	1,193	1,068	998	945	960	999	1,133	1,365	1,022
New York	187	179	188	187	168	174	115	160	142	152	207	196	203
Ohio	5,836	5,549	5,364	4,786	5,249	6,248	6,200	5,949	6,515	6,780	6,911	6,599	6,617
Oklahoma	24,062	22,847	22,274	22,405	22,747	22,978	22,955	23,181	24,698	24,170	25,327	26,062	25,148
Pennsylvania	1,474	1,547	1,507	1,537	1,564	1,462	1,427	1,523	1,655	1,635	1,571	1,588	1,629
Texas	72,210	68,733	67,590	64,797	65,022	65,835	66,141	68,019	68,468	69,228	72,431	71,524	69,662
Utah	125	126	129	125	144	152	133	141	134	129	151	157	152
West Virginia	387	392	472	436	414	422	465	568	510	506	515	565	538
Wyoming	5,234	5,700	6,051	6,127	7,039	7,431	7,289	7,163	6,929	7,117	7,722	7,978	7,852
Total pipeline and tank-farm stocks	167,941	164,555	161,556	157,710	162,444	165,500	164,934	166,077	171,074	171,730	179,173	177,982	175,481
Producers' stocks	17,194	18,175	17,431	17,443	17,370	17,553	17,700	17,724	17,701	18,254	17,705	17,821	17,991
Grand total: 1951	248,463	243,107	235,247	233,824	243,180	248,418	248,170	250,847	254,276	254,900	262,266	261,100	255,783
1950	253,356	246,610	243,750	241,230	244,605	239,877	242,287	240,270	237,393	242,311	246,424	249,525	248,463

[1] Final figures.

PRICES AND VALUE

The average value of crude petroleum at the well, as reported in the annual survey of the Bureau of Mines, rose from $2.51 per barrel in 1950 to $2.53 in 1951. The total value of crude petroleum at the well amounted to $4,963 million in 1950 and increased to $5,682 million in 1951, as a result of the increase of 2 cents per barrel and the gain of 13.7 percent in the volume of production.

The average value of crude oil at the well varies with the quality of the oil and the distance from market. The highest value crudes, owing to their high content of lubricants, originate in the Appalachian district. The value of crude from the Illinois basin is well above the average because of quality and nearness to refinery and product markets. The value of crude in Oklahoma and Kansas is slightly above the average, the good quality being somewhat offset by distance from markets. The value of Texas crude is a little above the average and is affected by the relative changes in the volume of production in the wide range of values owing to quality and location.

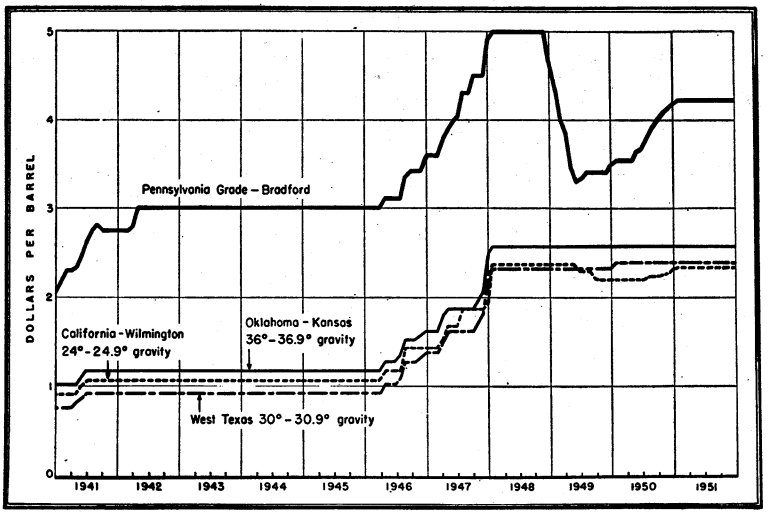

FIGURE 5.—Posted prices of selected grades of crude petroleum in the United States, 1941–51, by months.

The principal 1951 changes in value at the well by States include a sharp rise of 45 cents per barrel for New York, and similar increases for Pennsylvania and West Virginia; a gain of 9 cents per barrel for California, reflecting a relative scarcity of crude oil in relation to increased military demands and product exports; and declines of 7 cents per barrel in Mississippi and 5 cents in Montana. Changes for other States were relatively small and reflect local conditions or a shift in the volume of production between high and low value crudes.

There were no changes in the posted prices shown for representative types of crude in 1951. Only in the case of Pennsylvania Grade crudes and California crudes, which trended upward in 1950, would these figures indicate any increase in average prices in 1951.

TABLE 45.—Value at wells of crude petroleum produced in the United States, 1950–51, by States

State	1950		1951 [1]	
	Total (thousands of dollars)	Average per barrel	Total (thousands of dollars)	Average per barrel
Arkansas	76,530	$2.46	73,830	$2.48
California	707,630	2.16	797,550	2.25
Colorado	59,420	2.55	69,150	2.54
Illinois	171,820	2.77	161,230	2.77
Indiana	29,530	2.76	29,140	2.75
Kansas	276,500	2.57	296,110	2.57
Kentucky	28,650	2.76	32,190	2.77
Louisiana:				
Gulf Coast	438,250	2.66	500,200	2.65
Northern	116,270	2.63	113,310	2.63
Total Louisiana	554,520	2.65	613,510	2.65
Michigan	42,730	2.70	37,870	2.72
Mississippi	88,330	2.31	82,970	2.24
Montana	20,430	2.52	22,040	2.47
Nebraska	3,300	2.13	5,610	2.33
New Mexico	115,100	2.43	130,050	2.45
New York	15,660	3.78	17,990	4.23
Ohio	10,250	3.03	9,450	3.05
Oklahoma	423,020	2.57	482,620	2.57
Pennsylvania	45,300	3.82	47,390	4.25
Texas:				
Gulf Coast	542,000	2.72	650,360	2.72
West Texas	711,010	2.48	952,820	2.50
East Texas proper	259,240	2.65	267,640	2.65
Other districts	634,910	2.58	739,590	2.56
Total Texas	2,147,160	2.59	2,610,410	2.58
West Virginia	9,350	3.33	10,310	3.76
Wyoming	133,120	2.16	146,050	2.15
Alabama, Florida, Missouri, North Dakota, Tennessee, Utah, Virginia	5,030	2.00	6,240	2.00
Grand total	4,963,380	2.51	5,681,710	2.53

[1] Preliminary figures.

TABLE 46.—Posted price per barrel of petroleum at wells in the United States in 1951, by grades, with dates of change

Date	Pennsylvania Grade		Corning Grade in Buckeye Pipe Line Co.[2]	Western Kentucky [3]	Illinois Basin [4]	Midland, Mich.[5]	Oklahoma-Kansas [6]	
	Bradford and Allegany districts [1]	In Southwest Pennsylvania pipelines [2]					34°-34.9°	36°-36.9°
Jan. 1	$4.25	$3.82	$2.70	$2.77	$2.77	$2.80	$2.53	$2.57

Date	Panhandle Texas (Carson, Gray, Hutchinson, and Wheeler Counties), 35°-35.9° [7]	West Texas 30°-30.9° [7]	Lea County, N. Mex., 30°-30.9° [7]	South Texas, Duval-Mirando, 24°-24.9° [7]	East Texas [7]	Gulf Coast			
						Conroe, Tex.[8]	Texas, 30°-30.9° [8]	Texas, 20°-20.9° [8]	Louisiana, 30°-30.9° [9]
Jan. 1	$2.55	$2.38	$2.38	$2.53	$2.65	$2.83	$2.60	$2.40	$2.55

Date	Rodessa, La., 36°-36.9° [9]	Smackover, Ark.[10]	Elk Basin, Wyo., 30°-30.9°[4]	Salt Creek, Wyo., 36°-36.9°[11]	California [12]			
					Coalinga, 32°-32.9°	Kettleman, 37°-37.9°	Midway-Sunset, 19°-19.9°	Wilmington, 24°-24.9°
Jan. 1	$2.57	$2.08	$2.14	$2.57	$2.61	$2.80	$2.00	$2.33

[1] The Tide Water Associated Oil Co.
[2] The South Penn Oil Co.
[3] Sohio Corp.
[4] The Ohio Oil Co.
[5] The Pure Oil Co.
[6] Standard Oil Co. (Indiana).
[7] Humble Oil & Refining Co.
[8] The Texas Co.
[9] Esso Standard Oil Co.
[10] Arkansas Fuel Oil Co.
[11] Stanolind Oil & Gas Co.
[12] Standard Oil Co. of California.

REFINED PRODUCTS

GENERAL REVIEW

The total demand for all oils [5] averaged 7,467,000 barrels daily in 1951, a gain of 655,000 barrels daily or 9.6 percent. This increase in total demand included an abnormal increase in the exports of refined products, due to a shortage in the supply outside the United States after the closing of the Abadan refinery in Iran and a substantial gain in domestic demand in continental United States that included a material increase in the delivery of products to our Armed Forces for use at home and abroad. The increase of 13 percent in crude input at refineries, compared with 1950, was relatively higher than the gain in total demand because of the increase of 24.3 million barrels in refined stocks in 1951, compared with a decline in such stocks in 1950 of 16.0 million barrels.

The new supply of refined products comprises the volume of refinery output from crude oil, production of light products from natural gas, and imports of refined products. Crude runs to stills increased from 2,094.9 million barrels in 1950 to 2,370.4 million in 1951, a gain of 275.5 million barrels or over 13 percent. The production of light oils recovered from natural gas plus a small amount of motor benzol from coke ovens rose from 182.1 million

[5] For definition, *see* text footnote 1 at the beginning of this chapter.

barrels in 1950 to 205.7 million in 1951, a gain of 23.6 million barrels or 13 percent. Imports of refined products declined from 132.5 million barrels in 1950 to 128.6 million in 1951, a drop of 3.9 million barrels or 3 percent.

The marketed production of the light oils, other than crude, amounted to 204.9 million barrels in 1951, after the increase of 0.8 million barrels in stocks is deducted. Of this total, 129.0 million barrels was blended with gasoline, either at refineries, or outside points, or exported as such. The remaining 75.8 million barrels was mainly sold as liquefied gases for fuel and chemical use (72.4 million) or represented a small amount (3.4 million) of distillate and kerosine produced.

TABLE 47.—Runs to stills and output of petroleum products at refineries in the United States, 1947–51

[Thousands of barrels]

Product	1947	1948	1948 [1]	1949	1950	1951 [2]
Input:						
Crude petroleum:						
Domestic	1,754,987	1,907,027	1,924,335	1,789,756	1,918,854	2,188,677
Foreign	97,259	124,014	124,014	154,465	176,013	181,727
Total crude petroleum	1,852,246	2,031,041	2,048,349	1,944,221	2,094,867	2,370,404
Natural-gas liquids	70,692	76,237	76,218	85,457	94,639	99,250
Total input	1,922,938	2,107,278	2,124,567	2,029,678	2,189,506	2,469,654
Output:						
Gasoline	814,841	895,986	895,986	939,051	998,093	1,108,880
Kerosine	110,412	121,914	121,914	102,152	118,512	135,742
Distillate fuel oil	312,173	380,700	379,340	340,825	398,912	475,801
Residual fuel oil	447,795	466,317	479,988	424,909	425,217	469,377
Lubricating oil	51,765	51,416	51,416	45,389	51,735	61,489
Wax [3]	3,624	3,515	3,515	3,208	4,462	4,814
Coke [3]	12,077	14,494	14,494	16,959	17,224	18,977
Asphalt [3]	49,286	51,919	51,919	49,007	58,240	66,302
Road oil	7,074	7,915	7,916	7,691	6,928	6,100
Still gas [3]	85,564	81,159	81,159	82,621	83,743	96,294
Liquefied gases	18,670	23,676	23,676	23,469	29,083	33,045
Other finished products	5,678	6,929	6,929	4,236	4,717	7,201
Unfinished gasoline (net)	984	[4] 917	[4] 917	[4] 418	243	[4] 353
Other unfinished oils (net)	[4] 1,227	[4] 513	4,464	[4] 10,006	[4] 6,891	[4] 11,367
Shortage (or overage) [5]	4,222	2,768	2,768	585	(712)	(2,648)
Total output	1,922,938	2,107,278	2,124,567	2,029,678	2,189,506	2,469,654

[1] Includes California data on a new basis to compare with subsequent years.
[2] Preliminary figures.
[3] Conversion factors: 280 pounds of wax to the barrel; 5.0 barrels of coke to the short ton; 5.5 barrels of asphalt to the short ton; 3,600 cubic feet of still gas to the barrel.
[4] Negative quantity; represents net excess of unfinished oils rerun over unfinished oil produced.
[5] Includes losses or gains (parentheses) in volume during processing.

Imports of refined petroleum products in 1951 totaled 128.6 million barrels, including 118.7 million barrels of residual fuel, 1.9 million of distillate fuel, 0.4 million of motor fuel, 2.4 million of asphalt, and 5.2 million of unfinished oils for further refining. The only products to show an increase over 1950 were motor fuel and asphalt. Product imports exceeded refined exports by 56 million barrels in 1950 and by only 3 million in 1951.

TABLE 48.—Salient statistics of the major refined petroleum products in continental United States, 1947–51

[Thousands of barrels]

Product	1947	1948	1949	1950	1951 [1]
Motor fuel:					
Production	839,998	921,923	962,417	1,024,462	1,139,511
Imports	358	302		156	418
Exports	47,449	37,302	39,347	24,721	40,356
Stocks, end of year	87,407	101,060	110,417	116,024	125,243
Domestic demand	795,015	871,270	913,713	994,290	1,090,354
Kerosine:					
Production	110,412	121,914	102,152	118,512	135,742
Imports		135		245	
Exports	7,252	3,495	2,533	2,078	6,818
Stocks, end of year	17,722	[2] 23,941	20,888	19,723	24,928
Domestic demand	102,519	112,220	102,672	117,844	123,719
Distillate fuel oil:					
Production	312,173	380,700	340,825	398,912	475,801
Transfers from crude	3,263	3,543	2,701	2,537	2,863
Imports	4,175	2,546	1,825	2,602	1,924
Exports	29,877	21,293	12,295	12,653	22,674
Stocks, end of year	51,081	[2] 71,429	[3] 75,435	71,948	80,722
Domestic demand	298,273	340,576	329,278	394,885	449,140
Residual fuel oil:					
Production	447,795	466,317	424,909	425,217	469,377
Transfers from crude	27,091	23,847	[4] 4,750	5,325	6,006
Imports	54,244	53,269	75,175	120,036	118,675
Exports	10,623	13,011	12,641	16,228	29,058
Stocks, end of year	47,091	[2] 64,021	60,193	40,750	41,979
Domestic demand	518,510	500,543	496,021	553,793	563,771
Lubricants:					
Production	51,765	51,416	45,389	51,735	61,489
Imports	38	101			
Exports: Grease		[5] 396	[5] 392	[5] 383	[5] 448
Exports: Oil	14,262	12,996	12,520	13,869	16,969
Stocks, end of year	[6] 7,701	9,843	9,219	7,849	9,617
Domestic demand	36,481	35,983	33,101	38,853	42,304
Wax (1 barrel=280 pounds):					
Production	3,624	3,515	3,208	4,462	4,814
Imports	4	27			
Exports	1,107	994	1,031	1,193	1,351
Stocks, end of year	351	551	473	504	723
Domestic demand	2,478	2,348	2,255	3,238	3,244
Coke (5 barrels=1 short ton):					
Production	12,077	14,494	16,959	17,224	18,977
Exports	2,102	2,521	2,480	2,493	4,471
Stocks, end of year	343	646	698	408	519
Domestic demand	10,082	11,670	14,427	15,021	14,395
Asphalt (5.5 barrels=1 short ton):					
Production	49,286	51,919	49,007	58,240	66,302
Imports	1,159	1,557	1,185	1,795	2,368
Exports	3,262	1,628	1,569	983	1,185
Stocks, end of year	[6] 3,771	5,657	4,918	5,293	6,620
Domestic demand	47,023	49,962	49,362	58,677	66,158
Road oil:					
Production	7,074	7,915	7,691	6,928	6,100
Stocks, end of year	613	501	366	397	402
Domestic demand	7,067	8,027	7,826	6,897	6,095
Still gas: (1 barrel=3.600 cubic feet):					
Production	85,564	81,159	82,621	83,743	96,294
Liquefied gases:					
Production (liquefied refinery gases)	18,670	23,676	23,469	29,083	33,045
Transfers of liquefied gas from natural gasoline plants	35,310	42,991	45,982	58,184	72,431
Exports	1,266	1,089	1,279	1,632	2,121
Stocks, end of year	523	593	527	657	668
Domestic demand	52,761	65,508	68,238	85,505	103,344

For footnotes, see end of table.

TABLE 48.—Salient statistics of the major refined petroleum products in continental United States, 1947–51—Continued

[Thousands of barrels]

Product	1947	1948	1949	1950	1951 [1]
Miscellaneous:					
Production	5,678	6,929	4,236	4,717	7,201
Exports	922	[5] 213	[5] 220	[5] 250	[5] 373
Stocks, end of year	[6] 504	714	735	808	1,071
Domestic demand	4,722	6,506	3,995	4,394	6,565
Unfinished gasoline:					
Rerun (net)	[7] 984	917	418	[7] 243	353
Stocks, end of year	9,192	8,275	7,857	8,100	7,747
Other unfinished oils:					
Rerun (net)	1,227	513	10,006	6,891	11,367
Transfers of cycle products [8]	1,704	1,914	2,470	2,927	3,411
Imports	1,879	1,114	3,688	7,713	5,263
Stocks, end of year	43,847	[3] 61,885	58,037	61,786	59,093
Shortage (or overage) [9]	4,222	2,768	585	(712)	(2,648)

[1] Preliminary figures.
[2] Figure on new basis due to transfers in California of stock formerly reported as distillate and residual fuel oils to "Other unfinished oils" and exclusion of the following quantities from distributors' stocks: Kerosine, 115; distillate fuel oil, 1,469; residual fuel oil, 529. Figures for 1948 on the old basis and comparable with preceding years are as follows: Kerosine, 24,056; distillate fuel oil, 76,001; residual fuel oil, 76,970; other unfinished oils, 46,362.
[3] Figure on new basis due to additional terminal storage reported on the East Coast; figure on the old basis, 75,207.
[4] Beginning January 1949 for California, crude petroleum intended for charging cracking units excluded from transfers and considered as run to stills. Figure for 1948 on new basis and comparable with subsequent years, 6,699. Consequent adjustments were made in production.
[5] Beginning with January 1948, exports of grease were transferred from "Miscellaneous" to "Lubricants."
[6] Figure on new basis that excludes distributors' stocks in California and is comparable with subsequent years. Figures for 1947 on the old basis and comparable with preceding years are as follows: Lubricants, 8,624; asphalt 4,021; miscellaneous, 584.
[7] Negative quantity; represents net excess of unfinished oils produced over unfinished oils rerun.
[8] Products from natural gasoline plants added to unfinished oil stocks.
[9] Figures in parentheses represent overage.

Exports of refined products rose from 76.5 million barrels in 1950 to 125.8 million in 1951, a gain of 64 percent. Of the total increase in exports in 1951 of 49.3 million barrels, motor fuel gained 15.6 million, residual 12.8 million, distillate 10.0 million, kerosene 4.7 million, and other products 6.1 million. The largest gains in exports were to Western Europe, southern and eastern Asia, and Oceania—areas formerly receiving products from Iran.

The domestic demand in continental United States rose from 2,375 million barrels in 1950 to 2,571 million in 1951, a gain of 8.3 percent. Increases by products were 9.7 percent for motor fuel, 1.8 percent for residual fuel, 13.7 percent for distillate fuel, 5.0 percent for kerosine, and 9.5 percent for other products. All of these products are discussed separately in subsequent sections of this report.

Stocks of refined products increased from 326.9 million barrels to 351.1 million in 1951, a gain of 24.2 million, including a decline of 12.0 million in the California district and a gain of 36.3 million in all other districts.

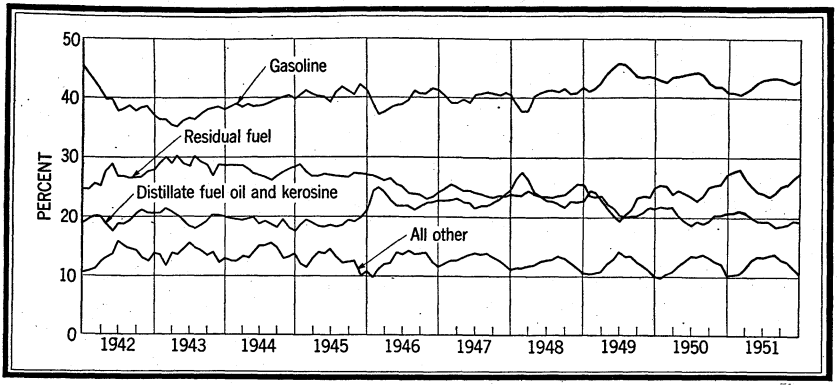

FIGURE 6.—Yields of principal products from crude run to stills in the United States, 1942–51, by months.

TABLE 49.—Percentage yields of refined petroleum products in the United States, 1942–51

Product	1942	1943	1944	1945	1946	1947	1948	1948[1]	1949	1950	1951[2]
Finished products:											
Gasoline:											
Cracked	22.3	22.0	23.2	23.3	22.5	(3)	(3)	(3)	(3)	(3)	(3)
Straight run	17.5	15.1	16.2	17.6	17.1	(3)	(3)	(3)	(3)	(3)	(3)
Total gasoline	39.8	37.1	39.4	40.9	39.6	40.2	40.3	40.1	43.7	43.0	42.4
Kerosine	5.1	5.0	4.7	4.7	6.0	6.0	6.0	6.0	5.2	5.6	5.7
Distillate fuel oil	14.7	14.8	14.4	14.5	16.6	16.8	18.7	18.5	17.5	19.0	20.0
Residual fuel oil	26.9	29.2	27.7	27.3	24.9	24.1	23.0	23.5	21.7	20.2	19.7
Lubricating oil	2.9	2.7	2.5	2.4	2.7	2.8	2.5	2.5	2.3	2.5	2.6
Wax	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2
Coke	.5	.5	.5	.6	.6	.7	.7	.7	.9	.8	.8
Asphalt	2.6	2.6	2.3	2.3	2.6	2.7	2.6	2.5	2.5	2.8	2.8
Road oil	.6	.2	.1	.2	.4	.4	.4	.4	.4	.3	.3
Still gas	5.9	6.1	6.1	6.0	5.1	4.6	4.0	4.0	4.2	4.0	4.1
Other	.6	.7	1.1	1.1	1.3	1.3	1.5	1.5	1.4	1.6	1.7
Unfinished products (net):											
Gasoline	.1	(4)	.1	5.3	(4 5)	(6)	(6)	.6	(6)	(6)	(6)
Other	5.3	.2	.1	5.3	5.1	(7)	(7)	(7)	(7)	(7)	(7)
Shortage (or overage)	.4	.7	.8	.4	.1	.2	.1	.1	------	------	(.3)
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

[1] Yields computed on the new basis for California to compare with subsequent years.
[2] Preliminary figures.
[3] Not separated after 1946.
[4] Less than 0.1 percent.
[5] Negative percentage; represents excess rerun over produced.
[6] Added to finished gasoline production in computing yields after 1946.
[7] Added to crude in computing yields after 1946.

The change in stocks, by principal products, were gains of 8.0 million barrels for finished and unfinished gasoline, 8.8 million for distillate fuel oil, 5.2 million for kerosine, 1.2 million for residual fuel oil, and 1.0 million for other products. In the California district there were declines in all groups, including 1.1 million for finished and unfinished gasoline, 4.0 million for distillate, 3.6 million for residual, 0.2 million for kerosine, and 3.0 million for other products.

TABLE 50.—Stocks of refined petroleum products in continental United States, 1950–51, by months

[Thousands of barrels]

Product	Jan. 31	Feb. 28	Mar. 31	Apr. 30	May 31	June 30	July 31	Aug. 31	Sept. 30	Oct. 31	Nov. 30	Dec. 31
1950												
Gasoline	116,624	124,177	124,924	119,584	112,915	106,026	102,769	99,423	97,904	97,844	100,995	108,669
Kerosine	18,260	16,126	13,001	13,383	17,304	21,117	23,151	25,803	27,677	28,292	25,526	19,723
Distillate fuel oil	63,932	52,206	37,777	37,530	42,739	53,679	61,664	68,426	78,270	85,643	86,113	71,948
Residual fuel oil	55,808	47,828	41,860	39,979	39,482	40,124	42,165	40,979	41,966	45,004	45,048	40,750
Lubricating oil	9,323	9,341	8,989	8,787	8,280	7,736	7,427	7,145	6,950	6,973	7,283	7,849
Wax	478	517	492	500	542	566	577	542	521	483	485	504
Coke	745	774	560	584	664	644	624	505	521	424	369	408
Asphalt	5,653	6,270	6,813	7,296	7,144	6,354	5,783	4,345	4,083	3,686	4,320	5,293
Road oil	436	502	479	670	834	740	698	475	468	418	373	397
LR-gases	571	537	579	697	684	640	666	666	619	619	694	657
Miscellaneous	692	651	626	669	655	666	683	656	599	601	651	808
Unfinished gasoline	8,674	8,619	8,842	8,473	8,120	8,048	8,286	7,644	7,844	7,920	8,010	8,100
Other unfinished oils	57,288	55,422	57,191	58,002	60,902	62,217	63,983	66,123	66,798	65,609	65,911	61,786
Total 1950	338,484	322,970	302,133	296,154	300,265	308,557	318,476	322,732	334,220	343,516	345,778	326,892
1951												
Gasoline	120,473	129,537	133,465	130,501	123,830	119,769	113,734	106,704	106,547	101,837	105,117	117,057
Kerosine	16,673	13,150	13,657	16,262	20,331	24,169	27,277	30,241	33,106	33,382	29,948	24,928
Distillate fuel oil	58,424	47,587	42,978	44,736	55,273	67,839	79,437	87,432	96,241	102,561	94,917	80,722
Residual fuel oil	40,317	39,409	37,516	36,910	39,317	41,566	45,163	47,243	48,212	48,415	45,378	41,979
Lubricating oil	8,160	8,386	8,209	8,393	8,451	8,444	8,662	8,875	8,866	8,914	9,111	9,617
Wax	517	498	503	545	580	601	640	673	706	690	701	723
Coke	430	578	592	626	613	560	496	484	472	412	415	519
Asphalt	6,094	7,055	8,074	8,649	8,508	8,026	7,131	5,853	5,213	4,479	5,366	6,620
Road oil	410	380	661	699	764	759	659	571	452	333	353	402
LR-gases	605	572	749	817	791	708	661	624	658	638	645	668
Miscellaneous	781	825	805	852	893	923	902	882	902	1,036	1,072	1,071
Unfinished gasoline	8,006	7,706	7,991	8,687	8,431	7,826	7,748	7,742	7,600	6,963	6,911	7,747
Other unfinished oils	58,446	59,971	60,087	61,274	61,930	63,066	61,193	61,241	62,223	61,787	61,401	59,093
Total 1951	319,336	315,654	315,287	318,951	329,712	344,256	353,703	358,565	371,198	371,447	361,335	351,146

TABLE 51.—Runs to stills and output of petroleum products at refineries in the United States, 1950–51, by months

[Thousands of barrels]

	January	February	March	April	May	June	July	August	September	October	November	December	Total
1950													
Input:													
Crude petroleum	169,987	148,837	165,418	155,797	171,599	169,663	182,330	188,078	181,778	188,393	182,539	190,448	2,094,867
Natural-gas liquids	7,279	6,773	7,352	6,984	7,113	7,321	7,506	8,510	8,520	9,302	8,968	9,011	94,639
Total input	177,266	155,610	172,770	162,781	178,712	176,984	189,836	196,588	190,298	197,695	191,507	199,459	2,189,506
Output:													
Gasoline	79,835	71,458	78,702	75,238	82,071	82,449	87,871	90,877	85,459	89,117	85,776	89,240	998,093
Kerosine	11,140	9,469	10,100	8,848	9,790	8,477	9,091	9,828	9,989	10,264	10,255	11,261	118,512
Distillate fuel oil	32,489	28,729	29,070	29,301	30,920	31,112	32,253	33,765	35,392	37,723	36,530	41,628	398,912
Residual fuel oil	37,491	32,818	35,768	31,426	32,954	32,058	35,338	35,585	35,343	38,759	37,202	40,475	425,217
Lubricating oil	3,932	3,587	4,086	3,645	4,039	4,002	4,151	4,686	4,646	4,987	4,906	5,068	51,735
Wax [1]	314	362	285	365	374	353	344	407	410	383	429	436	4,462
Coke [1]	1,454	1,295	1,271	1,230	1,482	1,519	1,591	1,576	1,415	1,447	1,439	1,505	17,224
Asphalt [1]	2,943	2,523	3,315	3,684	5,111	5,741	6,453	6,853	6,587	6,271	4,815	3,944	58,240
Road oil	146	155	161	442	576	981	1,086	1,396	953	589	256	187	6,928
Still gas [1]	6,150	5,659	6,270	6,268	7,278	7,482	8,085	7,970	7,360	7,268	6,885	7,068	83,743
LR-gases	2,334	1,984	2,164	2,356	2,272	2,267	2,397	2,442	2,298	2,611	2,862	3,096	29,083
Other miscellaneous	312	273	391	367	360	385	404	448	349	460	421	547	4,717
Unfinished gasoline (net)	817	[2] 55	223	[2] 369	[2] 353	[2] 72	238	[2] 642	200	76	90	90	243
Other unfinished oils (net)	[2] 1,527	[2] 2,658	983	[2] 128	2,051	408	667	1,346	[2] 162	[2] 2,243	[2] 544	[2] 5,084	[2] 6,891
Shortage (or overage) [3]	(564)	11	(19)	108	(213)	(178)	(133)	51	59	(17)	185	(2)	(712)
Total output	177,266	155,610	172,770	162,781	178,712	176,984	189,836	196,588	190,298	197,695	191,507	199,459	2,189,506
1951 [4]													
Input:													
Crude petroleum	199,958	183,745	200,535	185,488	199,521	197,246	200,322	202,721	196,752	199,826	198,258	206,032	2,370,404
Natural-gas liquids	8,045	7,028	7,997	7,803	8,274	7,586	7,982	8,658	8,804	9,318	8,917	8,838	99,250
Total input	208,003	190,773	208,532	193,291	207,795	204,832	208,304	211,379	205,556	209,144	207,175	214,870	2,469,654

Output:													
Gasoline	91,818	81,363	90,137	84,629	93,965	93,003	95,833	96,533	93,808	96,260	93,893	97,638	[4] 1,108,880
Kerosine	12,715	11,475	12,371	11,511	10,698	9,815	10,220	10,506	10,915	11,262	12,083	12,171	135,742
Distillate fuel oil	44,244	39,742	41,129	35,139	37,500	37,614	38,067	38,335	38,453	40,159	40,726	44,693	475,801
Residual fuel oil	42,397	38,696	41,771	36,908	39,202	38,303	39,516	37,993	36,843	37,944	39,111	40,693	469,377
Lubricating oil	5,061	4,339	5,108	5,175	5,454	5,094	5,241	5,379	4,905	5,432	5,144	5,157	61,489
Wax [1]	445	388	438	437	469	406	394	414	373	359	361	330	4,814
Coke [1]	1,636	1,438	1,483	1,431	1,675	1,574	1,629	1,595	1,580	1,640	1,673	1,623	18,977
Asphalt [1]	3,748	3,538	4,436	5,036	6,180	6,631	7,077	7,500	6,859	6,739	4,866	3,692	66,302
Road oil	186	69	434	249	574	887	1,009	1,246	666	367	255	158	6,100
Still gas [1]	6,988	6,199	7,607	7,821	9,139	8,963	9,273	8,962	8,279	7,944	7,334	7,785	96,294
LR-gases	3,000	2,828	3,112	2,809	2,617	2,454	2,463	2,716	2,530	2,690	2,697	3,129	33,045
Other miscellaneous	508	551	666	640	594	582	629	647	519	655	686	524	7,201
Unfinished gasoline (net)	[2] 94	[2] 300	285	696	[2] 256	[2] 605	[2] 78	[2] 6	[2] 142	[2] 637	[2] 52	836	[2] 353
Other unfinished oils (net)	[2] 4,326	492	[2] 645	603	[2] 71	590	[2] 2,704	[2] 340	310	[2] 1,166	[2] 1,056	[2] 3,054	[2] 11,367
Shortage (or overage) [3]	(323)	(45)	200	207	55	(479)	(265)	(101)	(342)	(504)	(546)	(505)	(2,648)
Total output	208,003	190,773	208,532	193,291	207,795	204,832	208,304	211,379	205,556	209,144	207,175	214,870	2,469,654

[1] Conversion factors: 280 pounds of wax to the barrel; 5.0 barrels of coke to the short ton; 5.5 barrels of asphalt to the short ton; 3,600 cubic feet of still gas to the barrel.
[2] Negative quantity; represents net excess of unfinished oils rerun over unfinished oils produced.
[3] Figures in parentheses represent overage.
[4] Preliminary figures.

TABLE 52.—Runs to stills and output of petroleum products at refineries in the United States, 1950–51, by districts

[Thousands of barrels]

	East Coast	Appalachian	Indiana, Illinois, Kentucky, etc.	Oklahoma, Kansas, etc.	Texas Inland	Texas Gulf Coast	Louisiana Gulf Coast	Arkansas-Louisiana Inland	Rocky Mountain	California	Total
1950											
Input:											
Crude petroleum	331,368	60,382	379,143	177,285	76,221	479,085	171,407	26,107	72,539	321,330	2,094,867
Natural-gas liquids	4,715	470	9,852	8,131	13,394	23,854	4,868	1,361	1,393	26,601	94,639
Total input	336,083	60,852	388,995	185,416	89,615	502,939	176,275	27,468	73,932	347,931	2,189,506
Output:											
Gasoline	135,556	27,023	197,848	97,994	51,489	222,837	81,994	9,886	33,599	139,867	998,093
Kerosine	13,304	3,808	23,996	6,400	4,242	38,103	20,073	2,677	2,080	3,829	118,512
Distillate fuel oil	73,482	7,785	62,485	37,920	10,690	101,938	37,709	5,325	13,852	47,726	398,912
Residual fuel oil	76,094	9,456	57,674	21,824	14,810	86,589	21,053	4,064	15,063	118,590	425,217
Lubricating oil	10,214	5,395	4,800	4,174	74	16,590	4,520	1,600	250	4,118	51,735
Wax [1]	1,478	352	283	406	6	793	742	----------	98	304	4,462
Coke [1]	1,762	286	7,891	1,406	322	1,417	1,538	165	638	1,799	17,224
Asphalt [1]	15,126	2,069	10,639	5,753	3,312	2,999	3,509	3,428	2,274	9,131	58,240
Road oil	131	----------	1,397	834	----------	71	2	11	1,838	2,644	6,928
Still gas [1]	11,230	3,536	18,792	6,182	2,974	20,524	5,414	741	2,490	11,860	83,743
LR-gases	4,814	59	2,514	1,034	1,263	7,433	5,467	476	161	5,862	29,083
Other miscellaneous	401	266	843	609	353	621	10	316	11	1,287	4,717
Unfinished gasoline (net)	[2] 573	131	[2] 61	30	509	138	[2] 289	2	24	332	243
Other unfinished oils (net)	[2] 6,923	[2] 96	2,073	[2] 1,055	[2] 2,107	2,810	[2] 2,389	[2] 1,020	709	1,107	[2] 6,891
Shortage (or overage) [3]	(13)	782	(2,179)	1,905	1,678	76	(3,078)	(203)	845	(525)	(712)
Total output	336,083	60,852	388,995	185,416	89,615	502,939	176,275	27,468	73,932	347,931	2,189,506
1951 [4]											
Input:											
Crude petroleum	370,394	65,455	438,427	189,699	89,511	571,991	183,065	28,889	83,843	349,130	2,370,404
Natural-gas liquids	3,709	492	11,572	9,049	13,598	28,751	4,548	1,406	1,735	24,390	99,250
Total input	374,103	65,947	449,999	198,748	103,109	600,742	187,613	30,295	85,578	373,520	2,469,654
Output:											
Gasoline	144,351	29,139	228,134	101,799	58,804	258,073	85,839	11,375	40,157	151,209	1,108,880
Kerosine	16,397	3,937	27,185	6,226	4,935	47,139	21,538	2,784	2,305	3,296	135,742
Distillate fuel oil	90,032	9,345	76,350	44,408	13,761	125,331	43,386	6,345	16,118	50,725	475,801
Residual fuel oil	84,266	10,483	63,485	24,014	15,564	94,065	22,529	2,866	17,909	134,196	469,377
Lubricating oil	11,261	5,422	6,026	4,717	79	20,653	6,492	1,893	249	4,697	61,489
Wax [1]	1,612	394	301	490	----------	897	721	----------	92	307	4,814
Coke [1]	1,801	317	8,598	1,398	323	1,303	1,718	660	874	1,985	18,977

Asphalt [1]	17,228	2,245	11,566	6,321	3,878	4,662	3,279	3,631	2,979	10,513	66,302
Road oil	209		1,394	464		30	3	15	1,617	2,368	6,100
Still gas [1]	12,330	3,865	21,973	7,313	3,387	24,631	5,299	1,325	3,156	13,015	96,294
LR-gases	4,884	112	3,540	1,194	2,039	9,960	6,198	480	206	4,432	33,045
Other miscellaneous	472	324	1,031	702	605	986	987	483	15	1,596	7,201
Unfinished gasoline (net)	[2] 609	[2] 144	[2] 159	[2] 63	1,010	140	[2] 221	2	[2] 24	[2] 285	[2] 353
Other unfinished oils (net)	[2] 9,859	40	2,554	[2] 1,847	[2] 2,783	11,870	[2] 6,349	[2] 1,030	[2] 439	[2] 3,524	[2] 11,367
Shortage (or overage) [3]	(292)	468	(1,979)	1,612	1,507	1,002	(3,806)	(534)	364	(1,010)	(2,648)
Total output	374,103	65,947	449,999	198,748	103,109	600,742	187,613	30,295	85,578	373,520	2,469,654

[1] Conversion factors: 280 pounds of wax to the barrel; 5.0 barrels of coke to the short ton; 5.5 barrels of asphalt to the short ton; 3,600 cubic feet of still gas to the barrel.
[2] Negative quantity; represents net excess of unfinished oils rerun over unfinished oils produced. [3] Figures in parentheses represent overage. [4] Preliminary figures.

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The prices of certain representative products in specified markets have been shown in the Minerals Yearbook over a series of years as a general indication of price trends.

The average value of Regular Grade gasoline at Oklahoma refineries rose from 10.32 cents per gallon in 1950 to 10.56 cents in 1951. The average tank-wagon price of kerosine at Chicago rose from 15.36 cents per gallon in 1950 to 15.80 cents in 1951. The average price of a selected bright stock at Oklahoma refineries rose from 21.21 cents per gallon in 1950 to 29.25 cents in 1951. The average price of Bunker "C" oil at New York rose from $2.09 per barrel in 1950 to $2.32 in 1951. The price of No. 2 distillate heating oil at New York rose from 8.35 cents per gallon in 1950 to 9.15 in 1951.

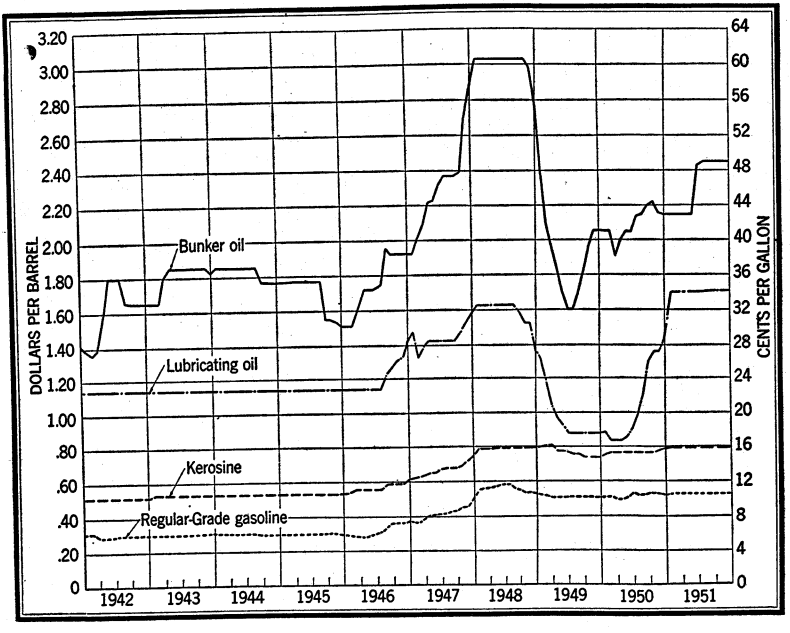

FIGURE 7.—Prices of Bunker "C" oil at New York Harbor, bright stock at Oklahoma refineries, tank-wagon prices of kerosine at Chicago, and Regular Grade gasoline at refineries in Oklahoma, 1942–51, by months.

REFINERY CAPACITY

The total reported crude capacity of refineries in the United States increased from 6,964,000 barrels daily on January 1, 1951, to 7,333,000 barrels daily on January 1, 1952—a gain of 369,000 barrels daily or 5.3 percent. The principal increases in capacity in 1951, by refinery districts, were gains of 131,000 barrels daily in the Texas Gulf, 83,000 in the Indiana-Illinois district, 71,000 in the East Coast, 43,000 in the Oklahoma-Kansas district, and 39,000 in the Texas Inland district.

The total capacity under construction was 283,000 barrels daily, including 84,000 in the Indiana-Illinois district, 59,000 in the Oklahoma-Kansas district, and 46,000 in the California district.

In the 3 years from January 1, 1949, to January 1, 1952, total crude-oil capacity at refineries increased 894,000 barrels or almost 14 percent. The largest gains during this period were 251,000 barrels daily in the Indiana-Illinois district, 196,000 barrels in the Texas Gulf, 163,000 barrels in the East Coast, 119,000 barrels in the Oklahoma-Kansas district, and 56,000 in the California district.

TABLE 53.—Petroleum-refinery capacity in the United States, January 1, 1947–52

Year	Number of refineries				Capacity (barrels per day)			
	Operating	Shut down	Total	Building	Operating	Shut down	Total	Building
1947	361	38	399	-------	5,336,399	233,083	5,569,482	162,200
1948	352	38	390	2	5,825,566	208,686	6,034,252	367,250
1949	336	39	375	3	6,230,505	208,490	6,438,995	341,500
1950	320	47	367	2	6,222,998	473,302	6,696,300	145,600
1951	325	32	357	1	6,701,815	261,829	6,963,644	160,100
1952	327	23	350	-------	7,161,366	171,519	7,332,885	282,680

AVIATION GASOLINE

The total demand for aviation grades of gasoline rose from 46.6 millions barrels in 1950 to 65.2 million in 1951, an increase of 18.6 million barrels or 40 percent. This increase was due almost entirely to a gain in exports and to a large increase in military requirements. Exports amounted to 7.1 million barrels in 1950 and 12.2 million in 1951. Exports in the last half of 1951 almost doubled compared with the first half. Domestic demand in the continental United States increased from 39.5 million barrels in 1950 to 53.0 million in 1951, a gain of 13.5 million. This domestic demand included reported deliveries to the Armed Forces that rose from 19.9 million barrels to 33.2 million.

The total demand for aviation grades of 100-octane and above rose from 37.6 million barrels in 1950 to 55.1 million in 1951, whereas the demand for lower grades and components rose only from 9.0 million to 10.1 million.

All aviation-gasoline figures are included in the total figures for motor fuel and gasoline in this chapter. It should be noted that the term "transfers out" represents rejected material returned for use as automotive gasoline; this item is subtracted from the gross production of aviation gasoline to determine the net production of marketable grades.

The data for aviation gasoline do not represent the total fuel used for aviation purposes. The use of jet fuels, blended from low-grade gasoline and either kerosine or distillate fuel, is expanding rapidly. A considerable number of small planes may use automotive types of gasoline.

TABLE 54.—Salient statistics of aviation gasoline in the United States, 1949 (total) and 1950, by months

[Thousands of barrels]

	1950													1949
	January	February	March	April	May	June	July	August	September	October	November	December	Total	
Production:														
100-octane and above	1,806	1,834	2,335	2,728	2,944	2,859	3,320	4,152	3,929	4,247	4,198	4,883	39,235	35,215
Other grades	1,238	836	1,013	409	839	1,095	944	744	1,178	1,407	1,282	1,051	12,036	11,738
Transfers out [1]	250	288	496	366	408	513	441	448	326	402	589	395	4,922	2,668
Exports	472	498	271	385	963	487	592	517	608	578	710	975	7,056	8,764
Stocks, end of period:														
100-octane and above	3,341	3,316	3,075	3,252	3,288	3,023	3,226	3,260	2,970	3,256	3,802	3,744	3,744	3,338
Other grades	4,599	4,710	4,683	4,194	3,850	3,570	3,430	2,873	3,030	3,323	3,413	3,476	3,476	4,106
Domestic demand: All grades	1,826	1,798	2,849	2,698	2,720	3,499	3,168	4,454	4,306	4,095	3,545	4,559	39,517	33,992
Total demand [2] by grades:														
100-octane and above	1,770	1,794	2,497	2,446	2,791	3,029	3,008	3,979	4,064	3,819	3,546	4,824	37,567	33,821
Other finished	514	473	597	606	835	857	728	951	805	832	680	645	8,523	8,600
Components	14	29	26	31	57	100	24	41	45	22	29	65	483	335
Production, by districts:														
100-octane and above:														
District 1	150	118	156	126	150	128	194	324	317	443	359	475	2,940	1,960
District 2	128	192	243	281	486	414	270	373	266	330	304	257	3,544	3,070
District 3	1,247	1,094	1,290	1,516	1,512	1,448	1,722	1,992	2,143	2,075	2,304	2,630	20,973	21,127
District 4	11	16	21	10	20	14	31	30	37	32	87	65	374	221
District 5	270	414	625	795	776	855	1,103	1,433	1,166	1,367	1,144	1,456	11,404	8,837
Total	1,806	1,834	2,335	2,728	2,944	2,859	3,320	4,152	3,929	4,247	4,198	4,883	39,235	35,215
Other grades:														
District 1	62	26	8	66	-------	99	161	80	101	19	----------	14	636	363
District 2	195	121	142	80	40	157	181	127	94	157	140	219	1,653	1,495
District 3	589	422	703	202	715	621	560	501	707	1,037	716	713	7,486	6,672
District 4	10	9	18	13	19	32	15	19	28	25	----------	8	196	185
District 5	382	258	142	48	65	186	27	17	248	169	426	97	2,065	3,023
Total	1,238	836	1,013	409	839	1,095	944	744	1,178	1,407	1,282	1,051	12,036	11,738

Stocks, by districts, end of period:														
100-octane and above:														
District 1	346	339	313	249	272	178	274	270	271	252	324	220	220	301
District 2	424	384	359	375	443	469	463	464	394	493	602	653	653	493
District 3	1,631	1,605	1,591	1,767	1,624	1,431	1,525	1,613	1,593	1,541	1,749	1,963	1,963	1,490
District 4	12	14	20	15	19	16	13	17	22	11	19	16	16	9
District 5	928	974	792	846	930	929	951	896	690	959	1,108	892	892	1,045
Total	3,341	3,316	3,075	3,252	3,288	3,023	3,226	3,260	2,970	3,256	3,802	3,744	3,744	3,338
Other grades:														
District 1	427	409	331	371	288	303	365	379	466	403	392	373	373	398
District 2	640	636	646	603	492	465	541	511	472	526	572	702	702	526
District 3	1,969	2,026	2,222	1,937	1,859	1,569	1,495	1,227	1,307	1,600	1,684	1,696	1,696	1,806
District 4	60	60	65	66	71	84	77	81	92	103	78	74	74	59
District 5	1,503	1,579	1,419	1,217	1,140	1,149	952	675	693	691	687	631	631	1,317
Total	4,599	4,710	4,683	4,194	3,850	3,570	3,430	2,873	3,030	3,323	3,413	3,476	3,476	4,106
Total demand,[2] by districts:														
District 1	123	140	215	192	175	234	123	366	317	478	277	580	3,220	2,055
District 2	275	312	64	366	551	527	360	518	465	334	285	287	4,644	4,100
District 3	1,394	1,370	1,599	1,655	2,116	2,184	2,005	2,456	2,586	2,629	2,527	2,868	25,389	26,575
District 4	17	23	28	27	30	36	56	36	46	54	91	80	524	369
District 5	489	451	914	843	811	1,005	1,216	1,595	1,500	1,178	1,075	1,719	12,796	9,657
Total	2,298	2,296	3,120	3,083	3,683	3,986	3,760	4,971	4,914	4,673	4,255	5,534	46,573	42,756

[1] Reject material used as automotive gasoline.
[2] Includes exports.

TABLE 55.—Salient statistics of aviation gasoline in the United States, 1950 (total) and 1951, by months

[Thousands of barrels]

	1951 [1]													1950
	January	February	March	April	May	June	July	August	September	October	November	December	Total	
Production:														
100-octane and above	4,091	4,144	5,017	4,464	4,900	4,426	4,663	5,159	4,853	4,792	5,266	5,435	57,210	39,235
Other grades	1,698	866	1,096	1,059	1,365	1,339	1,268	1,231	1,097	1,695	1,124	1,120	14,958	12,036
Transfers out [2]	454	315	364	445	569	594	774	656	383	544	393	403	5,894	4,922
Exports	415	431	884	663	915	858	1,228	1,327	1,272	1,150	1,646	1,367	12,156	7,056
Stocks, end of period:														
100-octane and above	3,518	3,837	4,048	4,053	4,006	3,817	3,844	3,925	4,369	3,895	3,853	4,356	4,356	3,744
Other grades	4,295	4,418	4,518	4,537	4,589	4,488	4,161	3,639	3,546	3,831	3,873	3,921	3,921	3,476
Domestic demand: All grades	4,327	3,822	4,554	4,391	4,776	4,603	4,229	4,848	3,944	4,982	4,351	4,234	53,061	39,517
Total demand [3] by grades:														
100-octane and above	4,129	3,726	4,687	4,356	4,843	4,513	4,500	4,923	4,296	5,144	5,165	4,809	55,091	37,567
Other finished	542	507	683	640	821	867	847	944	875	767	722	651	8,866	8,523
Components	71	20	68	58	27	81	110	308	45	221	110	141	1,260	483
Production, by districts:														
100-octane and above:														
District 1	381	390	515	471	394	246	452	569	489	473	674	763	5,817	2,940
District 2	430	366	498	502	611	537	464	717	607	498	411	489	6,130	3,544
District 3	2,121	2,280	2,741	2,258	2,693	2,502	2,472	2,528	2,527	2,563	3,125	3,005	30,815	20,973
District 4	70	61	72	62	63	45	71	61	62	106	71	66	810	374
District 5	1,089	1,047	1,191	1,171	1,139	1,096	1,204	1,284	1,168	1,152	985	1,112	13,638	11,404
Total	4,091	4,144	5,017	4,464	4,900	4,426	4,663	5,159	4,853	4,792	5,266	5,435	57,210	39,235
Other grades: [4]														
District 1	102	31	51	40	288	315	170	158	−13	45	114	−2	1,299	636
District 2	310	218	335	216	64	36	206	66	61	254	146	157	2,069	1,653
District 3	1,025	398	392	683	719	747	614	757	736	1,239	498	742	8,550	7,486
District 4	−7	−1	10	−9	33	38	3	15	22	−12	22	15	129	196
District 5	268	220	308	129	261	203	275	235	291	169	344	208	2,911	2,065
Total	1,698	866	1,096	1,059	1,365	1,339	1,268	1,231	1,097	1,695	1,124	1,120	14,958	12,036

Stocks, by districts, end of period:														
100-octane and above:														
District 1	321	258	595	624	645	468	546	560	615	559	674	562	562	220
District 2	636	658	564	495	572	548	573	658	683	592	570	622	622	653
District 3	1,686	1,845	1,699	1,729	1,703	1,932	1,661	1,724	1,947	1,741	1,858	2,243	2,243	1,963
District 4	23	23	17	13	23	22	26	26	24	25	32	28	28	16
District 5	852	1,053	1,173	1,192	1,063	847	1,038	957	1,100	978	719	901	901	892
Total	3,518	3,837	4,048	4,053	4,006	3,817	3,844	3,925	4,369	3,895	3,853	4,356	4,356	3,744
Other grades:														
District 1	487	489	552	531	585	641	534	532	458	480	584	583	583	373
District 2	849	1,016	1,208	1,329	1,217	1,072	920	811	685	737	736	792	792	702
District 3	2,174	2,085	1,833	1,890	1,921	1,903	1,861	1,513	1,587	1,949	1,809	1,817	1,817	1,696
District 4	56	47	46	26	43	61	46	45	51	26	29	30	30	74
District 5	729	781	879	761	823	811	800	738	765	639	715	699	699	631
Total	4,295	4,418	4,518	4,537	4,589	4,488	4,161	3,639	3,546	3,831	3,873	3,921	3,921	3,476
Total demand,[3] by districts:														
District 1	263	477	142	431	364	453	375	538	471	544	564	870	5,492	3,220
District 2	580	402	734	663	702	736	664	763	755	782	579	536	7,896	4,644
District 3	2,622	2,336	3,288	2,593	3,149	2,755	3,161	3,220	2,746	3,240	3,371	3,083	35,564	25,389
District 4	74	69	89	77	69	65	85	77	80	116	78	60	939	524
District 5	1,203	969	1,185	1,290	1,407	1,452	1,172	1,577	1,164	1,450	1,405	1,052	15,326	12,796
Total	4,742	4,253	5,438	5,054	5,691	5,461	5,457	6,175	5,216	6,132	5,997	5,601	65,217	46,573

[1] Preliminary figures.
[2] Reject material used as automotive gasoline.
[3] Includes exports.
[4] Includes 90–99-octane, below 90-octane, and net production of components. The negative production figures reported in some months by districts represent transfers of stocks of components outside the group.

MOTOR FUEL (GASOLINE AND NAPHTHA)

The total demand for motor fuel set another new record of 1,131 million barrels in 1951, a gain of about 112 million barrels or 11 percent compared with 1950. Total exports increased 15.6 million barrels or 63 percent, including an increase of 5.1 million barrels in aviation grades. The gain in total exports was due, primarily, to the shortage abroad after the shutdown of the oil industry in Iran. Domestic demand in continental United States rose from 994 million barrels in 1950 to 1,090 million in 1951, a gain of 96 million or almost 10 percent, and included an increase of 14 million barrels in the domestic demand for aviation grades.

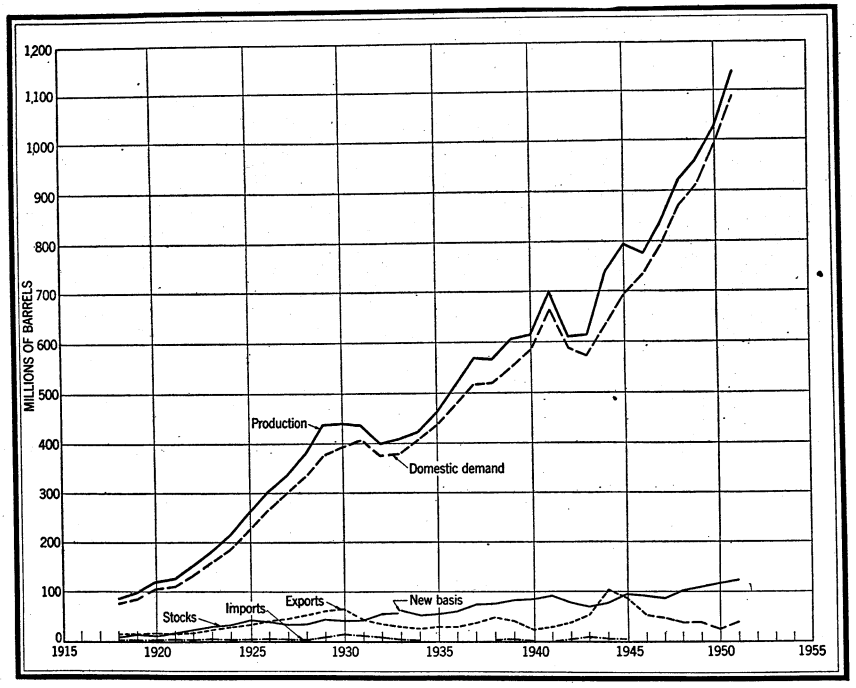

FIGURE 8.—Production, domestic demand, exports, imports, and stocks of motor fuel in the United States, 1918–51.

Production.—The total production of motor fuel rose from 1,024.5 million barrels in 1950 to 1,139.5 million in 1951. Production in 1951 included an output of 1,009.6 million barrels of gasoline and naphtha from crude oil and a net production of natural-gas liquids from natural gasoline and allied plants and motor benzol from coke ovens amounting to 129.9 million barrels. This latter figure was obtained by subtracting from the total output of such oils of 205.7 million barrels the production of 75.8 million barrels used for products other than motor fuel—liquefied petroleum gases and some kerosine and distillate fuel classed as transfers of cycle products. Including imports of motor fuel of 0.4 million in addition to the net production of 1,139.5 million barrels, the total new supply was 1,139.9 million. Deducting the increase in combined stocks of finished gasoline and natural-gas liquids of 9.2

TABLE 56.—Salient statistics of motor fuel in the United States, 1949 (total) and 1950, by months

[Thousands of barrels]

	1950						
	Jan.	Feb.	Mar.	Apr.	May	June	July
Production:							
Refinery gasoline:							
Gasoline	71,247	63,408	69,963	66,810	73,074	73,208	78,305
Naphtha	1,309	1,277	1,387	1,444	1,884	1,920	2,060
Natural-gas liquids	15,235	13,719	14,669	14,047	14,278	14,285	14,966
Less sales of LP-gases and transfers of cycle products [1]	5,664	4,803	5,209	4,710	4,450	4,245	4,361
Motor benzol, etc	21	21	17	17	17	17	17
Total production	82,148	73,622	80,827	77,608	84,803	85,185	90,987
Daily average	2,650	2,629	2,607	2,587	2,736	2,840	2,935
Imports			1	1	3	2	4
Exports	1,597	2,060	1,691	2,357	2,227	1,914	1,992
Daily average	52	74	55	79	72	64	64
Stocks, end of period:							
Finished gasoline	116,624	124,177	124,924	119,584	112,915	106,026	102,769
Natural-gas liquids	7,363	8,098	7,708	7,950	8,163	8,151	8,730
Total stocks	123,987	132,275	132,632	127,534	121,078	114,177	111,499
Domestic demand	66,981	63,274	78,780	80,350	89,035	90,174	91,677
Daily average	2,161	2,260	2,541	2,678	2,872	3,006	2,957

	1950—Continued						1949 (total)
	Aug.	Sept.	Oct.	Nov.	Dec.	Total	
Production:							
Refinery gasoline:							
Gasoline	80,199	74,853	77,774	74,804	78,058	881,703	837,495
Naphtha	2,168	2,086	2,041	2,004	2,171	21,751	16,099
Natural-gas liquids	15,423	15,440	16,450	16,232	17,217	181,961	157,086
Less sales of LP-gases and transfers of cycle products [1]	5,117	4,877	5,385	5,753	6,537	61,111	48,452
Motor benzol, etc	7	7	7	5	5	158	189
Total production	92,680	87,509	90,887	87,292	90,914	1,024,462	962,417
Daily average	2,990	2,917	2,932	2,910	2,933	2,807	2,637
Imports	3	2	134	4	2	156	
Exports	1,585	2,391	2,369	2,047	2,491	24,721	39,347
Daily average	51	80	76	68	80	68	108
Stocks, end of period:							
Finished gasoline	99,423	97,904	97,844	100,995	108,669	108,669	103,586
Natural-gas liquids	8,667	8,581	8,226	7,636	7,355	7,355	6,831
Total stocks	108,090	106,485	106,070	108,631	116,024	116,024	110,417
Domestic demand	94,507	86,725	89,067	82,688	81,032	994,290	913,713
Daily average	3,049	2,891	2,873	2,756	2,614	2,724	2,503

[1] Includes LP-gases sold for fuel and chemical uses.

TABLE 57.—Salient statistics of motor fuel in the United States, 1950 (total) and 1951, by months

[Thousands of barrels]

	1951[1]						
	Jan.	Feb.	Mar.	Apr.	May	June	July
Production:							
Refinery gasoline:							
Gasoline	81,738	72,432	79,774	74,422	83,033	82,692	85,140
Naphtha	2,035	1,903	2,366	2,404	2,658	2,725	2,711
Natural-gas liquids	17,305	15,622	17,774	16,702	16,640	15,920	16,357
Less sales of LP-gases and transfers of cycle products[2]	6,955	6,214	6,542	6,215	5,526	5,195	5,575
Motor benzol, etc	9	9	6	6	6	12	10
Total production	94,132	83,752	93,378	87,319	96,811	96,154	98,643
Daily average	3,037	2,991	3,012	2,911	3,123	3,205	3,182
Imports	133	4	12	4	93	1	11
Exports	1,788	1,607	2,349	2,444	2,830	3,159	4,191
Daily average	58	57	76	81	91	105	135
Stocks, end of period:							
Finished gasoline	120,473	129,537	133,465	130,501	123,830	119,769	113,734
Natural-gas liquids	7,474	7,842	8,109	8,522	9,079	10,043	10,065
Total stocks	127,947	137,379	141,574	139,023	132,909	129,812	123,799
Domestic demand	80,554	72,717	86,846	87,430	100,188	96,093	100,476
Daily average	2,599	2,597	2,801	2,914	3,232	3,203	3,241

	1951[1]—Continued						1950 (total)
	Aug.	Sept.	Oct.	Nov.	Dec.	Total	
Production:							
Refinery gasoline:							
Gasoline	86,011	82,986	84,851	82,956	86,652	982,687	881,703
Naphtha	1,864	2,018	2,091	2,020	2,148	26,943	21,751
Natural-gas liquids	16,969	17,029	18,123	18,146	18,925	205,512	181,961
Less sales of LP-gases and transfers of cycle products[2]	6,053	5,958	6,599	7,308	7,702	75,842	61,111
Motor benzol, etc	8	40	44	45	16	211	158
Total production	98,799	96,115	98,510	95,859	100,039	1,139,511	1,024,462
Daily average	3,187	3,204	3,178	3,195	3,227	3,122	2,807
Imports	2	8	134	6	10	418	156
Exports	4,807	4,782	3,984	4,507	3,908	40,356	24,721
Daily average	155	159	129	150	126	111	68
Stocks, end of period:							
Finished gasoline	106,704	106,547	101,837	105,117	117,057	117,057	108,669
Natural-gas liquids	9,883	9,578	9,003	8,379	8,186	8,186	7,355
Total stocks	116,587	116,125	110,840	113,496	125,243	125,243	116,024
Domestic demand	101,206	91,803	99,945	88,702	84,394	1,090,354	994,290
Daily average	3,265	3,060	3,224	2,957	2,722	2,987	2,724

[1] Preliminary figures.
[2] Includes LP-gases sold for fuel and chemical uses.

TABLE 58.—Production of gasoline in the United States in 1951, by district and month [1]

[Thousands of barrels]

District	January	February	March	April	May	June	July	August	September	October	November	December	Total
Gasoline:													
East Coast	11,274	9,855	10,644	9,845	10,890	10,914	11,204	12,355	12,183	11,757	11,562	12,485	134,968
Appalachian	2,257	1,989	2,204	2,398	2,556	2,526	2,489	2,248	2,434	2,398	2,289	2,521	28,309
Indiana, Illinois, Kentucky, etc	17,553	16,096	17,254	16,062	18,337	17,803	18,477	18,665	17,355	17,974	18,699	18,576	212,851
Oklahoma, Kansas, etc	8,122	7,072	7,709	7,214	7,375	7,945	7,347	7,270	7,800	7,718	7,539	8,334	91,445
Texas Inland	3,401	2,915	3,521	3,270	3,624	3,932	4,101	4,145	3,880	4,170	3,667	4,038	44,664
Texas Gulf Coast	18,628	15,197	17,996	16,498	18,636	17,950	19,227	19,655	18,516	19,482	18,514	19,726	220,025
Louisiana Gulf Coast	6,460	5,815	6,463	5,989	6,647	6,705	7,012	6,689	6,798	6,929	6,316	6,591	78,414
Arkansas, Louisiana Inland, etc	779	684	619	816	831	777	878	946	750	856	890	848	9,674
Rocky Mountain	3,025	3,095	3,282	2,864	3,222	3,385	3,465	3,339	3,099	2,955	3,271	3,314	38,316
California, Washington	10,239	9,714	10,082	9,466	10,915	10,755	10,940	10,699	10,171	10,612	10,209	10,219	124,021
Total gasoline	81,738	72,432	79,774	74,422	83,033	82,692	85,140	86,011	82,986	84,851	82,956	86,652	982,687
Naphtha:													
East Coast	307	395	475	652	854	955	991	183	256	203	156	247	5,674
Appalachian	35	24	26	34	34	33	33	22	27	23	19	28	338
Indiana, Illinois, Kentucky, etc	356	243	296	330	315	278	285	252	279	328	453	296	3,711
Oklahoma, Kansas, etc	95	86	117	82	118	116	84	77	150	123	133	124	1,305
Texas Inland	43	17	65	61	57	23	34	52	51	45	39	55	542
Texas Gulf Coast	729	671	934	757	790	842	736	789	675	852	676	846	9,297
Louisiana Gulf Coast	230	201	219	222	248	219	255	204	274	230	255	320	2,877
Arkansas, Louisiana Inland, etc	29	31	21	27	30	16	31	26	30	14	19	21	295
Rocky Mountain	3	11	9	7	9	6	2	12	8	5	19	15	106
California, Washington	208	224	204	232	203	237	260	247	268	268	251	196	2,798
Total naphtha	2,035	1,903	2,366	2,404	2,658	2,725	2,711	1,864	2,018	2,091	2,020	2,148	26,943
Percent yield of gasoline and naphtha [2]	41.0	40.4	41.0	41.9	42.8	43.1	43.2	43.3	43.2	42.9	42.6	42.9	42.4
Natural-gas liquids blended at refineries	8,045	7,028	7,997	7,803	8,274	7,586	7,982	8,658	8,804	9,318	8,917	8,838	99,250
Total production:													
East Coast	12,167	10,544	11,521	10,805	12,069	12,132	12,378	12,870	12,680	12,149	12,075	12,961	144,351
Appalachian	2,341	2,043	2,265	2,484	2,617	2,604	2,568	2,317	2,505	2,467	2,345	2,583	29,139
Indiana, Illinois, Kentucky, etc	18,803	17,179	18,367	17,405	19,737	19,029	19,730	19,854	18,571	19,352	20,157	19,950	228,134
Oklahoma, Kansas, etc	8,997	7,751	8,494	7,867	8,136	8,701	8,005	8,203	8,882	8,871	8,554	9,338	101,799
Texas Inland	4,451	3,831	4,626	4,283	4,942	4,805	5,206	5,364	5,295	5,696	4,938	5,367	58,804
Texas Gulf Coast	21,417	17,823	21,333	19,450	21,673	21,238	22,454	22,937	21,802	22,957	21,827	23,162	258,073
Louisiana Gulf Coast	7,126	6,376	7,033	6,546	7,243	7,270	7,648	7,285	7,436	7,562	6,985	7,329	85,839
Arkansas, Louisiana Inland, etc	921	822	770	962	968	887	1,018	1,084	928	1,003	1,019	993	11,375
Rocky Mountain	3,177	3,238	3,436	3,007	3,361	3,492	3,587	3,485	3,254	3,126	3,482	3,512	40,157
California, Washington	12,418	11,756	12,292	11,820	13,219	12,845	13,239	13,134	12,455	13,077	12,511	12,443	151,209
Total: 1951	91,818	81,363	90,137	84,629	93,965	93,003	95,833	96,533	93,808	96,260	93,893	97,638	1,108,880
1950	79,835	71,458	78,702	75,238	82,071	82,449	87,871	90,877	85,459	89,117	85,776	89,240	998,093

[1] Preliminary figures.

[2] Based on crude runs to stills adjusted for net change in stocks of unfinished oils.

million barrels results in the total demand for motor fuel of 1,130.7 million barrels in 1951.

Yields.—The average refinery yields of gasoline and naphtha from crude oil declined from 43.0 percent in 1950 to 42.4 percent in 1951. This decline in yield was related to the gain in distillate fuel yields from 19.0 percent to 20.0 percent, inasmuch as the gain in crude runs of 13 percent was higher than that in total gasoline demand and lower that that in distillate fuel total demand. Even with the reduced yield for gasoline, there was a substantial gain in the stocks of finished gasoline in 1951.

Exports.—Exports of motor fuel from continental United States, including shipments to the Territories and possessions, rose sharply from 24.7 million barrels in 1950 to 40.4 million in 1951, a gain of 63 percent. Exports in the first half of the year amounted to 14.2 million barrels and were 26.2 million in the last half, as the result of the shutdown in the Iran refinery. Exports of motor fuel to the Territories increased from 5.9 million barrels in 1950 to 6.9 million in 1951. Exports of aviation gasoline rose from 7.1 million barrels in 1950 to 12.2 million in 1951.

Total motor-fuel exports to foreign countries increased from 18.8 million barrels in 1950 to 33.5 million in 1951, an increase of 14.7 million barrels.

Domestic Demand.—The domestic demand for motor fuel set another new record and increased from 994 million barrels in 1950 to 1,090 million in 1951, a gain of 96 million or almost 10 percent. Domestic demand averaged 2,987,000 barrels daily in 1951, compared with 2,724,000 barrels daily in 1950.

The annual survey of the Bureau of Public Roads includes an analysis of civilian motor-fuel consumption based on tax returns from the States. The total shown in this survey is considerably smaller than the domestic demand shown by the Bureau of Mines. The difference represents the exclusion from the survey of deliveries to the Armed Forces of most of the naphtha used for industrial purposes and of some losses in production and transportation before the point of tax incidence. On the other hand, the survey includes, in addition to gasoline, an increasing amount of diesel fuels used by trucks.

In 1950 the total motor fuel consumed shown by the Bureau of Public Roads amounted to 959.0 million barrels, including 848.9 million for highway use, 99.4 million for reported nonhighway use, and 10.7 million barrels allowed for losses. The total and the highway use included 12.2 million barrels of special fuels other than gasoline, primarily diesel oil and liquefied gases. In 1951 total usage was 1,022.6 million barrels, including 907.8 million for highway use, 103.4 million for nonhighway uses, and 11.4 million barrels allowed for losses. Special fuels, other than gasoline, amounted to 16.3 million barrels with only 3 States not reporting, compared with 4 States in 1950. Total highway use showed a gain of 9.9 percent in 1950 and an increase of 6.9 percent in 1951.

Production and Consumption by States.—Table 59, showing production and consumption of gasoline by States, is designed to indicate roughly the areas of surplus production and deficit supply. The refinery-production figures are compiled from reports to the Bureau of Mines and do not include the natural gasoline used outside refineries. The consumption figures are compiled by the American Petroleum Institute from State tax reports. These figures are closer

to the domestic-demand figures of the Bureau of Mines than those of the Bureau of Public Roads, as they include deliveries to the Armed Forces for use in continental United States, although they do exclude shipments to our Armed Forces abroad.

In 1951 refinery production amounted to 1,109 million barrels and domestic consumption to 1,045 million, an excess production of 64 million barrels. The production figure includes a large part of the motor fuel for export as well as part of the increase in stocks during the year.

TABLE 59.—Production and consumption of gasoline in the United States, 1949–51, by States

[Thousands of barrels]

State	1949		1950		1951 [1]	
	Production	Consumption [2]	Production	Consumption [2]	Production	Consumption [2]
Alabama	(3)	12,239	(3)	13,653	(3)	15,363
Arizona		5,059		5,569		6,381
Arkansas	6,642	8,445	7,756	9,147	9,004	10,119
California	[4] 135,578	89,506	[4] 139,867	91,776	[4] 151,209	104,528
Colorado	3,423	10,029	3,844	10,828	4,210	11,736
Connecticut		11,174		12,154		12,903
Delaware		2,177		2,395		2,590
District of Columbia		4,355		4,715		4,911
Florida		18,620		20,922		22,955
Georgia	[5] 6,294	16,403	[5] 7,820	18,442	[5] 8,104	20,326
Idaho	(6)	4,372	(6)	4,756	(6)	5,005
Illinois	[7] 67,539	49,743	[7] 71,215	54,276	[7] 87,124	56,564
Indiana	58,314	26,421	63,320	29,222	66,514	31,179
Iowa		21,312		22,734		23,237
Kansas	[8] 39,373	16,746	[8] 46,088	17,701	[8] 46,466	18,723
Kentucky	[9] 12,909	12,506	[9] 13,210	13,640	[9] 13,504	14,648
Louisiana	[3] 82,109	11,722	[3] 84,125	13,195	[3] 88,210	14,303
Maine		5,150		5,400		5,718
Maryland	(5)	11,491	(5)	12,830	(5)	13,966
Massachusetts	[10] 2,926	21,937	[10] 1,455	23,634	[10] 1,762	24,366
Michigan	12,042	42,171	11,787	46,611	15,931	49,535
Minnesota	(7)	20,658	(7)	22,046	(7)	22,529
Mississippi	(3)	9,480	(3)	10,333	(3)	11,241
Missouri	(8)	25,294	(8)	28,207	(8)	30,138
Montana	5,447	5,095	6,756	5,389	7,732	5,533
Nebraska	(8)	10,031	(8)	10,986	(8)	11,650
Nevada		1,596		1,818		2,182
New Hampshire		2,970		3,187		3,303
New Jersey	35,096	27,922	51,172	31,378	58,262	33,255
New Mexico	2,397	4,882	2,717	5,453	3,143	5,973
New York	9,637	58,710	9,171	63,046	9,871	66,373
North Carolina		19,821		22,268		24,125
North Dakota		6,240		6,249		6,434
Ohio	38,862	49,165	50,117	53,173	58,059	55,978
Oklahoma	45,694	15,437	51,906	16,813	55,333	17,692
Oregon		11,434		12,313		13,021
Pennsylvania	74,587	49,287	79,181	53,056	80,299	56,451
Rhode Island	(10)	3,748	(10)	4,072	(10)	4,349
South Carolina	(5)	10,049	(5)	11,024	(5)	12,399
South Dakota		6,351		6,634	(8)	6,842
Tennessee	(9)	15,200	(9)	16,752	(9)	18,327
Texas	279,247	65,531	274,326	70,322	316,877	83,668
Utah	6,711	4,445	7,658	4,948	10,302	5,375
Vermont		2,229		2,320		2,396
Virginia		17,820		19,830		21,891
Washington	(4)	15,019	(4)	16,221	(4)	17,414
West Virginia	2,405	8,409	1,978	8,945	2,194	9,369
Wisconsin	(7)	21,850	(7)	23,571	(7)	24,648
Wyoming	[6] 11,819	2,970	[6] 12,624	3,124	[6] 14,770	3,358
Total	939,051	893,221	998,093	967,078	1,108,880	1,044,970

[1] Preliminary figures.
[2] American Petroleum Institute.
[3] Alabama and Mississippi included with Louisiana.
[4] Washington included with California.
[5] Maryland and South Carolina included with Georgia.
[6] Idaho included with Wyoming.
[7] Minnesota and Wisconsin included with Illinois.
[8] Missouri, Nebraska, and South Dakota included with Kansas.
[9] Tennessee included with Kentucky.
[10] Rhode Island included with Massachusetts.

Comparison of production and consumption in 1951, by broad districts, indicates the major distribution between surplus and deficit areas. The Gulf Coast States (including Texas, Louisiana, Mississippi, and Alabama) reported a refinery production of 405 million barrels compared with a consumption of 125 million—a surplus of 280 million. The known movements out of this district included shipments to the Atlantic States of 180 million barrels by boat and 16 million by pipeline; shipments north and west to other States include 28 million barrels by pipeline and 3 million by river barges. This district also supplied a considerable part of the exports.

The Atlantic Coast States produced 158 million barrels of motor fuel in 1951 and consumed 332 million—a deficit of 174 million barrels. Receipts from the Gulf Coast district of 180 million barrels by boat and 16 million by pipeline more than supplied this deficit and provided for a pipeline movement of about 2 million barrels west through Pennsylvania and some exports and military deliveries.

The Pacific Coast States (California, Oregon, Washington, Nevada, and Arizona) produced 151 million barrels of motor fuel and consumed 144 million. The surplus of 7 million barrels, which was supplemented by 1 million taken from stocks, was available for export and small shipments to other States.

The Mountain States (Montana, Idaho, Wyoming, Colorado, Utah, and New Mexico) produced 40 million barrels of motor fuel in 1951 and consumed 37 million barrels, leaving a surplus of 3 million barrels, which was the balance of receipts from and shipments to the Pacific Coast district and States to the east.

The remaining Central States produced 354 million barrels in 1951 and consumed 408 million barrels, indicating a deficit of 54 million. Most of this deficit was supplied from the Gulf States, but some shipments were received from the Atlantic Coast and Mountain States.

Although by no means complete, the review of data in this table gives a fair idea of the general distribution and consumption of motor fuel.

Methods of Distribution.—The expansion of product pipelines has resulted from the effort to secure a cheaper long-distance movement to inland markets in the upper Middle West and the inland areas of the Atlantic Coast States. The steady increase in the demand for motor fuel and the rapid gain in the consumption of distillate fuel oil for domestic heating have increased the volume of such movements.

In 1951 deliveries by the product lines totaled 454 million barrels—61 million more than in 1950. Deliveries of motor fuel amounted to 344 million barrels, a gain of 37 million compared with 1950, and represented 75.7 percent of total deliveries, compared with 77.9 percent in 1950. Deliveries of distillate fuel were 88 million barrels in 1951, a gain of 22 million, and increased from 16.9 percent of the total in 1950 to 19.4 percent in 1951. Deliveries of kerosine were 22 million barrels in 1951, an increase of 2 million, and represented 5.2 percent of total deliveries in 1950 and 4.9 percent in 1951. All three of these products can be shipped through the same line without much loss from intermingling at the point of contact.

Tanker movements of motor fuel from the gulf to the East Coast district increased from 167 million barrels in 1950 to 180 million in 1951. There were no shipments of motor fuel from California to the East Coast district in 1951, compared with 6 million barrels in 1950.

TABLE 60.—Movement of petroleum products by pipelines between PAW districts in the United States, 1950–51, by months [1]

[Thousands of barrels]

	January	February	March	April	May	June	July	August	September	October	November	December	Total
1950													
From district 1 to district 2:													
Gasoline	444	319	345	308	397	449	388	453	422	446	483	325	4,779
Kerosine	37	31				15	25	2	27		12		149
Distillate fuel oil	58	13			11	25	35		33	47			222
From district 3 to district 1:													
Gasoline	1,094	984	1,143	1,214	1,379	1,306	1,317	1,314	1,194	1,191	1,039	961	14,136
Kerosine	430	335	485	220	153	145	215	167	279	280	349	486	3,544
Distillate fuel oil	321	277	290	251	217	254	239	339	301	245	249	319	3,302
From district 3 to district 2:													
Gasoline	1,901	1,728	2,057	1,726	1,965	1,689	1,702	1,743	1,948	2,157	1,909	1,637	22,162
Kerosine	83	133	57	63	53	28	52	120	97	160	183	245	1,274
Distillate fuel oil	433	396	310	227	205	165	217	284	388	363	370	765	4,123
From district 3 to district 4:													
Gasoline	118	113	147	142	148	138	195	200	158	142	118	123	1,742
Kerosine	12	14	11	13	7	3		5	11	8	15	11	110
Distillate fuel oil	4	5	4	7	7	4	5	9	8	8	6	7	74
1951													
From district 1 to district 2:													
Gasoline	264	223	305	249	242	270	190	139	158	164	72	144	2,420
Kerosine				9	17	10				18			54
Distillate fuel oil			13	14	45	56	61		13	19	12	17	250
From district 3 to district 1:													
Gasoline	884	813	963	1,299	1,188	1,283	1,293	1,372	1,313	1,642	1,627	1,936	15,613
Kerosine	486	428	334	201	192	157	216	145	182	332	676	892	4,241
Distillate fuel oil	441	286	393	271	286	257	290	283	263	360	413	661	4,204
From district 3 to district 2:													
Gasoline	1,814	1,385	1,947	2,074	2,315	2,151	1,985	2,536	2,499	2,464	2,115	2,017	25,302
Kerosine	216	212	89	43	88	68	15	55	39	176	177	258	1,436
Distillate fuel oil	559	652	513	507	215	311	371	356	438	468	690	582	5,662
From district 3 to district 4:													
Gasoline	137	148	194	188	213	214	221	225	219	228	215	211	2,413
Kerosine	18	15	8	18	9	4	5	7	9	12	10	26	141
Distillate fuel oil	9	9	2	10	12	10	11	13	7	9	10	8	110

[1] Excludes shipment from district 4 to district 5.

TABLE 61.—Transportation of petroleum products by pipelines in 1950–51, by months

[Thousands of barrels]

	January	February	March	April	May	June	July	August	September	October	November	December	Total
1950													
Turned into lines: [1]													
Motor fuel	21,798	19,510	24,142	25,128	28,507	27,402	28,284	28,321	25,984	27,220	26,968	25,533	308,797
Kerosine	2,315	2,055	2,210	1,753	1,367	1,060	1,012	1,279	1,299	1,733	2,058	2,726	20,867
Distillate fuel oil	6,702	5,986	5,883	3,910	3,200	3,832	3,973	5,845	6,158	7,068	6,865	10,190	69,612
Delivered from lines: [1]													
Motor fuel	21,215	18,525	23,952	24,761	28,282	27,761	28,164	28,977	25,847	27,752	26,066	25,113	306,415
Kerosine	2,290	1,978	2,350	1,691	1,127	902	1,041	1,233	1,310	1,692	2,039	2,662	20,315
Distillate fuel oil	6,866	6,055	6,664	4,571	3,049	3,091	3,342	4,631	4,986	5,776	7,484	9,865	66,380
Shortage (or overage): [2]													
Motor fuel	37	50	53	73	85	77	106	121	138	81	48	58	927
Kerosine	42	33	42	31	30	21	16	37	22	30	36	36	376
Distillate fuel oil	11	3	(11)	10	4	7	(4)	1	7	22	29	40	119
Stocks in lines and working tanks at end of month:													
Motor fuel	12,477	13,412	13,549	13,843	13,983	13,547	13,561	12,784	12,783	12,170	13,024	13,386	13,386
Kerosine	723	767	585	616	826	963	918	927	894	905	888	916	916
Distillate fuel oil	2,797	2,725	1,955	1,284	1,431	2,165	2,800	4,013	5,178	6,448	5,800	6,085	6,085
1951 [3]													
Turned into lines: [1]													
Motor fuel	24,931	22,755	28,527	28,427	30,351	29,248	28,626	32,973	31,813	31,392	29,421	27,488	345,952
Kerosine	2,823	2,426	2,308	1,560	1,484	1,135	1,043	956	1,180	1,900	2,876	3,898	23,589
Distillate fuel oil	10,307	8,949	8,317	6,158	5,741	5,808	5,429	5,209	5,641	7,701	9,003	11,180	89,443
LP-gases	300	323	254	215	86	129	126	147	176	212	234	265	2,467
Delivered from lines: [1]													
Motor fuel	24,049	21,599	26,900	28,082	31,381	29,320	30,435	31,665	30,895	32,583	29,240	27,360	343,509
Kerosine	2,845	2,538	2,309	1,555	1,214	941	1,027	933	947	1,483	2,779	3,787	22,358
Distillate fuel oil	10,682	9,905	8,882	6,387	4,935	4,501	4,812	5,077	4,934	6,714	9,377	11,811	88,017
LP-gases	196	251	249	190	80	110	120	120	148	198	222	207	2,091
Shortage (or overage): [2]													
Motor fuel	----------	1	72	31	89	52	98	153	93	95	98	13	795
Kerosine	41	32	46	28	22	26	22	9	----------	25	62	32	345
Distillate fuel oil	19	28	(20)	11	18	4	22	22	25	32	(13)	26	174
LP-gases	13	25	20	12	17	17	18	11	22	19	16	19	209
Stocks in lines and working tanks at end of month:													
Motor fuel	14,268	15,423	16,978	17,292	16,173	16,049	14,142	15,297	16,122	14,836	14,919	15,034	15,034
Kerosine	853	709	662	639	887	1,055	1,049	1,063	1,296	1,688	1,723	1,802	1,802
Distillate fuel oil	5,691	4,707	4,162	3,922	4,710	6,013	6,608	6,718	7,400	8,355	7,994	7,337	7,337
LP-gases	91	138	123	136	125	127	115	131	137	132	128	167	167

[1] The quantities "Turned into lines" and "Delivered from lines" are on a net basis, eliminating intersystem transfers, and are not comparable with data published previous to 1949.

[2] Figures in parentheses represent overage.

[3] Preliminary figures.

Stocks.—Stocks of finished gasoline, as reported, include stocks held at refineries, bulk terminals, and by pipelines but not stocks in secondary distribution tanks, consumers' hands, or military custody. Stocks of finished gasoline increased 8.4 million barrels in 1951—from 108.7 million barrels on the first of the year to 117.1 million on December 31.

Stocks may be expressed in terms of days' supply by dividing the stocks at the end of a month by the daily average total demand for the succeeding month. On this basis, stocks of finished gasoline represented 40.6 days' supply in December 1951 compared with 40.9 days' supply in December 1950.

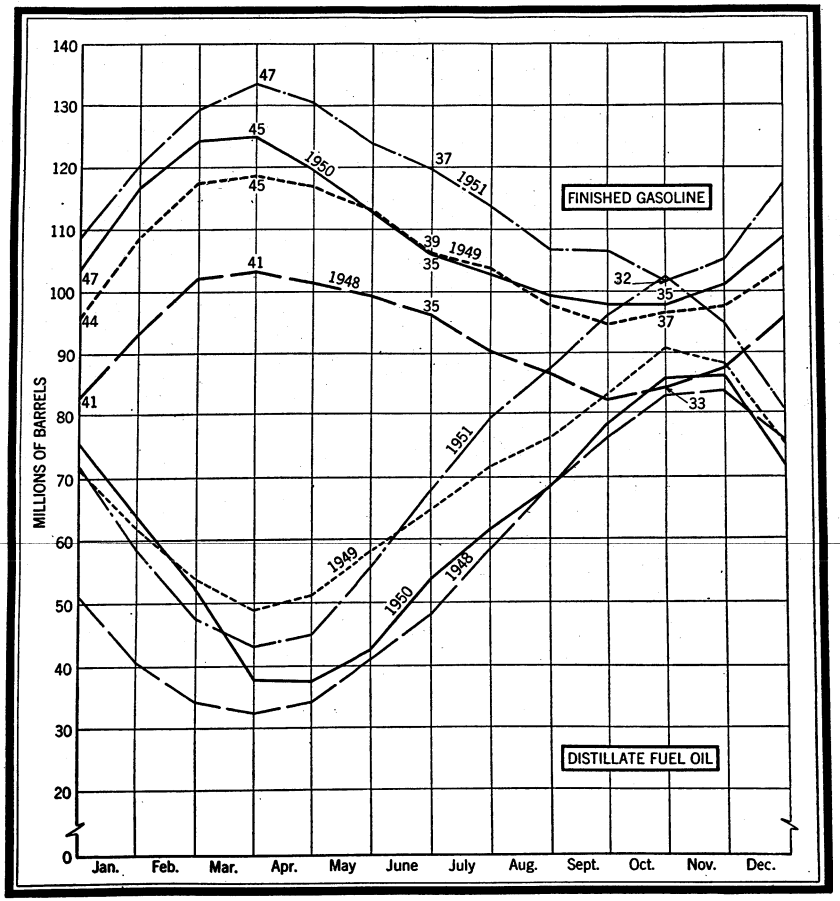

FIGURE 9.—Stocks of finished gasoline in the United States, 1948–51, by months, with figures representing days' supply at certain periods, and stocks of distillate fuel oil, 1948–51, by months.

TABLE 62.—Stocks of gasoline in the United States in 1951, by district and month

[Thousands of barrels]

District	Jan. 31	Feb. 28	Mar. 31	Apr. 30	May 31	June 30	July 31	Aug. 31	Sept. 30	Oct. 31	Nov. 30	Dec. 31
Finished gasoline: [1]												
East Coast	22,697	24,552	26,965	26,517	26,762	26,720	25,230	23,441	23,852	22,725	23,649	23,658
Appalachian	3,669	3,500	3,716	3,988	4,156	3,890	3,972	3,789	3,981	3,310	3,432	3,765
Indiana, Illinois, Kentucky, etc.	26,594	29,185	30,690	30,332	28,749	27,885	25,952	24,175	24,020	22,054	23,863	27,797
Oklahoma, Kansas, etc.	14,655	15,448	16,256	16,421	14,527	14,204	13,440	11,899	11,916	11,056	11,954	13,505
Texas Inland	3,887	4,200	3,914	3,642	3,426	3,164	3,253	3,520	3,470	3,498	3,482	4,422
Texas Gulf Coast	18,956	20,139	20,311	18,662	16,797	15,650	14,507	14,687	13,647	15,001	13,781	16,581
Louisiana Gulf Coast	8,430	8,879	7,055	6,773	6,097	5,959	5,854	5,742	5,756	5,891	5,869	6,736
Arkansas, Louisiana Inland, etc.	2,886	2,968	2,712	2,926	2,461	2,482	2,709	2,441	3,205	2,591	2,940	3,195
Rocky Mountain	4,483	5,342	5,919	5,767	5,565	5,401	4,907	3,988	3,550	3,026	3,622	4,332
California	14,216	15,324	15,927	15,473	15,290	14,414	13,910	13,022	13,150	12,685	12,525	13,066
Total finished gasoline	120,473	129,537	133,465	130,501	123,830	119,769	113,734	106,704	106,547	101,837	105,117	117,057
Unfinished gasoline:												
East Coast	915	942	1,027	1,147	1,378	1,303	1,195	1,244	1,095	1,130	1,158	1,333
Appalachian	407	411	486	409	381	368	358	369	341	349	330	331
Indiana, Illinois, Kentucky, etc.	966	838	870	825	782	732	886	860	789	595	685	703
Oklahoma, Kansas, etc.	183	236	259	222	238	212	182	224	188	209	160	193
Texas Inland	290	353	329	338	368	444	415	316	376	365	351	377
Texas Gulf Coast	3,223	2,786	2,879	3,406	3,214	2,973	2,958	3,009	2,835	2,736	2,565	2,928
Louisiana Gulf Coast	382	418	347	409	373	369	372	331	378	317	372	469
Arkansas, Louisiana Inland, etc.	1	2	5	10	8	6			8	2	4	5
Rocky Mountain	172	136	144	117	165	185	143	153	202	104	152	149
California	1,467	1,584	1,645	1,804	1,524	1,234	1,239	1,236	1,388	1,156	1,134	1,259
Total unfinished gasoline	8,006	7,706	7,991	8,687	8,431	7,826	7,748	7,742	7,600	6,963	6,911	7,747
Total finished and unfinished gasoline:												
East Coast	23,612	25,494	27,992	27,664	28,140	28,023	26,425	24,685	24,947	23,855	24,807	24,991
Appalachian	4,076	3,911	4,202	4,397	4,537	4,258	4,330	4,158	4,322	3,659	3,762	4,096
Indiana, Illinois, Kentucky, etc.	27,560	30,023	31,560	31,157	29,531	28,617	26,838	25,035	24,809	22,649	24,548	28,500
Oklahoma, Kansas, etc.	14,838	15,684	16,515	16,643	14,765	14,416	13,622	12,123	12,104	11,265	12,114	13,698
Texas Inland	4,177	4,553	4,243	3,980	3,794	3,608	3,668	3,836	3,846	3,863	3,833	4,799
Texas Gulf Coast	22,179	22,925	23,190	22,068	20,011	18,623	17,465	17,696	16,482	17,737	16,346	19,509
Louisiana Gulf Coast	8,812	9,297	7,402	7,182	6,470	6,328	6,226	6,073	6,134	6,208	6,241	7,205
Arkansas, Louisiana Inland, etc.	2,887	2,970	2,717	2,936	2,469	2,488	2,709	2,441	3,213	2,593	2,944	3,200
Rocky Mountain	4,655	5,478	6,063	5,884	5,730	5,586	5,050	4,141	3,752	3,130	3,774	4,481
California	15,683	16,908	17,572	17,277	16,814	15,648	15,149	14,258	14,538	13,841	13,659	14,325
Total: 1951	128,479	137,243	141,456	139,188	132,261	127,595	121,482	114,446	114,147	108,800	112,028	124,804
1950	125,298	132,796	133,766	128,057	121,035	114,074	111,055	107,067	105,748	105,764	109,005	116,769

[1] Includes stocks of finished gasoline at refineries and bulk terminals, and in pipelines.

TABLE 63.—Days' supply of motor fuel on hand in the United States at end of month, 1949–51 [1]

Month	1949			1950			1951 [2]		
	Finished gasoline	Natural-gas liquids	Total motor fuel	Finished gasoline	Natural-gas liquids	Total motor fuel	Finished gasoline	Natural-gas liquids	Total motor fuel
January	49.3	2.8	52.1	50.0	3.1	53.1	45.4	2.8	48.2
February	47.1	2.8	49.9	47.9	3.1	51.0	45.0	2.8	47.8
March	45.1	2.8	47.9	45.3	2.8	48.1	44.6	2.7	47.3
April	42.2	2.6	44.8	40.6	2.7	43.3	39.3	2.5	41.8
May	39.1	2.5	41.6	36.8	2.6	39.4	37.4	2.8	40.2
June	38.9	2.6	41.5	35.1	2.7	37.8	35.5	3.0	38.5
July	36.3	2.7	39.0	33.2	2.8	36.0	33.3	2.9	36.2
August	35.1	2.7	37.8	33.5	2.9	36.4	33.1	3.1	36.2
September	35.6	2.9	38.5	33.2	2.9	36.1	31.8	2.8	34.6
October	36.7	2.7	39.4	34.7	2.9	37.6	32.8	2.9	35.7
November	38.9	2.8	41.7	37.5	2.8	40.3	36.9	3.0	39.9
December	46.8	3.1	49.9	40.9	2.8	43.7	40.6	2.9	43.5

[1] Stocks divided by the daily average total demand (domestic demand plus exports) for succeeding month.
[2] Preliminary figures.

Prices.—The average dealers' net price for Regular Grade Gasoline (exclusive of taxes) in 50 representative cities in the United States provides an index of gasoline prices at the wholesale level. This average price, according to the American Petroleum Institute, rose from 15.10 cents per gallon in 1950 to 15.33 cents in 1951. Also reported by the American Petroleum Institute, the average service-station price, including all State, local, and Federal taxes, rose from 26.76 cents per gallon in 1950 to 27.15 cents in 1951. The average State tax rose from 5.09 cents per gallon to 5.16 cents, the average local tax (municipal and county) of 0.09 cent remained the same, and the average Federal tax increased from 1.5 cents per gallon in 1950 to 1.59 cents in 1951, owing to the increase in the rate effective November 1, 1951, from 1.5 cents to 2.0 cents per gallon.

TABLE 64.—Average monthly prices of gasoline in the United States, 1950–51, in cents per gallon

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average for year
1950													
Monthly average at refineries in Oklahoma, Grade 2 [1]	10.06	10.06	9.79	9.81	10.06	10.67	10.30	10.46	10.55	10.56	10.53	10.45	10.32
Average of 50 cities on 1st of month: [2]													
Dealers' net (ex. tax)	14.82	14.80	14.75	14.64	14.98	15.05	15.09	15.43	15.34	15.43	15.43	15.43	15.10
Service station (including State and local taxes only)	25.21	25.19	25.03	24.89	25.16	25.21	25.37	25.70	25.50	25.31	25.12	25.39	25.26
1951													
Monthly average at refineries in Oklahoma, regular, 82-octane [1]	10.56	10.56	10.56	10.56	10.56	10.56	10.56	10.56	10.56	10.56	10.55	10.50	10.56
Average of 50 cities on 1st of month: [2]													
Dealers' net (ex. tax)	15.46	15.45	15.45	15.45	15.45	15.18	15.15	15.26	15.29	15.20	15.29	15.34	15.33
Service station (including State and local taxes only)	25.85	25.76	25.73	25.68	25.56	25.24	25.33	25.52	25.45	25.40	25.64	25.63	25.56

[1] National Petroleum News.
[2] American Petroleum Institute; compiled by The Texas Co.

OTHER REFINED PRODUCTS

KEROSINE

With the 1951 production of kerosine 15 percent above the 1950 total, the supply was not only sufficient to meet an increased domestic demand (5 percent over 1950) and greatly expanded exports, but there was also a surplus to add to storage. These conditions were a change from those prevailing in 1950, as the production in that year, although well above the 1949 level, had to be augmented by small quantities derived from stocks and imports to satisfy domestic and export requirements.

The greater output of kerosine in 1951 was due almost entirely to a large increase (13 percent) in runs at refineries, as the gain in percentage yield was only trivial.

All areas showed a gain in kerosine production in 1951 over 1950, except the Oklahoma-Kansas and California refinery districts, where the quantities produced are relatively unimportant. About 35 percent of the kerosine production reported in 1951 was credited to the Texas Gulf Coast district, where the gain was nearly a quarter over the 1950 total. In the Indiana-Illinois-Kentucky group of States, which produce about one-fifth of the kerosine made in the country, the 1951 quantity was greater by 13 percent. The Louisiana Gulf Coast and the East Coast refinery districts are also important sources of kerosine, and there the outputs in 1951 were up 7 and 23 percent, respectively, over the 1950 quantities. In all these districts the higher production of kerosine in 1951 over 1950 was due largely to increased crude runs.

TABLE 65.—Salient statistics of kerosine in the United States, 1950–51, by month and district

[Thousands of barrels]

Month and district	Production		Yield (percent)		Domestic demand		Stocks, end of period	
	1950	1951[1]	1950	1951[1]	1950	1951[1]	1950	1951[1]
By months:								
January	11,140	12,715	6.5	6.2	13,906	15,633	18,260	16,673
February	9,469	11,475	6.2	6.3	11,413	14,789	16,126	13,150
March	10,100	12,371	6.1	6.2	12,939	11,788	13,001	13,657
April	8,848	11,511	5.7	6.2	8,371	8,678	13,383	16,262
May	9,790	10,698	5.8	5.4	5,700	5,877	17,304	20,331
June	8,477	9,815	5.0	5.0	4,629	5,494	21,117	24,169
July	9,091	10,220	5.0	5.0	6,892	6,490	23,151	27,277
August	9,828	10,506	5.3	5.2	7,035	6,455	25,803	30,241
September	9,989	10,915	5.5	5.6	7,920	6,640	27,677	33,106
October	10,264	11,262	5.4	5.6	9,486	10,171	28,292	33,382
November	10,255	12,083	5.6	6.1	12,737	14,960	25,526	29,948
December	11,261	12,171	5.8	5.8	16,816	16,744	19,723	24,928
Total	118,512	135,742	5.6	5.7	117,844	123,719	19,723	24,928
By district:								
East Coast	13,304	16,397	3.9	4.3	[2]	[2]	8,140	8,801
Appalachian	3,808	3,937	6.3	6.0			512	787
Indiana-Illinois-Kentucky, etc	23,996	27,185	6.3	6.2			4,212	5,146
Oklahoma, Kansas, etc	6,400	6,226	3.6	3.3			973	1,567
Texas Inland	4,242	4,935	5.4	5.3			427	411
Texas Gulf Coast	38,103	47,139	8.0	8.4			2,968	4,488
Louisiana Gulf Coast	20,073	21,538	11.6	11.4			1,275	2,330
Arkansas, Louisiana Inland, etc	2,677	2,784	9.9	9.3			256	720
Rocky Mountain	2,080	2,305	2.9	2.7			349	302
California	3,829	3,296	1.2	.9			611	376
Total	118,512	135,742	5.6	5.7	117,844	123,719	19,723	24,928

[1] Preliminary figures.

[2] Figures not available

Domestic requirements for kerosine in 1951 were 5 percent above the 1950 total, which increase compares with a 15-percent gain in 1950 over 1949. Warmer weather in 1951 than in 1950, with a resultant leveled-off demand for kerosine as a heating fuel, was the chief factor causing the lower rate of gain in 1951. A cold January in 1951 brought about a 10-percent increase over 1950 in the kerosine market during the first quarter; however, with comparatively warmer weather from then until October, the need for kerosine for heating purposes was lowered, and as a result there was a 10-percent decline in the domestic demand in the third quarter of 1951 compared with the same 3 months of 1950. With a colder October and November in 1951, the gain in kerosine requirements for the closing quarter of the year rose to 7 percent over the final months of 1950.

Exports of kerosine plus shipments to the United States Territories rose sharply from 2,078,000 barrels in 1950 to 6,818,000 in 1951. The larger proportions went to the United Kingdom (1,514,000 barrels); India (1,243,000 barrels), Egypt (1,231,000 barrels); and Canada (598,000 barrels). The greatly expanded shipments of kerosine to the United Kingdom, Egypt, and India were evidently to replace supplies usually obtained from Iran, which were cut off with the closing of the Abadan refinery early in 1951, owing to the dispute with the British owners over nationalization of the Iranian petroleum industry.

Kerosine stocks at the end of 1951 were more than a quarter above those reported for 1950 and were also higher than the previous record volume held at the close of 1948. Kerosine stored at refineries increased from 11,315,000 barrels in the final month of 1950 to 12,858,000 in December 1951—a 14-percent gain—whereas quantities held at bulk terminals and in transit in pipelines rose sharply from 8,408,000 barrels in 1950 to 12,070,000 in 1951. Kerosine in storage at the end of 1951 represented a 47-day domestic supply at the January 1952 daily rate of demand compared to a 39-day supply at the close of 1950.

Increased stocks of kerosine were reported for all refinery districts at the end of 1951 compared with the 1950 totals, except three areas—Texas Inland, Rocky Mountain, and California— where the quantities stored are relatively unimportant. In the East Coast district, where kerosine stocks represent more than a third of the national total, there was an 8-percent increase in the inventory during 1951. There was a 22-percent increase in the kerosine held in the Indiana-Illinois-Kentucky district, whereas quantities were about a fifth of the country's inventory, while in the Texas Gulf Coast district, third in importance as a storage area for kerosine, the total increased by a half in 1951 over 1950.

Sales of kerosine for various uses, according to the annual survey made by the Bureau of Mines, showed an increase of 4 percent in 1951 over the 1950 demand, compared with a 15-percent gain in 1950 over 1949. The larger share (68 percent of the total in 1950 and 70 percent in 1951) of the kerosine is used in range burners for cooking and space heating. In 1950 the weather was considerably colder than in 1949, which was an important factor in the large increase in the kerosine demand. The fact that still greater requirements for heating, as measured by degree-days, were not repeated in 1951, was probably the more important reason for the lower percentage gain in kerosine requirements for the year. Kerosine sold for range burner fuel was up by approximately 8 percent in 1951 over 1950, compared with a 21-

TABLE 66.—Sales of kerosine in the United States, 1950–51, by State and use

[Thousands of barrels]

District [1] and State	Sold as range oil		Tractor fuel		All other uses		Total	
	1950	1951	1950	1951	1950	1951	1950	1951
District 1:								
Connecticut	4,902	4,923	15	13	167	127	5,084	5,063
Delaware	625	634	1	7	29	49	655	690
District of Columbia	251	227	1	3	195	132	447	362
Florida	1,526	1,729	74	87	804	814	2,404	2,630
Georgia	1,702	1,810	179	140	584	625	2,465	2,575
Maine	2,950	2,965	18	18	215	314	3,183	3,297
Maryland	1,310	1,465	37	47	668	696	2,015	2,208
Massachusetts	12,687	12,615	44	34	496	789	13,227	13,438
New Hampshire	1,536	1,432	11	10	68	52	1,615	1,494
New Jersey	4,874	4,931	19	8	1,037	1,070	5,930	6,009
New York	9,709	9,884	72	69	954	1,001	10,735	10,954
North Carolina	3,769	4,363	241	165	1,884	2,120	5,894	6,648
Pennsylvania	2,521	2,627	126	137	1,415	1,397	4,062	4,161
Rhode Island	2,897	2,860	12	62	104	161	3,013	3,083
South Carolina	1,957	2,014	42	58	1,060	1,365	3,059	3,437
Vermont	809	831	3	11	63	67	875	909
Virginia	1,615	1,822	27	19	924	1,003	2,566	2,844
West Virginia	234	326	2	7	243	195	479	528
Total	55,874	57,458	924	895	10,910	11,977	67,708	70,330
District 2:								
Illinois	3,182	3,777	357	351	1,967	1,453	5,506	5,581
Indiana	1,905	2,537	129	122	2,155	1,621	4,189	4,280
Iowa	1,342	1,714	402	411	1,066	923	2,810	3,048
Kansas	412	745	208	209	410	390	1,030	1,344
Kentucky	489	704	52	70	808	620	1,349	1,394
Michigan	2,387	2,917	191	150	1,986	1,862	4,564	4,929
Minnesota	1,385	1,544	90	83	503	596	1,978	2,223
Missouri	1,456	1,622	51	52	774	661	2,281	2,335
Nebraska	504	608	97	86	160	166	761	860
North Dakota	485	613	82	76	122	210	689	899
Ohio	1,554	1,660	74	61	704	634	2,332	2,355
Oklahoma	815	910	165	161	959	813	1,939	1,884
South Dakota	498	671	87	78	86	89	671	838
Tennessee	1,309	1,508	71	78	971	978	2,351	2,564
Wisconsin	1,172	1,650	191	186	671	781	2,034	2,617
Total	18,895	23,180	2,247	2,174	13,342	11,797	34,484	37,151
District 3:								
Alabama	550	738	72	87	765	786	1,387	1,611
Arkansas	854	949	113	135	774	693	1,741	1,777
Louisiana	615	662	159	156	748	732	1,522	1,550
Mississippi	441	511	137	127	673	637	1,251	1,275
New Mexico	162	249	10	12	78	84	250	345
Texas	1,973	2,301	355	361	3,462	2,820	5,790	5,482
Total	4,595	5,410	846	878	6,500	5,752	11,941	12,040
District 4:								
Colorado	149	187	53	41	41	43	243	271
Idaho	25	29	3	2	12	19	40	50
Montana	109	174	45	29	77	64	231	267
Utah	14	16	4	3	9	9	27	28
Wyoming	66	76	8	3	166	145	240	224
Total	363	482	113	78	305	280	781	840
District 5:								
Arizona	6	2	------	------	49	47	55	49
California	116	74	------	------	2,755	2,334	2,871	2,408
Nevada	1	1	------	------	8	9	9	10
Oregon	12	10	------	------	193	172	205	182
Washington	7	6	------	------	223	212	230	218
Total	142	93	------	------	3,228	2,774	3,370	2,867
Total United States	79,869	86,623	4,130	4,025	34,285	32,580	118,284	123,228

[1] States are grouped according to petroleum-marketing districts rather than to conventional geographic regions.

percent gain in 1950 over the 1949 total. Some No. 1 fuel oil is also sold for range fuel and when this is added to the kerosine it shows a 9-percent increase in range-oil requirements for 1951 against a 21-percent increment in 1950 over 1949.

The amount of kerosine delivered for tractor fuel has steadily decreased in recent years, as gasoline and liquefied petroleum gases sold for this purpose have gained in importance. Sales of kerosine for tractor fuel declined by about 3 percent in 1951 compared with a shrinkage of 15 percent in 1950 from 1949 requirements. Kerosine sold for various miscellaneous uses, such as lamp fuel, orchard heating, weed burning, asphalt heating, dust control, etc., declined by 5 percent in 1951 against a 9-percent gain in 1950 over 1949.

Kerosine prices were held virtually stationary in 1951 under controls set up by the Office of Price Stabilization in contrast to many minor adjustments in 1950 compared with 1949. The only change in representative prices was for 41°–43° gravity water-white kerosine at Oklahoma refineries, where there was a reduction of a fractional cent per gallon in April 1951.

TABLE 67.—Sales of range oil in the United States, 1949–51, by States

[Thousands of barrels]

State	1949	1950	1951	
			Total	Percent of U. S. total
Massachusetts	13,486	13,505	13,479	13.1
New York	9,590	10,386	10,489	10.2
Illinois	5,002	6,184	6,936	6.7
New Jersey	4,701	5,426	5,481	5.3
Connecticut	4,361	5,238	5,251	5.1
Michigan	2,267	3,979	4,667	4.5
North Carolina	3,141	3,872	4,458	4.3
Indiana	1,709	2,516	3,397	3.3
Wisconsin	1,744	2,526	3,319	3.2
Maine	2,280	3,093	3,112	3.0
Rhode Island	2,811	3,058	3,028	2.9
Pennsylvania	2,407	2,838	2,937	2.9
Texas	1,964	2,064	2,826	2.8
Minnesota	1,435	2,454	2,666	2.6
Iowa	1,555	2,188	2,502	2.4
Missouri	1,469	2,308	2,448	2.4
Ohio	1,251	1,926	2,126	2.1
South Carolina	1,244	2,022	2,075	2.0
Virginia	1,628	1,723	1,926	1.9
Georgia	1,190	1,797	1,898	1.9
Florida	1,460	1,601	1,800	1.8
Tennessee	1,188	1,370	1,568	1.5
New Hampshire	1,299	1,636	1,525	1.5
Maryland	1,234	1,336	1,489	1.5
Arkansas	892	964	1,050	1.0
Oklahoma	814	923	1,012	1.0
All other	6,401	7,729	9,382	9.1
Total	78,523	94,662	102,847	100.0

TABLE 68.—Monthly average prices of kerosine in the United States, 1950–51, in cents per gallon

[Platt's Oil Price Handbook]

Year and grade	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average for year
1950													
41°–43° gravity water-white kerosine at refineries, Oklahoma	8.52	8.75	8.75	8.75	8.75	8.69	8.66	8.82	9.06	9.06	9.06	9.23	8.84
Kerosine (and/or No. 1 fuel oil) at New York Harbor	9.50	9.15	9.05	9.01	9.00	9.20	9.21	9.52	9.65	9.92	10.15	10.15	9.46
Kerosine, tank-wagon, at Chicago	15.09	15.30	15.30	15.30	15.30	15.30	15.30	15.30	15.30	15.30	15.67	15.80	15.36
Kerosine, tank-wagon, at New York City [1]	13.41	12.84	12.70	12.53	12.28	12.50	12.50	12.85	13.10	13.42	13.60	13.60	12.94
1951													
41°–43° gravity water-white kerosine at refineries, Oklahoma	9.44	9.44	9.44	9.40	9.31	9.31	9.31	9.31	9.31	9.31	9.31	9.31	9.35
Kerosine (and/or No. 1 fuel oil) at New York Harbor	10.15	10.15	10.15	10.15	10.15	10.15	10.15	10.15	10.15	10.15	10.15	10.15	10.15
Kerosine, tank-wagon, at Chicago	15.80	15.80	15.80	15.80	15.80	15.80	15.80	15.80	15.80	15.80	15.80	15.80	15.80
Kerosine, tank-wagon, at New York City [1]	13.60	13.60	13.60	13.60	13.60	13.60	13.60	13.60	13.60	13.60	13.60	13.60	13.60

[1] Manhattan and Queens.

Rail and truck shipments of kerosine from the California marketing area to other Western States totaled 20,000 barrels in 1951 compared with 25,000 in 1950. There have been no tanker shipments of kerosine from the west coast to the Atlantic seaboard in recent years. No kerosine was received on the west coast by overland routes in 1951, and the 1950 quantity was only 1,000 barrels.

Tanker and barge shipments of kerosine from gulf ports to the Atlantic seaboard increased only nominally—from 41,746,000 barrels in 1950 to 43,516,000 in 1951. The kerosine in this movement originating in Texas totaled 34,061,000 barrels in 1951, compared with 30,784,000 in 1950, whereas the quantity credited to Louisiana declined from 10,962,000 barrels in 1950 to 9,455,000 in 1951.

Tanker rates on kerosine shipped from gulf coast ports to New York fluctuated widely in 1951, with a sharp upward trend. A freight quotation of 88.2 cents a barrel at the end of December 1950 was raised to $1.084 in late January 1951. A slack-season "low" of 36.1 cents a barrel was posted on July 19; however, subsequent advances brought the rate to $1.084 a barrel at the end of November, the same level reached in January 1951. The average freight charge for kerosine for 1951 was 73.9 cents a barrel compared with 37.8 cents in 1950.

DISTILLATE FUEL OIL

Both the domestic demand and exports of distillate fuel oil showed important increases—14 percent and 79 percent, respectively, in 1951 over 1950; however, with a relatively large gain in production—19 percent—the supply was not only sufficient to satisfy these expanded markets, but an excess quantity was also diverted to storage. Additional supplies from "transfers"[6]—up 13 percent in 1951—and im-

[6] For definition, *see* text footnote 1 at the beginning of this chapter.

ports—down 26 percent—were relatively unimportant in volume. Ninety-nine percent of the distillate fuel oil came from new production in 1951, and about 93 percent of the total supply was diverted to the domestic market; 5 percent was exported, and the balance or 2 percent was added to storage. The production of distillate fuel oil in 1950 accounted for 98 percent of the supply, which in turn was supplemented by minor imports and "transfers" plus a small quantity taken from storage. The domestic demand accounted for 97 percent of the available quantity, and the balance was exported.

The domestic demand for distillate grades of fuel oil increased by 14 percent in 1951, compared with a 20-percent expansion in 1950 and a 3-percent decline reported in 1949. A cold January was the principal factor that brought about a 21-percent gain in the demand for light fuel oils in the first quarter of 1951 over the corresponding period of 1950. With a warmer second quarter in 1951 than in 1950, the indicated domestic demand showed only a nominal gain—11 percent—compared with a 30-percent increase in the same 3 months of 1950. The gain in domestic requirements of 4 percent in the third quarter and 13 percent in the final 3 months of 1951 were well below the percentage increases of 17 percent and 22 percent, respectively, reported for 1950 over the same periods of 1949.

Distillate-fuel-oil sales in 1951, according to the annual survey conducted by the Bureau of Mines, were 14 percent above the comparative 1950 totals. Deliveries to gas and electric power plants, the only sales that decreased, were down by 27 percent. The railroads in their shift to diesel equipment, strongly evident in recent years, bought 23 percent more light fuel oils, mostly diesel grades, in 1951 than in 1950; furthermore, the 1951 total for these distillates delivered to railroads was greater in volume than that for the residual grades for the first time. Sales of distillates, mostly diesel fuel, to vessels increased 12 percent over the 1950 total, in contrast to a 2-percent decline in 1950. Bunker deliveries of light fuel oils to vessels engaged in foreign trade increased by 45 percent from 5,229,000 barrels in 1950 to 7,580,000 in 1951, according to data compiled by the Bureau of the Census, United States Department of Commerce, whereas the indicated quantities of light fuel oils sold to vessels using coastal and inland waters declined from 7,643,000 barrels in 1950 to 6,813,000 in 1951.

Sales of distillate-grade fuel oils to gas and electric power plants dropped 27 percent in 1951, in contrast to a gain of 5 percent in 1950 over 1949. The drop was due largely to higher prices for fuel oil in 1951 and a resulting shift to other fuels and sources of energy, such as coal, natural gas, and hydro power. The total consumption of hydro power by electric power plants increased greatly in 1951 over 1950, according to records compiled by the Federal Power Commission. Smelters, mines, and manufacturing plants increased their purchases of distillate fuel oils by 13 percent in 1951 over 1950, compared with a 40-percent rise in 1950 over 1949. This lower rate of gain in 1951 in the requirements for light fuel oils by industrial plants, with the index of manufacturing up to 229 compared with 209 in 1950, according to the Federal Reserve Board, probably was due to increased fuel-oil prices in contrast to almost unchanged quotations for industrial grades of bituminous coal.

TABLE 69.—Salient statistics of distillate fuel oil in the United States, 1950–51, by month and district

[Thousands of barrels]

Month and district	Production		Yield (percent)		Transfers, east of California [1]		Imports		Exports		Domestic demand		Stocks, end of period	
	1950	1951 [2]	1950	1951 [2]	1950	1951 [2]	1950	1951 [2]	1950	1951 [2]	1950	1951 [2]	1950	1951 [2]
By months:														
January	32,489	44,244	18.9	21.7	229	229	61	250	876	916	43,406	57,331	63,932	58,424
February	28,729	39,742	19.0	21.7	192	211	30	139	1,193	844	39,484	50,085	52,206	47,587
March	29,070	41,129	17.7	20.4	204	253	53	35	1,152	980	42,604	45,046	37,777	42,978
April	29,301	35,139	18.8	19.0	193	232	98	121	1,033	1,549	28,806	32,185	37,530	44,736
May	30,920	37,500	18.2	18.8	196	243	130	505	874	2,192	25,163	25,519	42,739	55,273
June	31,112	37,614	18.4	19.1	203	241	225	264	895	1,421	19,705	24,132	53,679	67,839
July	32,253	38,067	17.8	18.7	204	235	508	30	1,201	2,457	23,779	24,277	61,664	79,437
August	33,765	38,335	18.1	18.9	223	248	526	57	967	3,460	26,785	27,185	68,426	87,432
September	35,392	38,453	19.5	19.6	209	234	274	211	1,066	2,818	24,965	27,271	78,270	96,241
October	37,723	40,159	19.8	20.0	221	233	204	153	1,341	2,570	29,434	31,655	85,643	102,561
November	36,530	40,726	20.0	20.4	226	248	237	33	1,112	1,430	35,411	47,221	86,113	94,917
December	41,628	44,693	21.3	21.4	237	256	256	126	943	2,037	55,343	57,233	71,948	80,722
Total	398,912	475,801	19.0	20.0	2,537	2,863	2,602	1,924	12,653	22,674	394,885	449,140	71,948	80,722
By districts:														
East Coast	73,482	90,032	21.7	23.7	--------	--------	(3)	(3)	(3)	(3)	(3)	(3)	21,986	26,637
Appalachian	7,785	9,345	12.9	14.3	--------	--------							794	1,141
Indiana, Illinois, Kentucky, etc	62,485	76,350	16.6	17.5	410	374							10,251	15,892
Oklahoma, Kansas, etc	37,920	44,408	21.3	23.2	418	424							7,887	9,957
Texas, Inland	10,690	13,761	13.7	14.9	961	1,200							1,032	1,710
Texas Gulf Coast	101,938	125,331	21.4	22.4	393	462							12,443	12,220
Louisiana Gulf Coast	37,709	43,386	21.7	22.9	91	89							3,621	3,328
Arkansas, Louisiana Inland, etc	5,375	6,345	19.6	21.2	46	67							861	1,031
Rocky Mountain	13,852	16,118	19.3	19.1	218	247							1,948	1,734
California	47,726	50,725	14.9	14.4	--------	--------							11,125	7,072
Total	398,912	475,801	19.0	20.0	2,537	2,863	2,602	1,924	12,653	22,674	394,885	449,140	71,948	80,722

[1] Figures represent crude oil used as fuel on pipelines, which is considered part of the demand for distillate. No transfers reported from California district for 1950–51.
[2] Preliminary figures.
[3] Figures not available.

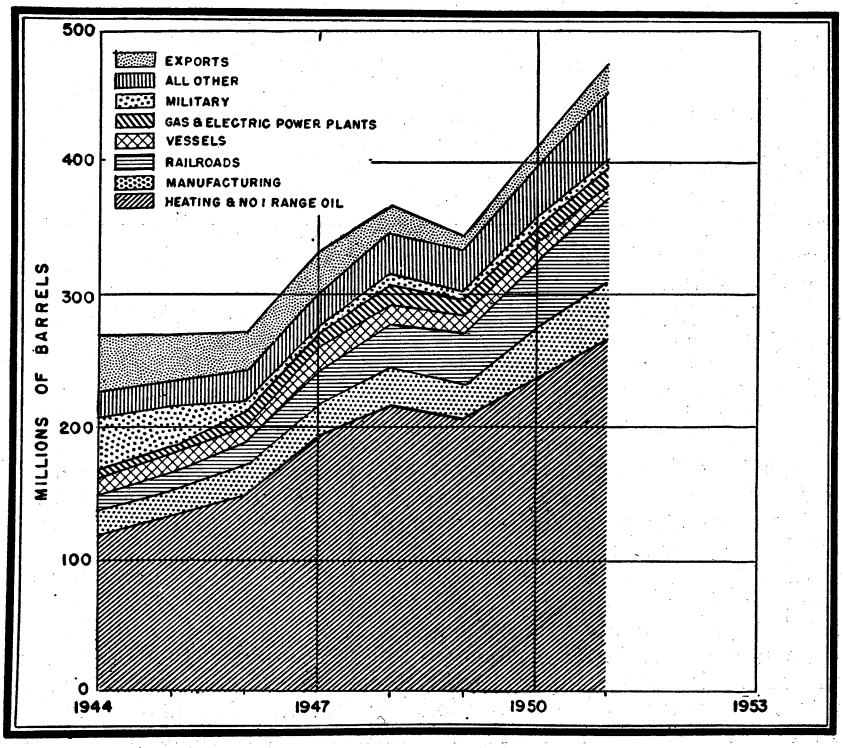

FIGURE 10.—Sales of distillate fuel oil, including diesel oil and range oil, in the United States, 1944–51, by uses.

TABLE 70.—Sales of distillate fuel oil [1] in the United States, 1947–51, by uses

[Thousands of barrels]

Use	1947	1948	1949	1950	1951
Railroads	23,619	31,006	38,604	48,703	59,962
Vessels (including tankers)	14,475	14,511	13,121	12,872	14,393
Gas and electric power plants	14,216	14,856	12,550	13,207	9,612
Smelters, mines, and manufacturing industries [2]	24,489	29,932	26,424	37,121	42,067
Heating oils [2]	178,359	200,024	190,387	220,947	249,258
Fuel oil (No. 1) sold as range oil	11,632	13,534	12,279	14,793	16,224
U. S. Army, Navy, Air Force, and Coast Guard	5,176	9,071	6,109	6,553	8,430
Oil-company fuel	2,191	3,625	4,151	5,692	8,811
Miscellaneous uses	23,857	25,414	25,571	35,418	40,151
Total United States	298,014	341,973	329,196	395,306	448,908
Exports and shipments to U. S. Territories and possessions	29,877	21,293	12,295	12,653	22,674
Total	327,891	363,266	341,491	407,959	471,582

[1] Includes diesel fuel.

[2] Oil used to heat manufacturing plants is included under "Smelters, mines, and manufacturing industries," as the amount so used cannot be separated from the major portion used to generate power. Oil used to heat military and other Government buildings is included under "Heating oils."

In 1951, with a 10-percent increase in domestic burners over the 1950 number in use and with no change in the need for heating as measured by degree-days,[7] sales of light fuel oil (Grades 1–4) for space heating were 13 percent above the 1950 total. This gain in demand compares with a 16-percent increase in 1950, when burners in use were 15 percent above 1949 installations and the weather was 8 percent colder. The light fuel oil sold for heating accounted for approximately 56 percent of the total distillate-fuel-oil sales in both 1950 and 1951. No. 1 fuel oil delivered for range burner fuel showed a 10-percent increase in 1951 compared with a 20-percent gain in 1950 over the 1949 total.

Stepped-up military activities during the entire year are reflected in a 29-percent rise in the purchases of light fuel oils by the armed services, in contrast to a gain of 7 percent in 1950 over 1949 requirements. Oil companies use only a relatively small amount of distillate fuel oils in their various operations; however, with crude production up by 14 percent and a 13-percent gain in crude runs at refineries in 1951 compared with 1950, the quantity consumed increased by 55 percent, which compares with a 37-percent gain in 1950 over the 1949 total.

Major requirements for distillate fuel, including diesel oil and range oil, in recent years, are shown graphically in figure 10.

Closing of the Abadan refinery in Iran at the end of June 1951 and the necessity of finding other major sources of supply to satisfy world markets was probably the principal factor that caused United States exports and Territorial shipments of distillate fuel oil to almost double in volume in 1951 compared with 1950. The more important export items that increased were as follows: Canada, 5,401,000 barrels in 1950 and 6,547,000 in 1951; United Kingdom, 1,166,000 in 1950 and 3,410,000 in 1951; Mexico, 392,000 in 1950 and 1,165,000 in 1951; Sweden, 590,000 in 1950 and 1,123,000 in 1951; and the Philippines, 7,000 in 1950 and 379,000 in 1951. Although there were no exports of light fuel oil to the following countries in 1950, they were credited with relatively important quantities in 1951 as indicated: Netherlands Antilles, 1,749,000 barrels; Australia, 684,000; and Japan, 683,000. It is believed that the distillate shipped to the Netherlands Antilles was used for cracking stock in its petroleum refineries.

The 19-percent gain in the production of distillate fuel oil in 1951 can be attributed mainly to a 13-percent increase in crude runs to stills and secondly to a slightly higher yield—20 percent in 1951 against 19 percent in 1950. The light fuel oil produced at petroleum refineries in 1951 made up 99 percent of the total supply, compared with 98 percent in 1950.

There was a 23-percent gain in distillate-fuel-oil output in 1951 in both the Texas Gulf Coast area, where a quarter of the supply originates, and in the East Coast area, where a fifth of the total is produced. The Illinois-Indiana-Kentucky refinery district is another important source—about 16 percent of the national total—of light fuel oils, and there the output in 1951 was greater by 22 percent. Distillates made in the California refinery district account for about 11 percent of the annual production, and the quantity was up by 6 percent in 1951 over the 1950 total.

[7] The number of degree-days is the monthly sum of the differences between 65° and the daily mean temperature below 65°. Experience has shown that to heat buildings to a temperature of approximately 70° the amount of fuel or heat used per day is proportional to the number of degrees the average outside temperature falls below 65°.

TABLE 71.—Sales of distillate fuel oil [1] in the United States, 1947–51, by States

[Thousands of barrels]

District [2] and State	1947	1948	1949	1950	1951
District 1:					
Connecticut	8,635	10,487	9,510	11,067	11,777
Delaware	783	866	1,013	1,285	1,556
District of Columbia	2,733	2,789	2,246	2,433	2,982
Florida	3,760	4,068	3,824	4,648	5,343
Georgia	1,956	2,593	2,604	3,202	3,962
Maine	2,266	2,638	2,576	3,496	3,935
Maryland	7,551	8,442	7,691	8,981	10,898
Massachusetts	19,290	20,919	19,741	22,769	27,261
New Hampshire	1,387	1,455	1,945	2,765	3,102
New Jersey	26,011	28,755	26,993	30,521	32,298
New York	38,888	45,902	45,252	52,173	56,334
North Carolina	2,552	3,220	3,491	4,354	5,490
Pennsylvania	19,916	22,198	20,849	28,266	34,585
Rhode Island	3,389	3,413	3,408	4,116	4,260
South Carolina	1,427	1,662	1,630	1,854	2,202
Vermont	816	875	1,054	1,117	1,166
Virginia	4,539	5,319	5,380	7,855	9,156
West Virginia	475	585	554	651	1,229
Total	146,374	166,186	159,761	191,553	217,536
District 2:					
Illinois	20,906	21,622	19,582	26,320	28,517
Indiana	6,153	8,429	8,080	10,776	13,205
Iowa	6,099	7,435	7,610	8,925	9,791
Kansas	2,881	4,094	3,185	4,527	5,552
Kentucky	1,586	1,980	1,956	2,274	2,753
Michigan	12,277	13,713	14,562	18,493	20,334
Minnesota	9,327	10,229	10,094	12,448	14,560
Missouri	7,072	8,110	6,822	7,815	8,684
Nebraska	3,340	3,744	3,386	3,707	3,829
North Dakota	1,067	1,312	1,616	1,939	2,026
Ohio	7,479	10,120	9,442	12,059	14,474
Oklahoma	1,084	1,571	1,929	1,928	2,223
South Dakota	1,338	1,434	1,510	1,893	2,133
Tennessee	2,018	2,143	2,125	3,062	3,428
Wisconsin	8,203	8,609	8,279	10,285	11,437
Total	90,830	104,545	100,178	126,451	142,946
District 3:					
Alabama	1,937	2,493	2,340	2,692	2,846
Arkansas	1,733	1,838	2,162	2,414	2,244
Louisiana	3,274	4,268	4,021	4,619	5,224
Mississippi	912	1,002	1,010	1,271	1,507
New Mexico	708	653	715	950	972
Texas	8,035	10,120	9,238	12,790	16,183
Total	16,599	20,374	19,486	24,736	28,976
District 4:					
Colorado	1,724	1,976	1,683	1,831	2,036
Idaho	1,034	1,570	1,562	1,770	2,291
Montana	1,660	1,810	1,965	2,478	2,851
Utah	1,223	1,448	1,474	2,001	2,334
Wyoming	643	1,600	1,504	1,732	1,893
Total	6,284	8,404	8,188	9,812	11,405
District 5:					
Arizona	1,173	1,342	1,021	1,020	1,233
California	20,481	22,573	21,232	19,212	22,031
Nevada	951	1,363	1,772	1,843	2,102
Oregon	5,720	6,181	6,343	7,725	8,534
Washington	9,602	11,005	11,215	12,954	14,145
Total	37,927	42,464	41,583	42,754	48,045
Total United States	298,014	341,973	329,196	395,306	448,908

[1] Includes diesel fuel oil.

[2] States are grouped according to petroleum-marketing districts rather than to conventional geographic regions.

Pipeline companies use some light crude petroleum as fuel, and the quantity is entered into the distillate fuel-oil account as "transfers." This item increased by 13 percent in 1951 compared to 1950 and represented less than 1 percent of the available light fuel oils.

Distillate-fuel-oil stocks held at the end of 1951 were 12 percent greater than those reported at the close of 1950. The 44,682,000 barrels stored at refineries on December 31, 1951, were 7 percent over the comparative quantity of 41,632,000 for 1950, whereas supplies reported at bulk terminals and in pipelines rose 19 percent from 30,316,000 barrels in 1950 to 36,040,000 in 1951. The light fuel oil in storage at the year end of 1951 represented a 40-day supply at the January 1952 daily rate of domestic demand, compared with a 39-day reserve at the close of 1950.

Most refinery districts showed important buildups in distillate-fuel-oil stocks during 1951. A third of the light-fuel-oil inventory was reported from the East Coast States, where the gain in the amount stored increased by 21 percent. There was an outstanding stock increase of 55 percent in the Indiana-Illinois-Kentucky district, where the total at the end of 1951 represented a fifth of the national reserve. Relatively important distillate stocks are credited to the Texas Gulf and California districts; however, the quantities declined by 2 and 36 percent, respectively, during 1951. This big shrinkage in West Coast distillate stocks in 1951 was largely the result of a tight supply in the area, as reported sales of light fuel oil were up by 12 percent, whereas the local production in 1951 was only 6 percent above the 1950 total. The 1951 year-end inventory for the Louisiana Gulf district, although not relatively important in volume, was 8 percent below the comparative quantity for 1950.

Rail and truck shipments of distillate from the west coast to other Western States continued a downward trend from 606,000 barrels in 1950 to 521,000 in 1951. Tanker shipments of distillate fuel oil from California to the east coast rose sharply from 66,000 barrels in 1949 to 1,554,000 in 1950 and then declined to only 34,000 in 1951. Distillate fuel oil shipped overland into the Pacific Coast marketing area increased from 1,095,000 barrels in 1950 to 1,669,000 in 1951.

Tanker and barge shipments of distillate fuel oil from the Gulf area to the Atlantic seaboard have increased steadily in recent years from 102,147,000 barrels in 1949 to 115,328,000 in 1950 and to 129,953,000 in 1951. The quantities shipped from Texas have expanded from 80,748,000 barrels in 1949 to 93,600,000 in 1950 and to 106,285,000 in 1951. Louisiana was credited with 21,399,000 barrels in 1949, 21,728,000 in 1950, and 23,668,000 in 1951.

Tanker rates for No. 2 distillate fuel oil from the Gulf coast to New York averaged 78.1 cents a barrel in 1951 compared with 39.5 cents in 1950. There were numerous changes in this freight charge in 1951 and a high of $1.138 a barrel was quoted in late January and again at the end of November. The 1951 low of 37.8 cents a barrel held for a few days in late July.

There were very few changes in representative distillate fuel oil wholesale prices during 1951, because of controls set up by the Office of Price Stabilization. In contrast to numerous adjustments in the price of No. 2 fuel oil at refineries in Oklahoma in 1950, there were only four minor changes in 1951, which resulted in a net reduction of less than a tenth of a cent a gallon during the 12 months. Other

TABLE 72.—Monthly average prices of distillate fuel oil and diesel fuel in the United States, 1950–51

[Platt's Oil Price Handbook]

Year and grade	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average for year
1950													
No. 2 fuel oil at refineries, Oklahoma—cents per gallon	7.85	8.03	8.06	8.03	7.94	7.92	7.96	8.15	8.37	8.38	8.38	8.46	8.13
No. 2 fuel oil at New York Harbor—cents per gallon	8.37	7.94	7.85	7.75	7.87	8.10	8.11	8.43	8.60	8.90	9.15	9.15	8.35
Diesel oil, shore plants, New York Harbor—cents per gallon	8.97	8.46	8.37	8.15	8.31	8.53	8.56	8.84	9.00	9.31	9.55	9.55	8.80
Diesel oil for ships:													
New York dollars per barrel	3.69	3.53	3.47	3.36	3.40	3.48	3.48	3.56	3.69	3.80	3.90	3.90	3.60
New Orleans—do	3.35	3.35	3.30	3.22	3.24	3.28	3.28	3.36	3.49	3.49	3.49	3.49	3.36
San Pedro—do	3.35	3.35	3.35	3.35	3.35	3.35	3.35	3.35	3.35	3.43	3.44	3.44	3.37
1951													
No. 2 fuel oil at refineries, Oklahoma—cents per gallon	8.56	8.56	8.56	8.52	8.40	8.38	8.38	8.38	8.38	8.44	8.50	8.50	8.46
No. 2 fuel oil at New York Harbor—cents per gallon	9.15	9.15	9.15	9.15	9.15	9.15	9.15	9.15	9.15	9.15	9.15	9.15	9.15
Diesel oil, shore plants, New York Harbor—cents per gallon	9.55	9.55	9.55	9.55	9.55	9.55	9.55	9.55	9.55	9.55	9.55	9.55	9.55
Diesel oil for ships:													
New York dollars per barrel	3.90	3.90	3.90	3.90	3.90	3.90	3.90	3.90	3.90	3.90	3.90	3.90	3.90
New Orleans—do	3.49	3.49	3.49	3.49	3.49	3.49	3.49	3.49	3.49	3.49	3.49	3.49	3.49
San Pedro—do	3.44	3.44	3.44	3.44	3.44	3.44	3.44	3.44	3.44	3.44	3.44	3.44	3.44

representative quotations for light fuel oils, including diesel grades remained at the same level throughout all of 1951.

Average retail fuel prices in a number of cities are published monthly by the Bureau of Labor Statistics, United States Department of Labor. The average price of No. 2 distillate fuel oil in New York City was 12.63 cents a gallon until May 1951, when it advanced to 12.75 cents, a quotation that held until November, when there was a slight reduction to an average of 12.71 cents a gallon. The average price for this grade of fuel oil for all of 1951 was 12.70 cents a gallon compared with 11.72 cents in 1950. The average price of No. 2 in Chicago was 13.63 cents a gallon from January through April 1951 and then dropped to 13.57 cents, a value that held for the remainder of the year. The average quotation was 13.59 cents a gallon in 1951 or slightly higher than the 1950 average of 12.64 cents.

RESIDUAL FUEL OIL

There was only a nominal increase—2 percent—in the domestic demand for residual fuel oil in 1951; however exports were up sharply, 79 percent compared with those of 1950. Production of heavy grades of fuel oil in 1951 was greater by 10 percent, and the transfers also gained 13 percent; consequently, there was a slight surplus in the supply, which was diverted to storage. Imports were lower by 1 percent compared with 1950 receipts from foreign sources. Demand and supply factors in 1951 differed from those prevailing in 1950, when both the domestic and export markets were considerably expanded; with virtually no increase in production, it was necessary to draw heavily on available stocks, even though imports and transfers were well above 1949 levels.

TABLE 73.—Salient statistics of residual fuel oil in the United States, 1950–51, by month and district

[Thousands of barrels]

Month and district	Production		Yield (percent)		Transfers [1]				Imports		Exports		Domestic demand		Stocks, end of period	
					East of California		California									
	1950	1951 [2]	1950	1951 [2]	1950	1951 [2]	1950	1951 [2]	1950	1951 [2]	1950	1951 [2]	1950	1951 [2]	1950	1951 [2]
By months:																
January	37,491	42,397	21.9	20.8	252	377	283	120	10,204	13,842	1,178	946	51,437	56,223	55,808	40,317
February	32,818	38,696	21.7	21.1	273	325	100	106	7,189	12,102	978	1,036	47,382	51,101	47,828	39,409
March	35,768	41,771	21.8	20.8	302	327	45	110	11,680	10,941	1,604	1,474	52,159	53,568	41,860	37,516
April	31,426	36,908	20.1	20.0	286	281	97	116	10,528	10,376	1,201	1,446	43,017	46,841	39,979	36,910
May	32,954	39,202	19.4	19.6	285	338	147	130	9,302	9,768	1,270	2,927	41,915	44,104	39,482	39,317
June	32,058	38,303	18.9	19.5	275	298	165	98	9,043	8,605	1,844	2,902	39,055	42,153	40,124	41,566
July	35,338	39,516	19.5	19.5	292	333	128	147	8,429	6,672	1,299	3,671	40,847	39,400	42,165	45,163
August	35,585	37,993	19.1	18.7	332	337	193	293	9,251	7,357	1,639	3,446	44,908	40,454	40,979	47,243
September	35,343	36,843	19.4	18.8	310	309	130	286	9,097	6,532	1,189	3,454	42,704	39,547	41,966	48,212
October	38,759	37,944	20.3	18.9	370	351	155	211	10,846	9,758	898	3,045	46,194	45,016	45,004	48,415
November	37,202	39,111	20.3	19.6	327	408	116	147	11,778	10,682	1,402	2,403	47,977	50,982	45,048	45,378
December	40,475	40,693	20.7	19.4	345	407	117	151	12,689	12,040	1,726	2,308	56,198	54,382	40,750	41,979
Total	425,217	469,377	20.2	19.7	3,649	4,091	1,676	1,915	120,036	118,675	16,228	29,058	553,793	563,771	40,750	41,979
By districts:																
East Coast	76,094	84,266	22.5	22.2											9,912	10,381
Appalachian	9,456	10,483	15.6	16.0											499	823
Indiana-Illinois-Kentucky, etc	57,674	63,485	15.3	14.6	713	764									3,619	5,715
Oklahoma, Kansas, etc	21,824	24,014	12.2	12.5	586	429									1,102	1,789
Texas Inland	14,810	15,564	18.9	16.9	554	557			(3)	(3)	(3)	(3)	(3)	(3)	795	1,126
Texas Gulf Coast	86,589	94,065	18.2	16.8	256	254									5,080	6,040
Louisiana Gulf Coast	21,053	22,529	12.1	11.9	708	757									2,186	1,886
Arkansas, Louisiana Inland, etc	4,064	2,866	15.0	9.6	389	545									140	142
Rocky Mountain	15,063	17,909	21.0	21.3	443	785									810	1,111
California	118,590	134,196	37.0	38.0			1,676	1,915							16,607	12,966
Total	425,217	469,377	20.2	19.7	3,649	4,091	1,676	1,915	120,036	118,675	16,228	29,058	553,793	563,771	40,750	41,979

[1] Represents crude oil used as fuel on leases and for general industrial purposes.

[2] Preliminary figures.

[3] Figures not available.

The domestic demand for residual fuel oil in 1951 rose to a new level for the second consecutive year. However, the gain in 1951 over 1950 (2 percent) was not as great as in 1950 when the increase over 1949 was 12 percent. There were substantial gains in all quarters of 1950 over 1949, but the percentage increase was less marked in the final 3 months. This tapering off continued into 1951 and resulted in an actual decline from 1950 of 7 percent in the third quarter compared to a 13-percent gain in the corresponding period of 1950 over 1949. The demand for heavy fuel oils was virtually the same in the closing quarters of both 1950 and 1951.

According to the annual canvass by the Bureau of Mines, sales of residual fuel oils showed a net overall increase of only 2 percent in 1951 over 1950, as deliveries to railroads and to the gas and electric public utilities were down sharply. The railroads, with their greatly expanded use of diesel equipment, bought 10 percent less heavy fuel oil in 1951 than in 1950, which compared with a 4-percent drop in 1950 from 1949 requirements. Suppliers reported a 15-percent gain in sales of heavy fuel oils to vessels in 1951 against a 4-percent increase in 1950 over 1949. Vessels engaged in foreign trade were credited with purchases of 63,809,000 barrels of heavy-fuel-oil bunkers at American ports in 1951 compared with 50,815,000 in 1950—a gain of 26 percent—according to the records of the Bureau of the Census, United States Department of Commerce. The indicated demand for heavy fuel oils by vessels using coastal and inland waters increased from 42,132,000 barrels in 1950 to 43,198,000 in 1951.

The fact that gas and electric power companies turned strongly to other sources of energy in 1951, owing largely to higher fuel-oil prices, was reflected in a 24-percent decline in their purchases of residual fuel oils. This sharp drop in heavy-fuel-oil sales to the utilities in 1951 contrasted with a substantial 16-percent gain in 1950 over the 1949 total. The index of industrial production, an indicator of the need for all fuels by heavy industries, rose from 209 in 1950 to 229 in 1951. Apparently higher prices for heavy fuel oil, in contrast to virtually stable prices for industrial grades of coal, were the important factor that limited sales of residual fuel oils to smelters, mines, and manufacturing plants to a 6-percent gain in 1951, compared with a 21-percent increase in 1950 over 1949 requirements.

Considerably colder weather and an 8-percent increase in commercial burners in use were factors that brought about a 20-percent expansion over 1949 in sales of heavy heating oils in 1950. There was a similar percentage gain in the number of commercial burners in use in 1951, but virtually no change in the coldness of the weather as measured by degree-days; consequently, sales of heavy grades of fuel oil for heating purposes showed only a nominal gain of 5 percent.

The Nation's military services increased purchases of Navy Grade and other heavy fuel oils by 34 percent in 1951, the first full year of operations since the beginning of hostilities in Korea. This stepped-up demand in 1951 compares with a 25-percent gain in military requirements for heavy fuel oils in 1950, when a tense international situation had prevailed only during the second half of the year.

The quantity of heavy fuel oil, including some crude petroleum and acid sludge, consumed by oil companies in their field and refinery operations has declined in recent years, as the petroleum industry has turned more and more to natural gas, refinery gas, and purchased

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electricity as sources of energy. Heavy grades of fuel oil used by oil companies increased less than 2 percent in 1951 over 1950 requirements, compared with a 3-percent gain in 1950 over 1949, and the quantities represented about a tenth of the residual-fuel-oil total for both years.

TABLE 74.—Sales of residual fuel oil [1] in the United States, 1947–51, by uses

[Thousands of barrels]

Use	1947	1948	1949	1950	1951
Railroads	97,500	89,588	63,467	60,878	54,998
Vessels (including tankers)	101,900	95,763	89,362	92,947	107,007
Gas and electric power plants	60,964	56,812	80,092	93,062	70,550
Smelters, mines, and manufacturing industries	115,108	117,780	122,633	148,111	157,279
Heating oils	56,402	58,639	60,414	72,716	76,164
U. S. Army, Navy, Air Force, and Coast Guard	19,147	24,655	22,724	28,333	38,054
Oil-company fuel	62,649	56,637	[2] 51,667	53,263	54,056
Miscellaneous uses	6,859	6,623	4,574	4,898	5,280
Total United States	520,529	506,497	[2] 494,933	554,208	563,388
Exports and shipments to U. S. Territories and possessions	10,623	13,011	12,641	16,228	29,058
Total	531,152	519,508	[2] 507,574	570,436	592,446

[1] Includes Navy grade and crude oil burned as fuel.
[2] Revised.

Sales of residual fuel oils in recent years are shown graphically in figure 11. All grades of heavy fuel oil and crude petroleum and acid sludge used as fuel are included.

Closing of the Abadan refinery in Iran in mid-1951, which necessitated a realinement of world fuel-oil-supply sources, was probably the principal factor that brought about a 79-percent increase in residual-fuel-oil exports and shipments to United States Territories in 1951 compared with 1950. The countries that received the largest shipments of heavy fuel oil in 1951 were as follows: Canada, 5,761,000 barrels; Japan, 3,991,000; Mexico, 2,328,000; Chile, 1,962,000; Australia, 1,803,000; Cuba, 1,229,000; and the United Kingdom, 1,109,000.

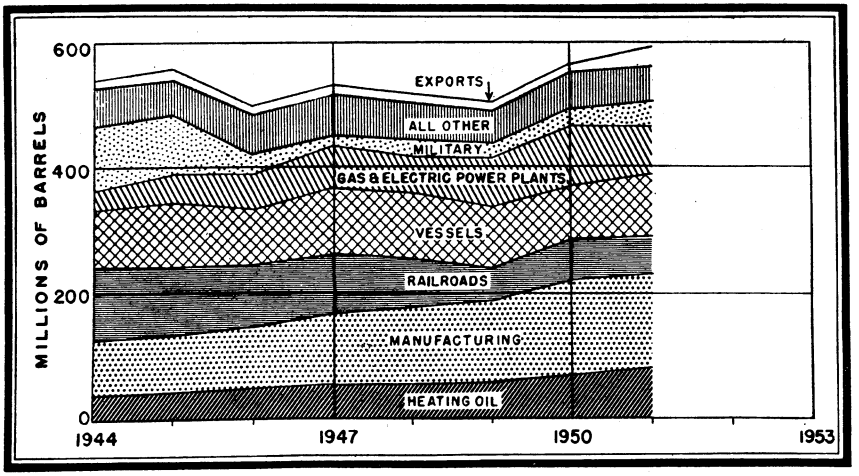

FIGURE 11.—Sales of residual fuel oil in the United States, 1944–51, by uses.

TABLE 75.—Sales of residual fuel oil [1] in the United States, 1947–51, by States

[Thousands of barrels]

District [2] and State	1947	1948	1949	1950	1951
District 1:					
Connecticut	8,838	10,066	14,515	16,845	14,888
Delaware	1,139	1,043	1,921	2,373	1,888
District of Columbia	935	855	1,427	1,188	1,688
Florida	15,519	16,132	15,671	17,009	20,322
Georgia	2,933	3,375	4,227	4,733	5,619
Maine	2,809	2,342	2,704	3,550	3,178
Maryland	17,119	13,276	13,521	14,168	15,814
Massachusetts	16,976	18,082	23,476	30,715	29,883
New Hampshire	959	909	1,175	1,873	2,326
New Jersey	46,167	33,680	37,973	49,092	44,775
New York	32,907	45,871	49,168	61,829	52,684
North Carolina	433	461	560	990	1,109
Pennsylvania	35,794	37,240	35,391	41,110	42,614
Rhode Island	7,088	7,917	8,508	10,891	10,030
South Carolina	2,349	2,496	2,610	3,652	4,145
Vermont	262	258	281	382	300
Virginia	11,298	10,590	12,200	12,883	18,037
West Virginia	828	1,171	1,366	1,587	1,464
Total	204,353	205,764	226,694	274,870	270,764
District 2:					
Illinois	17,047	15,276	15,570	19,517	20,257
Indiana	12,386	13,497	13,343	15,841	16,850
Iowa	777	742	1,176	1,321	1,365
Kansas	11,224	10,166	8,226	5,893	7,110
Kentucky	824	1,303	1,679	1,260	1,007
Michigan	7,046	11,051	11,403	12,708	13,743
Minnesota	1,022	1,315	1,467	2,432	2,431
Missouri	6,920	6,609	5,260	5,389	5,379
Nebraska	378	329	422	550	467
North Dakota	414	447	358	297	224
Ohio	16,534	16,089	16,779	18,004	18,017
Oklahoma	8,276	7,723	5,438	4,783	3,890
South Dakota	257	288	262	294	231
Tennessee	1,015	890	919	1,398	1,331
Wisconsin	1,358	1,497	1,515	1,712	1,861
Total	85,478	87,222	83,817	91,399	94,163
District 3:					
Alabama	3,294	2,296	1,891	2,271	2,417
Arkansas	2,253	2,080	1,833	2,273	2,051
Louisiana	14,835	19,434	15,220	11,221	10,953
Mississippi	343	411	314	348	257
New Mexico	840	685	460	696	532
Texas	66,789	63,376	48,481	48,560	50,464
Total	88,354	88,282	68,199	65,369	66,674
District 4:					
Colorado	1,218	886	783	1,050	1,068
Idaho	460	456	480	629	945
Montana	5,444	4,935	3,702	4,222	4,958
Utah	1,486	1,585	3,639	4,767	4,979
Wyoming	3,741	3,877	2,959	3,024	3,252
Total	12,349	11,739	11,563	13,692	15,202
District 5:					
Arizona	3,491	1,841	1,087	1,448	1,157
California	90,916	79,081	77,171	78,397	85,884
Nevada	5,957	4,372	1,514	2,889	2,685
Oregon	15,482	14,892	12,845	12,429	12,215
Washington	14,149	13,304	12,043	13,715	14,644
Total	129,995	113,490	104,660	108,878	116,585
Total United States	520,529	506,497	494,933	554,208	563,388

[1] Includes Navy grade and some crude oil burned as fuel.
[2] States are grouped according to petroleum-marketing districts rather than to conventional geographic regions.

A 10-percent gain in the production of residual fuel oil in 1951 compared with 1950 was definitely due to higher crude runs at refineries, as the percentage yield dropped fractionally. Residual fuel oils from new production made up 79 percent of the supply in 1951 compared with 75 percent in 1950. All refinery districts reported higher outputs of heavy fuel oil in 1951, except the Arkansas-Louisiana Inland area, where the quantity produced is relatively unimportant. About 30 percent of the residual fuel oils were produced in the California district, where a 13-percent gain was associated with both higher refinery runs and an increased percentage yield. The East Coast and the Indiana-Illinois-Kentucky [refinery] districts] produced important quantities of heavy fuel oils, and gains in those areas in 1951 of 11 and 10 percent, respectively, were the result of stepped-up crude runs, as percentage yields were down slightly. A higher crude throughput coupled with a lower yield also prevailed in the Texas Gulf district, which produced a fifth of all residuals in 1951 or a quantity 9 percent above the 1950 total. The volume of heavy fuel oils coming from the other refinery districts was relatively small.

Heavy crude oil burned as fuel on oil-company leases and in industrial plants is entered into the residual-fuel-oil account as transfers, and the quantity so used each year represents about 1 percent of the supply from all sources. About one-third of the transfers is reported from the California refinery district, whereas the balance is credited to the other refinery areas of the country, not including the East Coast and Appalachian districts. Transfers increased 13 percent in 1951 over the 1950 total, with a 14-percent gain in the West Coast district and a 12-percent gain for the area east of California.

Imports of heavy fuel oil account for about a fifth of the total supply from all sources. There was an unusually large increase—60 percent—in the quantity received from foreign sources in 1950 over the 1949 total, but this was not repeated in 1951, as there was a 1-percent decline in the volume, probably due to closing of the Abadan refinery in Iran and the resulting readjustment of world supply sources. In 1951, as in 1950, most imported residual fuel oil came from Netherland Antilles—95,057,000 barrels—with smaller amounts from Venezuela—24,611,000 barrels—and from Trinidad and Tobago—1,835,000 barrels.

Heavy-fuel-oil stocks at the close of 1951 showed a net increase of only 3 percent over the 1950 total; however, there were some rather important changes in the different refinery districts. A heavy decrease in residual-fuel-oil stocks reported for the California refinery area in 1950 was repeated in 1951, but in a lesser degree. The shrinkage there of about 50 percent in 1950 from 1949 was due to large shipments of heavy fuel oil to the east coast; and a further 22-percent decline in 1951 was undoubtedly associated with heavy exports, which about doubled during the year, and greater military requirements. About a quarter of the heavy fuel oils are stored in the East Coast district, where there was only a nominal increase—5 percent—in 1951 over the 1950 year-end quantity. Residual stocks increased in 1951 by 58 percent in the Indiana-Illinois-Kentucky district and by 19 percent in the Texas Gulf area, other important storage areas.

Residual-fuel-oil inventories at petroleum refineries increased 7 percent from 31,003,000 barrels at the close of 1950 to 33,035,000 a year later, whereas quantities reported at bulk terminals and in pipelines

decreased 8 percent from 9,747,000 barrels in 1950 to 8,944,000 in 1951. The refinery stocks made up 76 percent of the total heavy-fuel-oil stocks in 1950 and 79 percent at the end of 1951, and the bulk and pipeline share declined proportionately during the same interval. Year-end stocks of heavy fuel oils for both 1950 and 1951 represented a 23-day supply at the following January daily rate of domestic demand.

There was a small in-and-out movement of residual fuel oils by rail and truck between the Pacific Coast marketing area and other Western States. Shipments out of California were 467,000 barrels in 1951 compared with 362,000 in 1950, whereas receipts in the Pacific Coast area from other States totaled 370,000 barrels in 1950 and 356,000 in 1951.

Tanker shipments of heavy fuel oils from California to the east coast, which reached a record volume of 15,429,000 barrels in 1950, dwindled to a mere 140,000 barrels in 1951.

Barge and tanker shipments of residual fuel oil from the gulf coast to the Atlantic seaboard of 60,379,000 barrels in 1951 were only slightly above the 1950 total of 59,292,000 barrels. The quantity originating n Te xas declined from 53,102,000 barrels in 1950 to 52,868,000 in 1951, whereas that from Louisiana showed a substantial gain (21 percent) from 6,190,000 barrels in 1950 to 7,511,000 in 1951.

The tanker rate for Bunker "C" fuel oil on the gulf coast-New York run more than doubled from an average of 41.1 cents a barrel in 1950 to 87.4 cents in 1951. The freight charge on this heavy grade of fuel oil rose to $1.315 a barrel in late January 1951, in mid-February, and again just after the middle of December. The 1951 low quotation of 41.7 cents a barrel held for a week in the middle of May.

An upward trend in average prices for the year for residual fuel oils, evident in 1950, was continued in 1951, although the actual number of changes were far less numerous in the later year. An average quotation for No. 6 grade at refineries in Oklahoma of $1.88 a barrel dating from December 19, 1950, was reduced to an average of $1.80 on May 1, 1951, and to $1.78 on May 4. There was a third reduction to $1.73 a barrel on October 9, however, the average value for all of 1951 was $1.80 a barrel compared with $1.64 in 1950. An average price of $3.10 a barrel for No. 5 fuel oil at New York Harbor, dating from late October 1950, held until June 4, 1951, when it was raised to $3.25 and then to $3.40 on June 6, at which level it remained unchanged for the balance of the year. The average quotation for this No. 5 grade advanced from $2.79 in 1950 to $3.27 in 1951.

A quotation of $2.15 a barrel for Bunker "C" for ships' bunkers at New York Harbor posted in November 1950 was raised to $2.30 and then to $2.45 a barrel in early June 1951, where it remained unchanged, resulting in an average price of $2.32 for all of 1951 compared with $2.09 a barrel in 1950. A price of $1.85 a barrel for Bunker "C" at New Orleans, announced in July 1950, held throughout 1951. Likewise, the quotation for Bunker "C" at San Pedro, Calif., of $1.78 a barrel dating from mid-December 1950 was maintained throughout 1951.

Retail prices of various fuels in a number of cities are published monthly by the Bureau of Labor Statistics, United States Department of Labor. These releases show that the price for No. 6 Grade in New York in dumps of 100 gallons or more rose gradually from an average of 6.14 cents a gallon in January 1951 to 6.92 cents in June

TABLE 76.—Monthly average prices of residual fuel oil in the United States, 1950–51, in dollars per barrel

[Platt's Oil Price Handbook]

Year and grade	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average for year
1950													
No. 6 fuel oil at refineries, Oklahoma	1.34	1.52	1.57	1.60	1.67	1.69	1.68	1.68	1.70	1.70	1.70	1.79	1.64
No. 5 fuel oil at New York Harbor	2.75	2.69	2.55	2.59	2.63	2.63	2.71	2.80	2.94	3.03	3.10	3.10	2.79
Bunker "C" for ships:													
New York	2.05	2.05	1.91	2.00	2.05	2.05	2.14	2.15	2.20	2.22	2.16	2.15	2.09
New Orleans	1.75	1.75	1.60	1.70	1.75	1.75	1.84	1.85	1.85	1.85	1.85	1.85	1.78
San Pedro	1.25	1.25	1.25	1.25	1.25	1.26	1.46	1.55	1.55	1.55	1.55	1.71	1.41
1951													
No. 6 fuel oil at refineries, Oklahoma	1.88	1.88	1.88	1.88	1.78	1.78	1.78	1.78	1.78	1.74	1.73	1.73	1.80
No. 5 fuel oil at New York Harbor	3.10	3.10	3.10	3.10	3.10	3.37	3.40	3.40	3.40	3.40	3.40	3.40	3.27
Bunker "C" for ships:													
New York	2.15	2.15	2.15	2.15	2.15	2.43	2.45	2.45	2.45	2.45	2.45	2.45	2.32
New Orleans	1.85	1.85	1.85	1.85	1.85	1.85	1.85	1.85	1.85	1.85	1.85	1.85	1.85
San Pedro	1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.78

and that the quotation remained at that level for the balance of the year. The average price for this heavy fuel oil at New York for all of 1951 was 6.63 cents a gallon compared with 5.93 cents in 1950. No. 5 fuel oil at Chicago, priced at 10 cents a gallon in January 1951, advanced to an average of 10.13 cents in May, and then dropped back to 10 cents a gallon for the balance of 1951. The average quotation for 1951 was 10.09 cents a gallon against 9.27 cents in 1950.

LUBRICANTS

The refinery production of lubricating oils and greases increased from 51.7 million barrels in 1950 to 61.5 million in 1951. Of the total increase of 9.8 million barrels, 4.1 million was in the Texas Gulf district, 2.0 million in the Louisiana Gulf district, 1.2 million in the Indiana-Illinois district, 1.0 million barrels in the East Coast district, and 0.6 million in the California district. In 1951 the percentage of total production by districts was 33.6 percent in the Texas Gulf, 18.3 percent in the East Coast, 10.6 percent in the Louisiana Gulf, 9.8 percent in the Indiana-Illinois district, 8.8 percent in the Appalachian, 7.7 percent in the Oklahoma-Kansas, 7.6 percent in California, and 3.6 percent in all other districts. Production exceeded demand, as 1.8 million barrels was added to stocks.

The total demand for lubricants rose to 59.7 million barrels in 1951, a gain of 6.6 million. Exports increased 3.2 million barrels to 17.4 million, and the domestic demand of 42.3 million barrels showed a gain of 3.5 million or 9 percent. No current figures are available on the relative demand for industrial and automotive uses. The automotive demand has been affected by the growing practice of reclaiming lubricants for reuse and by less frequent changes in oil.

Table 78 shows the prices of representative grades of lubricants for 1950 and 1951.

TABLE 77.—Salient statistics of lubricants in the United States, 1950–51, by month and district

Month and district	Production (thousand barrels)		Yield (percent)		Domestic demand (thousand barrels)		Stocks, end of period (thousand barrels)	
	1950	1951 [1]	1950	1951 [1]	1950	1951 [1]	1950	1951 [1]
By months:								
January	3,932	5,061	2.3	2.5	2,846	3,539	9,323	8,160
February	3,587	4,339	2.4	2.4	2,370	3,115	9,341	8,386
March	4,086	5,108	2.5	2.5	3,271	3,691	8,989	8,209
April	3,645	5,175	2.3	2.8	2,544	3,550	8,787	8,393
May	4,039	5,454	2.4	2.7	3,346	3,850	8,280	8,451
June	4,002	5,094	2.4	2.6	3,588	3,632	7,736	8,444
July	4,151	5,241	2.3	2.6	3,314	3,348	7,427	8,662
August	4,686	5,379	2.5	2.6	3,822	3,592	7,145	8,875
September	4,646	4,905	2.6	2.5	3,511	3,313	6,950	8,866
October	4,987	5,432	2.6	2.7	3,906	4,090	6,973	8,914
November	4,906	5,144	2.7	2.6	3,322	3,421	7,283	9,111
December	5,068	5,157	2.6	2.5	3,013	3,163	7,849	9,617
Total	51,735	61,489	2.5	2.6	38,853	42,304	7,849	9,617
By districts:								
East Coast	10,214	11,261	3.0	3.0			1,965	2,694
Appalachian	5,395	5,422	8.9	8.3			535	579
Indiana, Illinois, Kentucky, etc.	4,800	6,026	1.3	1.4			915	1,085
Oklahoma, Kansas, etc.	4,174	4,717	2.3	2.5			385	536
Texas Inland	74	79	.1	.1			23	20
Texas Gulf Coast	16,590	20,653	3.5	3.7	(2)	(2)	2,578	3,111
Louisiana Gulf Coast	4,520	6,492	2.6	3.4			599	696
Arkansas, Louisiana Inland, etc.	1,600	1,893	5.9	6.3			68	98
Rocky Mountain	250	249	.3	.3			117	114
California	4,118	4,697	1.3	1.3			664	684
Total	51,735	61,489	2.5	2.6	38,853	42,304	7,849	9,617

[1] Preliminary figures.

[2] Figures not available.

TABLE 78.—Average monthly refinery prices of five selected grades of lubricating oil in the United States, 1950–51, in cents per gallon

[National Petroleum News]

Year and grade	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average for year
1950													
Oklahoma:													
200 viscosity, No. 3 color, neutral	12.45	12.00	12.00	12.00	12.05	12.50	13.13	14.57	16.35	17.48	17.50	17.90	14.16
150–160 viscosity at 210°, bright stock, 10–25 pour test	17.65	16.75	16.75	16.75	17.09	18.20	19.88	22.29	26.00	27.23	27.25	28.70	21.21
Pennsylvania:													
200 viscosity, No. 3 color, neutral, 420–425 flash, 25 pour test	17.50	17.50	17.50	17.31	17.90	18.74	21.73	25.00	26.05	27.00	27.00	28.45	21.81
600 steam-refined, cylinder stock, filterable	11.75	11.75	11.75	11.75	12.00	13.06	15.16	18.48	20.63	22.00	22.05	24.23	16.22
Gulf Coast: 500 viscosity, No. 2½–3½ color, neutral	12.00	12.00	12.00	12.00	12.00	12.73	13.28	14.00	14.00	14.00	14.51	14.85	13.10
1951													
Oklahoma:													
200 viscosity, No. 3 color, neutral	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00
150–160° viscosity at 210°, bright stock, 10–25 pour test	29.25	29.25	29.25	29.25	29.25	29.25	29.25	29.25	29.25	29.25	29.25	29.25	29.25
Pennsylvania:													
200 viscosity, No. 3 color, neutral 420–425 flash, 25 pour test	29.00	29.00	29.00	29.14	29.50	29.50	29.50	29.50	29.50	29.50	29.50	29.50	29.35
600 steam-refined, cylinder stock, filterable	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00
Gulf Coast: 500 viscosity, No. 2½–3½ color, neutral	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00

TABLE 79.—Salient statistics of wax in the United States, 1950–51, by type, month, and district

[Thousands of barrels] [1]

Month and district	Production						Domestic demand (all types)		Exports (all types)		Stocks, end of period					
	1950			1951 [2]							1950			1951 [2]		
	Microcrystalline	Fully refined	Other	Microcrystalline	Fully refined	Other	1950	1951 [2]	1950	1951 [2]	Microcrystalline	Fully refined	Other	Microcrystalline	Fully refined	Other
By months:																
January	17	172	125	41	216	188	196	318	113	114	48	174	256	76	172	269
February	32	237	93	37	192	159	236	285	87	122	60	262	195	59	162	277
March	20	176	89	39	235	164	240	301	70	132	51	219	222	61	170	272
April	31	211	123	38	218	181	271	279	86	116	78	197	225	61	180	304
May	28	181	165	48	229	192	258	283	74	151	53	229	260	72	187	321
June	32	166	155	26	209	171	240	269	89	116	55	225	286	69	184	348
July	35	162	147	37	188	169	248	245	85	110	61	206	310	69	196	375
August	38	182	187	39	209	166	329	277	113	104	59	169	314	78	192	403
September	36	219	155	25	212	136	296	245	135	95	54	155	312	95	198	413
October	47	204	132	30	212	117	309	281	112	94	63	161	259	88	212	390
November	46	236	147	25	179	157	308	248	119	102	69	161	255	83	215	403
December	43	211	182	29	180	121	307	213	110	95	74	157	273	90	239	394
Total	405	2,357	1,700	414	2,479	1,921	3,238	3,244	1,193	1,351	74	157	273	90	239	394
By districts:																
East Coast	142	821	515	174	899	539					15	37	111	17	74	96
Appalachian	28	141	183	21	137	236					16	14	26	15	34	27
Indiana, Illinois, Kentucky, etc	1	251	31	6	237	58					-------	7	48	1	10	94
Oklahoma, Kansas, etc	96	39	271	101	34	355	(3)	(3)	(3)	(3)	19	4	11	26	7	17
Texas Inland	-------	-------	6	-------	-------	-------					-------	-------	-------	-------	-------	-------
Texas Gulf Coast	98	579	116	81	640	176					22	33	21	30	27	65
Louisiana Gulf Coast	22	140	580	20	162	539					2	13	38	1	11	64
Rocky Mountain	18	82	[4] −2	11	63	18					-------	8	18	-------	7	31
California	-------	304	-------	-------	307	-------					-------	41	-------	-------	69	-------
Total	405	2,357	1,700	414	2,479	1,921	3,238	3,244	1,193	1,351	74	157	273	90	239	394

[1] Conversion factor: 280 pounds to the barrel. [2] Preliminary figures. [3] Figures not available. [4] Negative figure indicates some transfer figure not recorded.

LIQUEFIED GASES

The sale of liquefied gases for fuel, chemical, and motor fuel uses has expanded rapidly and now ranks after kerosine in the volume of total demand. Liquefied gases are derived from two sources—production from liquids recovered from natural gas at natural gasoline and allied plants and at refineries from the treatment of still gas.

The production from oil refineries rose from 29.1 million barrels in 1950 to 33.0 million in 1951. The transfers of production from natural-gasoline plants increased from 58.2 million barrels in 1950 to 72.4 million in 1951. The transfers represented 66.7 percent of the total supply in 1950 and 68.7 percent in 1951. The output at refineries was 33.3 percent of the total in 1950 and 31.3 percent in 1951. The product from the two sources cannot be distinguished when sold to the consumer or exported.

The total demand for liquefied gases rose from 87.1 million barrels in 1950 to 105.4 million in 1951, a gain of 18.3 million barrels or 21 percent. Exports increased from 1.6 million barrels to 2.1 million, and domestic demand rose from 85.5 million to 103.4 million, a gain of 17.8 million barrels or 20.9 percent. The details of the sales of liquefied gases by types and uses can be found in the Natural-Gas Liquids Chapter.

OTHER PRODUCTS

Wax.—The total refinery production of wax increased from 4,462,000 barrels in 1950 to 4,814,000 in 1951 (converted at the rate of 280 pounds to the barrel).

Out of the total increase in production of 352,000 barrels in 1951, 134,000 was in the East Coast district, 104,000 in the Texas Gulf, 84,000 in the Oklahoma-Kansas district, and 42,000 in the Appalachian district; Louisiana Gulf Coast production declined 21,000 barrels. The East Coast district produced 33.1 percent of the total in 1950 and 33.5 percent in 1951.

In 1951, 219,000 barrels was added to stocks and total demand was 4,595,000 barrels, including exports of 1,351,000 and domestic demand of 3,244,000 barrels. Compared with 1950, exports increased 158,000 barrels and domestic demand only 6,000 barrels.

TABLE 80.—Average monthly refinery price of 124°–126° white crude scale wax at Pennsylvania refineries, 1947–51, in cents per pound

[National Petroleum News]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average for year
1947	6.19	7.06	7.75	7.75	7.75	7.75	7.75	7.75	7.75	7.85	7.88	8.03	7.61
1948	8.57	8.75	8.71	8.50	8.50	8.38	8.13	8.10	7.45	7.38	7.38	6.30	8.01
1949	5.38	5.23	5.28	5.25	4.97	4.95	4.92	4.90	4.18	3.98	4.60	4.63	4.85
1950	4.24	3.63	3.63	3.63	3.59	3.50	3.51	3.80	4.35	4.94	5.52	6.58	4.24
1951	6.64	6.63	6.63	6.55	6.30	6.10	5.75	5.47	5.31	5.26	5.24	5.13	5.92

Coke.—The production of petroleum coke continued to increase in 1951, amounting to 19.0 million barrels compared with 17.2 million in 1950 (converted at the rate of 5 barrels to the short ton). The largest increases in production were 0.7 million barrels in the Indiana-Illinois district and 0.5 million in the Arkansas-Louisiana Inland

district. The Indiana-Illinois district was the largest producer, accounting for 45.8 percent of the total in 1950 and 45.3 percent in 1951.

The total demand for petroleum coke increased from 17.5 million barrels in 1950 to 18.9 million in 1951. Exports increased from 2.5 million barrels to 4.5 million, whereas domestic demand declined from 15.0 million barrels to 14.4 million in 1951.

TABLE 81.—Salient statistics of petroleum coke in the United States, 1950–51, by month and district[1]

Month and district	Production (thousand barrels)		Yield (percent)		Domestic demand (thousand barrels)		Stocks, end of period (thousand barrels)	
	1950	1951[2]	1950	1951[2]	1950	1951[2]	1950	1951[2]
By months:								
January	1,454	1,636	0.8	0.8	1,310	1,503	745	430
February	1,295	1,438	.8	.8	1,200	1,034	774	578
March	1,271	1,483	.8	.7	1,405	1,091	560	592
April	1,230	1,431	.8	.8	1,021	1,015	584	626
May	1,482	1,675	.9	.9	1,196	1,282	664	613
June	1,519	1,574	.9	.8	1,382	1,125	644	560
July	1,591	1,629	.9	.8	1,317	1,314	624	496
August	1,576	1,595	.8	.8	1,515	1,006	505	484
September	1,415	1,580	.8	.8	1,060	1,237	521	472
October	1,447	1,640	.8	.8	1,109	1,359	424	412
November	1,439	1,673	.8	.8	1,238	1,196	369	415
December	1,505	1,623	.8	.8	1,268	1,233	408	519
Total	17,224	18,977	0.8	0.8	15,021	14,395	408	519
By districts:								
East Coast	1,762	1,801	0.5	0.5				
Appalachian	286	317	.5	.5			8	
Indiana, Illinois, Kentucky, etc.	7,891	8,598	2.1	2.0			169	206
Oklahoma, Kansas, etc.	1,406	1,398	.8	.7			56	38
Texas, Inland	322	323	.4	.3	(3)	(3)	7	2
Texas Gulf Coast	1,417	1,303	.3	.2			3	3
Louisiana Gulf Coast	1,538	1,718	.9	.9				
Arkansas, Louisiana Inland, etc.	165	660	.6	2.2			47	73
Rocky Mountain	638	874	.9	1.0			15	14
California	1,799	1,985	.6	.6			103	183
Total	17,224	18,977	0.8	0.8	15,021	14,395	408	519

[1] Conversion factor: 5 barrels to the short ton.
[2] Preliminary figures.
[3] Figures not available.

Asphalt and Road Oil.—The total demand for petroleum asphalt increased 7.7 million barrels to 67.3 million in 1951 (converted at the rate of 5.5 barrels to the short ton). Domestic demand amounted to 66.2 million barrels, a gain of 7.5 million or almost 13 percent. The domestic demand for road oil amounted to 6.1 million barrels in 1951, a decline of 0.8 million or about 12 percent. The details as to sales of asphalt and types of product are contained in the Asphalt chapter of the Minerals Yearbook.

Still Gas.—The production of still gas increased from 83.7 million barrels in 1950 to 96.3 million in 1951—a gain of about 15 percent. The reported figure in cubic feet increased from 301 billion in 1950 to 347 billion in 1951. The conversion from cubic feet to barrels is in terms of the crude-oil equivalent to balance the refinery input and output, rather than on the basis of heating value. The major part of the still gas is consumed as fuel at the refineries.

Miscellaneous Oils.—The production of miscellaneous products amounted to 7,201,000 barrels in 1951.

TABLE 82.—Production of still gas in the United States, 1949–51, by districts

District	1949		1950		1951 [1]	
	Million cubic feet	Equivalent, in thousand barrels	Million cubic feet	Equivalent, in thousand barrels	Million cubic feet	Equivalent, in thousand barrels
East Coast	36,637	10,177	40,428	11,230	44,388	12,330
Appalachian	12,110	3,364	12,730	3,536	13,914	3,865
Indiana, Illinois, Kentucky, etc.	64,127	17,813	67,651	18,792	79,103	21,973
Oklahoma, Kansas, etc.	20,693	5,748	22,255	6,182	26,327	7,313
Texas Inland	13,533	3,759	10,706	2,974	12,193	3,387
Texas Gulf Coast	80,640	22,400	73,887	20,524	88,672	24,631
Louisiana Gulf Coast	18,756	5,210	19,490	5,414	19,076	5,299
Arkansas, Louisiana Inland, etc.	3,733	1,037	2,668	741	4,770	1,325
Rocky Mountain	7,243	2,012	8,964	2,490	11,361	3,156
California	39,964	11,101	42,696	11,860	46,854	13,015
Total	297,436	82,621	301,475	83,743	346,658	96,294

[1] Preliminary figures.

TABLE 83.—Production of miscellaneous finished oils in the United States in 1951, by district and class

[Thousands of barrels]

District	Petrolatum [1]	Absorption oil	Medicinal oil	Specialties	Solvents	Other	Total
East Coast	23		52	291	106		472
Appalachian	271			16	37		324
Indiana, Illinois, Kentucky, etc.	81			867		83	1,031
Oklahoma, Kansas, etc.	424	158		25	24	71	702
Texas Inland		587		17		1	605
Texas Gulf Coast	333	134		110	67	342	986
Louisiana Gulf Coast	2	4		972		9	987
Arkansas, Louisiana Inland, etc.		392	88	3			483
Rocky Mountain	1	11				3	15
California		13	47	975	137	424	1,596
Total	1,135	1,299	187	3,276	371	933	7,201

[1] Conversion factor: 300 pounds to the barrel.

INTERCOASTAL SHIPMENTS [8]

Shipments of mineral oils, crude and refined, from gulf coast ports to east coast ports were 12.5 percent larger in 1951 than 1950. Crude petroleum was the largest single item in 1951; it constituted 31 percent of the total shipments. A 19-percent increase in crude coastwise shipments brought crude petroleum from second rank in 1950 to first place in 1951. Gasoline, which held first place in 1950 with nearly 30 percent of the total, in spite of a quantitative increase from 1950 to 1951, fell to second place in 1951 with a little less than 29 percent of intercoastal shipments.

The increased shipments of crude petroleum from the gulf coast to the east coast may be ascribed to larger refinery runs and to a comparatively small increase in receipts of foreign crude at east coast refineries. The 10-percent increase in shipments of refined products from the gulf coast to the east coast was due to a demand for petroleum products even greater than the enlarged output of east coast refineries could supply and to a small decline in imports of refined products.

[8] By A. H. Redfield (deceased), Petroleum and Natural Gas Branch, Bureau of Mines.

TABLE 84.—Mineral oils, crude and refined, shipped by tanker from gulf coast to east coast ports of the United States, 1950–51, by classes[1]

[Thousands of barrels]

Year and class	January	February	March	April	May	June	July	August	September	October	November	December	Total
1950													
Crude petroleum	12,784	8,789	11,277	13,779	15,257	13,684	16,062	14,012	14,630	15,413	14,387	13,669	163,743
Gasoline	13,637	10,755	11,591	13,842	14,634	13,576	14,548	14,659	14,696	15,758	14,668	14,332	166,696
Kerosine	4,489	3,203	3,013	3,228	2,055	2,705	2,968	4,077	3,246	3,571	4,018	5,173	41,746
Distillate fuel oil	13,906	9,147	11,055	8,131	7,972	6,876	6,894	8,246	9,082	9,905	10,407	13,707	115,328
Residual fuel oil	5,716	4,476	5,743	4,275	3,847	3,910	4,424	4,215	4,560	5,901	5,260	6,965	59,292
Lubricating oils	515	533	458	494	697	548	450	462	657	565	665	773	6,817
Miscellaneous oils	401	528	534	110	468	664	539	722	407	508	491	606	5,978
Total	51,448	37,431	43,671	43,859	44,930	41,963	45,885	46,393	47,278	51,621	49,896	55,225	559,600
1951													
Crude petroleum	14,457	15,299	17,475	15,307	15,996	15,435	15,606	15,341	16,791	17,372	17,505	18,329	194,913
Gasoline	12,739	12,989	16,777	15,430	17,441	15,717	15,597	15,422	15,468	14,933	14,927	12,686	180,126
Kerosine	5,109	4,666	4,756	3,059	3,015	2,126	3,141	3,056	2,819	2,902	4,087	4,780	43,516
Distillate fuel oil	15,876	12,988	13,406	10,296	8,796	8,125	8,341	9,888	9,643	8,803	10,824	12,967	129,953
Residual fuel oil	6,164	5,867	5,642	4,302	3,678	4,730	5,779	3,961	4,839	4,676	4,901	5,840	60,379
Lubricating oils	702	669	941	709	903	1,102	1,423	670	710	651	747	652	9,879
Miscellaneous oils	857	889	1,584	766	901	1,084	940	905	722	979	744	550	10,921
Total	55,904	53,367	60,581	49,869	50,730	48,319	50,827	49,243	50,992	50,316	53,735	55,804	629,687

[1] Oil and Gas Division, U. S. Department of the Interior.

Intercoastal shipments of refined oils from California to east coast ports, which began in 1946 with 740,000 barrels and climbed by 1950 to 23,450,000 barrels, amounted in 1951 to 577,000 barrels. No gasoline was included in the 1951 total, and 58 percent of the entire shipments consisted of lubricating oil.

FOREIGN TRADE [9]

For a number of years it has been the established custom of the Bureau of Mines to relate all its published statistics of petroleum imports and exports to continental United States. Accordingly, statistics of petroleum imports published in table 85 are net imports of crude and refined petroleum into continental United States and do not include such imports into the Territories. Correspondingly, statistics of petroleum exports used in table 87 include not only exports to foreign countries but also shipments from continental United States to the Territories, less exports from the Territories. The Bureau of Mines has published in table 85 figures obtained directly from the petroleum refiners covering their direct receipts of foreign crude. Such figures harmonize with the figures reported by the refineries for stocks and for runs to stills. Where it is desired to show the origins of the imports and the destinations of the exports, recourse is had to the statistics published by the Bureau of the Census, Department of Commerce.

Imports.—Imports of mineral oils, crude and refined, into continental United States decreased 1 percent from 1950 to 1951. They constituted nearly 13 percent of the total new supply in continental United States in 1950 and 11 percent in 1951. Total imports exceeded total exports by 179 percent in 1950 and 99 percent in 1951.

Crude petroleum, distillate fuel oil, and residual fuel oil together made up 97 percent of the total mineral-oil imports into continental United States both in 1950 and 1951. Crude petroleum alone constitutes 57 percent of the total in 1950 and 58 percent in 1951.

Venezuela supplied 42 percent of the total petroleum imports into continental United States and the Territories in 1950 and in 1951, the Netherland Antilles 32 percent in 1950 and 31 percent in 1951, Mexico nearly 6 percent both in 1950 and in 1951, and Colombia 5 percent in both years. A newer source of supply, the countries bordering the Persian Gulf, furnished nearly 14 percent of the total in both 1950 and 1951.

Of the crude petroleum imported in 1950, Venezuela provided 62 percent. Colombia 9 percent, Mexico nearly 6 percent, and Kuwait and Saudi Arabia 23 percent. In 1951 Venezuela provided 60 percent, Colombia 9 percent, Mexico 7 percent, Kuwait and Saudi Arabia 21 percent, and British Malaya 2 percent.

Of the residual fuel oil imported into continental United States and the Territories the Netherland Antilles supplied 79 percent in 1950, Venezuela 18 percent and other Caribbean countries 2 percent. Of the corresponding imports in 1951, the Netherland Antilles sent 78 percent, Venezuela 20 percent, and other Caribbean countries less than 2 percent.

[9] By A. H. Redfield (deceased), Petroleum and Natural Gas Branch, Bureau of Mines.

TABLE 85.—Mineral oils, crude and refined, imported into continental United States, 1950–51, by months [1]

[Thousands of barrels]

Class	January	February	March	April	May	June	July	August	September	October	November	December	Total
1950													
Crude petroleum	15,102	11,499	14,614	15,336	13,618	14,931	15,076	15,539	15,760	15,809	13,992	16,438	177,714
Refined products:													
Motor fuel			1	1	3	2	4	3	2	134	4	2	156
Kerosine	245												245
Distillate fuel oil	61	30	53	98	130	225	508	526	274	204	237	256	2,602
Residual fuel oil	10,204	7,189	11,680	10,528	9,302	9,043	8,429	9,251	9,097	10,846	11,778	12,689	120,036
Asphalt	66	6	127	73	72	233	222	257	144	279	141	175	1,795
Unfinished oils	486	540	545	726	628	700	841	585	630	832	576	624	7,713
Total	26,164	19,264	27,020	26,762	23,753	25,134	25,080	26,161	25,907	28,104	26,728	30,184	310,261
1951 [2]													
Crude petroleum	15,472	13,096	14,971	15,319	16,051	16,889	16,940	16,404	15,000	13,054	12,760	13,117	179,073
Refined products:													
Motor fuel	133	4	12	4	93	1	11	2	8	134	6	10	418
Distillate fuel oil	250	139	35	121	505	264	30	57	211	153	33	126	1,924
Residual fuel oil	13,842	12,102	10,941	10,376	9,768	8,605	6,672	7,357	6,532	9,758	10,682	12,040	118,675
Asphalt	102	189	250	147	246	209	200	234	116	229	239	207	2,368
Unfinished oils	631	709	450	330	485	306	587	133	451	504	337	340	5,263
Total	30,430	26,239	26,659	26,297	27,148	26,274	24,440	24,187	22,318	23,832	24,057	25,840	307,721

[1] Imports of crude as reported to Bureau of Mines; imports of refined products compiled from records of U. S. Department of Commerce; figures may differ slightly from those used in other sections of this chapter.

[2] Preliminary figures

TABLE 86.—Crude petroleum and major petroleum products imported for consumption into the United States, 1950–51, by countries, in thousands of barrels [1]

[U. S. Department of Commerce]

Country	Crude petroleum	Motor fuel [2]	Kerosine	Distillate oil [3]	Residual oil [4]	Unfinished oil	Total
1950							
North America:							
Canada	5	57	(5)	1	1	12	76
Mexico	[6] 9,840	(5)		(5)	1,025	6,699	[6] 17,564
Netherland Antilles		[6] 198	270	[6] 1,166	[6] 97,146	7	[6] 98,787
Trinidad and Tobago	216	5		(5)	2,019	763	3,003
Total	[6] 10,061	[6] 260	270	[6] 1,167	[6] 100,191	7,481	[6] 119,430
South America:							
Chile						(5)	(5)
Colombia	15,699				4		15,703
Venezuela	[6] 107,726			278	[6] 22,195	31	[6] 130,230
Total	[6] 123,425			278	[6] 22,199	31	[6] 145,933
Europe:							
Belgium-Luxembourg		8					8
Czechoslovakia		23					23
Germany	(5)	11					11
Netherlands						(5)	(5)
Poland-Danzig		114					114
United Kingdom		368		(5)		(5)	368
Total	(5)	524		(5)		(5)	524
Asia:							
Arabia Peninsula States, n. e. s.	116						116
Iran	123						123
Kuwait	26,163				183		26,346
Saudi Arabia	[6] 14,032			695	157		[6] 14,884
State of Bahrein				[6] 890	307		[6] 1,197
Total	[6] 40,434			[6] 1,585	647		[6] 42,666
Grand total	[6] 173,920	[6] 784	270	[6] 3,030	[6] 123,037	7,512	[6] 308,553
Imports into United States Territories and possessions from foreign countries:							
Alaska		(5)					(5)
Hawaii				418	33		451
Puerto Rico		[6] 73	25	18	2,404		[6] 2,520
Total		[6] 73	25	436	2,437		[6] 2,971
Total net imports into continental United States	[6] 173,920	[6] 711	245	[6] 2,594	[6] 120,600	7,512	[6] 305,582
1951							
North America:							
Canada	473	82	(5)	2	2	2	561
Canal Zone				(5)			(5)
Guatemala					1		1
Mexico	12,889				214	4,573	17,676
Netherland Antilles		401		1,059	95,057	25	96,542
Trinidad and Tobago	220	6		67	1,835	108	2,236
Total	13,582	489	(5)	1,128	97,109	4,708	117,016
South America:							
Colombia	16,683						16,683
Venezuela	105,857			400	24,611	557	131,425
Total	122,540			400	24,611	557	148,108
Europe:							
Belgium-Luxembourg		128					128
Czechoslovakia		16					16
Denmark					(5)		(5)
France		45					45
Germany	(5)			(5)			(5)
Netherlands		238					238
United Kingdom		1,197		(5)			1,197
Total	(5)	1,624		(5)	(5)		1,624

For footnotes, see end of table.

TABLE 86.—Crude petroleum and major petroleum products imported for consumption into the United States, 1950–51, by countries, in thousands of barrels [1]—Continued

[U. S. Department of Commerce]

Country	Crude petroleum	Motor fuel [2]	Kerosine	Distillate oil [3]	Residual oil [4]	Unfinished oil	Total
1951—Continued							
Asia:							
British Malaya	3,543			1			3,544
Indonesia	(5)						(5)
Kuwait	21,648						21,648
Saudi Arabia	16,161			960			17,121
State of Bahrein			(5)	419	104		523
Total	41,352		(5)	1,380	104		42,836
Africa:							
French Morocco			(5)				
French West Africa			(5)				
Total			(5)				
Grand total	177,474	2,113	(5)	2,908	121,824	5,265	309,584
Imports into United States Territories and possessions from foreign countries:							
Alaska		(5)					(5)
Hawaii				1,138			1,138
Puerto Rico		15			2,803		2,818
Total		15		1,138	2,803		3,956
Total net imports into continental United States	177,474	2,098	(5)	1,770	119,021	5,265	305,628

[1] Compiled by M. B. Price and E. D. Page, of the Bureau of Mines, from records of the U. S. Department of Commerce.
[2] Includes naphtha and benzol.
[3] Includes quantities imported free of duty for supply of vessels and aircraft.
[4] Includes quantities imported free of duty for manufacture in bond and export, and for supply of vessels and aircraft.
[5] Less than 500 barrels.
[6] Revised figure.

Exports.—Continental United States, formerly a net exporter of mineral oils, continued in 1951 to be a net importer. The excess of all petroleum imports over all petroleum exports—over 116 million barrels in 1949—increased in 1950 to nearly 199 million barrels but declined to 153 million barrels in 1951, as United States exports of refined products increased 64.5 percent to meet the abnormal foreign demand occasioned by the shutdown of the Abadan refinery and as Caribbean exports of refined oils were diverted from the United States to Europe.

Crude petroleum, in contrast to most refined products, showed an excess of imports of nearly 143 million barrels in 1950 and of 150 million barrels in 1951. At the same time, imports of residual fuel oil exceeded exports of this product by nearly 104 million barrels in 1950 and by more than 90 million barrels in 1951. With regard to other refined petroleum products, exports exceeded imports by nearly 48 million barrels in 1950 and nearly 87 million barrels in 1951.

Exports of crude petroleum decreased nearly 18 percent from 1950 to 1951. Of the 1951 exports, 74 percent went to Canada, 8 percent to Japan, nearly 8 percent to Cuba, not quite 5 percent to Argentina, and the remaining 5 percent to various European countries. None was shipped to the United States Territories or possessions.

Exports and Territorial shipments of motor fuel from continental United States increased 62 percent from 1950 to 1951. The principal gains were in exports to Europe, notably to the United Kingdom, Africa, especially the Union of South Africa, Australia and New Zealand, and in shipments to the United States Territories and possessions. The increased exports of motor fuel from the United States to the United Kingdom and to other members of the sterling area, even at the cost of greater dollar expenditures by the purchasers, largely reflected the abrupt closure in July 1951 of the Abadan refinery, which had previously supplied these areas.

Exports and Territorial shipments of kerosine increased nearly 231 percent from 1950 to 1951. The most striking increases were in exports to the United Kingdom, India, Egypt, and Australia and in shipments to Territories and possessions other than Alaska and Hawaii.

Exports and Territorial shipments of distillate fuel oil from continental United States were 79 percent larger in 1951 than in 1950. Large gains were made in exports to Canada, the Netherland Antilles, Sweden, the United Kingdom, Japan, the Philippines, Australia, and New Zealand and in shipments to the United States Territories and possessions.

Exports and Territorial shipments of residual fuel oil from continental United States increased 79 percent from 1950 to 1951. Larger exports were made to North American destinations, notably to Canada, Cuba, and Mexico. Exports to South America were only slightly less in 1951 than in 1950. Exports of residual fuel oil to Europe were 11 times as large in 1951 as in 1950. Chief destinations in 1951 were the United Kingdom, Norway, Germany, and Sweden, all of which in 1950 were relatively small importers of residual fuel oil. The most striking increase was in exports to Asia, notably to Japan, British Malaya, and the Philippines. Australia and New Zealand, which took no residual fuel oil from the United States in 1950, received more than 2 million barrels of residual fuel oil from this source in 1951. Territorial shipments of residual fuel oil to Alaska and Hawaii were increased 12 percent from 1950 to 1951.

Exports and Territorial shipments of lubricating oils from continental United States increased 22 percent from 1950 to 1951, in spite of decreases in exports to Europe, Asia, and Oceania, and smaller decreases in exports to Africa. The gain was almost entirely in exports to destinations which may not be disclosed for security reasons.

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TABLE 87.—Mineral oils, crude and refined, shipped from continental United States, including shipments to Territories and possessions, 1950–51, by class and month [1]

[Thousands of barrels]

Year and class	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1950													
Crude petroleum	2,130	2,328	2,153	2,968	2,946	3,095	3,274	3,096	2,654	4,033	3,229	2,917	34,823
Refined products:													
Motor fuel [2]	1,597	2,060	1,691	2,357	2,227	1,914	1,992	1,585	2,391	2,369	2,047	2,491	24,721
Kerosine	107	190	286	95	169	35	165	141	195	163	284	248	2,078
Distillate fuel oil	876	1,193	1,152	1,033	874	895	1,201	967	1,066	1,341	1,112	943	12,653
Residual fuel oil	1,178	978	1,604	1,201	1,270	1,844	1,299	1,639	1,189	898	1,402	1,726	16,228
Lubricants	982	1,199	1,167	1,303	1,200	958	1,146	1,146	1,330	1,058	1,274	1,489	14,252
Paraffin wax	113	87	70	86	74	89	85	113	135	112	119	110	1,193
Coke	97	66	80	185	206	157	294	180	339	435	256	198	2,493
Asphalt	91	41	88	55	175	80	83	40	121	82	65	62	983
Liquefied gases	109	140	115	133	114	118	158	121	165	137	151	171	1,632
Miscellaneous	18	25	17	20	18	19	24	21	25	22	15	26	250
Total refined	5,168	5,979	6,270	6,468	6,327	6,109	6,447	5,953	6,956	6,617	6,725	7,464	76,483
Total crude and refined	7,298	8,307	8,423	9,436	9,273	9,204	9,721	9,049	9,610	10,650	9,954	10,381	111,306
1951 [3]													
Crude petroleum	2,913	2,471	2,640	3,615	1,791	2,342	2,320	2,361	2,199	1,947	1,858	2,147	28,604
Refined products:													
Motor fuel [2]	1,788	1,607	2,349	2,444	2,830	3,159	4,191	4,807	4,782	3,984	4,507	3,908	40,356
Kerosine	132	209	76	228	752	483	622	1,087	1,410	815	557	447	6,818
Distillate fuel oil	916	844	980	1,549	2,192	1,421	2,457	3,460	2,818	2,570	1,430	2,037	22,674
Residual fuel oil	946	1,036	1,474	1,446	2,927	2,902	3,671	3,446	3,454	3,045	2,403	2,308	29,058
Lubricants	1,211	998	1,594	1,441	1,546	1,469	1,675	1,574	1,601	1,294	1,526	1,488	17,417
Paraffin wax	114	122	132	116	151	116	110	104	95	94	102	95	1,351
Coke	111	256	378	382	406	502	379	601	355	341	474	286	4,471
Asphalt	26	69	76	60	179	74	161	106	174	53	77	130	1,185
Liquefied gases	145	117	203	234	124	151	206	182	206	189	182	182	2,121
Miscellaneous	24	32	37	40	36	42	34	30	24	28	18	28	373
Total refined	5,413	5,290	7,299	7,940	11,143	10,319	13,506	15,397	14,919	12,413	11,276	10,909	125,824
Total crude and refined	8,326	7,761	9,939	11,555	12,934	12,661	15,826	17,758	17,118	14,360	13,134	13,056	154,428

[1] Compiled from records of U. S. Department of Commerce, except Alaska and Hawaii, which are Bureau of Mines' data; figures may differ slightly from those used in other sections of this chapter.
[2] Includes benzol, natural gasoline, and antiknock compounds.
[3] Preliminary figures.

TABLE 88.—Crude petroleum and major petroleum products exported from the United States, in 1951, by country of destination, and shipments to and exports from Territories and possessions, in thousands of barrels [1] [2]

[U. S. Department of Commerce]

Destination	Crude petroleum	Motor fuel [3]	Kerosine	Distillate oil	Residual oil	Lubricating oil [3]	Wax	Total
North America:								
Canada	21,172	4,171	598	6,547	5,761	662	128	39,039
Canal Zone	-------	314	60	632	595	3	(4)	1,604
Cuba	2,167	1,295	16	331	1,229	85	21	5,144
El Salvador	-------	148	14	14	319	4	5	504
Guatemala	-------	94	9	16	537	8	22	686
Honduras	-------	21	2	65	124	8	2	222
Mexico	-------	3,003	105	1,165	2,328	228	205	7,034
Netherlands Antilles	-------	1,064	232	1,749	-------	25	(4)	3,070
Nicaragua	-------	14	2	70	158	8	4	256
Panama	-------	(4)	1	-------	187	4	1	193
Trinidad and Tobago	-------	(4)	-------	-------	-------	8	1	9
Other North America	-------	53	14	65	29	38	9	208
Total	23,339	10,177	1,053	10,654	11,267	1,081	398	57,969
South America:								
Argentina	1,356	3	76	41	-------	228	28	1,732
Bolivia	-------	1	(4)	87	12	13	12	125
Brazil	-------	148	31	25	-------	598	82	884
Chile	-------	3	(4)	72	1,962	88	62	2,187
Colombia	-------	37	(4)	(4)	-------	21	99	157
Peru	-------	1	-------	-------	-------	12	19	32
Uruguay	-------	3	-------	-------	-------	31	3	37
Venezuela	-------	5	1	-------	-------	43	35	84
Other South America	-------	4	2	11	-------	14	19	50
Total	1,356	205	110	236	1,974	1,048	359	5,288
Europe:								
Belgium-Luxembourg	-------	360	17	210	101	774	24	1,486
Denmark	-------	248	49	74	91	252	2	716
France	638	247	-------	105	-------	512	63	1,565
Germany	-------	382	-------	299	207	139	4	1,031
Greece	-------	(4)	13	-------	-------	41	4	58
Italy	212	143	(4)	26	-------	402	47	830
Netherlands	-------	100	31	247	-------	445	15	838
Norway	133	388	20	333	667	88	12	1,641
Portugal	65	33	-------	33	-------	69	12	212
Sweden	-------	660	29	1,123	158	301	23	2,294
Switzerland	-------	286	44	118	(4)	140	10	598
Turkey	-------	73	153	(4)	-------	145	6	377
United Kingdom	457	5,668	1,514	3,410	1,109	2,025	188	14,371
Yugoslavia	-------	(4)	-------	-------	-------	14	6	20
Other Europe	-------	103	16	175	124	165	35	618
Total	1,505	8,691	1,886	6,153	2,457	5,512	451	26,655
Asia:								
British Malaya	-------	-------	-------	153	777	89	2	1,021
Ceylon	-------	-------	-------	(4)	466	31	(4)	497
Hong Kong	-------	4	-------	25	99	20	(4)	148
India	-------	79	1,243	50	130	622	1	2,125
Japan	2,403	30	-------	683	3,991	118	56	7,281
Pakistan	-------	-------	101	67	62	98	(4)	328
Philippines	-------	4	88	379	736	164	39	1,410
Taiwan (Formosa)	-------	5	(4)	(4)	-------	29	4	38
Other Asia	-------	3	-------	106	-------	211	17	337
Total	2,403	125	1,432	1,463	6,261	1,382	119	13,185
Africa:								
Algeria	-------	5	-------	33	-------	16	3	57
Belgian Congo	-------	31	1	-------	7	51	(4)	90
Egypt	-------	5	1,231	65	-------	227	3	1,531
French Equatorial Africa	-------	108	22	32	30	7	-------	199
French Morocco	-------	175	(4)	39	-------	19	-------	233
French West Africa	-------	132	32	84	-------	27	(4)	275
Gold Coast	-------	2	-------	80	-------	23	(4)	105
Mozambique	-------	75	15	-------	-------	17	(4)	107
Union of South Africa	-------	1,319	59	29	-------	265	11	1,683
Other Africa	-------	152	22	89	79	158	3	503
Total	-------	2,004	1,382	451	116	810	20	4,783

For footnotes, see end of table.

TABLE 88.—Crude petroleum and major petroleum products exported from the United States, in 1951, by country of destination, and shipments to and exports from Territories and possessions, in thousands of barrels [1] [2]—Con.

[U. S. Department of Commerce]

Destination	Crude petroleum	Motor fuel [3]	Kerosine	Distillate oil	Residual oil	Lubricating oil [3]	Wax	Total
Oceania:								
Australia	--------	1,404	123	684	1,803	309	2	4,325
New Zealand	--------	501	2	240	220	134	(4)	1,097
Other Oceania	--------	14	9	30	25	2	------	80
Total Oceania	--------	1,919	134	954	2,048	445	2	5,502
Grand total	28,603	33,192	5,997	19,911	24,123	16,591	1,349	129,766
Shipments from continental United States to Territories and possessions:								
Alaska and Hawaii [5]	--------	4,069	150	2,558	4,872	133	--------	11,782
Other [6]	--------	2,997	735	331	47	70	(4)	4,180
Total	--------	7,066	885	2,889	4,919	203	(4)	15,962
Exports from Territories and possessions to foreign countries:								
Alaska	--------	87	7	160	(4)	(4)	--------	254
Hawaii	--------	(4)	(4)	(4)	43	--------	--------	43
Puerto Rico	--------	--------	2	1	--------	--------	--------	3
Total	--------	87	9	161	43	(4)	--------	300
Total net shipments from continental United States	28,603	40,171	6,873	22,639	28,999	16,794	1,349	145,428

[1] Compiled by M. B. Price and E. D. Page, of the Bureau of Mines, from records of the U. S. Department of Commerce.

[2] Changes in Minerals Yearbook, 1950, pp. 997–998, are as follows: Wax exported to Hong Kong, 44; total Asia, 89; total, 1,192; grand total, 1,192.

[3] Country and continent totals exclude, but the grand totals include 10,071 thousand barrels of motor fuel and 6,313 thousand barrels of lubricating oils, for which country breakdown may not be published for security reasons.

[4] Less than 500 barrels.

[5] Figures represent shipments from refining companies for export to Alaska and Hawaii through Pacific coast ports, as reported to Bureau of Mines by shippers.

[6] Figures represent shipments to all other possessions and areas administered by the United States as reported by the U. S. Department of Commerce, January–July; and estimates by the Bureau of Mines, August–December.

WORLD PRODUCTION

Despite elimination of Iran from the list of producing countries in the middle of 1951, the loss in output was made up by other countries. The world petroleum production stood at an alltime high in 1951. It increased nearly 13 percent—from 10,419,000 barrels daily in 1950 to 11,734,000 barrels daily in 1951.

The chief gains, both quantitative and proportional, were in the Western Hemisphere. The United States contributed most, with an increase of nearly 14 percent—from 5,407,000 barrels daily in 1950 to 6,149,000 in 1951. As in 1950, it supplied 52 percent of the world total in 1951. Venezuela showed the next-largest quantitative increase from 1950 to 1951. Increased drilling, new pipelines, and enlarged refining capacity stimulated petroleum production.

The most striking increase in petroleum production (66 percent) occurred in Canada. This increase may be attributed chiefly to three new oil fields: (1) The Williston Basin in southwestern Manitoba; (2) northwestern Alberta to Fort St. John in northeastern British Columbia; and (3) Alberta southeast of Edmonton. The opening of the Interprovincial Pipeline gave these western fields access to markets in eastern Canada.

Mexico raised its petroleum production 7 percent from 1950 to 1951. Five new producing fields were added in 1951.

In the Middle East, a 47-percent decrease in the petroleum production of Iran was more than compensated by rising output in Kuwait and Saudi Arabia. In Iraq a new 16-inch pipeline from Kirkuk to the Mediterranean supplemented the existing two 12-inch lines to Tripoli and Haifa; and a new 80-mile pipeline to the Persian Gulf gave an outlet to crude petroleum from the new oil field at Zubair. New drilling increased the production of the Dukhan field in Qatar 47 percent from 1950 to 1951.

In Europe the noteworthy increase in petroleum production was in Western Germany, where the Emsland district was still the most important producer.

TABLE 89.—World production of crude petroleum, 1947–51, by countries, in thousands of barrels

[Compiled by Berenice B. Mitchell]

Country	1947	1948	1949	1950	1951 [1]
North America:					
Barbados	(2)	(2)	(2)		
Canada (sales, incl. natural gasoline)	7,692	12,287	21,305	[3] 29,044	48,097
Cuba [4] [5]	300	159	206	156	128
Mexico	56,284	58,508	60,910	72,443	77,312
Trinidad	20,521	20,111	20,617	20,632	20,843
United States	1,856,987	2,020,185	1,841,940	[3] 1,973,574	2,244,529
Total North America	1,941,784	2,111,250	1,944,978	[3] 2,095,849	2,390,909
South America:					
Argentina	21,846	23,734	22,589	23,353	24,465
Bolivia	377	464	678	616	523
Brazil	97	144	109	[3] 339	691
Chile				629	759
Colombia	24,794	23,792	29,722	34,059	38,403
Ecuador	2,282	2,563	2,617	2,632	2,708
Peru	12,764	14,069	14,790	15,077	16,110
Venezuela	434,905	490,015	482,316	546,783	622,216
Total South America	497,065	554,781	552,821	[3] 623,488	705,875
Europe:					
Albania [5]	2,000	1,500	2,188	[3] 2,800	1,200
Austria	6,285	6,149	[5] 6,100	[3] [5] 10,200	[5] 14,600
Czechoslovakia	210	204	292	[5] 292	[5] 650
France	356	369	411	909	2,036
Germany, West	4,032	4,489	5,947	[3] 8,107	9,681
Hungary	4,330	3,647	3,791	[3] [5] 3,700	[5] 3,500
Italy	81	71	71	63	136
Netherlands	1,478	3,443	4,314	4,897	4,942
Poland	951	[5] 1,039	[3] [5] 1,125	[5] 1,205	[5] 1,502
Rumania	28,552	[5] 34,000	[5] 33,700	[5] 32,000	[5] 31,000
U. S. S. R. [5] [6]	187,463	218,000	237,700	266,200	285,000
United Kingdom	351	323	338	340	335
Yugoslavia	290	270	470	780	1,092
Total Europe [6]	236,379	273,504	[3] 296,447	[3] 331,493	[5] 355,674
Asia:					
Bahrein Island	9,411	10,915	10,985	11,016	10,994
Burma	59	341	248	[5] 450	[5] 645
China	374	533	730	[5] 730	[5] 730
India	1,863	1,875	1,906	1,867	1,949
Indonesia	8,020	[7] 31,900	[7] 44,932	[7] 50,148	[7] 57,199
Iran	154,998	190,384	204,712	242,475	[5] 127,600
Iraq	35,834	26,115	30,957	[3] 49,726	65,122
Japan	1,276	1,122	1,353	2,048	2,337
Kuwait	16,225	46,500	90,000	125,722	204,910
Pakistan	356	490	824	[3] 1,281	1,348
Qatar			750	12,268	18,009
Sarawak and Brunei	12,970	20,124	25,108	30,958	37,506
Saudi Arabia	89,852	142,853	174,008	199,547	277,963
Taiwan (Formosa)	22	23	22	23	21
Turkey		[3] 13	95	[3] 108	129
U. S. S. R.: Sakhalin [5]	7,000	7,000	7,000	7,000	7,000
Total Asia [6]	338,260	[3] 480,188	593,630	[3] 735,367	813,462
Africa:					
Algeria	1	1	2	24	49
Egypt	8,627	13,398	15,997	16,373	16,311
French Morocco	21	100	136	305	587
Total Africa	8,649	13,499	16,135	16,702	16,947
Oceania:					
Australia (Victoria)		1	1	[3] 1	2
New Zealand	2	2	7	7	5
Total Oceania	2	3	8	[3] 8	7
Grand total	3,022,139	[3] 3,433,225	[3] 3,404,019	[3] 3,802,907	4,282,874

[1] Preliminary figures. [2] Less than 500 barrels. [3] Revised figure.
[4] Natural naphtha and gas oil. [5] Estimate.
[6] U. S. S. R. in Asia (except Sakhalin) included with U. S. S. R. in Europe.
[7] Includes New Guinea whose production amounted to 1,725,500 barrels in 1949, 1,748,000 barrels in 1950, and 1,745,790 barrels in 1951.

Phosphate Rock

By Bertrand L. Johnson and G. E. Tucker

GENERAL SUMMARY

MINE production of phosphate rock in the United States in 1951 (10.8 million long tons) was approximately one-third of a million tons less than the record high of 1950 (11.1 million tons). Decreases were shown in Florida and Tennessee; an increase of 9 percent was reported, however, in the Western States total. Total stocks in producers' hands decreased.

Sales increased, rising from 10.3 million long tons in 1950 to 11.1 million tons in 1951 (a record high); part of this came from stocks. (See fig. 1.) There were large increases in sales in Florida and the Western States, while those of Tennessee rock increased only slightly. The total value of the phosphate rock sold or used in 1951 rose to $66.2 million, a record high value and a little more than 7 million dollars above the 1950 level. The P_2O_5 content of the phosphate rock sold or used in 1951 increased to a new record high of 3.6 million long

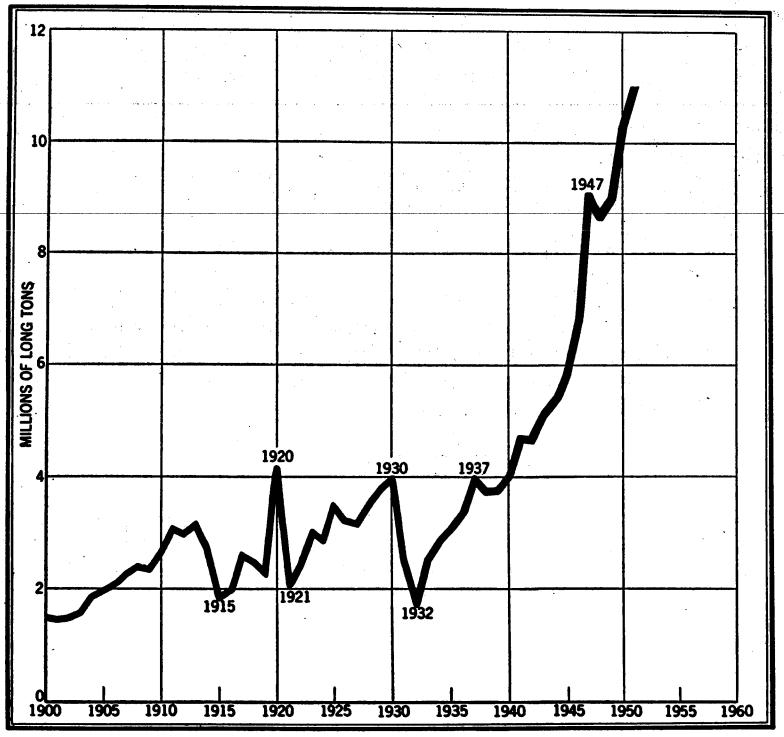

FIGURE 1.—Phosphate rock sold or used by producers in the United States, 1900–51.

TABLE 1.—Salient statistics of the phosphate-rock industry in the United States, 1950–51

	1950				1951			
	Long tons		Value at mines		Long tons		Value at mines	
	Rock	P_2O_5 content	Total	Average	Rock	P_2O_5 content	Total	Average
Production (mine)[1]	11,114,159	3,565,793	(2)	(2)	10,775,032	3,458,265	(2)	(2)
Sold or used by producers:								
Florida:								
Land pebble	7,933,009	2,673,882	$44,430,646	$5.60	8,329,033	2,800,135	$49,185,072	$5.91
Soft rock	81,542	16,994	408,595	5.01	92,183	18,694	495,243	5.37
Hard rock	71,319	25,133	538,601	7.55	75,615	26,647	582,247	7.70
Total, Florida	8,085,870	2,716,009	45,377,842	5.61	8,496,831	2,845,476	50,262,562	5.92
Tennessee[3]	1,384,473	390,190	10,028,404	7.24	1,419,892	391,518	10,604,638	7.47
Western States:								
Idaho	573,044	163,272	2,125,065	3.71	694,446	184,610	1,748,074	2.52
Utah					580	180	2,900	5.00
Wyoming					178,948	57,059	1,186,523	6.63
Montana	210,165	66,641	1,496,537	7.12	304,507	90,808	2,353,381	7.73
Total Western States	783,209	229,913	3,621,602	4.62	1,178,481	332,657	5,290,878	4.49
Total United States	10,253,552	3,336,112	59,027,848	5.76	11,095,204	3,569,651	66,158,078	5.96
Imports	87,173	(2)	[4] 1,113,974	[4] 12.78	89,823	(2)	[4] 1,379,767	[4] 15.36
Exports[5]	1,759,800	(2)	10,364,550	5.89	1,677,076	(2)	10,873,460	6.48
Apparent consumption[6]	8,580,925	(2)			9,507,951	(2)		
Stocks in producers' hands Dec. 31:[8]								
Florida	1,357,000	[7] 454,000	(2)	(2)	1,033,000	342,000	(2)	(2)
Tennessee[3 8 9]	[7] 600,000	[7] 172,000	(2)	(2)	539,000	151,000	(2)	(2)
Western States	[7] 301,000	80,000	(2)	(2)	230,000	62,000	(2)	(2)
Total stocks	[7] 2,258,000	[7] 706,000	(2)	(2)	1,802,000	555,000	(2)	(2)

[1] Includes brown-rock matrix of sinter grade.
[2] Data not available.
[3] Includes sintered matrix.
[4] Market value (price) at port of shipment and time of exportation to the United States.
[5] As reported to the Bureau of Mines by domestic producers.
[6] Quantity sold or used by producers plus imports minus exports.
[7] Revised figure.
[8] Excludes plant stocks of washer-grade matrix.
[9] Includes brown-rock matrix of sinter grade and sintered brown rock.

tons from 3.3 million tons in 1950. Imports increased both in quantity and value in 1951. Exports, however, as reported by producers to the Bureau of Mines, were below 1950 in quantity, but above in value. Apparent consumption of phosphate rock in 1951 rose to a record high of 9.5 million long tons.

DOMESTIC PRODUCTION

Mine production of phosphate rock in the United States in 1951 (10,775,000 long tons) was 339,000 tons below the record high of 1950 (11,114,000 tons). Decreases occurred in Florida and Tennessee, more than offsetting a 9-percent rise in the Western States total.

TABLE 2.—Phosphate rock mined in the United States, 1942–51, by States, in long tons

Year	Florida	Tennessee [1]	Western States	United States	Year	Florida	Tennessee [1]	Western States	United States
1942	2,984,503	1,568,162	266,273	4,818,938	1947	6,381,282	1,489,980	1,239,727	9,110,989
1943	3,274,266	1,868,407	227,294	5,369,967	1948	7,184,297	1,499,547	704,316	9,388,160
1944	3,486,482	1,413,246	300,274	5,200,002	1949	6,695,407	1,403,469	778,598	8,877,474
1945	3,814,935	1,260,849	323,955	5,399,739	1950	8,597,227	1,472,017	1,044,915	11,114,159
1946	5,280,402	1,316,107	572,330	7,168,839	1951	8,211,820	1,424,516	1,138,696	10,775,032

[1] Includes some brown-rock matrix of sinter grade, a small quantity of apatite from Virginia in 1942–47 and 1949, and in 1942–43 some matrix of washer grade.

SALES

A record high of 11,095,000 long tons of domestic phosphate rock sold or used was reached in 1951, an increase over 1950 of 842,000 tons. The total value of $66,158,000 was likewise a record high.

TABLE 3.—Phosphate rock sold or used by producers in the United States, 1946–51

Year	Long tons	Value at mines		Year	Long tons	Value at mines	
		Total	Average			Total	Average
1946	6,860,713	$31,043,821	$4.52	1949	8,986,933	$51,415,027	$5.72
1947	9,027,030	46,638,837	5.17	1950	10,253,552	59,027,848	5.76
1948	8,668,769	50,501,598	5.83	1951	11,095,204	66,158,078	5.96

TABLE 4.—Phosphate rock sold or used by producers in the United States in 1950–51, by grade and State

Grades—B. P. L.[1] content (percent)	Florida		Tennessee [2]		Western States		Total United States	
	Long tons	Percent of total	Long tons	Percent of total	Long tons	Percent of total	Long tons	Percent of total
1950								
Below 60	153,539	2	440,488	32	226,391	29	820,418	8
60 to 66			299,228	22	818	(3)	300,046	3
68 basis, 66 minimum	507,827	6	536,522	39	300,131	38	1,344,480	13
70 minimum	868,016	11	88,957	6	251,469	32	1,208,442	12
72 minimum	1,446,706	18	18,736	1	4,400	1	1,469,842	14
75 basis, 74 minimum	3,064,690	38	542	(3)			3,065,232	30
77 basis, 76 minimum	2,045,092	25					2,045,092	20
Total	8,085,870	100	1,384,473	100	783,209	100	10,253,552	100
1951								
Below 60	227,183	3	527,024	37	516,209	44	1,270,416	11
60 to 66			596,820	42	69,263	6	666,083	6
68 basis, 66 minimum	759,161	9	193,468	14	235,981	20	1,188,610	11
70 minimum	763,631	9	101,605	7	258,100	22	1,123,336	10
72 minimum	1,297,467	15			98,928	8	1,396,395	13
75 basis, 74 minimum	3,616,625	42	975	(3)			3,617,600	33
77 basis, 76 minimum	1,832,764	22					1,832,764	16
Total	8,496,831	100	1,419,892	100	1,178,481	100	11,095,204	100

[1] Bone phosphate of lime, $Ca_3(PO_4)_2$.
[2] Includes sintered matrix.
[3] Less than 0.5 percent.

REVIEW BY STATES

SOUTHERN STATES

Florida.—The upward trend in the marketed production (sold or used by producers) of Florida phosphate rock continued in 1951; a record total of 8,497,000 long tons valued at $50,263,000 was attained. By far the greater part of the production came from the land-pebble field, with relatively small quantities of hard-rock phosphate and soft phosphate (waste-pond phosphates from the hard-rock field) being produced. The sales of soft rock continued to be somewhat larger than those of hard rock.

TABLE 5.—Florida phosphate rock sold or used by producers, 1947–51, by kinds

Year	Hard rock			Soft rock [1]		
	Long tons	Value at mines		Long tons	Value at mines	
		Total	Average		Total	Average
1947	79,330	$618,330	$7.79	88,620	$326,064	$3.68
1948	48,198	368,586	7.65	69,335	293,927	4.24
1949	23,804	173,211	7.28	77,088	344,787	4.47
1950	71,319	538,601	7.55	81,542	408,595	5.01
1951	75,615	582,247	7.70	92,183	495,243	5.37

Year	Land pebble			Total		
	Long tons	Value at mines		Long tons	Value at mines	
		Total	Average		Total	Average
1947	6,314,077	$31,975,858	$5.06	6,482,027	$32,920,252	$5.08
1948	6,421,725	37,070,381	5.77	6,539,258	37,732,894	5.77
1949	6,715,097	37,339,985	5.56	6,815,989	37,857,983	5.55
1950	7,933,009	44,430,646	5.60	8,085,870	45,377,842	5.61
1951	8,329,033	49,185,072	5.91	8,496,831	50,262,562	5.92

[1] Includes material from waste-pond operations.

In the land-pebble phosphate-rock field, the American Agricultural Chemical Corp. operated its No. 3 and No. 12 mines and washers, its recovery unit, and its drying plant at Pierce in 1951. The American Cyanamid Co. operated both its Saddle Creek and Sydney mines and washers and dried the phosphate rock produced at its Brewster drying plant. A description of the Sydney plant was published early in 1951.[1] This company has reclaimed for grazing purposes a large worked-out tract of land scarred by the phosphate-mining operations by smoothing off the area to form low, rolling hills and then planting indigo and grass. The Armour Fertilizer Works reported that there were no mining operations in 1951 at its Florida property near Bartow. The capacity of its triple superphosphate plant, however, was being doubled. The Coronet Phosphate Co. operated its Eleanor and Tenoroc mines and washers and its Coronet drier during the year. The Davison Chemical Corp. mined and washed phosphate rock at

[1] Lenhart, W. B., Latest Recovery Methods Highlight Florida Phosphate Plant: Rock Products, vol. 54, No. 3, March 1951, pp. 74–81.

its Bonny Lake and Pauway No. 4 mines and washers and dried the washed phosphate rock at its Ridgewood drying plant. The International Minerals & Chemical Corp. operated its Achan, Peace Valley, and Noralyn mines and washers and its Mulberry and Noralyn driers in 1951. The new company office building and warehouse and service center at Bartow were completed in 1951. Three new dragline excavators were said to have been installed in 1951, and building construction was begun on a new phosphate chemical plant near Mulberry to produce triple superphosphate, defluorinated phosphate, and uranium compounds. Automatic controls in the pumping and flotation operations of this company were described in papers given at the St. Louis meeting of the American Institute of Mining and Metallurgical Engineers, February 19 to 22, 1951.[2] Swift & Co. operated its Swift No. 5 and Swift No. 6 mines and washers, drying the phosphate rock at its Agricola drying plant. The Virginia-Carolina Chemical Corp. operated its Homine and Clear Springs mines and washers and mined feed from the Phosmico debris dump. The Phosmico and Nichols drying plants were in operation. Some phosphate rock was calcined.

In the hard-rock phosphate field the Kibler-Camp Phosphate Enterprise continued to operate its Section 12 mine, washer, and drying plant. Shipments were entirely for domestic consumption.

Several soft-rock phosphate-mining companies were in operation in 1951, mining the fine-grained phosphatic residues in the old waste-pond dumps near Hernando, High Springs, and Dunnellon in the hard-rock phosphate field. Part of this material was sold for domestic use as a phosphatic fertilizer for direct application to the soil, some for stock and poultry feed, and a small quantity for fertilizer filler. Some was exported to Canada.

The use of isopachous and related maps in studies of phosphate rock in the Florida land-pebble area was described in a paper published late in 1951.[3]

Tennessee.—Tennessee remained the second largest phosphate-rock-producing State. The quantity of phosphate rock sold or used by Tennessee producers in 1951 was 35,419 long tons greater than in 1950, increasing from 1,384,000 tons in that year to 1,420,000 tons in 1951. The total value in 1951 was $576,000 above that of 1950 and reached $10,605,000.

TABLE 6.—Tennessee phosphate rock[1] sold or used by producers, 1946–51

Year	Long tons	Value at mines		Year	Long tons	Value at mines	
		Total	Average			Total	Average
1946	1,362,600	$7,014,490	$5.15	1949	1,344,470	$9,067,589	$6.74
1947	1,411,884	7,779,099	5.51	1950	1,384,473	10,028,404	7.24
1948	1,307,507	8,231,251	6.30	1951	1,419,892	10,604,638	7.47

[1] Includes brown-rock matrix of sinter grade and a small quantity of Tennessee blue rock in 1946–47 and Virginia apatite in 1946–47 and 1949.

[2] Loehr, H. T., Jr., Automatic Controls in the Pumping of Phosphate Matrix at International Minerals & Chemical Corp. Mines in Polk County, Fla.: Pit & Quarry, vol. 43, No. 10, April 1951, p. 67 (abs.).
Lawver, J. E., Automatic pH control in Florida Phosphate-Rock Flotation: Pit & Quarry, vol. 43, No. 10, April 1951, p. 67 (abs.).

[3] Wayland, T. E., Use of Isopachous and Related Maps in the Florida Phosphate District: Trans. Am. Inst. Min. and Met. Eng., Min. Eng., vol. 3, No. 11, November 1951, pp. 975–979.

A short summary of the history of phosphate-rock mining in Tennessee was included in a general review of the history and development of phosphate-rock mining published in 1951.[4]

In 1951 the International Minerals & Chemical Corp. acquired the Hoover & Mason Phosphate Co., operating in the brown-rock phosphate district, Mount Pleasant, Tenn. It also purchased the Thomson Phosphate Co., of Chicago, Ill., a sales and distributing organization of ground phosphate rock to dealers and farmers for direct application to the soil. Thomson's source of raw material had been the International Minerals & Chemical Corp. This latter company operated mines and washers in 1951 at Mount Pleasant and Wales, in the Tennessee brown-rock-phosphate field.

The Tennessee Valley Authority continued mining and processing activities in Tennessee and technological operations at its chemical plant at Muscle Shoals, Ala., in 1951. According to the Authority's annual report for the fiscal year ended June 30, 1951, 426,400 tons of phosphate matrix was mined from its Tennessee properties. These properties normally provide 60 percent of the raw phosphate used by TVA, the remainder being chiefly high-grade Florida land pebble. TVA was prospecting in the Florida hard-rock phosphate field for an additional supply.

During fiscal 1951 TVA produced over 33,500 tons of elemental phosphorus from its electric furnaces. Phosphorus-bearing byproducts were 3,100 tons of potash-phosphate ash fertilizer and 9,700 tons of ferrophosphorus. There was produced about 142,900 tons of concentrated superphosphate, making a total of 1,334,000 tons since production began. TVA's production of calcium metaphosphate (60–62 percent P_2O_5) in the fiscal year ended June 30, 1951, was 31,300 tons, of which about 24,000 tons was sold and about 6,500 used for test demonstrations. A two-furnace demonstration plant for the production of fused tricalcium phosphate (26–30 percent P_2O_5) was in operation at Columbia, Tenn. Nearly 17,500 tons was produced in the fiscal year ended June 30, 1951. Pilot-plant studies were continued by TVA on two processes for the production of nitraphosphate fertilizer in which nitric acid is used in the treatment of phosphate rock.

The Monsanto Chemical Co., St. Louis, Mo., and the Victor Chemical Works, Chicago, Ill., continued to produce elemental phosphorus at their plants at Monsanto and Mount Pleasant, respectively, in the Tennessee brown-rock phosphate field.

One of the older phosphate-rock producers, the Federal Chemical Co., with properties in the Mount Pleasant, Tenn., district, did not operate during 1951.

WESTERN STATES

Total marketed production (sold or used by producers) of Western States phosphate rock rose from 783,000 long tons in 1950 to 1,178,000 tons in 1951. The total value also increased, rising from $3,622,000 in 1950 to $5,291,000 in 1951. Phosphate rock was produced and sold in all four States of the western field in 1951—Idaho, Montana, Utah, and Wyoming. Idaho led in sales, with Montana second and Wyoming third. (*See* fig. 2.)

[4] Fuller, R. B., The History and Development of Phosphate-Rock Mining: Trans. Am. Inst. Min. and Met. Eng., Min. Eng., vol. 3, No. 8, August 1951, pp. 708–712.

TABLE 7.—Western States phosphate rock sold or used by producers, 1947–51

Year	Idaho [1]			Montana		
	Long tons	Value at mines		Long tons	Value at mines	
		Total	Average		Total	Average
1947	845,045	$4,077,885	$4.83	236,229	$1,571,117	$6.65
1948	434,375	2,122,089	4.89	248,683	1,720,254	6.92
1949	471,305	1,915,125	4.06	355,169	2,574,330	7.25
1950	573,044	2,125,065	3.71	210,165	1,496,537	7.12
1951	694,446	1,748,074	2.52	304,507	2,353,381	7.73

Year	Utah			Wyoming			Total		
	Long tons	Value at mines		Long tons	Value at mines		Long tons	Value at mines	
		Total	Average		Total	Average		Total	Average
1947	(1)	(1)	(1)	51,845	$290,484	$5.60	1,133,119	$5,939,486	$5.24
1948	(1)	(1)	(1)	138,946	695,110	5.00	822,004	4,537,453	5.52
1949				(1)	(1)	(1)	826,474	4,489,455	5.43
1950	(1)	(1)	(1)	(1)	(1)	(1)	783,209	3,621,602	4.62
1951	580	$2,900	$5.00	178,948	1,186,523	6.63	1,178,481	5,290,878	4.49

[1] Idaho includes Utah in 1947–48 and 1950, and Wyoming in 1949–50.

Idaho.—Idaho retained its position as the leading phosphate-rock producer of the Western States in 1951, increasing its output considerably to 694,000 long tons, with a value of $1,748,000. The average value per ton was low ($2.52) because of the large quantities of low-grade phosphate produced for smelting in elemental phosphorus electric furnaces. A 1951 article describes the phosphate rock industry of Idaho.[5]

Three companies reported producing phosphate rock in Idaho in 1951. The Simplot Fertilizer Co., Pocatello, Idaho, continued its open-pit operations at the Gay mine on the Fort Hall Indian Reservation, Bingham County, about 16 miles east of Fort Hall. The high-grade phosphate rock from this property is used by that company for the production of superphosphate at Pocatello. The low-grade phosphatic shales from this operation go to the Westvaco elemental phosphorus electric furnaces at Pocatello. The Anaconda Copper Mining Co. operated its No. 3 phosphate rock mine at Conda, Caribou County, Idaho, processing the phosphate rock at the company plant at Anaconda, Mont., largely to triple superphosphate through the use of its byproduct sulfuric acid. The San Francisco Chemical Co., Montpelier, Idaho, reopened and operated its Waterloo mine on Waterloo Hill 5 miles east of Montpelier in 1951.

Fifteen phosphate leases, originally assigned to the J. R. Simplot Co., were reassigned in 1951, by the Secretary of the Interior, to the Monsanto Chemical Co., St. Louis, Mo. Monsanto purchased the leases from Simplot and was expected to smelt the phosphate rock produced from these leases in an elemental phosphorus electric furnace plant to be built near Soda Springs, Idaho.

[5] Utley, H. F., Idaho's Vast Phosphate Beds Yield Raw Material For Big Operations: Pit & Quarry, vol. 43, No. 11, May 1951, pp. 83–85.

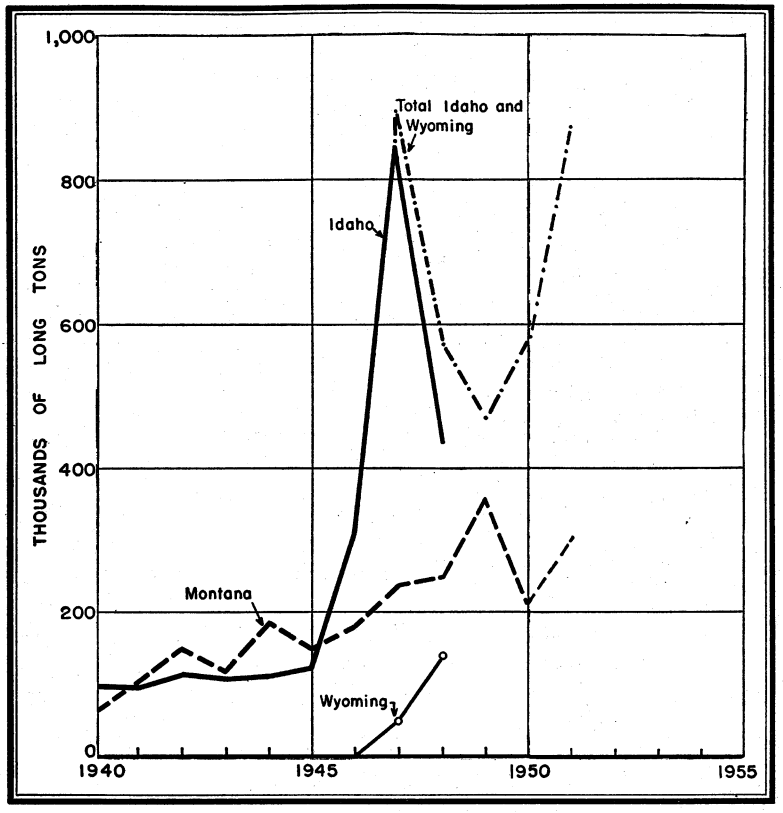

FIGURE 2.—Western States phosphate rock sold or used by producers, 1940–51.

Montana.—Marketed production of Montana phosphate rock in 1951 partly recovered from the sharp decline from 1949 to 1950, rising to 305,000 long tons, valued at $2,353,000 from 210,000 tons, valued at $1,497,000 in 1950.

The Montana Phosphate Products Co., Trail, British Columbia, operated its Anderson, Graveley, and Luke mines, all in the Garrison district, Powell County, in 1951. The Luke mine was closed temporarily part of the year. All phosphate rock produced from these mines was exported to the plant of the parent company, Consolidated Mining & Smelting Co., of Canada, Ltd., at Trail, British Columbia. Mining operations were also carried on by George Relyea at the Relyea phosphate mine, in the Garrison district, and the output was also shipped to Trail, British Columbia.

In the Philipsburg district, Granite County, the only mining operation reported for 1951 was that of Soluble Phosphates, Ltd., Maxville, which mined and shipped a small quantity of low-grade phosphate rock from its Maxville mine.

The Williams Phosphate Corp. was reported to have begun development of its phosphate-rock property near Alder, Madison County, in 1951 and to have begun installation of a primary crusher and ore bin.

The Victor Chemical Works operated its Maiden Rock and Canyon Creek mines near Melrose and produced phosphate rock for use in its electric smelter furnaces at Silver Bow.

Utah.—The only phosphate-rock-producing company in Utah in 1951 was the Pearl Phosphate Co. (307 South Central Ave., Ontario, Calif.), formerly the Pearl & Toland Phosphate Co., which operated its property at the south end of the Crawford Mountains in Rich County, northeastern Utah, near Woodruff. Most of the material was shipped for direct application to the soil.

Wyoming.—The reported production and shipments of Wyoming phosphate rock in 1951 showed a considerable increase over 1950. The State is an important producer of phosphate rock and stands in third place in the Western States group.

Two companies produced phosphate rock in Wyoming in 1951—the San Francisco Chemical Co., by far the larger producer, and Phosphate Mines, Inc. The San Francisco Chemical Co., operated the Leefe mine near Sage, Wyo. Phosphate Mines, Inc., Kemmerer, Wyo., mined a small quantity of phosphate rock in 1951 but shipped a much larger amount from stock for direct application to the soil.

Phosphate Fertilizer, Inc., Kemmerer, Wyo., was reported to have begun construction in 1951 of a fertilizer plant of 100 tons daily capacity at Phosphate near Kemmerer for processing phosphate rock, using a German process involving the heating of the phosphate rock in rotary kilns to render it soluble in ammonium citrate solution, then cooling and crushing the material for marketing.

CONSUMPTION AND USES

The apparent consumption of phosphate rock in the United States in 1951 increased 927,000 long tons to a record high of 9,508,000 tons from 8,581,000 tons in 1950.

TABLE 8.—Apparent consumption[1] of phosphate rock in the United States, 1946–51, in long tons

Year	Long tons	Year	Long tons
1946	6,221,525	1949	7,735,005
1947	7,425,784	1950	8,580,925
1948	7,700,081	1951	9,507,951

[1] Quantity sold or used by producers, plus imports minus exports.

Data regarding the sales of phosphate rock by uses both for individual States and for the United States are shown in table 9.

TABLE 9.—Phosphate rock sold or used by producers in the United States, 1950–51, by use and State

Uses	Florida		Tennessee		Western States		Total United States	
	Long tons	Percent of total	Long tons	Percent of total	Long tons	Percent of total	Long tons	Percent of total
1950								
Domestic:								
Superphosphates	5,483,159	68	301,923	22	200,105	26	5,985,187	59
Phosphates, phosphoric acid, phosphorus, ferrophosphorus	407,735	5	830,837	60	297,362	38	1,535,934	15
Direct application to soil	562,993	7	219,522	16	73,383	9	855,898	8
Fertilizer filler	773	(1)	14,610	1			15,383	(1)
Stock and poultry feed	81,665	1	16,871	1	2,104	(1)	100,640	1
Undistributed [2]			710	(1)			710	(1)
Exports [3]	1,549,545	19			210,255	27	1,759,800	17
Total	8,085,870	100	1,384,473	100	783,209	100	10,253,552	100
1951								
Domestic:								
Superphosphates	5,493,396	65	322,607	23	294,510	25	6,110,513	55
Phosphates, phosphoric acid, phosphorus, ferrosphosphorus	739,414	9	867,165	61	564,235	48	2,170,814	20
Direct application to soil	710,710	8	210,780	15	72,394	6	993,884	9
Fertilizer filler	392	(1)	16,454	1			16,846	(1)
Stock and poultry feed	120,493	1	1,663	(1)			122,156	1
Undistributed [2]			1,223	(1)	2,692	(1)	3,915	(1)
Exports [3]	1,432,426	17			244,650	21	1,677,076	15
Total	8,496,831	100	1,419,892	100	1,178,481	100	11,095,204	100

[1] Less than 0.5 percent.
[2] Includes phosphate rock used in pig-iron blast furnaces, parting compounds, research, defluorinated phosphate rock, refractories, and other uses.
[3] As reported to the Bureau of Mines by domestic producers.

Certain details regarding the domestic superphosphate industry are given in table 10.

TABLE 10.—Production, shipments, and stocks of superphosphates (18 percent available phosphoric acid), 1947–51, in short tons

[Bureau of the Census]

	1947	1948	1949	1950	1951
Production	9,292,677	9,319,697	9,075,903	9,296,051	9,432,283
Shipments	4,752,324	4,789,668	4,845,175	5,065,101	4,807,919
Stocks in manufacturers' hands Dec. 31	856,382	1,216,788	1,139,372	1,050,718	1,067,965

Details regarding the 1950–51 consumption of phosphatic commercial fertilizers are published annually by the United States Department of Agriculture.[6]

PRICES

Prices for phosphate rock were included under the general price freeze order of January 26, 1951 (General Ceiling Price Regulations—GCPR—January 26, 1951) in which prices were set at the highest level reached in the base period between December 19, 1950, and January 25, 1951. No changes were reported in the trade journals

[6] Scholl, Walter, and Wallace, H. M., Consumption of Commercial Fertilizers in U. S., 1950–51: Agric. Chem., vol. 7, No. 6, June 1952, pp. 33–40.

during 1951 in the price quotations for Florida land pebble or Tennessee brown-rock phosphate. The price quotations of the Oil, Paint, and Drug Reporter as of January 8, 1951, and December 31, 1951, are given in table 11. Quotations for Western States phosphate rock are not given in the trade journals.

TABLE 11.—Prices per long ton of Florida and Tennessee unground, washed, and dried phosphate rock, in bulk, f. o. b. cars at mine, in 1951, by grades

[Oil, Paint and Drug Reporter]

Grades (percent) [1]	Florida land pebble		Tennessee brown rock	
	Jan. 8, 1951	Dec. 31, 1951	Jan. 8, 1951	Dec. 31, 1951
70/68 B. P. L.	$4.35–4.40	$4.35–4.40		
72/70 B. P. L.	5.00	5.00		
75/74 B. P. L.	6.00	6.00		
77/76 B. P. L.	7.00	7.00		
27–26 P_2O_5			$6.45	$6.45
30–29 P_2O_5			7.21	7.21

[1] B. P. L. signifies bone phosphate of lime, $Ca_3(PO_4)_2$.

FOREIGN TRADE [7]

Data on imports and exports of phosphate rock and other phosphatic materials are shown in tables 12 to 15. The imports of phosphate rock in 1951 were principally from the Netherlands Antilles (97 percent). The balance came from Belgium, Mexico, and Canada, in the order named.

Sales or shipments of phosphate rock for export as reported by domestic producers to the Bureau of Mines are given in the section on Consumption and Uses.

TABLE 12.—Phosphate rock and phosphatic fertilizers imported for consumption in the United States, 1950–51

[U. S. Department of Commerce]

Fertilizer	1950		1951	
	Long tons	Value	Long tons	Value
Phosphates, crude, not elsewhere specified	87,173	$1,113,974	89,823	$1,379,767
Superphosphates (acid phosphate):				
Normal (standard), not over 25 percent P_2O_5 content	4,062	108,842	2,455	73,535
Concentrated (treble), over 25 percent P_2O_5 content	446	24,094	160	10,739
Total superphosphates	4,508	132,936	2,615	84,274
Ammonium phosphates, used as fertilizer	[1] 96,156	[1] 6,141,816	120,502	8,450,659
Bone dust, or animal carbon and bone ash, fit only for fertilizer	40,225	1,869,331	43,455	2,654,660
Guano	105	7,228	137	10,568
Slag, basic, ground or unground	179	4,846	96	2,757
Precipitated bone, fertilizer grade	876	62,484	12,719	1,116,036

[1] Revised figure.

[7] Figures on imports and exports (unless otherwise indicated) compiled by M. B. Price and E. D. Page of the Bureau of Mines, from records of the United States Department of Commerce.

TABLE 13.—Phosphate rock exported from the United States, 1950–51, by grade and country of destination

[U. S. Department of Commerce]

Grade and country	1950		1951	
	Long tons	Value	Long tons	Value
Florida:				
High-grade hard rock:				
Canada	381	$4,572	2,467	$29,340
Mexico			26	585
Sweden	26,743	244,917	1,498	14,231
Taiwan (Formosa)	4,926	35,589	10.005	87,644
Total high-grade hard rock	32,050	285,078	13,996	131,800
Land pebble:				
Argentina			4,428	42,066
Belgium-Luxembourg	73,969	500,059	33,665	290,693
Brazil	2,011	18,099	20,862	189,955
Canada	[1] 192,784	[1] 1,670,687	174,377	1,271,593
Colombia	303	4,155	1,213	17,294
Costa Rica			178	2,400
Cuba	12,930	96,709	18,347	143,203
El Salvador	[2]	[2]	400	5,700
Germany	117,129	863,048	34,081	276,881
Guatemala			100	1,425
Israel	12,236	103,673		
Italy	394,977	3,539,448	75,914	704,381
Japan	530,036	2,904,867	633,731	4,543,079
Liberia			3	165
Mexico	9,008	54,173	9,022	54,847
Netherlands	93,522	888,605	179,010	1,567,211
Philippines			45	580
Sweden	10,107	90,412	47,774	433,455
Switzerland			4,937	41,470
Taiwan (Formosa)	24,646	187,701	29,489	258,321
Union of South Africa			10,106	96,005
United Kingdom	87,875	783,312	161,025	1,284,264
Uruguay			3,468	32,946
Venezuela			580	18,850
Total land pebble	1,561,533	11,704,948	1,442,755	11,276,784
Other phosphate rock: [3]				
Canada	237,215	2,866,378	266,506	3,293,108
Cuba			50	825
El Salvador	528	5,401		
Japan			2,044	26,572
Mexico	559	6,720	1,628	20,432
Norway	100	2,664		
Thailand	9	219		
Venezuela	54	3,060		
Total other phosphate rock	238,465	2,884,442	270,228	3,340,937
Grand total	1,832,048	14,874,468	1,726,979	14,749,521

[1] Revised figure.
[2] Revised to none.
[3] Includes colloidal matrix; sintered matrix; soft phosphate rock; and Tennessee, Idaho, and Montana rock.

TABLE 14.—"Other phosphate material" [1] exported from the United States, 1946–51

[U. S. Department of Commerce]

Year	Long tons	Value	Year	Long tons	Value
1946	1,018	$144,478	1949	3,225	$224,375
1947	1,129	220,906	1950	1,350	247,880
1948	1,002	188,163	1951	2,316	372,685

[1] Class includes animal carbon; apatite; bone ash, dust, and meal; char dust; duplex basic phosphate; tricalcium phosphate; and defluorinated phosphate rock.

TABLE 15.—Superphosphates (acid phosphates) exported from the United States, 1950–51, by country of destination

[U. S. Department of Commerce]

Country	1950		1951	
	Long tons	Value	Long tons	Value
Brazil	19,936	$417,843	24,061	$760,754
Canada	146,397	2,626,295	169,185	3,349,733
Chile	9	1,040	44	4,459
Colombia	1,384	95,536	491	17,665
Costa Rica	2,416	127,003	2,157	106,549
Dominican Republic	373	22,425	934	66,979
El Salvador	970	42,329	1,630	36,089
Germany	804	19,200		
Guatemala	98	5,291	94	3,932
Iceland	1,889	110,355	570	43,065
Indochina			984	23,373
Korea	28,569	747,149		
Mexico	185	20,045	686	58,280
Peru	40	4,253	113	11,380
Philippines	1,596	115,997	1,027	29,920
Poland-Danzig	14,514	212,275		
Taiwan (Formosa)			2,069	94,997
Venezuela	75	4,557	854	32,850
West Indies:				
British:				
Leeward and Windward Islands	20	604		
Other British	4	225	27	1,907
Cuba	22,887	492,976	61,333	1,187,253
Haiti	125	7,863	5	575
Other countries	271	10,864	425	17,938
Total	242,562	5,084,125	266,689	5,847,638

TECHNOLOGY

Among the significant papers published recently on developments in phosphate-rock technology, in addition to those cited in other parts of this chapter, were the following:

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TURRENTINE, J. W. Phosphate Production Without Sulfuric Acid. Chem. and Eng. News, vol. 29, No. 4, Aug. 20, 1951, pp. 3454–3456.
WEISMAN, W. I. Concentrating H_3PO_4. Chem. Eng., vol. 58, No. 6, June 1951, pp. 210–211.

WORLD REVIEW

Table 16 gives available figures on production of phosphate rock in various countries in 1947–51.

TABLE 16.—World production of phosphate rock, 1947–51, by countries, in metric tons [1]

[Compiled by Helen L. Hunt]

Country [1]	1947	1948	1949	1950	1951
Algeria	713,790	670,591	645,906	684,657	776,575
Angaur Island	107,898	76,713	157,049	[2] 119,000	[3] 144,843
Angola	[4]	[4]	[4]	1,033	943
Australia	5,402	2,170	11	1,653	8,027
Austria	11,525	[4]	[4]	[4]	[4]
Belgium	58,045	68,938	44,643	50,846	[4]
Brazil (apatite)	5,592	[4]	4,553	[4]	[4]
British Borneo (guano)	283	427	508	653	659
Canada			18	117	
Chile (apatite)	13,994	59,529	49,311	13,437	[4]
China	[4]	[4]	[2] 20,000	[2] 20,000	[2] 20,000
Christmas Island (Indian Ocean) (exports)	106,765	108,311	255,236	320,423	337,677
Egypt	371,227	377,005	350,480	397,207	499,976
France	104,068	84,580	67,509	73,752	110,000
French Morocco	2,960,735	3,226,700	3,693,000	[5] 3,872,241	4,716,800
French West Africa (aluminum phosphate)	853	3,965	5,675	11,035	23,580
Germany, West	698	473			
India (apatite)	867	1,132	588	3,025	[4]
Indonesia			[2] 5,000		
Ireland	10,780		[4]	[4]	[4]
Israel and Jordan (exports)	6,058	[2] 4,000	[4]	[4]	6,888
Japan	6,802	3,590	684	258	143
Makatea Island (French Oceania) (exports)	196,430	183,104	239,532	245,804	277,858
Nauru Island (exports)	177,606	544,298	802,070	1,070,358	942,945
Netherlands Antilles	79,229	58,827	92,784	104,240	106,902
New Zealand	203				
Norway (guano)				2,538	[4]
Ocean Island (exports)	212,456	126,854	265,087	251,218	256,451
Philippines, Republic of the (guano)			10,998	32,606	[4]
Seychelles Islands (exports)	14,516	21,722	14,171	10,005	4,547
Southern Rhodesia	9		67	36	
South-West Africa (guano)	2,223	1,038	957	581	785
Spain	20,204	23,012	23,093	24,080	22,830
Sweden (apatite)	7,696	1,441	1,604	2,044	[4]
Tanganyika Territory	220	313	157	468	345
Tunisia	1,759,236	1,863,710	1,441,918	1,524,800	1,678,905
Uganda	7,269			467	[4]
Union of South Africa	41,831	39,656	56,471	51,844	81,840
U. S. S. R. [2]	2,032,000	2,336,915	2,540,125	2,540,125	[4]
United States (sold or used by producers)	9,171,914	8,807,903	9,131,173	10,418,122	11,273,282
Total (estimate)	18,240,000	18,755,000	[5] 19,960,000	[5] 21,875,000	23,420,000

[1] In addition to countries listed, Korea, Poland and Rumania produce phosphate rock; but data on output are not available and estimates by the author of the chapter have been included in the total.
[2] Estimate.
[3] Exports.
[4] Data not available; estimate by author of chapter included in total.
[5] Revised figure.

BASIC SLAG

Basic slag is a comparatively limited source of agricultural phosphorus in the United States. Domestic production comes from a single company smelting a phosphatic iron ore in the Birmingham, Ala., district. No figures on production or sales are released for publication by this company. Annual imports are negligible. In 1950, 179 long tons were imported; in 1951, only 96 tons. No exports were reported.

Platinum-Group Metals

By James E. Bell and Kathleen M. McBreen

GENERAL SUMMARY

FEATURES of the platinum-group metals in 1951 were large total domestic consumption for the second consecutive year and adoption of controls on platinum sales. Prices continued high. Sales of platinum were substantially smaller than in 1950, but sales of palladium rose sharply and exceeded those of platinum over an annual period for the first time on record. Inadequate supplies of platinum led to the issuance in April of National Production Authority Order M–54 prohibiting the sale of platinum for unessential uses. Total imports of the platinum-group metals were at a new high for the second consecutive year. The strong demand for the platinum-group metals was due largely to requirements for the military program and defense-supporting industries.

TABLE 1.—Salient statistics of platinum-group metals in the United States, 1950–51, in troy ounces

	1950	1951		1950	1951
Production:			Stocks in hands of refiners, importers, and dealers, Dec. 31:		
Crude platinum from placers and byproduct platinum-group metals	[1] 37,855	[1] 36,951	Platinum	125,234	138,977
Refinery production:			Palladium	107,854	138,099
New metal:			Other	33,474	36,815
Platinum	56,757	36,007	Total	266,562	313,891
Palladium	11,819	6,520			
Other	4,553	10,534	Imports for consumption:		
Total	73,129	53,061	Unrefined materials	[2] 48,551	63,594
			Refined metals	[2] 378,996	537,812
Secondary metal:			Total	[2] 427,547	601,406
Platinum	33,894	22,470			
Palladium	21,167	27,999	Exports:		
Other	3,052	2,889	Ore and concentrates	82	732
Total	58,113	53,358	Refined metals and alloys, including scrap	37,699	60,848
			Manufactures (except jewelry)	12,640	17,348
Consumption:					
Platinum	308,998	209,695			
Palladium	150,456	222,545			
Other	36,491	30,295			
Total	495,945	462,535			

[1] Includes Alaska.
[2] Revised figure.

Refinery production of platinum (new and secondary combined) in the United States in 1951 was 35 percent below that of 1950, and imports of refined platinum were 31 percent greater. Domestic consumption, as measured by sales, declined 32 percent, and stocks of

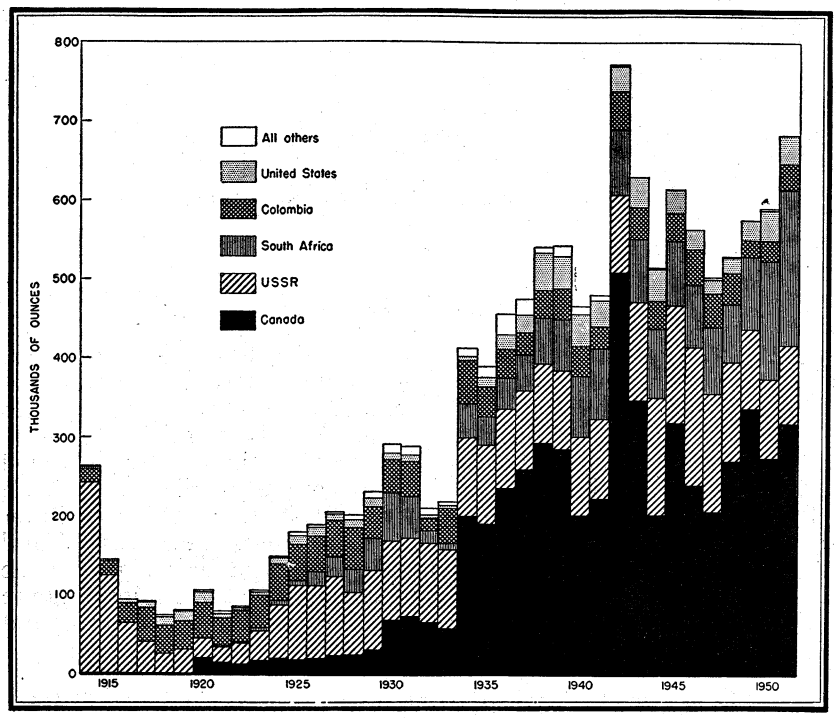

FIGURE 1.—World production of platinum-group metals, 1914–51.

refiners and dealers rose 11 percent. The chemical industry was the largest user, increasing to 47 percent of the total sales in 1951 from 37 percent in the preceding year.

Refinery production of palladium in the United States in 1951 was 5 percent above that of 1950, and imports of refined palladium were 62 percent greater. Stocks of refiners and dealers increased 28 percent. Domestic consumption, as measured by sales, rose 48 percent. The electrical industry maintained its accustomed position as the largest user, taking 52 percent of the total sales.

Refinery production of iridium, of osmium, of rhodium, and of ruthenium in the United States in 1951 was higher than in 1950, particularly that of rhodium. Imports of iridium, osmium, and ruthenium were each smaller in 1951 than in 1950, but those of rhodium were greater. Domestic consumption of the four metals together decreased 17 percent, while stocks of refiners and dealers rose 10 percent.

Total imports of platinum-group metals into the United States in 1951 were 41 percent greater than in the previous record year 1950.

In July the Rustenburg Platinum Mines, Ltd., the principal producer of platinum-group metals in South Africa, announced plans to increase its output substantially. Figure 1 shows graphically the trend in world production of platinum-group metals since 1914.

Government Regulations.—In the face of serious shortages of platinum for the military program and essential civilian requirements, and as a result of meetings on February 19, 1951, and March 16, 1951, between members of the Industry Advisory Committee for Platinum and officials of various Government agencies, National Production Authority Order M–54 was issued effective April 1, 1951. This order forbade purchase of platinum for investment or speculative purposes and prohibited its delivery or acceptance for use in many consumer items, largely jewelry. Platinum in the inventory of manufacturers of the prohibited items on April 1 was exempted from the provisions of the order.

CRUDE-PLATINUM PRODUCTION

Mine returns and refinery reports indicate a domestic mine output of 36,951 troy ounces of platinum-group metals in 1951 compared with 37,855 ounces in 1950. This production includes crude platinum recovered from placer-platinum deposits in the Goodnews Bay district in southwestern Alaska, byproduct crude platinum recovered from gold placer-mining operations in California, and platinum-group metals contained in small quantities in some gold and copper ores and recovered as a byproduct of smelting and refining. No production of byproduct crude platinum was reported in Montana or Oregon in 1951.

Purchases.—United States buyers reported the purchase in 1951 of 39,426 ounces of crude platinum from Alaska, California, Colombia, Union of South Africa, British Columbia (Canada), and Panama. The corresponding quantity in 1950 was 69,056 ounces.

RECOVERY OF REFINED PLATINUM-GROUP METALS

New Metals Recovered.—Reports from refiners indicate recovery in the United States of 53,061 ounces of new platinum-group metals in 1951, a 27 percent decrease from that in 1950. Seventy-nine percent of this output was recovered from crude platinum, chiefly from Alaska and Colombia, and 21 percent as a byproduct of gold and copper ores, the same proportions as in 1950.

Secondary Metals Recovered.—The domestic recovery of platinum-group metals in 1951 from the refining of scrap, sweeps, etc., was 53,358 ounces compared with 58,113 ounces in the preceding year.

Substantial quantities of wornout catalysts, spinnerets, laboratory ware and equipment, and other products are returned to refiners for refining or reworking. The refined platinum-group metals recovered from this source (or their equivalent in refined metals) are returned to the consumers. The platinum-group metals so recovered are not considered secondary production and are not included in the figures for secondary metals.

TABLE 2.—New platinum-group metals recovered by refiners in the United States, 1942–46 (average) and 1947–49, and 1950–51 by sources, in troy ounces

	Platinum	Palladium	Iridium	Osmium	Rhodium	Ruthenium	Total
1942–46 (average)	173,195	53,235	4,714	773	4,509	2,555	238,981
1947	54,011	4,156	1,605	419	563	103	60,857
1948	33,520	4,408	1,009	349	156	149	39,591
1949	42,228	6,008	2,131	980	208	371	51,926
1950							
From domestic—							
Crude platinum	14,379	37	1,131	278	251	22	16,098
Gold and copper refining	3,722	11,533	93	----------	134	27	15,509
Total	18,101	11,570	1,224	278	385	49	31,607
From foreign crude platinum	38,656	249	1,127	1,017	48	425	41,522
Total, 1950	56,757	11,819	2,351	1,295	433	474	73,129
1951							
From domestic—							
Crude platinum	16,543	101	2,423	483	235	50	19,835
Gold and copper refining	5,017	3,999	10	----------	125	1	9,152
Total	21,560	4,100	2,433	483	360	51	28,987
From foreign—							
Crude platinum Nickel and copper refining	14,447	2,420	1,984	1,233	2,519	1,471	24,074
Total, 1951	36,007	6,520	4,417	1,716	2,879	1,522	53,061

TABLE 3.—Secondary platinum-group metals recovered in the United States, 1942–46 (average) and 1947–51, in troy ounces

	Platinum	Palladium	Iridium	Others	Total
1942–46 (average)	62,006	26,108	1,620	3,535	93,269
1947	54,190	27,492	2,089	3,317	87,088
1948	58,527	28,418	2,214	4,742	93,901
1949	41,734	37,209	1,101	3,403	83,447
1950	33,894	21,167	1,064	1,988	58,113
1951	22,470	27,999	1,014	1,875	53,358

Technology.—An article on spectrographic methods of analysis for minor constituents in palladium and platinum refinery sponge was published in 1951.[1]

CONSUMPTION AND USES

Sales of the platinum-group metals to consumers in the United States totaled 462,535 troy ounces in 1951 compared with 495,945 ounces in the preceding year, a 7-percent drop.

Sales of platinum to domestic consumers were 209,695 ounces in 1951 and represented 45 percent of the total sales of platinum-group metals; corresponding figures for 1950 were 308,998 ounces and 62 percent. The chemical industry was the largest user in 1951 and accounted for 47 percent of the domestic platinum sales, followed by the electrical industry with 33 percent. Reflecting the restrictions imposed by Order M–54, sales for jewelry and decorative uses declined from 41 percent of the total platinum sales in 1950 to 12 percent in 1951. Sales of platinum for dental and medical, and miscellaneous uses were, respectively, 20 and 34 percent lower in 1951 than in 1950.

[1] Hawley, J. E., Wark, W. J., Lewis, C. L., and Ott, W. L., Spectrographic Analysis of Palladium and Platinum Sponge: Canadian Min. and Met. Bull., vol. 44, No. 474, October 1951, pp. 669–677.

TABLE 4.—Platinum-group metals sold to consuming industries in the United States in 1950 and 1951, in troy ounces

Industry	Platinum	Palladium	Iridium, osmium, rhodium, and ruthenium	Total
1950				
Chemical	114,430	16,673	13,875	144,978
Electrical	45,229	80,024	3,316	128,569
Dental and medical	18,182	18,359	371	36,912
Jewelry and decorative	127,374	35,293	12,810	175,477
Miscellaneous and undistributed	3,783	107	6,119	10,009
Total	308,998	150,456	36,491	495,945
1951				
Chemical	97,813	38,527	16,834	153,174
Electrical	70,144	116,601	3,340	190,085
Dental and medical	14,475	30,497	162	45,134
Jewelry and decorative	24,759	35,500	5,379	65,638
Miscellaneous and undistributed	2,504	1,420	4,580	8,504
Total	209,695	222,545	30,295	462,535

In 1951, 222,545 ounces of palladium were sold to domestic consumers, a gain of 72,089 ounces over the preceding year and the largest on record, accounting for 48 percent of the total sales of the group. There were increased sales for all uses, particularly the electrical industry. The distribution of consumption by uses was: Chemical 17 percent, electrical 52, dental and medical 14, jewelry and decorative 16, and miscellaneous less than 1.

Iridium, osmium, rhodium, and ruthenium together accounted for 7 percent of the total of platinum-group metals sold in 1951, the same as in 1950. By quantity the sales were as follows: Iridium 5,556 ounces, osmium 2,441 ounces, rhodium 15,634 ounces, and ruthenium 6,664 ounces—a total of 30,295 ounces.

The platinum-group metals are used as pure metals, combined, clad, or alloyed with other metals. (*See* page 801 of the Platinum and Allied Metals chapter of Minerals Yearbook, 1943, for a comprehensive table showing uses of these metals.)

The chemical applications of the platinum-group metals arise from their catalytic activity and their resistance to corrosion and other chemical action, even at high temperatures. Catalytic uses include the production of nitric and sulfuric acids, hydrogenation and dehydrogenation, the synthesis of hydrocarbons, and hydroxylation. A recent and expanding development is the use of platinum as a catalyst for producing high-octane gasoline from low-grade and natural gasoline. Pure platinum and iridium-platinum alloys are used as insoluble anodes in various electroplating processes, and chemical laboratories have long used platinum for crucibles, electrodes, and other ware and equipment. Platinum-gold and rhodium-platinum alloys have been used many years in spinnerets for making rayon fiber from viscose. Fiber glass in rapidly increasing quantities is produced in a somewhat similar way by forcing molten glass through banks of platinum nozzles, whence it emerges in fine streams that are stretched to filaments of minute diameter.

The platinum-group metals have numerous electrical applications

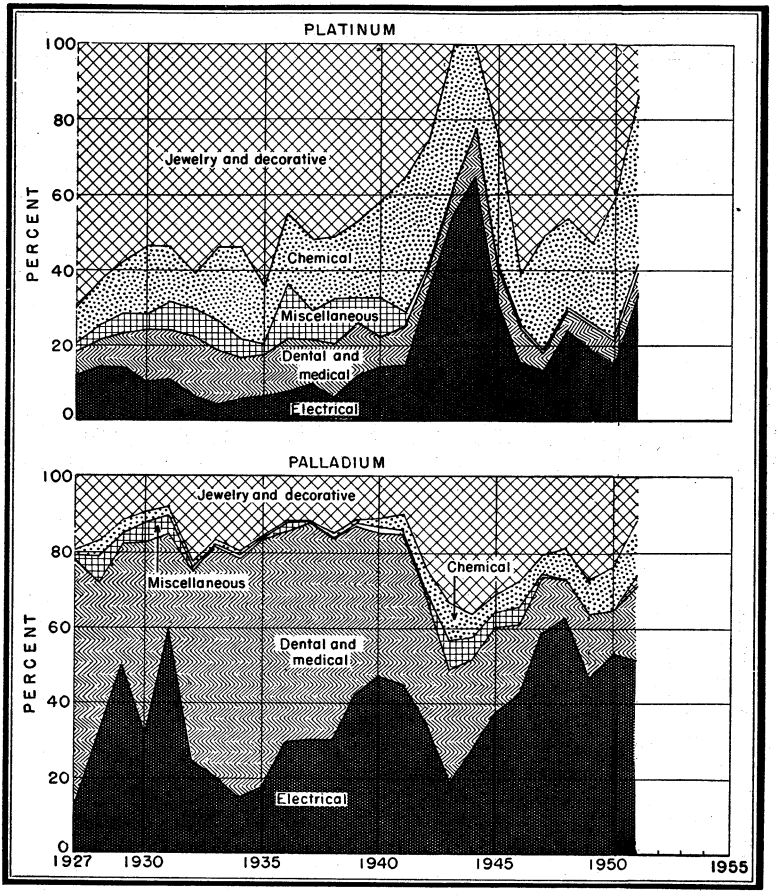

FIGURE 2.—Sales of platinum and palladium to various consuming industries in the United States, 1927–51, as percent of total.

based on their resistance to tarnishing by oxidation or sulfidation, resistance to spark erosion, high melting temperatures, and good mechanical properties. Palladium is used extensively in the contacts of telephone relays. Platinum, either pure or hardened with iridium or ruthenium, is used for contacts in voltage regulators, thermostats, relays, and contacts in high-tension magnetos. Sparkplugs equipped with platinum-alloy electrodes have long life and resistance to fouling. Platinum and platinum alloys are employed in numerous delicate electrical and laboratory instruments and in electronic tubes. Rhodium electroplate provides a surface of high reflectivity for reflectors.

Because of their strength, workability, and resistance to tarnish, alloys of platinum and palladium are used extensively for dentistry in cast and wrought forms and as pins and anchors.

Platinum hardened with iridium or ruthenium is widely accepted as the ideal metal in the jewelry and decorative arts, particularly for gem-set jewelry. Palladium alloyed with ruthenium is gaining acceptance for jewelry, particularly in Europe. Both platinum and palladium are beaten into leaf for use in signs, book bindings, etc.

STOCKS

Stocks of platinum-group metals in all forms in the hands of refiners, dealers, and importers, as reported to the Bureau of Mines, totaled 313,891 troy ounces on December 31, 1951, compared with 266,562 ounces a year earlier, an increase of 18 percent.

TABLE 5.—Stocks of platinum-group metals held by refiners, importers, and dealers in the United States, December 31, 1947–51, in troy ounces

Year	Platinum	Palladium	Iridium, osmium, rhodium, and ruthenium	Total
1947	133,300	167,364	36,859	337,523
1948	146,823	142,211	34,540	323,574
1949	138,049	122,408	35,587	296,044
1950	125,234	107,854	33,474	266,562
1951	138,977	138,099	36,815	313,891

PRICES

The quoted retail prices of the platinum-group metals remained unchanged during 1951 and were as follows per fine troy ounce: Platinum $93, palladium $24, iridium $200, osmium $200–$215, rhodium $125, and ruthenium $93. However, substantial sales of platinum are reported to have been made at prices higher than $93. During 1951 the two London refineries that handle the production of platinum-group metals of Canada and South Africa maintained their respective prices for platinum at £33¼ ($93.10) and £27 ($75.60) per ounce, while reserving most of the supplies available to them for essential requirements; prices for the remainder were bid up considerably in the free market. The London price for palladium ranged from £8 ($22.40) to £9 ($25.20) per ounce during 1951.

United States buyers reported purchases at $73.18 to $103.51 per ounce for domestic and foreign crude platinum in 1951. This price range resulted chiefly from fluctuations in quotations for refined metals and variations in the iridium content of the crude platinum.

FOREIGN TRADE [2]

Imports.—Imports of platinum-group metals into the United States in 1951 totaled 41 percent more than those in the previous record year 1950 and thus reached an alltime high for the second consecutive year. The principal sources were Canada (288,022 ounces), Colombia (25,181 ounces), Japan (114,731 ounces), Netherlands (43,098 ounces) United Kingdom (20,442 ounces), Union of South Africa (77,796 ounces), and U. S. S. R. (16,075 ounces). Imports of refined metals in 1951 totaled 537,812 troy ounces compared with 378,996 ounces (revised) in 1950; imports of unrefined metals totaled 63,594 ounces compared with 48,551 ounces (revised). Imports of refined platinum, palladium, and rhodium were 31, 62, and 57 percent greater, respectively, in 1951 than in 1950; and imports of refined iridium, osmium, and ruthenium were 54, 13, and 9 percent less, respectively.

[2] Figures on imports and exports compiled by M. B. Price and E. D. Page, of the Bureau of Mines, from records of the U. S. Department of Commerce.

TABLE 6.—Platinum-group metals imported for consumption in the United States, 1942–46 (average) and 1947–51

[U. S. Department of Commerce]

Year	Troy ounces	Value	Year	Troy ounces	Value
1942–46 (average)	366,164	$11,832,437	1949	218,284	$11,855,150
1947	308,865	11,792,126	1950	[1] 427,547	[1] 23,220,709
1948	272,733	14,973,356	1951	601,406	36,306,118

[1] Revised figure.

TABLE 7.—Platinum-group metals (unmanufactured) imported for consumption in the United States, 1950–51, by countries, in troy ounces [1]

[U. S. Department of Commerce]

Country	Unrefined materials [2]				Refined metals					Total
	Ores and concentrates of platinum metals	Platinum grain and nuggets (including crude, dust, and residues)	Platinum sponge and scrap	Osmiridium	Platinum	Palladium	Iridium	Osmium	Rhodium and ruthenium	
1950										
Belgium-Luxembourg					455					455
Canada	204	(3)	[4] 1,494		108,958	63,021	4,701		14,633	[4] 193,011
China			1,342		288					1,630
Colombia		35,605								35,605
Egypt					1,370					1,370
France			125		[4] 113		100			[4] 338
Germany					13	217	100	318		648
Hong Kong			200		283					483
Japan			104		345				34	483
Lebanon					[4] 381					[4] 381
Netherlands					760	8,270	204		110	9,344
Norway					[4] 1,830	750	165		540	[4] 3,285
Panama					72					72
Switzerland			513		4,966	2,028	197	64	[4] 185	[4] 7,953
Taiwan (Formosa)					482					482
Union of South Africa			5,005	1,231	11,527	5,539	500	700	2,700	27,202
U. S. S. R.					1,469	44,427				45,896
United Kingdom		188	11	2,011	[4] 70,380	22,854	835	435	1,532	[4] 98,246
Venezuela	360					48			72	480
Other countries	64		94		6	19			(3)	183
Total	628	35,793	[4] 8,888	3,242	[4] 203,698	147,173	6,802	1,517	[4] 19,806	[4] 427,547
1951										
Belgium-Luxembourg					366					366
Canada	42	94	248		111,200	151,877	1,801		22,760	288,022
China					202					202
Colombia	456	23,465	1,260							25,181
Denmark			791		15					806
Hong Kong			727		252					979
Italy					306	2,524				2,830
Japan			33,086		81,645					114,731
Lebanon						4,534				4,534
Netherlands					301	42,659			138	43,098
Norway		75			1,650	910	100		625	3,360
Panama		903								903
Switzerland					1,682		24			1,706
Union of South Africa				594	57,185	15,767	600	700	2,950	77,796
U. S. S. R.						16,075				16,075
United Kingdom		111		1,689	12,379	4,773	619	620	251	20,442
Other countries			53		290	32				375
Total	498	24,648	36,165	2,283	267,473	239,151	3,144	1,320	26,724	601,406

[1] On the basis of detailed information received by the Bureau of Mines from importers, certain items recorded by the U. S. Department of Commerce as "grain and nuggets," and "sponge and scrap" have been reclassified and included with other groups in this table.

[2] U. S. Department of Commerce categories are in terms of metal content. It is believed, however, that in many instances, gross weights are actually reported.

[3] Less than 0.5 troy ounce.

[4] Revised figure.

TABLE 8.—Platinum-group metals (unmanufactured) imported for consumption in the United States, 1950–51[1]

[U. S. Department of Commerce]

Material	1950		1951	
	Troy ounces	Value	Troy ounces	Value
Unrefined materials:[2]				
Ores and concentrates of platinum metals	628	$26,306	498	$44,555
Platinum grain and nuggets (including crude, dust, and residues)	35,793	2,071,135	24,648	1,958,891
Platinum sponge and scrap	[3] 8,888	[3] 568,852	36,165	3,104,587
Osmiridium	3,242	259,377	2,283	192,101
Total	[3] 48,551	[3] 2,925,670	63,594	5,300,134
Refined metals:				
Platinum	[3] 203,698	[3] 14,468,024	267,473	22,753,594
Palladium	147,173	2,971,191	239,151	4,796,263
Iridium	6,802	760,797	3,144	532,892
Osmium	1,517	253,028	1,320	285,745
Rhodium	13,152	1,404,877	20,665	2,195,944
Ruthenium	[3] 6,654	[3] 437,122	6,059	441,546
Total	[3] 378,996	[3] 20,295,039	537,812	31,005,984
Grand total	[3] 427,547	[3] 23,220,709	601,406	36,306,118

[1] On the basis of detailed information received by the Bureau of Mines from importers, certain items recorded by the U. S. Department of Commerce as "grain and nuggets," and "sponge and scrap" have been reclassified and included with other groups in this table.
[2] U. S. Department of Commerce categories are in terms of metal content. It is believed, however, that in many instances, gross weights are actually reported.
[3] Revised figure.

Exports.—Exports of refined platinum (including scrap) decreased to 8,760 ounces in 1951 from 12,753 ounces in 1950; exports of the other platinum-group metals (including scrap) rose to 52,088 ounces from 24,946 ounces. France was the largest buyer of platinum in 1951 taking 4,529 ounces, followed by Germany with 1,744 ounces. For the other platinum-group metals, Germany was the largest market, taking 35,866 ounces.

TABLE 9.—Platinum-group metals exported from the United States, 1947–51[1]

[U. S. Department of Commerce]

Year	Ore and concentrates		Platinum (bars, ingots, sheets, wire, sponge, and other forms, including scrap)		Palladium, rhodium, iridium, osmiridium, ruthenium and osmium (metal and alloys, including scrap)		Platinum-group manufactures, except jewelry	
	Troy ounces	Value	Troy ounces	Value	Troy ounces	Value	Troy ounces	Value
1947	42	$1,322	17,766	$977,468	7,783	$256,150	6,327	$335,797
1948	5	500	15,471	1,198,994	20,994	495,660	4,874	219,405
1949	165	1,985	18,150	1,379,976	22,628	745,349	20,702	452,824
1950	82	265	12,753	994,362	24,946	802,970	12,640	521,575
1951	732	117,500	8,760	834,985	52,088	1,355,514	17,348	932,085

[1] Quantities are gross weight.

TABLE 10.—Platinum-group metals exported from the United States, 1950–51, by countries [1]

[U. S. Department of Commerce]

Country	Platinum (bars, ingots, sheets, wire, sponge, and other forms, including scrap)		Palladium, rhodium, iridium, osmiridium, ruthenium and osmium (metal and alloys, including scrap)		Platinum-group manufactures, except jewelry	
	Troy ounces	Value	Troy ounces	Value	Troy ounces	Value
1950						
Argentina			539	$11,860		
Austria	341	$30,100	638	14,000		
Belgium-Luxembourg			838	18,971	1	$117
Brazil	193	15,615	6	1,647	89	7,759
Canada	402	35,245	227	26,589	11,862	478,537
Chile	20	2,098	91	6,178	21	1,730
Colombia	1	141	231	5,976	20	1,920
Cuba	668	40,991	120	2,829	13	849
Denmark	160	12,860				
France	2,918	263,140	32	6,352	79	3,477
Germany	6,010	433,269	18,763	585,020		
Hong Kong	130	5,524	198	13,881	2	146
Italy	64	4,210	272	14,762	12	278
Mexico	1,147	93,780	394	10,560	48	3,685
Philippines	17	1,183	30	853	56	1,880
Spain			456	11,383		
Switzerland	424	36,619	1,643	48,173	16	125
United Kingdom	2	100	204	17,619		
Venezuela	124	9,254	157	3,742	23	930
Other countries	132	10,233	107	2,575	398	20,142
Total	12,753	994,362	24,946	802,970	12,640	521,575
1951						
Argentina			623	16,175	6	775
Austria			2,000	44,000		
Belgium-Luxembourg	16	608	1,504	33,847		
Brazil	137	14,703	386	12,742	394	11,589
Canada	499	55,825	498	41,542	15,130	841,856
Chile	13	1,173			160	4,685
Colombia			95	2,527	67	3,594
Cuba	150	13,055	240	6,034	47	328
France	4,529	424,681	510	39,300	6	1,251
Germany	1,744	160,384	35,866	853,992		
Israel	1	109	740	16,374	12	1,198
Italy	(2)	1,067	2,796	79,639	1,016	34,315
Mexico	308	32,650	502	12,253	42	3,265
Netherlands	515	48,153	50	6,150		
Peru	4	356	22	645	26	2,967
Switzerland	557	56,145	401	8,967	78	6,055
United Kingdom	183	17,019	4,558	148,665	2	168
Uruguay			416	9,963	14	963
Venezuela	78	7,479	220	5,421	115	3,641
Other countries	26	1,578	661	17,278	233	15,435
Total	8,760	834,985	52,088	1,355,514	17,348	932,085

[1] Quantities are gross weight.
[2] Less than 0.5 troy ounce.

WORLD REVIEW

Canada.—Most of the output of platinum-group metals of Canada is obtained as a byproduct from the nickel-copper ores of the Sudbury district; a small quantity is recovered incident to gold-placer mining in British Columbia. According to the Dominion Bureau of Statistics, the total production of Canada in 1951 was 154,956 troy ounces of platinum and 162,480 ounces of other platinum-group metals; corresponding figures for 1950 were 124,571 ounces and 148,741 ounces.

Deliveries of platinum-group metals by The International Nickel Co. of Canada, Ltd., were 375,438 ounces in 1951 compared with 267,316 ounces in 1950.

Colombia.—The production of platinum-group metals of Colombia results from placer-mining operations in the Choco district, mostly by dredges. The crude material averages about 85 percent platinum-group metals. Figures for the output are difficult to obtain. The South American Gold & Platinum Co., which supplies most of the production, recovered 20,344 ounces of crude platinum-group metals in 1951 compared with 25,968 ounces in 1950.

TABLE 11.—World production of platinum-group metals, 1942–46 (average) and 1947–51, in troy ounces

[Compiled by Berenice B. Mitchell]

Country	1942–46 (average)	1947	1948	1949	1950	1951
Australia:						
New South Wales: Placer platinum	2					
Tasmania: Placer osmiridium	109	99	92	39	46	33
Belgian Congo: Palladium from refineries			209	106		
Canada:						
Platinum: Placer and from refining nickel-copper matte	[1] 198,490	94,570	121,404	153,784	[2] 124,571	154,956
Other platinum-group metals: From refining nickel-copper matte	[1] 193,549	110,332	148,343	182,233	[2] 148,741	162,480
Colombia: Placer platinum	38,113	41,415	40,047	20,797	26,445	32,000
Ethiopia: Placer platinum	616	[3] 1,548	[3] 460	[3] 355	([4])	[3] 60
Italy: Platinum from refineries	90					
Japan: Platinum from refineries			31	34	1,938	245
New Guinea				4		5
New Zealand: Placer platinum	8					8
Papua: Placer platinum [5]					([6])	2
Sierra Leone: Placer platinum	24	431	109	38		([4])
Union of South Africa:						
Platinum-group metals from platinum ores	75,097	23,332	22,549	30,500	144,217	190,898
Concentrates (platinum-group metal content) from platinum ores		55,508	46,374	56,800		
Osmiridium from gold ores	6,453	6,071	5,520	6,031	6,449	6,359
U. S. S. R.: Placer platinum and from refining nickel-copper ores (estimate)	150,000	150,000	125,000	100,000	100,000	100,000
United States: Placer platinum and from domestic gold and copper refining	33,701	18,406	19,253	24,807	37,855	36,951
Total (estimate)	[1] 700,000	500,000	525,000	575,000	[2] 600,000	675,000

[1] Includes adjustments in 1945 for metals produced in Canada in 1938–44 but not included in the statistics for those years.
[2] Revised figure.
[3] Exports for year ended Sept. 10 of year stated.
[4] Data not available; estimate included in total.
[5] Year ended June 30 of year stated.
[6] Less than 0.5 ounce.

Union of South Africa.—Platinum-group metals are obtained in the Union of South Africa from two sources—as an osmiridium byproduct from gold mining on the Rand and as the principal product of mining operations on the Merensky Reef, a horizon of the Bushveld igneous complex in the Transvaal. Detailed discussion of these two sources was included in the Minerals Yearbook, 1950, chapter on Platinum-Group Metals (pages 1032–1033).

The Rustenburg Platinum Mines, Ltd., has absorbed a number of former producers and in 1951, as in 1950, was the only concern mining on the Merensky Reef. This company announced plans in 1951 to expand its plant capacity from 75,000 tons of ore per month to 125,000 tons, reaching full production in 1953. At this scale, the indicated output of platinum-group metals is around 400,000 ounces annually.

During the last 15 years the average recovery of osmiridium on the Rand was somewhat over 0.10 ounce per 1,000 tons of gold ore milled.

Potash

By E. Robert Ruhlman and Gertrude E. Tucker

GENERAL SUMMARY

INCREASES in both domestic production and imports of potash materials made 1951 the record year, with a total supply of over 1.6 million tons of potash (K_2O) available for consumption. Sales of domestic marketable potassium salts rose 10 percent. Exports increased both in quantity and value. Apparent consumption and producers' stocks also increased.

TABLE 1.—Salient statistics of the potash industry in the United States, 1949–51

	1949	1950 [1]	1951
Production of potassium salts (marketable)..short tons..	2,056,609	2,242,647	2,474,870
Approximate equivalent K_2O ..do..	1,118,395	1,287,724	1,420,323
Sales of potassium salts by producers..do..	2,062,789	2,221,920	2,451,913
Approximate equivalent K_2O..do..	1,120,653	1,276,164	1,408,408
Value at plant	$35,105,799	$39,774,447	$44,788,880
Average per ton	$17.02	$17.90	$18.27
Imports of potash materials..short tons..	43,719	381,490	574,361
Approximate equivalent K_2O..do..	19,216	200,529	313,454
Value	$2,358,557	$13,993,974	$18,543,112
Exports of potash materials..short tons..	126,757	117,137	124,251
Approximate equivalent K_2O [2]..do..	69,558	65,047	68,674
Value	$7,110,835	$5,534,176	$7,601,646
Apparent consumption of potassium salts [3]..short tons..	1,979,751	2,486,273	2,902,023
Approximate equivalent K_2O..do..	1,070,311	1,411,646	1,653,188

[1] Revised figures except short tons and approximate K_2O equivalent of exports.
[2] Estimate by Bureau of Mines.
[3] Quantity sold by producers, plus imports, minus exports.

An article relating to the determination of potash [1] and an abstract of a paper presented at the Institute of Physics on microdetermination of Na and K were published in 1951.[2]

PRODUCTION AND SALES

The upward trend in the production of domestic marketable potassium salts continued in 1951. Both production and sales increased about 10 percent in quantity over 1950, and the value of the potassium salts sold in 1951 was 13 percent greater than in 1950. Production of potassium salts in 1951 totaled 2,474,870 short tons, with an equivalent K_2O content of 1,420,323 tons. Sales were 2,451,913 tons, with an equivalent K_2O content of 1,408,408 tons. Producers' stocks increased 22,957 tons during the year to a total of 62,597 tons on December 31, 1951. The total value of sales was $44.8 million in 1951. The average value per ton of potassium salts sold in 1951 was $18.27, compared with $17.90 (revised) in 1950.

[1] Friedmann, Hans, Potash Content by Geiger Counter: Eng. and Min. Jour., vol. 152, No. 10, October 1951, pp. 90–91 and 119.
[2] Keynes, R. D., Radioactive Tracers in Analysis: Microdetermination of Na and K by Activation Analysis: Chem. Age, vol. 54, No. 1665, June 9, 1951, pp. 876 and 884.

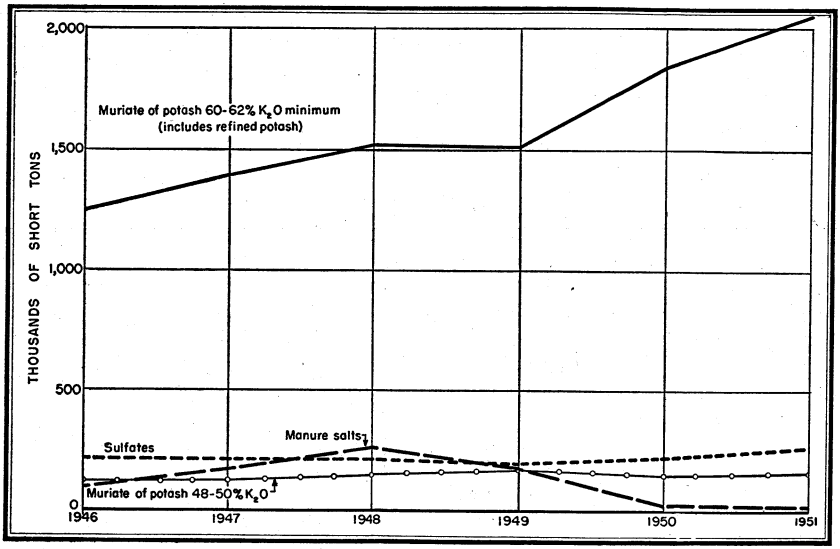

FIGURE 1.—Potassium salts produced in the United States, 1946–51, by grades.

TABLE 2.—Potassium salts produced in the United States, 1949–51, by grades, in short tons

Grade	1949	1950	1951
Muriate of potash:			
60–62 percent K_2O minimum [1]	1,513,128	[2] 1,846,459	2,047,793
48–50 percent K_2O minimum	172,475	151,547	155,797
Manure salts	177,315	21,532	19,775
Sulfate of potash and sulfate of potash-magnesia	193,691	223,109	251,505
Total	2,056,609	[2] 2,242,647	2,474,870

[1] Includes refined potash and some 93–96 percent KCl.
[2] Revised figure.

TABLE 3.—Potassium salts produced, sold, and in producers' stocks in the United States, 1947–51

Year	Production			Sales				Producers' stocks, Dec. 31	
	Operators	Potassium salts (short tons)	Equivalent potash (K_2O) (short tons)	Operators	Potassium salts (short tons)	Equivalent potash (K_2O) (short tons)	Value f. o. b. plant	Potassium salts (short tons)	Equivalent potash (K_2O) (short tons)
1947	7	1,905,776	1,029,875	7	1,953,307	1,053,266	$34,716,051	35,428	14,697
1948	7	2,138,493	1,139,881	7	2,148,807	1,143,339	35,998,758	25,093	11,211
1949	8	2,056,609	1,118,395	8	2,062,789	1,120,653	35,105,799	18,913	9,066
1950 [1]	7	2,242,647	1,287,724	7	2,221,920	1,276,164	39,774,447	39,640	20,620
1951	9	2,474,870	1,420,323	9	2,451,913	1,408,408	44,788,880	62,597	32,302

[1] All figures are revised except those for number of operators.

The production of both grades of muriate of potash (60–62 percent K_2O minimum and 48–50 percent K_2O minimum) increased in 1951 over 1950. Production of the higher-grade muriate rose 11 percent to a new high of 2,047,793 short tons, and the production of the lower-grade muriate rose 3 percent to 155,797 short tons. The production of manure salts dropped to 19,775 tons. The combined production of sulfate of potash and sulfate of potash-magnesia increased 13 percent in 1951 (as compared to 1950) to 251,505 tons.

California, New Mexico, and Utah supplied nearly all of the reported production of domestic marketable potassium salts, over 86 percent coming from the Permian deposits of southeastern New Mexico. A fourth company in the Carlsbad area, the Duval Sulphur & Potash Co., began production late in 1951.

The potash-producing companies in the United States in 1951, by States, were as follows:

California:
- The American Potash & Chemical Corp., 3030 W. 6th St., Los Angeles 54, Calif. (plant at Trona, on Searles Lake, Calif.).
- A. M. Blumer, 465 California St., San Francisco, Calif. (byproduct from Santa Cruz Cement Co., Davenport, Calif.).

Maryland:
- North American Cement Corporation, 41 East 42nd St., New York 17, N. Y. (plant at Security, Md.).

Michigan:
- The Dow Chemical Co., Midland, Mich. (brine wells and plant near Midland, Mich.).

New Mexico:
- Duval Sulphur & Potash Co., Mellie Esperson Bldg., Houston 2, Tex. (mine and plant near Carlsbad, N. Mex.).
- International Minerals & Chemical Corp., 20 N. Wacker Dr., Chicago, Ill. (mine and plant near Carlsbad, N. Mex.).
- Potash Company of America, Inc., Carlsbad, N. Mex. (mine and plant near Carlsbad, N. Mex.).
- United States Potash Co., Inc., 30 Rockefeller Plaza, New York 20, N. Y. (mine and plant near Carlsbad, N. Mex.).

Utah:
- Bonneville, Ltd., 540 West Seventh South, Salt Lake City 4, Utah (plant near Wendover, Utah).

REVIEW BY STATES

California.—The American Potash & Chemical Corp. continued to be the leading potash-producing company in California. Potassium chloride and potassium sulfate were marketed from a potash-bearing brine pumped from the crystalline salt mass of Searles Lake. In 1951 the Mathieson Chemical Corp. acquired the 25-percent interest in the American Potash & Chemical Corp. formerly held by the Heyden Chemical Corp.

A second producer of potassium compounds in California is A. M. Blumer of San Francisco. For many years his organization has been distributing potash-bearing agricultural lime. This material is portland cement flue dust and at present most of it is obtained from the Cottrell precipitators at the Davenport plant of the Santa Cruz Portland Cement Co. The material is largely lime in the form of calcium carbonate and calcium oxide. It contains variable amounts of potassium sulfate up to as much as 15 percent equivalent K_2O. No attempt is made to sort the material or to control the potash content.[3]

Maryland.—The North American Cement Corp., the only potash producer in Maryland, produced, as a byproduct, an impure low-

[3] California Journal of Mines and Geology, The Mineral Industry of California—Its Status and Relation to National Defense in 1950–51: Vol. 48, No. 1, January 1952, p. 117.

grade sulfate of potash at its cement plant at Security, Washington County, near Hagerstown. The product was sold for agricultural use.

Michigan.—The Dow Chemical Co. continued to produce potassium chloride from its brine wells at Midland. This was the only reported potash producer in Michigan in 1951.

New Mexico.—Mine production of crude potassium salts in the Carlsbad region of New Mexico reached a new high of over 6.6 million short tons, a 14-percent increase above 1950. The grade (K_2O equivalent) of the crude salts mined decreased in 1951 to 20.40 percent compared to 20.65 percent in 1950 and 21.00 percent in 1949. Production and sales of marketable salts both showed increases in 1951.

The four producing companies—Duval Sulphur & Potash Co., International Minerals & Chemical Corp., Potash Company of America, and the United States Potash Co.—mined sylvite ore (sylvinite), and International Minerals & Chemical Corp. also mined langbeinite. Most of the sylvite ore (potassium chloride) was processed to yield 60-percent or higher-grade muriate. The langbeinite was treated by the producer to yield potassium sulfate and potassium-magnesium sulfate.

An article published in 1951 described the stratigraphic and mineralogic relationships of the potash beds in New Mexico.[4]

TABLE 4.—Production and sales of potassium salts in New Mexico, 1947–51, in short tons

Year	Crude salts [1]		Marketable potassium salts				
	Mine production		Production		Sales		
	Gross weight	K_2O equivalent	Gross weight	K_2O equivalent	Gross weight	K_2O equivalent	Value
1947	4,655,732	965,583	1,625,870	866,070	1,659,266	880,605	$28,035,675
1948	5,108,372	1,069,675	1,841,054	964,940	1,850,976	967,945	29,177,328
1949	4,852,903	1,018,886	1,733,739	927,621	1,744,427	932,497	27,950,111
1950	5,802,004	1,198,021	1,904,565	1,086,996	1,878,094	1,072,772	31,944,365
1951	6,615,891	1,349,572	2,138,439	1,223,139	2,216,391	1,217,617	37,209,740

[1] Sylvite and langbeinite.

The Duval Sulphur & Potash Co. mine and plant were nearly completed in 1951, and preliminary production was begun. Full production was planned for early 1952.

Freeport Sulphur Co. continued exploration for potash in Eddy and Lea Counties approximately 32 miles east of Carlsbad. Additional diamond drilling was planned before any definite production program would be announced.

International Minerals & Chemical Corp. continued development of an extension of the present ore body. Sinking of the third shaft was completed, and a fourth shaft was begun. Both new shafts will be for ventilation and service. All ore will continue to be hoisted through No. 1 shaft. This new ore body is considerably larger than the original. In 1951, the corporation published a booklet describing its operations.[5]

[4] Dunlap, J. C., Geologic Studies in A New Mexico Potash Mine: Econ. Geol., vol. 46, No. 8, December 1951, pp. 909–923.

[5] International Minerals & Chemical Corp., Potash Div.: Potash—An Essential Mineral: 1951, 43 pp.

The new plant of the Potash Company of America at Dumas, Tex., was put into operation early in 1951, using potassium chloride from the company mines in the Carlsbad region to produce potassium sulfate and hydrochloric acid. At the Carlsbad plant improvements included expansion of the flotation section of the mill, increases in capacity of the steam and electric plants, expansion of the chemical-grade KCl plant, and installation of two Joy continuous miners. The new shaft in which a freezing method was being used to consolidate the quicksands and to prevent water inflow during sinking, reached a depth of 700 feet at the end of 1951. Total depth was to be 800 feet. A description of the sinking method was published.[6]

The Southwest Potash Corp., a wholly-owned subsidiary of the American Metal Co., Ltd., continued construction of its surface plant and development of the mine. At the end of 1951, the overall project was about 65 percent completed. Production was scheduled to begin in August 1952.[7]

In 1951, the United States Potash Co. began a 3-year program of construction and expansion. The major projects included construction of a new office building in Carlsbad, installation of additional equipment in the refinery, and sinking of a new shaft nearly 6 miles northeast of the No. 1 shaft. This new shaft, for ventilation and the transportation of men and supplies, was to be 15 feet in diameter and 1,300 feet deep. New equipment put into service during the year included several Diesel-powered items, radio telephones for better communication, additional ventilation fans, a new hoist at the No. 2 shaft, and other equipment to improve the operations and to protect the health and safety of the men.

Utah.—Bonneville, Ltd., the only reported producer of potash in Utah in 1951, continued to produce potassium chloride at its plant near Wendover, Tooele County, from the brines of Salduro Marsh. The company reported completion of 8 more wells to recover brine from about 1,200 feet below the surface. Other improvements included additional electrical capacity and equipment and 3 more Diesel caterpillar 20-ton wagons used to haul the potash salts to the mill.

The Kalunite plant in Salt Lake City was acquired by Vitro Chemical Co., from J. R. Simplot for use as a uranium and vanadium refinery.[8]

CONSUMPTION

The apparent consumption (producers' sales plus imports minus exports) of potash (K_2O) rose over 17 percent in 1951 to 1,653,188 short tons of K_2O as compared with 1950. The apparent consumption and sales of domestic producers as reported to the Bureau of Mines are shown in figure 2. The sales of domestic potash (K_2O) were 85 percent of apparent consumption in 1951 compared with 90 percent in 1950.

[6] Haworth, Russell G., Apply Freezing Method in Potash Field: Min. Cong. Jour., vol. 38, No. 2, January 1952, pp. 26–29.
[7] American Metal Co., Ltd., annual report for the 64th year, ended December 31, 1951: 49 pp.
[8] Engineering and Mining Journal, vol. 152, No. 2, February 1951, p. 163.

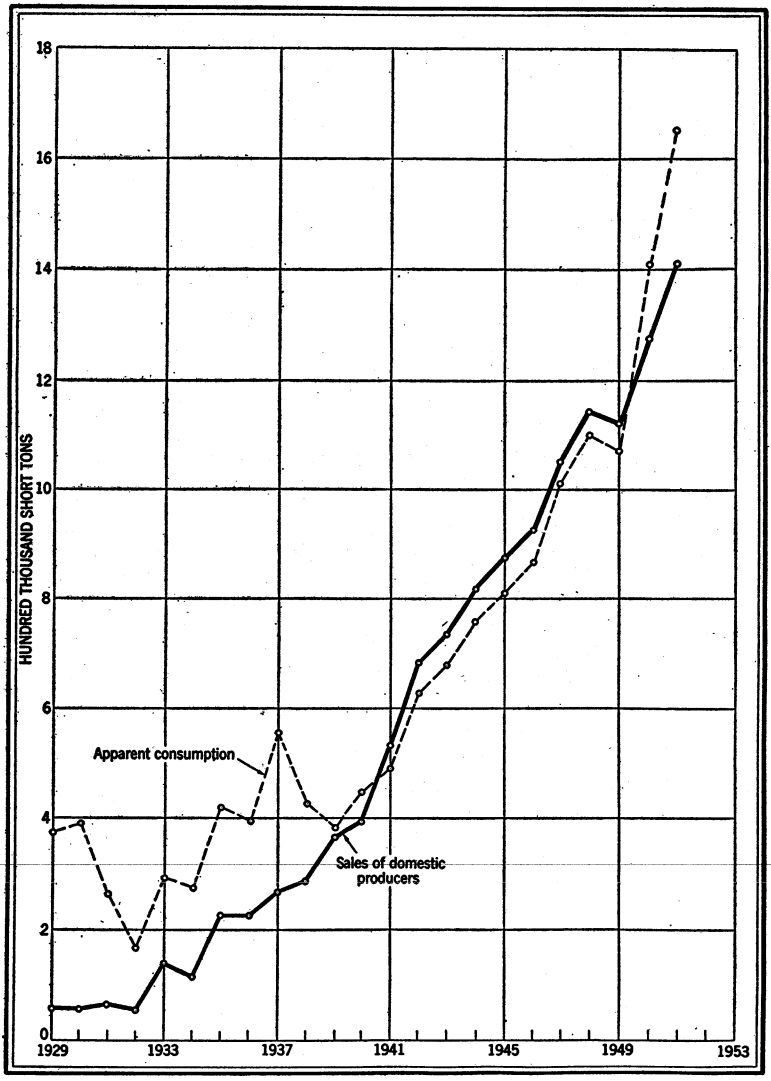

FIGURE 2.—Comparison of apparent domestic consumption of potash (K_2O) and sales of domestic producers of potash in the United States, 1929–51.

TABLE 5.—Apparent consumption [1] of potash in the United States, 1946–51, in short tons

Year	Potassium salts	Approximate equivalent K_2O	Year	Potassium salts	Approximate equivalent K_2O
1946	1,568,721	867,096	1949	1,979,751	1,070,311
1947	1,879,441	1,011,142	1950 [2]	2,486,273	1,411,646
1948	2,073,629	1,100,787	1951	2,902,023	1,653,188

[1] Quantity sold by producers, plus imports, minus exports.
[2] Revised figures.

According to the American Potash Institute (press notice, March 17, 1952):

Deliveries of potash in North America again made a new record in 1951, amounting to 3,004,666 tons of salts containing an equivalent of 1,707,525 tons K_2O. This was an increase of 241,926 tons K_2O or 17 percent over 1950. Deliveries by the five leading domestic producers were the highest ever achieved, 1,382,408 tons K_2O. Imports were 325,117 tons K_2O, also a record high.

Deliveries for agricultural purposes in the continental United States for 1951 were 1,490,178 tons K_2O, an increase of 226,059 tons over 1950. Canada received 60,792 tons K_2O, Cuba 14,876 tons, Puerto Rico 27,766 tons, and Hawaii 14,214 tons. Exports to other countries amounted to 12,270 tons K_2O.

In this country the potash was delivered in 45 States and the District of Columbia. Illinois and Ohio with over 120,000 tons K_2O were the leading States in deliveries of agricultural potash and were followed in order by Georgia, Virginia, North Carolina, Florida, and Indiana, each taking more than 90,000 tons K_2O during the year. Due to shipments across State lines, consumption does not necessarily correspond to deliveries within a State.

The 60 percent muriate of potash continues to be by far the most popular material, comprising 76 percent of the total K_2O delivered for agricultural purposes. The 50 percent muriate of potash made up 15 percent, manure salts less than 1 percent, and sulfate of potash and sulfate of potash-magnesia 8 percent of deliveries.

Deliveries for chemical purposes in 1951 were 131,359 tons of muriate of potash containing an equivalent of 82,512 tons K_2O and 9,761 tons of sulfate of potash containing 4,916 tons K_2O. The total chemical deliveries of 87,429 tons K_2O were 7,082 tons or 9 percent more than in 1950.

Deliveries of agricultural and chemical potash in North America from 1941 to 1951 are shown in figure 3.

TABLE 6.—Deliveries of potash salts in 1951, by State of destination, in short tons of K_2O

[American Potash Institute]

State	Agricultural potash	Chemical potash	State	Agricultural potash	Chemical potash
Alabama	68,563		Nebraska	949	
Arizona	371		Nevada		3,401
Arkansas	39,341		New Hampshire	52	90
California	16,918	4,094	New Jersey	21,485	2,606
Colorado	867		New Mexico	76	
Connecticut	4,277	81	New York	37,249	55,365
Delaware	4,726	599	North Carolina	95,683	
District of Columbia	121		North Dakota	1,544	
Florida	92,802		Ohio	121,976	3,022
Georgia	117,592	175	Oklahoma	2,784	327
Idaho	271		Oregon	3,206	415
Illinois	136,783	1,632	Pennsylvania	27,054	704
Indiana	90,093	60	Rhode Island	1,271	
Iowa	21,855	597	South Carolina	68,273	
Kansas	1,887	366	Tennessee	53,541	800
Kentucky	21,640		Texas	27,512	3,930
Louisiana	38,202		Utah	396	61
Maine	10,336	13	Vermont	632	
Maryland	88,272	1,561	Virginia	100,617	683
Massachusetts	16,781	156	Washington	3,623	
Michigan	27,628	945	West Virginia	767	4,941
Minnesota	27,721		Wisconsin	37,797	
Mississippi	32,611				
Missouri	23,819	291	Total	1,490,178	86,915
Montana	214				

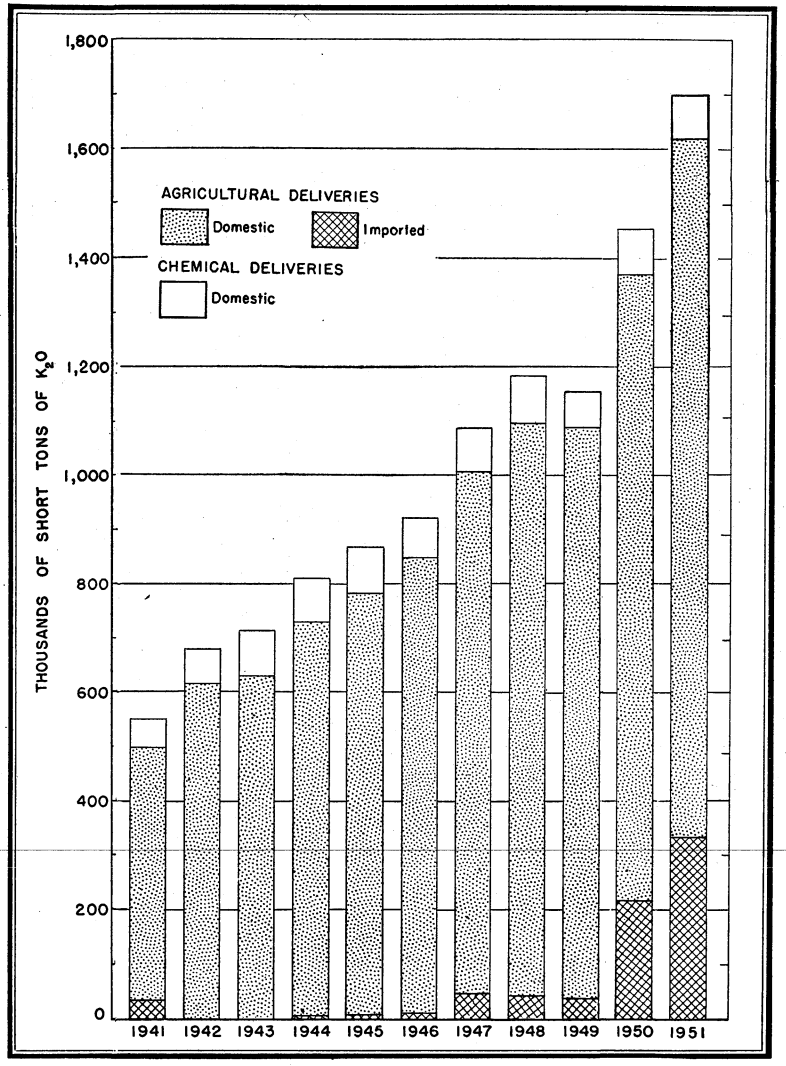

FIGURE 3. Potash deliveries in North America, 1941–51, by use group (American Potash Institute).

STOCKS

In 1951, as in 1950, stocks in producers' hands increased. The trend since 1926 is presented graphically in figure 4; data for 1947–51 are given in table 3.

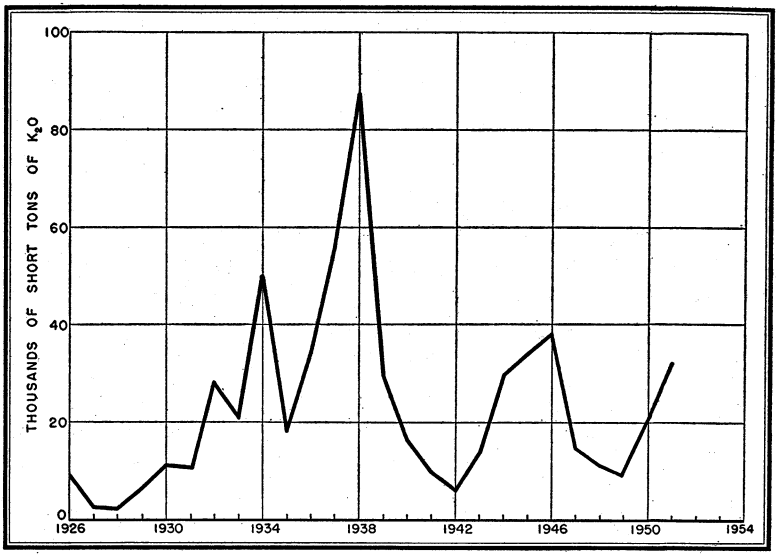

FIGURE 4.—Producers' stocks of potassium salts at end of year, 1926–51, in short tons of equivalent potash (K_2O).

PRICES

Prices for agricultural grade potash were frozen by GCPR (General Ceiling Price Regulation—issued by the Office of Price Stabilization) at the highest price charged during the base period of December 19, 1950–January 25, 1951. Potash prices in the early months of 1951 were the same as those listed in the producers' price schedules for the 1950–51 season. Supplementary Regulation 59 to GCPR, effective September 15, established ceiling prices for muriate of potash as follows:

Shipping point:	*Ceiling per unit (20 lb.)*
Carlsbad, N. Mex	$0.42
Wendover, Utah	.42
Trona, Calif	.505

The American Potash & Chemical Corp. issued its price schedule on May 15, 1951, for agricultural-grade Trona potash for the 1951–52 season. Its list price for muriate of potash 60 percent K_2O minimum, f. o. b. Trona, Calif., bulk in carlots of not less than 40 tons, was 50.5 cents per unit K_2O and for sulfate of potash 95–98 percent K_2SO_4 was 86 cents per unit K_2O. The list prices of both muriate and sulfate were subject to seasonal discounts. There were additional charges for shipments in bags.

The New Mexico producers' price schedules of agricultural-grade potash for the 1951–52 season, issued during April, May and June, 1951, are shown in table 7.

TABLE 7.—Prices of agricultural potash quoted by producers, f. o. b. Carlsbad, N. Mex., for 1951–52 season [1]

Salt	Grade	Brand	Producer	Price	
				Period	Per unit K_2O
Muriate of potash	62–63 percent K_2O	Sunshine State	U. S. P.	June 1–May 31	$0.42
Do	60 percent K_2O minimum, standard.	Red Muriate	P. C. A.	May 29–Sept. 15	.425
				Sept. 15–May 31	.42
Do	60 percent K_2O minimum	International	I. M. & C.	June 1–May 31	.42.
Do	60 percent K_2O minimum, granular.	Red Muriate	P. C. A.	May 29–Sept. 15	.44
				Sept. 15–May 31	.435
Do	48–52 percent K_2O granular.	Sunshine State	U. S. P.	June 1–May 31	.42
Do [2]	50 percent K_2O minimum	International	I. M. & C.	June 1–May 31	.42
Manure salts	22 percent K_2O minimum	Red Muriate	P. C. A.	May 29–May 31	.21
Do	Run-of-mine 20 percent K_2O minimum.	Sunshine State	U. S. P.	June 1–May 31	.21
Sulfate of potash	48.6 percent K_2O minimum.	International	I. M. & C.	June 1–May 31	.745
Sulfate of potash-magnesia.	Basis 40 percent K_2SO_4, 18% MgO.	International Sulpho-mag.	do	June 1–May 31	[3] 16.00

[1] Bulk in carlots (minimum 40 tons). Subject to seasonal discounts.
[2] International Minerals & Chemical Corp. quoted muriate of potash, 50–51 percent K_2O, packed in 5-ply plain paper bags, 100 pounds each, at $25.75 per short ton June 1–May 31.
[3] Per short ton.

FOREIGN TRADE [9]

Imports.—Total imports of potash salts increased over 50 percent in 1951 over 1950, the highest reported since 1938, rising from 381,490 short tons (200,529 tons K_2O) in 1950 to 574,361 tons (313,454 tons K_2O) in 1951. This was due entirely to a large increase in the arrivals of potassium-bearing fertilizer materials. The total value of imports rose over 4½ million dollars to $18,543,112 in 1951. Germany, Spain, and France supplied 65, 17, and 10 percent, respectively, of the potash imports in 1951.

Potash for fertilizer use constituted 98 percent of the total K_2O imports in 1951 and for chemical use 2 percent.

The average K_2O content of potash imports increased from 52½ to 54½ percent in 1951 as compared to 1950. Muriate (chloride), the principal potassium salt imported in 1951, came mainly from Germany, Spain, and France, with minor amounts from Belgium-Luxembourg and Poland-Danzig. Germany supplied substantial amounts of potassium sulfate and carbonate, 45,917 and 1,605 short tons, respectively. Imports of crude sodium-potassium nitrate from Chile were 73 percent less than in 1950.

[9] Figures on imports and exports compiled by M. B. Price and E. D. Page of the Bureau of Mines, from records of the U. S. Department of Commerce.

TABLE 8.—Potash materials imported for consumption in the United States, 1950–51

[U. S. Department of Commerce]

Material	Approximate equivalent as potash (K_2O) (percent)	1950				1951			
		Short tons	Approximate equivalent as potash (K_2O)		Value	Short tons	Approximate equivalent as potash (K_2O)		Value
			Short tons	Percent of total			Short tons	Percent of total	
Used chiefly in fertilizers:									
Muriate (chloride)	56.4	[1] 297,769	[1] 167,942	83.8	$9,244,446	492,632	277,844	88.6	$12,696,703
Potassium nitrate, crude	40.0	20	9	-------	2,465	6,453	2,581	.8	291,276
Potassium-sodium nitrate mixtures, crude	14.0	20,409	2,857	1.4	882,582	8,249	1,155	.4	336,783
Potassium sulfate, crude	50.0	44,125	22,063	11.0	1,558,465	52,355	26,178	8.4	1,716,730
Other potash fertilizer material	6.0	2,645	1,055	.5	84,000	-------	-------	------	----------
Total fertilizer	-------	[1] 364,968	[1] 193,926	96.7	11,771,958	559,689	307,758	98.2	15,041,492
Used chiefly in chemical industries:									
Bicarbonate	46.0	42	19	3.3	5,994	55	25	1.8	13,585
Bitartrate:									
Argols	20.0	7,980	1,596		613,031	7,635	1,527		1,178,031
Cream of tartar	25.0	465	116		130,837	707	177		337,883
Carbonate	61.0	[1] 5,266	[1] 3,212		600,999	2,226	1,358		294,187
Caustic	80.0	813	650		143,758	1,645	1,316		355,214
Chlorate and perchlorate	36.0	343	123		52,541	369	133		96,532
Chromate and dichromate	40.0	149	60		28,683	59	24		11,811
Cyanide	70.0	713	499		467,985	935	655		793,995
Ferricyanide	42.0	94	39		61,528	271	114		245,768
Ferrocyanide	44.0	7	3		1,903	9	4		4,192
Nitrate	46.0	175	81		18,357	117	54		15,460
Permanganate	29.0	145	42		29,568	62	18		18,396
Rochelle salts	22.0	9	2		4,508	-------	-------		----------
All other	50.0	[1] 321	161		[1] 62,324	582	291		136,566
Total chemical	-------	[1] 16,522	[1] 6,603	3.3	[1] 2,222,016	14,672	5,696	1.8	3,501,620
Grand total	-------	[1] 381,490	[1] 200,529	100.0	[1] 13,993,974	574,361	313,454	100.0	18,543,112

[1] Revised figure.

TABLE 9.—Potash materials imported for consumption in the United States, 1950–51, by countries, in short tons

[Figures in parentheses in column headings indicate, in percent, approximate equivalent as potash (K_2O)]

[U. S. Department of Commerce]

Country	Bitartrate		Carbonate	Caustic hydroxide	Chlorate and perchlorate	Cyanide	Muriate (chloride)	Potassium nitrate, crude	Potassium sodium nitrate mixtures, crude	Potassium sulfate, crude	All other [1]	Total	
	Argols or wine lees	Cream of tartar										Short tons	Value
	(20)	(25)	(61)	(80)	(36)	(70)	(56.4)	(40)	(14)	(50)			
1950													
Algeria	1,900											1,900	$135,337
Belgium-Luxembourg			55	66			250				99	470	56,923
Canada				23	6		49				9	87	13,396
Chile					25				20,409			20,434	888,111
China			4					(2)				4	1,862
Czechoslovakia				1		154					133	288	111,827
France	2,017	3	186	11		39	58,703	20		2,523	32	63,534	2,171,130
French Morocco	118											118	7,379
Germany			[3] 4,773	463		307	[3] 139,240			40,598	3,029	[3] 188,410	6,403,379
Italy	1,725	190									1	1,916	178,000
Japan											(2)	(2)	100
Lebanon							1,003					1,003	35,964
Netherlands			28			3	110				52	193	36,716
Norway											1	1	[3] 1,851
Poland-Danzig				110			31,540			904		32,554	1,011,500
Portugal	802											802	61,170
Spain		272					49,000					49,272	1,868,411
Sweden			220	139							[3] 164	[3] 523	97,161
Switzerland					312	(2)						312	45,793
Tunisia	1,418											1,418	86,104
U. S. S. R.							17,874			100		17,974	605,502
United Kingdom			(2)			210					67	277	176,358
Total	7,980	465	[3] 5,266	813	343	713	[3] 297,769	20	20,409	44,125	[3] 3,587	[3] 381,490	[3] 13,993,974
1951													
Algeria	2,000											2,000	290,315
Belgium-Luxembourg				298		1	11,957			1,600	50	13,906	536,253
Canada					5		144	5	3		1	158	10,292
Chile	347							6,392	5,566			12,305	597,677
China			(2)					(2)				(2)	63
Czechoslovakia				1							124	125	100,976
Ecuador							340					340	13,905
France	970	55	495	252	28	16	54,309			2,898	170	59,193	2,124,040
French Morocco	223											223	40,790
Germany			1,605	657		625	320,392	56	2,680	45,917	477	372,409	10,420,207
Hong Kong			1									1	287
Italy	1,720	317				6					24	2,067	420,913
Japan											6	6	2,433
Netherlands			125	220							136	481	165,570
Norway											(2)	(2)	995
Peru	5											5	1,350
Poland-Danzig							9,815			1,940		11,755	303,003
Portugal	1,845	2										1,847	320,554
Spain		305					94,573					94,878	2,645,664
Sweden				217							99	316	106,851
Switzerland					336						16	352	88,429
Tunisia	525											525	67,229
United Kingdom		28				287	1,102				52	1,469	285,216
Total	7,635	707	2,226	1,645	369	935	492,632	6,453	8,249	52,355	1,155	574,361	18,543,112

[1] Approximate equivalent as potash (K_2O)—1950: 36 percent (revised); 1951: 42 percent.
[2] Less than 0.5 ton.
[3] Revised figure.

Exports.—Potash materials exported from the United States in 1951 rose 6 percent in quantity and 37 percent in value over 1950, with both fertilizer and chemical grades showing increases. Canada, Brazil, and Cuba received 94 percent of the 109,139 short tons of the fertilizer potash exported in 1951, with smaller amounts going mainly to countries in the Western Hemisphere. The exports of chemical potash materials (15,112 tons) containing 7,556 tons of K_2O were widely distributed, Canada, Brazil, Sweden, and Mexico being the leading recipients.

TABLE 10.—Potash materials exported from the United States, 1947–51

[U. S. Department of Commerce]

Year	Fertilizer		Chemical		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1947	102,939	$3,251,645	21,970	$5,434,462	124,909	$8,686,107
1948	104,176	3,498,240	23,892	4,790,715	128,068	8,288,955
1949	111,156	3,818,006	15,601	3,292,829	126,757	7,110,835
1950	107,972	3,813,000	9,165	[1] 1,721,176	117,137	[1] 5,534,176
1951	109,139	4,023,434	15,112	3,578,212	124,251	7,601,646

[1] Revised figure.

TABLE 11.—Potash materials exported from the United States, 1950–51, by country of destination

[U. S. Department of Commerce]

Country	Fertilizer				Chemical			
	1950		1951		1950		1951	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Argentina					13	$5,806	683	$274,285
Australia					6	5,476	77	23,006
Austria					9	4,155	4	1,822
Barbados	2,131	$91,502						
Belgium-Luxembourg					155	23,606	380	102,156
Brazil	13,349	603,362	16,707	$865,867	2,161	379,782	2,655	737,464
Canada	66,440	2,175,405	75,997	2,539,273	2,960	392,500	3,671	603,455
Chile					51	16,719	95	27,160
China					160	[1] 32,562		
Colombia	2,073	76,197	111	6,920	568	129,704	355	100,352
Costa Rica	600	22,000	545	23,448	50	13,617	29	9,238
Cuba	16,514	592,870	9,678	333,937	253	65,025	269	79,895
Dominican Republic	645	29,112	581	21,650	3	1,170	5	1,216
Ecuador	51	2,797	50	2,950	17	4,509	33	9,709
El Salvador	250	11,068	235	11,522	41	10,690	27	10,445
France							288	136,800
Greece					7	3,101	116	25,685
Guatemala	20	1,213	17	494	89	22,076	115	28,991
Hong Kong					139	27,457	5	1,211
India					141	42,888	267	81,571
Italy					96	20,616	464	85,278
Leeward Islands	573	25,567	22	942			1	498
Mexico	3,986	136,923	2,798	106,914	1,222	294,468	1,052	298,588
Netherlands							61	17,845
New Zealand					2	343	117	21,660
Norway					7	2,702	16	5,148
Pakistan					6	4,734	51	24,747
Peru			20	1,147	39	10,302	67	24,153
Philippines	1,034	31,403	766	32,437	89	32,209	248	65,729
Portugal					1	885	30	6,544
Sweden			165	7,484	330	15,532	1,485	65,922
Switzerland			5	285	52	13,244	113	28,663
Turkey							231	45,423
Union of South Africa					16	9,847	297	91,679
United Kingdom					3	4,612	512	187,811
Uruguay	168	6,827	661	26,575	34	6,850	548	115,798
Venezuela	115	5,523	722	37,799	126	36,248	200	62,879
Yugoslavia					4	5,171	127	24,026
Other countries	23	1,231	59	3,790	315	82,570	418	151,360
Total	107,972	3,813,000	109,139	4,023,434	9,165	[1] 1,721,176	15,112	3,578,212

[1] Revised figure.

WORLD REVIEW

Available statistics of potash output in the various producing countries, as well as estimated totals of world production, are shown in table 12.

Canada.—Western Potash Corp., Ltd., has the potash mineral rights to 120,000 acres—100,000 acres of crown land and 20,000 of Canadian Pacific Railroad lands—in the Unity district, Saskatchewan. The company has done considerable research work on brining methods of extracting the potash, which is over 4,000 feet below the surface. Continued drilling has shown that the potash beds are about 11 feet thick and extend over 12 miles. The lateral extent of the beds was not known by the close of 1951.

France.—Modernization of the potash mines and plants under the Monnet plan, as announced in 1946, was progressing ahead of schedule. Modernization and replacement of mining equipment had increased the mine output per man per day to approximately 6 metric tons. Refinery modernization and expansion were not completed by the end of 1951.

The marketing of all French potash was controlled by the Société Commerciale des Potasses d'Alsace. In general, potash was sold abroad for "what the market will bear." [10]

Germany (Western).—Expansion of potash production through rehabilitation of existing facilities and development of new deposits again made West Germany one of the leading producers in 1951, with a reported output exceeding 1 million metric tons of K_2O. Operations at the Königshall-Hindenburg mine and the mine at Bokeloh were resumed. At the former, high-grade salts containing 25 percent to 27 percent K_2O were found.[11]

A new shaft was being sunk at Buggingen, Baden, on the east bank of the Rhine, searching for a possible extension of the French deposits in Alsace.

Limited coal supplies seriously hampered further expansion.

Israel and Jordan.—The plant of the Palestine Potash, Ltd., at the south end of the Dead Sea, remained idle pending completion of the road from the plant to Beersheba. Production was scheduled to resume late in 1952. The problems of obtaining enough fresh water and securing foreign capital were serious handicaps to the company.[12]

[10] Bureau of Mines, Mineral Trade Notes: Vol. 33, No. 2, August 1951, p. 32.
[11] Chemical and Engineering News, German Potash Production to be Raised Further: Vol. 29, No. 44, Oct. 29, 1951, p. 4614.
[12] Oil, Paint and Drug Reporter, Palestine Potash, Ltd., Plan to Resume Output Stymied: Vol. 160, No. 4, July 23, 1951, p. 45.

TABLE 12.—World production of potassium salts and equivalent K_2O, 1946–51, by countries, in metric tons [1]

[Compiled by Helen L. Hunt]

Country [1]	1946		1947		1948		1949		1950		1951	
	Potassium salts	Equivalent K_2O	Potassium salts	Equivalent K_2O	Potassium salts	Equivalent K_2O	Potassium salts	Equivalent K_2O	Potassium salts	Equivalent K_2O	Potassium salts	Equivalent K_2O
North America: United States	1,531,079	845,321	1,728,882	934,282	1,939,998	1,034,077	1,865,715	1,014,586	[2] 2,034,485	[2] 1,168,197	2,245,153	1,288,489
South America: Chile			3,259	900	6,655	1,913	5,020	1,422	(3)	1,442	(3)	(3)
Europe:												
France (Alsace)	3,558,760	574,495	4,168,725	632,844	[2] 4,480,268	[2] 683,585	[2] 4,956,000	896,000	5,562,000	1,017,800	5,518,800	987,600
Germany:												
West Germany	2,648,842	288,558	3,455,586	342,409	5,276,348	538,507	7,290,000	[2] 748,800	8,926,700	911,600	10,835,000	1,280,000
East Germany	(3)	658,600	(3)	[4] 720,000	(3)	[4] 823,000	(3)	(3)	(3)	(3)	(3)	(3)
Spain	[2] 793,320	136,541	[2] 917,865	195,892	992,743	151,185	918,156	137,700	[2] 1,013,333	152,000	1,084,609	190,000
Asia:												
China	(3)	(3)	1,000	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)
India	[5] 3,512	[5] 1,727	4,211	2,032	3,020	2,540	6,456	3,048	(3)	(3)	(3)	(3)
Israel-Jordan [6]	90,571	45,300	123,163	[2] 60,330	[7] 9,724	[7] 5,834						
Japan			2,259	(3)	1,984	(3)	3,544	213	3,396	203	(3)	(3)
Africa: Eritrea					115	(3)	420	203	555	264		
Australia:												
New South Wales	727	54	406	30	712	53	436	33	406	30	[4] 350	[4] 25
Western Australia	35,700	529	34,882	572	39,759	652	32,782	1,471	919	84	(3)	(3)
Total (estimated)		2,700,000		3,000,000		3,500,000		4,000,000		4,400,000		4,800,000

[1] In addition to countries listed, Ethiopia, Italy, Korea, and U. S. S. R. are reported to produce potash salts, but statistics of production are not available; estimates by senior author of chapter included in total.
[2] Revised figure.
[3] Data not available; estimate by author of chapter included in total.
[4] Estimate.
[5] Exports plus consumption.
[6] Production in fiscal year ended June 30 of year stated. 1946–48 is for Palestine. Extracted from waters of Dead Sea.
[7] Production ceased April 1948 when the Palestine Potash, Ltd., plant was damaged during hostilities.

Spain.—Plans for the construction of a plant to produce polyvinyl chloride and caustic potash in Mondoz were announced by Etino-Quimica S. A. The chloride was to be used by the company in manufacturing plastics and the potash exported as potassium hydroxide.[13]

According to the National Industrial Plan, as announced by the Ministry of Industry and Commerce in January 1950, the Potasas de Navarra, Pamplona, Province of Navarra, was scheduled to begin exploration for new potash deposits during the second half of 1951.[14]

United Kingdom.—British Potash Development Co., Ltd., was formed in 1951 to "develop, extend and carry on the winning of potassium, sodium and magnesium salts and other minerals, metals, lodes, ores and other raw materials, etc.," especially the potash deposits discovered by the work of Imperial Chemical Industries, Ltd., Fisons, Ltd., and the Anglo-Iranian Oil Group, in the North Riding district of Yorkshire.[15]

In the past the United Kingdom has depended upon foreign sources for all its requirements of potash. The Yorkshire deposits, when developed, would save the country about 7 million pounds sterling a year.

These deposits were described in the Potash chapter of Minerals Yearbook, 1950 (p. 1051).

[13] Chemical and Engineering News, Spain to Have New Polyvinyl Chloride and Potash Plant: Vol. 29, No. 5, Feb. 5, 1951, p. 482.
[14] Bureau of Mines, Mineral Trade Notes: Vol. 32, No. 5, May 1951, p. 58.
[15] Chemical and Engineering News, Potash Production Company Formed in Britain: Vol. 29, No. 6, Feb. 5, 1951, p. 482.

Salines—Miscellaneous

By Joseph C. Arundale and F. M. Barsigian [1]

GENERAL SUMMARY

THE HIGH LEVEL of industrial activity during 1951 was reflected in record sales of many of the miscellaneous salines—calcium chloride, bromine, soda ash, salt cake, and borax. Some shortages in these basic raw materials were reported early in 1951, but by the end of the year expanded production facilities and a leveling in demand put supply and demand almost in balance.

CALCIUM CHLORIDE

Sales of calcium chloride recovered from natural brines in 1951 exceeded those in any previous year. Stabilization of dirt-road surfaces and dust control continued as the most important use. The role of calcium chloride in the construction and maintenance of roads was discussed in several articles.[2] In these articles it was concluded that the extent and cost of maintenance of gravel-surfaced roads can be reduced, with the added advantage of dust palliation. Several examples of procedures for applying calcium chloride were also outlined.

TABLE 1.—Calcium chloride and calcium-magnesium chloride from natural brines sold by producers in the United States, 1946–51

[In terms of 75 percent (Ca, Mg) Cl_2]

Year	Short tons	Value	Year	Short tons	Value
1946	262,147	$2,278,954	1949	255,797	$3,260,675
1947	271,206	2,650,205	1950	299,821	3,801,508
1948	309,660	3,906,858	1951	328,042	4,756,242

Certain precautions are necessary in producing ready-mixed concrete during cold weather to assure adequate strength. Heating the ingredients and adding an accelerator is a method which has been used. Calcium chloride as the accelerator or as an ingredient of accelerators is sometimes used. Suggested procedures, where the use of such material is indicated, have been published.[3]

[1] Figures on imports and exports compiled by M. B. Price and E. D. Page, of the Bureau of Mines, from records of the U. S. Department of Commerce.

[2] American Road Builders' Association, Construction and Maintenance of Local Rural Roads: Tech. Bull. 180, 1951, 22 pp.
Kling, George, Construction and Maintenance of Roads: Constructioneer, June 18, 1951, pp. 30–31.
Calcium Chloride Association News; Loudoun County, Va. Improves Secondary Roads: April 1951, pp. 3–4, 9.

[3] National Ready Mixed Concrete Association, Cold-Weather Ready-Mixed Concrete: Washington, D. C., January 1951, 14 pp.
Calcium Chloride Institute News, Cold-Weather Concreting: December 1951, pp. 3–4.

TABLE 2.—Calcium chloride imported for consumption in and exported from the United States, 1947–51

[U. S. Department of Commerce

Year	Imports		Exports	
	Short tons	Value	Short tons	Value
1947	250	$5,514	11,955	$502,818
1948	5	249	11,456	437,763
1949	(1)	20	21,094	507,845
1950	1,881	54,170	15,624	[2] 403,230
1951	813	37,451	18,637	559,284

[1] Less than 0.5 ton.
[2] Revised figure.

Another important use for calcium chloride is in "freeze-proofing" coal, iron ore, and other materials shipped in bulk in railroad cars or stockpiled in the open. It is often sprayed in solution on the ore but in some instances is applied in flake form. Equipment and procedures were described.[4]

The following companies produced calcium chloride (and calcium magnesium chloride) from natural brines in 1951: California Rock Salt Co., 2436 Hunter St., Los Angeles 21, Calif., plant at Amboy, Calif.; Hill Bros. Chemical Co., 2159 Bay St., Los Angeles 21, Calif., plant at Amboy Calif.; Michigan Chemical Corp., 500 N. Bankson St., St. Louis, Mich.; Dow Chemical Co., Midland, Mich.; Pomeroy Salt Corp., Pomeroy, Ohio, plant at Minersville, Ohio; Westvaco Chemical Division, Food Machinery & Chemical Corp., South Charleston 3, W. Va.; Wilkinson Chemical Co., Mayville, Mich.; and National Chloride Co. of America, 354 S. Spring St., Los Angeles 13, Calif., plant at Amboy, Calif.

According to Oil, Paint and Drug Reporter, the prices for calcium chloride were unchanged throughout 1951: Flake, 77–80 percent, paper bags, carlots, works, freight equalized, $25 per ton; liquor, same basis, 40 percent, tank cars, $10.50 per ton; pellets, bags, carlots, works, $31.25 per ton; solid, 73–75 percent, drums, carlots, freight equalized, $23.50 per ton.

BROMINE

Sales of bromine and bromine compounds during 1951 were at the highest level in history. At the end of World War II, sales dropped drastically and then began a steady increase. The principal use for bromine is as ethylene dibromide in gasoline antiknock additive. The number of automobiles on the Nation's highways is increasing each year, and motorists are demanding more and better gasoline. This, in turn, is increasing the demand for antiknock fluid. Expanding airplane production and air-miles flown are increasing the quantity of high-grade gasoline being burned. More bromine is being used in fumigating soils, grains and other foods, and food-processing equipment. An unlimited reserve supply of bromine is available in seawater and natural brines, and domestic producers are expanding production facilities.

[4] Engineering and Mining Journal, Vol. 152, No. 4, April 1951, p. 103. Calcium Chloride Institute News, February 1951, pp. 3–4.

In the United States the largest producer, Ethyl-Dow Chemical Co., recovers bromine from seawater at Freeport, Tex. A second seawater plant is operated by Westvaco Chemical Division of Food Machinery & Chemical Corp. in the San Francisco Bay area. The following firms recover bromine from well brines in Michigan: The Dow Chemical Co., Midland, second largest producer in the United States, Great Lakes Chemical Corp. at Filer City, Michigan Chemical Corp. at St. Louis, and Morton Salt Co. at Manistee. Pomeroy Salt Co. at Minersville, Ohio, and Westvaco Chemical at South Charleston, W. Va., also treat well brines. American Potash & Chemical Corp. recovers bromine from the brine of Searles Lake in California.

TABLE 3.—Bromine and bromine in compounds sold or used by primary producers in the United States, 1946–51

Year	Pounds	Value	Year	Pounds	Value
1946	42,780,925	$8,560,434	1949	88,725,709	$16,267,908
1947	78,177,650	14,837,104	1950	98,502,300	18,794,978
1948	76,047,551	14,825,470	1951	129,563,073	26,179,556

TABLE 4.—Bromine and bromine compounds sold or used by primary producers in the United States, 1950–51

	1950			1951		
	Pounds		Value	Pounds		Value
	Gross weight	Bromine content [1]		Gross weight	Bromine content [1]	
Elemental bromine	4,063,314	4,063,314	$760,274	[2] 6,420,016	[2] 6,420,016	[2] $1,312,409
Sodium bromide	993,614	771,541	256,942	1,005,685	780,915	278,500
Potassium bromide	2,879,256	1,933,420	748,253	3,287,821	2,207,773	897,511
Ammonium bromide	403,190	328,922	116,868	401,300	327,381	128,016
Other including ethylene dibromide	108,079,443	91,405,103	16,912,641	141,275,259	119,826,988	23,563,120
Total	116,418,817	98,502,300	18,794,978	152,390,081	129,563,073	26,179,556

[1] Calculated as theoretical bromine content present in compound.
[2] Also includes some bromine used to make other products than those listed below. Before 1951 this quantity was excluded.

According to Oil, Paint and Drug Reporter, prices for bromine and the principal bromine compounds were unchanged throughout 1951. Purified bromine in cases, freight allowed, east of the Rockies or in lead-lined drums delivered, was quoted at 25 cents per pound. Potassium bromide, U. S. P., was quoted at 34 to 37 cents per pound and sodium bromide, U. S. P., at 34 to 35 cents per pound.

IODINE

Iodine was produced in the United States by Dow Chemical Co. and Deepwater Chemical Co., Ltd., from waste oil-field brines in California. The Bureau of Mines does not publish the figure on domestic production to avoid disclosure of individual company operations.

For many years Chile has been the world's most important source of iodine. In the Provinces of Antofagasta and Taropaca iodine occurs principally as the mineral lautarite associated with the nitrate deposits. Chile Nitrate Sales Corp., sales agent for producers in Chile, imported 667,426 pounds of iodine into the United States during the year. This organization maintains large stocks in New York City for rapid distribution to consumers in this country.

In Japan, iodine is recovered from seaweed and brine. In 1951 184,681 pounds of iodine was imported from Japan. This source developed since World War II and shipped increasing quantities each year.

These three sources—domestic, Chile, Japan—supplied all United States requirements.

It was reported that a water-sterilization tablet containing triglycine hydroperiodide. recently tested in Korea, was more effective against cysts responsible for amoebic dysentery than those containing other halogens as the active ingredient.[5]

TABLE 5.—Crude iodine consumed in the United States in 1950–51

Compound manufactured	1950			1951		
	Number of plants	Crude iodine consumed		Number of plants	Crude iodine consumed	
		Pounds	Percent of total		Pounds	Percent of total
Resublimed iodine	5	145,534	11	6	137,918	11
Potassium iodide	8	1,014,940	73	9	787,936	64
Sodium iodide	5	59,818	4	5	114,307	9
Other inorganic compounds	7	57,705	4	8	45,198	4
Organic compounds	12	114,148	8	16	152,563	12
Total	[1] 22	1,392,145	100	[1] 25	1,237,922	100

[1] A plant producing more than 1 product is counted but once in arriving at total.

TABLE 6.—Crude iodine imported for consumption in the United States, 1946–51

[U. S. Department of Commerce]

Year	Pounds	Value	Year	Pounds	Value
1946	886,578	$976,190	1949	489,999	$719,758
1947	2,260,506	2,756,888	1950	724,858	1,055,946
1948	592,136	847,752	1951	852,107	1,320,328

The many uses for radioactive iodine (I^{131}) were reviewed.[6]

Iodine 132 (I^{132}) is reported to have been made available on a commercial basis. This material has a half-life of 2.4 hours and may prove valuable in medical and biological studies.[7]

The physical properties of over 500 inorganic iodine compounds were listed by the Chilean Iodine Educational Bureau, Inc., 120 Broadway, New York 5, N. Y.[8] Much additional information on the subject of iodine is available from this organization.

[5] Science News Letter, vol. 59, No. 19, May 12, 1951, p. 302.
[6] Chemical and Engineering News, vol. 29, No. 7, Feb. 12, 1951, p. 556.
[7] Winsche, W. E., Stang, L. G., Jr., and Tucker, W. D., Production of Iodine-132: Nucleonics, vol. 8, No. 3, March 1951, pp. 14–18.
[8] Chilean Iodine Educational Bureau, Iodine Abstracts and Reviews: Vol. 2, No. 1, January–April 1951, 43 pp., New York.

According to Oil, Paint and Drug Reporter, the price of crude domestic iodine at the beginning of 1951 was $1.70 per pound. In February it was quoted at $1.70 to $1.90 per pound; in November, at $1.70 to $2.04 per pound; in December, at $1.84 to $2.04.

SODIUM COMPOUNDS

Sodium Carbonate.—Soda ash is a basic chemical and a good indicator of industrial activity. The shortage of soda ash during 1950 hampered many industries and was carried over into the early part of 1951 as consumers attempted to replenish inventories depleted the previous year. However, later in 1951 demand lessened, the backlog of orders was reduced, and by the end of the year deliveries were being made on request.

Sales of natural soda ash—only a small percentage of total soda-ash production—were virtually the same as in the previous year. This natural material is produced in California largely for use on the west coast. Only during periods of shortage has it been able to compete in the East with the manufactured product.

Sales of natural soda ash were reported by the following producers in California in 1951: American Potash & Chemical Corp., 3030 W. 6th St., Los Angeles 54, Calif., on Searles Lake; Columbia-Southern Chemical Corp., subsidiary of Pittsburgh Plate Glass Co., Bartlett, Calif.; Kaiser Aluminum & Chemical Corp., 1924 Broadway, Oakland 12, Calif., on Owens Lake; Natural Soda Products Co., 405 Montgomery St., San Francisco 4, Calif., plant at Keeler, and West End Chemical Co., 608 Latham Square Building, Oakland 12, Calif., plant at Westend.

Outside California, natural sodium carbonate is produced only near Green River, Wyo. In this area, trona (hydrous sodium carbonate) occurs as a bedded deposit at a depth of about 1,500 feet. A considerable tonnage of trona has been produced from these deposits in the past few years. In 1951 Westvaco Chemical Division of Food Machinery & Chemical Corp. began to expand its mining facilities and to construct new refining facilities with a reported capacity of 300,000 tons of refined soda ash annually.[9]

TABLE 7.—Manufactured sodium carbonate produced [1] and natural sodium carbonates sold or used by producers in the United States, 1947–51

Year	Manufactured soda ash (ammonia-soda process) [2]	Natural sodium carbonates [3]	
	Short tons	Short tons	Value
1947	4,524,668	293,051	$5,862,178
1948	4,575,452	[4] 288,769	[4] 6,623,280
1949	3,916,016	[4] 200,496	[4] 4,163,714
1950	3,991,199	351,075	7,543,769
1951	5,093,927	350,688	8,368,037

[1] U. S. Bureau of the Census.
[2] Total wet and dry (98–100 percent Na_2CO_3). Includes quantities used in manufacturing caustic soda and sodium bicarbonate and quantities processed to finished light and finished dense soda ash.
[3] Soda ash and trona (sesquicarbonate).
[4] Exclusive of Wyoming.

[9] Chemical Engineering, vol. 58, No. 6, June 1951, pp. 72, 76.

According to Oil, Paint and Drug Reporter, the price of soda ash was unchanged throughout 1951 at $1.30 per 100 pounds dense ash, 58 percent, bulk, carlots, works, and $1.20 per 100 pounds for light ash, same basis.

The consumption pattern of sodium carbonate, as estimated by Chemical Engineering, is shown in table 8.

TABLE 8.—Estimated consumption of sodium carbonate in the United States 1947–51, by industries, in thousands of short tons

Chemical Engineering]

Industry	1947	1948	1949	1950	1951
Glass	1,440	1,370	1,190	1,225	1,640
Soap	135	130	125	105	120
Caustic and bicarbonate	1,130	1,137	875	700	940
Other chemicals	1,030	1,030	950	1,050	1,253
Cleansers and modified sodas	130	135	130	110	142
Pulp and paper	260	230	200	200	470
Water softeners	100	110	110	100	128
Petroleum refining	22	24	24	24	29
Textiles	71	69	55	65	56
Nonferrous metallurgy	190	210	210	245	333
Exports	107	207	76	50	152
Miscellaneous	185	220	175	151	287
Total	4,800	4,872	4,120	4,025	5,550

Sodium Sulfate.—Increasing demands for sodium sulfate from the kraft pulp and glass industries created a tight supply situation in the first part of 1951. However, production was increased, demand leveled and, by the end of the year, suppliers were able to make prompt shipments.

Much of the sodium sulfate produced in the United States is a coproduct or byproduct in the manufacture of hydrochloric acid, rayon, and several other products. However, a considerable tonnage is recovered from natural deposits. The following firms reported production from natural sources in 1951: American Potash & Chemical Corp., 3030 W. 6th St., Los Angeles 54, Calif., on Searles Lake; Iowa Soda Products Co., P. O. Box 476, Council Bluffs, Iowa, plant at Rawlins, Wyo.; Ozark-Mahoning Co., P. O. Box 449, Tulsa 1, Okla., plant at Monahans, Tex.; and Wm. E. Pratt, P. O. Box 738, Casper, Wyo.

The Bureau of Mines issued a report of an investigation of sodium sulfate deposits at Bull Lake in Carbon County, Wyo.[10] Bull Lake is one of several saline lakes situated a few miles north of Rawlings, Wyo. Drilling in the lake totaled 512 feet. Saline beds were found in thicknesses up to 26 feet. Some samples contained over 50 percent sodium sulfate.

According to Oil, Paint and Drug Reporter, salt cake, bulk, works, was quoted unchanged at $17 per ton throughout the year. Glauber's salt, anhydrous, crystalline, bags, carlots, works, freight allowed, was quoted at $45 per ton. Anhydrous sodium sulfate, technical grade, bags, carlots, works, was quoted at $2 per 100 pounds.

[10] Young, W. A., Investigation of Sodium Sulfate Deposits in Bull Lake, Carbon County, Wyo.: Bureau of Mines Rept. of Investigations 4816, 1951, 9 pp.

TABLE 9.—Sodium sulfate produced and sold or used, by producers in the United States, 1947–51

Year	Production (manufactured [1] and natural) (short tons)			Sold or used by producers (natural only)	
	Salt cake (crude)	Glauber's salt (100 percent $Na_2SO_4.10H_2O$)	Anhydrous refined (100 percent Na_2SO_4)	Short tons [2]	Value
1947	693,517	202,285	134,969	257,294	$3,329,094
1948	668,246	184,744	169,018	265,862	4,248,613
1949	537,843	156,634	136,276	186,223	2,733,853
1950	561,395	185,626	184,254	186,537	2,199,336
1951	707,388	219,942	233,666	(3)	(3)

[1] U. S. Bureau of the Census.
[2] Includes Glauber's salt converted to 100 percent Na_2SO_4 basis.
[3] Figures withheld to avoid disclosure of individual company operations.

TABLE 10.—Sodium sulfate imported for consumption in the United States, 1947–51

[U. S. Department of Commerce]

Year	Crude (salt cake)		Crystallized (Glauber's salt)		Anhydrous		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1947	49,157	$583,377	91	$1,760			49,248	$585,137
1948	29,612	468,561					29,612	468,561
1949	21,090	294,367	53	1,152	245	$4,953	21,388	300,472
1950	61,612	737,118			5,565	107,330	67,177	844,448
1951	77,559	940,202			3,904	101,139	81,463	1,041,341

Sodium Metal.—In response to increased demands, domestic sodium-metal production capacity has been greatly expanded, and further expansions were planned. Increased production of tetraethyl-lead gasoline antiknock compound and synthetic detergents have been important factors in the greater demand.

Most of the present sodium production is by the electrolysis of a mixture of salt (NaCl) and calcium chloride in a Downs cell. There are three domestic producers: National Distillers Chemical Corp., Ashtabula, Ohio; E. I. du Pont de Nemours & Co., Inc., Niagara Falls, N. Y.; and Ethyl Corp., Baton Rouge, La.

In 1951, 118,904 short tons of sodium metal was produced in the United States, according to the United States Bureau of the Census.

National Distillers Chemical Corp. offered commercially a sodium-calcium mixture, normally recycled in its process. This product contains 65 to 75 percent sodium by weight and 15 to 25 percent calcium.[11] This firm also issued a booklet entitled "Handling Metallic Sodium," which contains helpful information on safe handling methods used in commercial operation.

Oil, Paint and Drug Reporter quoted prices of sodium in 1951 as follows: In tanks, works, 16 cents per pound; in bricks, drums, works, 17 to 18 cents per pound until March, 17 to 19 cents per pound to the end of 1951.

[11] Oil, Paint and Drug Reporter, vol. 159, No. 11, Mar. 12, 1951, p. 5.

BORATES

The high level of industrial activity during 1951 created an unprecedented demand for boron compounds; as a result, a new production record was established for this important industrial raw material.

Production of boron-treated steels was growing rapidly, and interest continued unabated during 1951. It was estimated that by the end of 1951 as much as 15 to 20 percent of the alloy steel produced in the United States contained boron.[12]

A number of articles were published in which the background of boron steels was reviewed, technical details were presented, and applications and performance were discussed.[13]

TABLE 11.—Salient statistics of boron minerals and compounds in the United States, 1947–51

	1947	1948	1949	1950	1951
Sold or used by producers: [1]					
Short tons:					
Gross weight	501,935	450,932	467,592	647,735	862,797
B_2O_3 content	145,700	134,700	139,200	191,000	241,000
Value [2]	$11,844,108	$11,147,735	$11,511,893	$15,890,000	$20,030,000
Imports for consumption (refined):					
Pounds	1,884	3,056	886	[3] 1,224	1,424
Value	$747	$1,503	$435	[3] $416	$497
Exports:					
Short tons	85,736	70,940	109,491	142,580	213,445
Value	$4,651,642	$4,075,049	$6,862,928	$8,301,081	$13,322,383
Apparent consumption: Short tons [4]	416,200	379,994	358,101	505,167	649,353

[1] Borax, anhydrous sodium tetraborate, kernite, boric acid, and colemanite.
[2] Partly estimated.
[3] In addition, 21,286 pounds of crude valued at $200.
[4] Quantity sold or used by producers plus imports minus exports.

In 1951 the following firms reported production of boron minerals: American Potash & Chemical Corp., 3030 W. 6th St., Los Angeles 54, Calif., plant at Trona on Searles Lake; Pacific Coast Borax Co., 630 Shatto Place, Los Angeles 5, Calif., mines at Death Valley Junction and Boron; United States Borax Co., 630 Shatto Place, Los Angeles 5, Calif., mine near Shoshone; West End Chemical Co., 608 Latham Square Building, Oakland 12, Calif., plant at Westend on Searles Lake.

Oil, Paint and Drug Reporter quoted technical-grade borax, granular, bulk, carlots, works, unchanged throughout the year at $33.25 per ton.

[12] Iron Age, vol. 168, No. 11, Sept. 13, 1951, p. 106.
[13] Brown, D. I., Boron Steels—New Era in Alloy Metallurgy: Iron Age, vol. 168, No. 1, July 5, 1951, pp. 79–85; vol. 168, No. 2, July 12, 1951, pp. 85–90; vol. 168, No. 3, July 19, 1951, pp. 102–106; vol. 168, No. 4, July 26, 1951, pp. 68–72; vol. 168, No. 6, Aug. 9, 1951, pp. 75–80.
Metal Progress, Boron Steels: Vol. 60, August 1951, pp. 81–92; Caterpillar's Experience With Boron Steels: Vol. 60, September 1951, pp. 66–68.
Parker, C. M., Boron Engineering Steels: Steel, vol. 129, No. 16, October 15, 1951, pp. 76–79.
Society of Automotive Engineers, ISTC Division VIII, Reports on Boron Steels: Vol. 59, August 1951, pp. 17–31; September 1951, pp. 51–58; October 1951, pp. 41–47.
Wray, P. R., Boron Steels for Constructional Parts and For Carburizing: Metal Progress, vol. 60, July 1951, pp. 52–56.
Wray, P. R., Role of Boron Steels in Present Emergency: Soc. Auto. Eng. Jour., vol. 59, July 1951, pp. 46–52.

Salt

By Florence E. Harris and F. M. Barsigian

GENERAL SUMMARY

PRODUCTION of salt in the United States reached an extraordinarily high level in 1951, chiefly under the stimulus of increased chemical requirements. The total output of 20.2 million short tons valued at $69.7 million showed a quantity gain of 22 percent and a value gain of 16 percent over 1950. Outstanding features were the 2½-million increase in the output of salt in brine, which was 27 percent greater than in 1950, and the gain of about three-fourths of a million tons, or 19 percent, in sales of rock salt. Evaporated-salt production gained 10 percent.

TABLE 1.—Salient statistics of the salt industry in the United States,[1] 1947–51

	1947	1948	1949	1950	1951
Sold or used by producers:					
Dry salt:					
Evaporated (manufactured)...short tons	3,158,718	3,207,403	3,284,361	3,329,288	3,654,808
Rock salt...do	3,754,353	3,846,846	3,444,341	3,927,267	4,662 194
Total...do	6,913,071	7,054,249	6,728,702	7,256,555	8,317,002
Value	$43,032,621	$46,430,927	$45,956,223	$51,795,728	$58,425,022
Average per ton	$6.22	$6.58	$6.83	$7.14	$7.02
In brine:					
Short tons	9,140,811	9,349,044	8,843,513	9,373,254	11,890,129
Value	$9,159,067	$7,900,855	$7,670,015	$8,115,615	$11,309,978
Total salt:					
Short tons	16,053,882	16,403,293	15,572,215	16,629,809	20,207,131
Value[2]	$52,191,688	$54,331,782	$53,626,238	$59,911,343	$69,735,000
Imports for consumption:					
Short tons	1,909	5,621	6,309	7,869	4,329
Value	$22,893	$40,748	$60,605	$58,819	$46,831
Exports:					
Short tons	[3] 188,307	387,601	359,776	190,377	439,114
Value	[3] $1,588,847	$5,930,170	$3,353,115	$1,776,062	$3,501.904
Apparent consumption[4]...short tons	[3] 15,771,005	16,021,313	15,218,748	16,447,301	19,772,346

[1] Includes Puerto Rico.
[2] Values are f. o. b. mine or refinery and do not include cost of cooperage or containers.
[3] 96,479 short tons valued at $2,347,679, shipped under the U. S. Army Civilian Supply Program, is excluded from exports shown but is deducted from apparent consumption.
[4] Quantity sold or used by producers, plus imports, minus exports.

Exports, largely to Japan and Canada, increased to nearly 440,000 tons, but imports declined to only 4,300 tons.

World production of salt was estimated at about 53.5 million metric tons.

Figure 1 shows that the output of the salt industry has been advancing more rapidly than general industrial production.

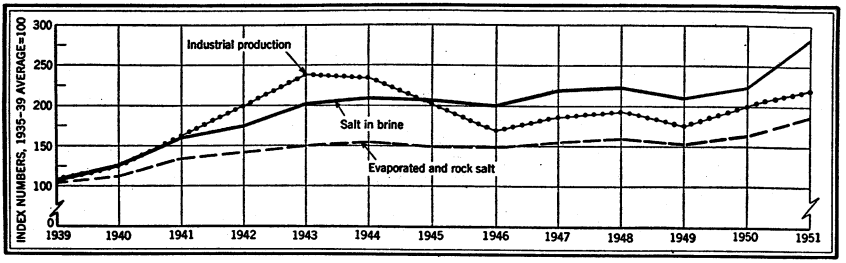

FIGURE 1.—Index of salt in brine and of evaporated and rock salt sold or used compared with industrial production, 1939–51. Index of industrial production from Federal Reserve Board.

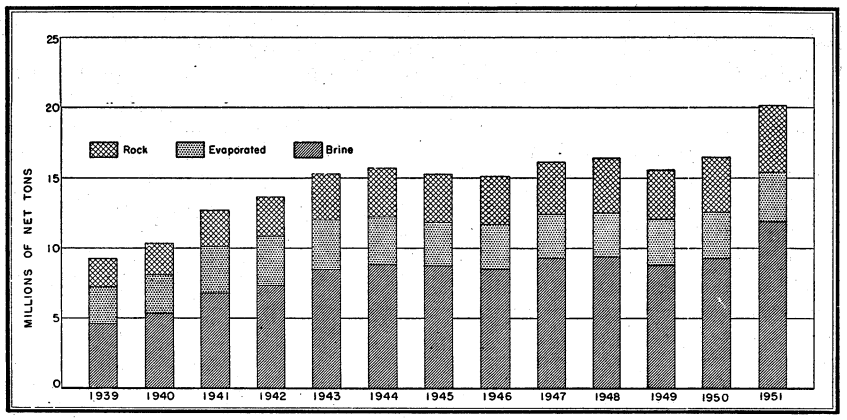

FIGURE 2.—Rock salt, evaporated salt, and brine (salt content) sold or used by producers in the United States, 1939–51.

PRODUCTION

PRODUCTION BY STATES

Requirements of the defense production programs and a general advance in industrial activity stimulated production of salt in 1951. Output increased in all salt-producing States, and production facilities were expanded in most of them in 1951. Of the 1951 total, five States—Michigan, New York, Ohio, Louisiana, and Texas—supplied nearly 84 percent.

Accomplishments in 1951 by States follow.

Alabama.—Although no salt was produced in Alabama in 1951, the Mathieson Chemical Corp. began construction of the plant of its subsidiary, the Mathieson Alabama Chemical Corp., to supply salt from brine wells within the State for the manufacture of chlorine and caustic soda in 1952. Construction of the $11 million plant was begun in the late spring of 1951. The company will obtain the salt from the McIntosh salt dome about 40 miles north of Mobile.

TABLE 2.—Salt sold or used by producers in the United States, 1949–51, by States

State	1949			1950			1951		
	Quantity		Value	Quantity		Value	Quantity		Value
	Short tons	Percent of total		Short tons	Percent of total		Short tons	Percent of total	
California	964,807	6	$4,110,271	868,496	5	$3,816,655	1,275,574	6	$5,261,780
Kansas	832,442	5	5,217,844	846,374	5	5,914,514	900,917	5	6,639,343
Louisiana	2,030,076	13	5,837,714	2,278,811	14	6,902,502	2,737,149	14	7,662,179
Michigan	4,064,106	26	16,109,117	4,446,667	27	18,178,765	5,137,639	25	21,221,330
New York	2,951,750	19	12,709,819	2,806,927	17	14,405,362	3,518,715	17	16,552,890
Ohio	2,195,778	14	5,134,923	2,515,205	15	5,491,553	3,112,472	15	5,848,478
Puerto Rico	12,664	(1)	77,322	13,545	(1)	137,225	10,566	(1)	119,338
Texas	1,641,171	11	2,419,963	1,852,138	11	2,846,789	2,401,063	12	4,000,100
Utah	78,611	1	386,935	116,694	1	511,938	131,444	1	570,379
West Virginia	355,515	2	1,288,471	367,942	2	1,238,588	379,299	2	1,314,818
Other States [2]	445,295	3	333,859	517,010	3	467,452	602,293	3	544,365
Total	15,572,215	100	53,626,238	16,629,809	100	59,911,343	20,207,131	100	69,735,000

[1] Less than 0.5 percent.
[2] Includes Nevada, New Mexico, Oklahoma, and Virginia.

California.—Production of salt was greatly accelerated in 1951 as a result of augmented demands by the chemical industry and the Japanese market. The Leslie Salt Co. formed a subsidiary company, the Leslie Terminal Co., to operate the dock and ship-loading facilities at Redwood City. The first ship was loaded late in March 1951. During 1951 evaporating and crystallizing ponds and a washing plant were being built near the terminal, but no yield was expected from these new ponds for several years. The salt loaded at the new dock was brought by rail from the operations at Newark and Alvarado.[1] In 1951 the Metropolitan Water District of Southern California concluded experiments at Dale Lake and was awaiting action on its application to lease about 1,840 acres of salt-bearing land on the public domain from the United States Department of the Interior. The water district has been obtaining its salt for water softening from the Bristol Lake operations of the California Salt Co.[2]

Kansas.—To improve the production of certain grades of salt in Kansas, a study was made, and the results were published in 1951.[3]

Louisiana.—Although it did not affect the 1951 production of salt, the Solvay Process Division of Allied Chemicals and Dye Corp. began a $13 million 2-year construction program at Baton Rouge, La., designed to expand its soda-ash plant capacity by one-third.[4]

Michigan.—International Salt Co. rock-salt mine 1,100 feet under Detroit, Mich., was described.[5] This is the only rock salt mine in the State; all other production is from wells. In the preparation of salt for marketing, the Manistee Iron Works Co. has developed a small

[1] California Journal of Mines and Geology, California Mineral Industry: Vol. 48, No. 1, January 1952, p. 117.
[2] Work cited in footnote 1.
[3] Bowdish, Frank W., Beneficiation of Kansas Number Four Salt; State Geol. Survey of Kansas, Bull. 90, pt. 8, Univ. of Kansas publications, Lawrence, Kans., 1951, pp. 193–218.
[4] Chemical Engineering, More Soda Ash Capacity: Vol. 58, No. 8, August 1951, p. 70.
[5] Business Week, 1,100 Feet Under Detroit: No. 1114, Jan. 6, 1951, pp. 38–39.

packaged-salt plant, which is said to employ radically improved methods of heat recovery.[6]

New York.—The Solvay Process Division, Allied Chemical and Dye Corp., in June 1951, announced plans to construct a new mercury-cell chlorine-caustic soda unit at its plant near Syracuse. The new $10 million plant would double the capacity of Solvay's chlorine-producing facilities at Syracuse. It was estimated that it would require 1½ to 2 years to complete the project. Solvay has large salt reserves.[7]

Ohio.—International Salt Co., Inc. (headquarters, Scranton, Pa.), continued to search for a large salt deposit near Ashtabula, Ohio. The company's drilling on a tract near Strongsville was described.[8]

Texas.—The new Kleer mine of Morton Salt Co., which replaced the old mine at the same site at Grand Saline, Tex., and had been functioning for 1½ years and the new evaporating plant for refining salt by the vacuum and grainer methods were described in a 1951 article.[9] The marketing of brine by the Texas Brine Corp. at Houston was described. This company obtains its salt from its affiliate, United Salt Corp., the brine from a dome 5 miles from Houston, and the rock salt from Hockley, Tex. The saturated brine is delivered in trailer tank trucks with a capacity of 2,000 to 4,000 gallons of brine (5,300 to 10,600 pounds of salt) to customers within a radius of 250 miles from Houston. Cost of brine to customers who use it in paper mills, synthetic-rubber plants, electrolytic caustic units, water-softening plants, oil operations, and ice and refrigeration plants, is on the basis of salt content.[10]

West Virginia.—In mid-1951 the Pittsburgh Plate Glass Co. announced plans for an $8½ million expansion of facilities to produce chlorine and caustic soda at the Natrium plant operated by its subsidiary, the Southern Alkali Corp. Salt for manufacturing these chemicals was to be obtained from the brine wells of Pittsburgh Plate Glass Co. at the site.[11]

In April 1951 the Southern Alkali Corp. became a wholly owned subsidiary of the Pittsburgh Plate Glass Co. The parent company subsequently transferred its Columbia Chemical Division to Southern Alkali Corp., which then operated plants producing chlorine, alkali, and related chemicals based on salt at Barberton, Ohio, Natrium, W. Va., Corpus Christi, Tex., Lake Charles, La., and Bartlett, Calif.[12] The Solvay Process Division expanded facilities for producing salt because of increasing demands for chlorine at Hopewell, Va. The process used to produce chlorine and caustic was described.[13]

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[6] Chemical Engineering, Packaged-Salt Plant: Vol. 58, No. 4, April 1951, p. 74.
[7] Oil, Paint, and Drug Reporter, Solvay to Expand Chlorine Capacity at Syracuse Plant: Vol. 160, No. 1, June 2, 1951, p. 5.
Chemical Engineering, Solvay Installing Mercury Cell Unit: Vol. 58, No. 8, August 1951, p. 70.
[8] Chemical Engineering, New Salt Source for Ohio Chemical Industry: Vol. 58, No. 4, April 1951, p. 76.
[9] Avery, William M., Morton's Kleer Mine at Grand Saline Rates Among Finest in Salt Industry: Pit and Quarry, vol. 44, No. 4, October 1951, pp. 74–78.
[10] Chemical and Metallurgical Engineering, Portable Brine Maker Hauls Rock Salt to Texas Plants: Vol. 58, No. 5, May 1951, pp. 227–228.
[11] Oil, Paint and Drug Reporter, Southern Alkali Begins Chlorine Plant Expansion: Vol. 160, No. 2, July 9, 1951, p. 4.
[12] Chemical and Engineering News, Pittsburgh Plate Records New High in Sales: Vol. 29, No. 37, Sept. 10, 1951, p. 3756.
[13] Chemical Engineering, vol. 58, No. 8, August 1951, p. 70.

PRODUCTION BY METHOD OF RECOVERY

The quantities of salt produced by each of the basic methods of recovery are given in table 3.

TABLE 3.—Salt sold or used by producers in the United States,[1] 1950–51, by method of recovery

Method of recovery	1950		1951	
	Short tons	Value	Short tons	Value
Evaporated:				
Bulk:				
Open pans or grainers	468,169	$7,545,403	450,835	$7,860,364
Vacuum pans	1,868,804	18,640,894	1,912,223	19,287,970
Solar	726,480	2,708,065	1,007,489	3,750,780
Pressed blocks	265,835	3,465,935	284,261	3,936,356
Rock:				
Bulk	3,864,186	18,730,831	4,591,597	22,801,609
Pressed blocks	63,081	704,600	70,597	787,943
Salt in brine (sold or used as such)	9,373,254	8,115,615	11,890,129	11,309,978
Total	16,629,809	59,911,343	20,207,131	69,735,000

[1] Includes production in Puerto Rico.

Evaporated Salt.—Forty-eight plants in 12 States and Puerto Rico produced 3,655,000 short tons of evaporated salt in 1951. Production by States is given in table 4.

TABLE 4.—Evaporated salt sold or used by producers in the United States, 1949–51, by States

State	1949		1950		1951	
	Short tons	Value	Short tons	Value	Short tons	Value
Kansas	334,611	$3,616,344	344,751	$4,066,310	360,785	$4,659,036
Louisiana	99,725	886,953	115,308	1,119,300	119,368	1,170,304
Michigan	873,949	9,904,170	868,349	10,736,781	818,845	11,081,126
New York	417,518	5,535,001	487,245	6,375,966	502,216	6,419,061
Ohio	445,591	3,976,109	472,966	4,274,738	479,246	3,908,141
Puerto Rico	12,664	77,322	13,545	137,225	10,566	119,338
Texas	(1)	(1)	(1)	(1)	87,644	1,137,376
Other States[2]	1,100,303	5,727,845	1,027,124	5,649,977	1,276,138	6,341,088
Total	3,284,361	29,723,744	3,329,288	32,360,297	3,654,808	34,835,470

[1] Included with "Other States" to avoid disclosure of individual company operations.
[2] Includes California, Nevada, New Mexico, Oklahoma, Texas (as indicated by footnote 1 above), Utah, and West Virginia.

Rock Salt.—Shipments of rock salt reported from 18 mines in 8 States increased 735,000 tons in 1951 over 1950. Rock-salt production for many years has centered in the North and South Central States.

TABLE 5.—Rock salt sold by producers in the United States, 1946–51

Year	Short tons	Value	Year	Short tons	Value
1946	3,412,008	$13,308,001	1949	3,444,341	$16,232,479
1947	3,754,353	15,989,680	1950	3,927,267	19,435,431
1948	3,846,846	16,970,742	1951	4,662,194	23,589,552

Pressed Blocks.—In 1951 pressed blocks were made from evaporated salt in 22 plants and from rock salt in 8 plants in 8 States. The first and largest use for pressed blocks is for cattle. A new application in 1951 was the substitution of pressed blocks for bags of salt in cooling systems. The salt blocks dissolve at the proper rate, and the nuisance of lint from the bags is avoided.

TABLE 6.—Pressed-salt blocks sold by original producers of the salt in the United States, 1947–51

Year	From evaporated salt		From rock salt		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1947	260,399	$2,708,857	69,163	$638,958	329,562	$3,347,815
1948	274,511	2,933,694	48,830	459,986	323,341	3,393,680
1949	268,838	3,270,664	62,749	602,855	331,587	3,873,519
1950	265,835	3,465,935	63,081	704,600	328,916	4,170,535
1951	284,261	3,936,356	70,597	787,943	354,858	4,724,299

Salt in Brine.—In response chiefly to the rising demand for chlorine and soda ash, facilities for the production of salt in brine were expanded greatly. Output of salt in brine totaled 11,890,000 short tons in 1951 compared with 9,373,000 tons in 1950. It was 59 percent of total salt production in 1951, compared with 56 percent in 1950.

CONSUMPTION AND USES

Table 7 shows domestic consumption primarily. The largest use of salt was for the manufacture of soda ash—41 percent of the total in 1951. In addition, most of the salt exported to Japan apparently was used for manufacturing soda ash. The next important use was for chlorine and chlorine compounds—23 percent. Expansion programs were adopted by most of the chemical companies producing these salt derivatives.

Increases, although on a smaller scale, were noted for highways, ice control, "other chemicals" (*see* table 7), livestock and agriculture, water treatment, canning, meat packing, and metallurgy—including metallic sodium production.

Minor decreases occurred in use of salt in dyes and organic chemicals, hides and leather, and table and other household uses.

The "Undistributed" item in table 7 includes a number of miscellaneous uses of all three types of salt. Following are some of the more important applications of the "Undistributed" salt in 1951.

About 130,000 tons of salt (exclusive of chlorine and other salt derivatives so used) was employed in the manufacture of rubber. This was 80,000 tons more than in 1950. About 52,000 tons was used in making pulp and paper, an advance of 17,000 tons over 1950. Other uses included sales to State and Federal Governments and to industry for brick and tile and in making glass, explosives, oil-well drilling, pharmaceuticals, petroleum refining, and vegetable-oil refining.

TABLE 7.—Salt sold or used by producers in the United States, 1950–51, by class and use, in thousands of short tons

Use	1950				1951			
	Evaporated	Rock	Brine	Total	Evaporated	Rock	Brine	Total
Chlorine, bleaches, chlorates, etc.	419	739	2,731	3,889	515	917	3,277	4,709
Soda ash	(1)		6,379	[1] 6,379	(1)		8,303	[1] 8,303
Dyes and organic chemicals	68	[2] 84		[2] 152	52	77		129
Soap (precipitant)	53	11		64	51	10		61
Other chemicals	102	[2] 609	(3)	[2 3] 711	107	728	(3)	[3] 835
Textile processing	29	[2] 100	(3)	[2 3] 129	21	103	(3)	[3] 124
Hides and leather	112	[2] 145	(3)	[2 3] 257	93	139	(3)	[3] 232
Meat packing	339	[2] 388		[2] 727	352	395		747
Fish curing	34	12		46	32	14		46
Butter, cheese, and other dairy products	71	5		76	63	6		69
Canning and preserving	138	25		163	173	29		202
Other food processing	219	20		239	221	10		231
Refrigeration	54	[2] 133	(3)	[2 3] 187	58	134	(3)	[3] 192
Livestock, agriculture, and general farm use [4]	670	286		956	735	321		1,056
Highways, railroads and other dust and ice control	[2] 13	[2] 578		[2] 591	19	766		785
Table and other household use	527	95		622	496	104		600
Water treatment	278	[2] 274	(3)	[2 3] 552	295	315	(3)	[3] 610
Metallurgy	28	[2] 71		[2] 99	36	81		117
Undistributed [5]	[2] 176	[2] 352	263	[2] 791	336	513	310	1,159
Total	3,330	3,927	9,373	16,630	3,655	4,662	11,890	20,207

[1] Data for evaporated salt included with "Undistributed" to avoid disclosure of individual company operations.
[2] Revised figure.
[3] Data for salt in brine included with "Undistributed" to avoid disclosure of individual company operations.
[4] Livestock salt is about 90 percent of the total.
[5] Comprises miscellaneous uses and uses for which data may not be shown separately (*see* footnotes 1 and 3); also includes some exports and consumption in Territories and possessions.

Geographical Distribution.—Salt is transported from the areas of production to consumers by rail, truck, boat, and pipeline. The dry salt is shipped by the first three methods exclusively. Brine is transported to refineries and chemical plants chiefly by pipelines ranging from a few feet to as much as 60 miles in length. An innovation in recent years has been the haulage and delivery of brine by trailer tank trucks in Texas, mentioned under Production by States.

Primary shipments of salt to various States by the producers are shown in table 8.

TABLE 8.—Distribution (shipments) of evaporated and rock salt in the United States, 1950–51, by State of destination, in short tons

Destination	1950		1951	
	Evaporated	Rock	Evaporated	Rock
Alabama	17,172	99,387	16,898	97,996
Arizona	19,198	2,239	17,846	3,295
Arkansas	12,918	56,939	12,327	74,742
California	408,418	53,927	456,083	88,525
Colorado	42,311	27,650	47,173	69,085
Connecticut	14,172	19,104	14,159	20,836
Delaware	5,030	10,257	4,605	7,739
District of Columbia	5,642	1,730	5,696	2,139
Florida	10,906	33,340	10,341	35,667
Georgia	23,572	49,582	23,095	48,708
Idaho	17,948	2,484	18,923	1,315
Illinois	231,858	277,045	234,814	312,540
Indiana	113,567	75,277	113,024	84,245
Iowa	113,400	99,597	115,298	96,609
Kansas	54,398	191,770	56,200	193,122
Kentucky	36,373	73,712	31,660	116,450
Louisiana	16,357	121,596	19,288	130,756
Maine	11,846	59,060	10,044	72,639
Maryland	38,347	71,285	41,440	81,871
Massachusetts	60,350	95,163	51,914	94,147
Michigan	115,548	176,054	123,886	227,740
Minnesota	118,087	74,217	118,898	73,117
Mississippi	10,864	25,589	9,265	24,954
Missouri	77,207	63,769	78,831	71,168
Montana	21,502	1,306	21,779	1,024
Nebraska	58,365	66,246	65,446	64,119
Nevada	6,748	86,093	4,807	141,780
New Hampshire	5,397	68,554	5,344	70,191
New Jersey	120,293	142,785	117,470	150,451
New Mexico	10,195	23,054	12,979	30,561
New York	220,557	613,067	213,213	708,011
North Carolina	51,943	71,740	47,646	78,621
North Dakota	12,213	4,423	11,230	4,688
Ohio	203,993	218,315	211,091	320,925
Oklahoma	31,145	19,815	33,347	20,972
Oregon	60,167	523	98,844	470
Pennsylvania	136,306	121,886	139,422	142,037
Rhode Island	8,966	12,928	8,360	12,322
South Carolina	12,776	19,854	12,249	19,730
South Dakota	20,291	14,145	22,744	15,210
Tennessee	35,567	73,081	33,363	72,596
Texas	60,403	207,140	93,296	241,252
Utah	23,421	1,672	28,244	2,630
Vermont	7,067	27,627	5,926	27,644
Virginia	61,841	93,487	58,766	107,744
Washington	216,348	340	250,943	1,040
West Virginia	155,128	72,874	160,815	115,158
Wisconsin	134,112	47,039	136,709	55,169
Wyoming	10,515	2,987	11,128	2,880
Other [1]	68,540	155,513	217,939	225,564
Total	3,329,288	3,927,267	3,654,808	4,662,194

[1] Includes shipments to Territories and possessions of the United States, exports, and some shipments to unspecified destinations.

TABLE 9.—Salt shipped to possessions and other areas administered by the United States,[1] 1949–51

[U. S. Department of Commerce]

Area	1949		1950		1951	
	Short tons	Value	Short tons	Value	Short tons	Value
American Samoa	20	$821	1	$127	3	$120
Guam	51	3,556	103	5,740	147	9,001
Puerto Rico	6,651	397,918	9,822	640,277	7,108	458,207
Virgin Islands	36	2,688	39	3,766	40	4,177
Total	6,758	404,983	9,965	649,910	7,298	471,505

[1] Salt is also shipped to the Territories of Alaska and Hawaii, but no record has been kept of these shipments since March 1948.

PRICES

Prices quoted at works by the Oil, Paint and Drug Reporter, for salt, throughout 1951 are shown in table 10.

TABLE 10.—Price of bagged salt, at works, in 1951, per 100 pounds

[Oil, Paint and Drug Reporter]

Rock salt:	
Paper bags, carlots	$0. 94
Burlap bags, carlots	1. 09
Paper bags, less than carlots	1. 15
Burlap bags, less than carlots	1. 30
Table, vacuum, common fine, bags:	
Carlots	1. 09
Less than carlots	1. 20

FOREIGN TRADE [15]

Imports of salt in 1951 were about half those in 1950, whereas exports of salt more than doubled.

Imports.—Almost all of the salt imported in 1951 was from Canada; 69 percent was packaged.

TABLE 11.—Salt imported for consumption in the United States, 1950–51, by countries

[U. S. Department of Commerce]

Country	1950		1951	
	Short tons	Value	Short tons	Value
Bahamas	65	$180	18	$630
Canada	4,284	48,507	4,311	46,096
Jamaica	3,439	9,380	----------	----------
Netherlands Antilles	80	688	----------	----------
United Kingdom	1	64	(1)	105
Total	7,869	58,819	4,329	46,831

[1] Less than 0.5 ton.

TABLE 12.—Salt imported for consumption in the United States, 1947–51, by classes

[U. S. Department of Commerce]

Year	In bags, sacks, barrels, or other packages (dutiable)		Bulk			
			Dutiable		Free (used in curing fish)	
	Short tons	Value	Short tons	Value	Short tons	Value
1947	376	$8,571	1,533	$14,322	----------	----------
1948	1,591	20,971	3,262	17,033	768	$2,744
1949	2,851	40,308	3,458	20,297	----------	----------
1950	3,395	43,567	4,474	15,252	----------	----------
1951	2,991	37,245	1,338	9,586	----------	----------

Exports.—In 1951 exports of salt were over twice as large as in 1950, chiefly because of large shipments to Japan compared with only a few tons in 1950. Salt exports to Canada increased about 30,000 tons. In 1951 total salt exports of 439,100 short tons represented a new all-time high record, superseding that of 387,600 tons in 1948.

[15] Figures on imports and exports compiled by M. B. Price and E. D. Page, of the Bureau of Mines, from records of the U. S. Department of Commerce.

Of the salt exports in 1951, 47 percent by tonnage and 35 percent by value was shipped to Japan, 45 percent by tonnage and 44 percent by value to Canada, and the remainder to more than 30 other countries.

The difference in the values given reflects the fact the material shipped to Japan was chiefly crude salt for industrial uses and that shipped to Canada was high-grade salt.

TABLE 13.—Salt exported from the United States, 1950–51, by countries

[U. S. Department of Commerce]

Country	1950		1951	
	Short tons	Value	Short tons	Value
North America:				
Bermuda	17	$920	8	$746
Canada	169,275	1,255,998	197,784	1,541,973
Central America:				
Canal Zone	732	36,465	894	38,282
Costa Rica	54	7,220	153	4,749
Guatemala	202	4,790	207	6,539
Honduras	148	4,225	304	12,093
Nicaragua	483	12,509	348	9,327
Panama	246	8,940	3,073	100,875
Mexico	5,443	122,357	6,867	159,436
West Indies:				
British:				
Jamaica			5	160
Other British	1	109	6	623
Cuba	10,299	214,962	9,899	203,844
Dominican Republic	139	9,505	154	12,558
Haiti	15	992	12	862
Netherlands Antilles	330	17,332	318	18,963
Other North America	90	2,348	219	12,290
South America:				
Argentina	9	1,190	11	1,824
Brazil	(1)	216	3	1,181
Ecuador			110	3,483
Uruguay	10	1,676	(1)	138
Venezuela	4	2,374	2	1,322
Other South America	6	1,095	11	2,029
Europe:				
Austria	2	455		
France	3	100	1	688
United Kingdom			(1)	427
Other Europe			12	2,040
Asia:				
Japan	29	2,003	205,291	1,237,711
Korea			10,008	34,028
Philippines	2,741	58,343	2,858	65,404
Saudi Arabia	51	5,241	79	4,614
Other Asia	5	1,929	20	3,793
Africa:				
Belgian Congo	27	1,502	(1)	138
Liberia			24	1,598
Other Africa	9	858	16	1,030
Oceania:				
French Pacific Islands	7	408	194	7,360
New Zealand			223	9,776
Total	190,377	1,776,062	439,114	3,501,904

[1] Less than 0.5 ton.

WORLD REVIEW

In 1951 the output of salt increased in most of the large and many of the small producing countries. Overall world production was 5 million tons greater in 1951 than in 1950. The United States produced roughly one-third of the recorded world output shown in table 14. All tonnages in this section are metric, unless otherwise specified.

TABLE 14.—World production of salt, 1946–51, by countries, in metric tons [1]

[Compiled by Helen L. Hunt]

Country [1]	1946	1947	1948	1949	1950	1951
North America:						
Canada	486,781	672,697	[2] 668,284	[2] 681,278	[2] 779,132	876,542
Costa Rica	8,000	6,252	6,500	8,200	8,400	5,445
Guatemala	(3)	(3)	11,474	11,962	[2] 11,502	12,061
Honduras	850	726	1,089	(3)	4,397	4,650
Mexico	131,972	122,235	[4] 156,685	(3)	(3)	(3)
Nicaragua	[4] 6,000	7,503	[4] 9,475	[4] 10,230	11,172	12,289
Panama	7,958	4,412	3,374	3,408	[2] 5,000	7,480
Salvador	22,680	16,483	21,213	[2 4] 16,000	[4] 16,000	[4] 27,200
United States:						
Rock salt	3,095,305	3,405,874	3,489,782	3,124,637	3,562,738	4,229,449
Other salt	10,632,274	11,157,887	11,390,957	11,002,165	11,523,492	14,102,056
West Indies:						
British:						
Bahamas	36,580	60,960	63,000	60,960	60,960	51,000
Turks and Caicos Islands	31,571	----------	38,610	61,765	60,960	(3)
Cuba	56,782	51,225	55,339	59,874	59,266	63,500
Dominican Republic:						
Rock salt	2,776	2,084	2,365	2,412	2,304	2,270
Other salt	15,746	14,918	13,079	8,140	13,740	8,092
Haiti [4]	8,000	8,000	8,000	8,000	(3)	(3)
Netherlands Antilles	2,017	217	482	370	3,000	(3)
South America:						
Argentina:						
Rock salt	(3)	(3)	} (3)	(3)	(3)	(3)
Other salt	384,000	384,000				
Brazil	609,198	562,570	781,378	800,872	873,803	(3)
Chile:						
Rock salt	52,093	54,289	47,164	35,079	46,709	} (3)
Other salt	[4] 31,033	[4] 28,001	[4] 30,804	4,450	942	
Colombia	[2] 124,292	121,247	[2] 124,352	[2] 126,092	[2] 141,963	162,124
Ecuador	35,070	29,400	25,110	16,833	34,902	32,756
Peru	56,615	60,108	63,049	[2] 55,968	66,501	(3)
Venezuela	90,555	35,794	35,533	71,926	56,439	38,920
Europe:						
Austria:						
Rock salt	554	4,348	1,752	719	1,085	692
Other salt	168,150	[2] 268,307	[2] 278,492	[2] 304,792	[2] 327,428	362,294
Bulgaria:						
Rock salt	13,659	(3)	} [4] 120,000	(3)	(3)	(3)
Other salt	(3)	(3)				
Czechoslovakia [5]	9,232	(3)	(3)	(3)	(3)	(3)
France:						
Rock salt and salt from springs	1,514,470	2,148,140	2,489,036	2,034,847	2,049,373	(3)
Other salt	476,750	467,410	446,539	[2] 742,721	604,550	430,608
Germany, West	1,619,112	1,825,062	2,035,694	1,800,000	2,470,000	2,757,785
Greece	105,000	51,000	52,208	86,776	102,329	82,434
Italy:						
Rock salt	[2] 412,654	[2] 723,140	[2] 727,083	814,420	717,158	746,321
Other salt	792,844	[2] 534,794	464,456	576,535	651,935	965,652
Malta	1,402	1,631	1,869	1,807	1,827	3,841
Netherlands	[2] 194,706	[2] 251,426	250,417	331,000	412,570	[4] 473,000
Poland	280,099	619,770	725,774	[2] 836,253	(3)	(3)
Portugal:						
Rock salt	46	69	49	41	42	(3)
Other salt [6]	82,974	25,071	10,660	16,903	30,765	29,374
Rumania: Rock salt	345,000	314,485	(3)	(3)	(3)	(3)
Spain:						
Rock salt	262,651	265,248	292,881	288,896	[2] 308,228	367,809
Other salt	510,121	569,343	696,600	546,886	901,575	893,297
Switzerland	92,089	107,757	112,218	[4] 100,000	94,000	114,000
United Kingdom:						
Great Britain:						
Rock salt	20,819	40,639	41,000	[2] 41,658	41,658	(3)
Other salt	3,385,540	3,148,639	3,794,000	[2] 3,741,000	4,223,814	(3)
Northern Ireland	13,474	12,603	[2] 13,000	[2] 13,000	13,000	13,251
Yugoslavia	113,200	111,200	102,300	[4] 108,900	131,000	95,646
Asia:						
Aden	114,856	197,672	275,408	308,302	259,972	309,186
Burma	44,621	52,566	44,880	31,692	21,457	(3)
Ceylon	43,666	23,231	78,300	28,780	66,093	36,990
China [4]	1,683,000	2,007,000	2,480,000	2,000,000	2,500,000	3,000,000
Cyprus	[7] 3,429	15,622	----------	----------	4,133	11,198
India:						
Rock salt	266,447	4,605	4,123	4,229	5,130	5,519
Other salt	2,235,390	1,560,471	[2] 2,296,759	[2] 2,017,831	[2] 2,609,029	2,889,377

For footnotes, see end of table.

TABLE 14.—World production of salt, 1946–51, by countries, in metric tons [1]—Continued

[Compiled by Helen L. Hunt]

Country [1]	1946	1947	1948	1949	1950	1951
Asia—Continued						
Indochina	[8] 14,735	41,556	64,000	113,600	[2] 75,722	93,908
Indonesia	80,000	12,000	360,000	320,000	375,000	[4] 300,000
Iran	([3])	[9] 6,000	([3])	[4] 100,000	[4] 100,000	76,252
Iraq	9,512	12,365	14,000	8,989	[2] 11,861	16,503
Israel-Jordan:						
Rock salt	1,571	2,454	([3])	([3])	([3])	([3])
Other salt	23,163	12,567	8,302	[2] 11,500	18,000	12,212
Japan	[10] 358,946	247,466	339,668	395,676	418,144	430,405
Korea	[4] 152,000	[4] 131,000	[11] 89,979	[11] 188,812	([3])	([3])
Lebanon	([3])	([3])	[4] 5,080	[4] 2,540	6,604	([3])
Pakistan:						
Rock salt	([12])	201,290	154,060	175,162	142,522	147,109
Other salt	([12])	217,755	184,625	205,318		
Philippine Islands	([3])	([3])	([3])	[2] 52,276	56,283	52,960
Portuguese India	[6] 15,428	20,321	[6] 10,719	18,132	17,608	31,577
Syria	[2] 15,437	20,728	[2] 20,321	[4] 26,000	[2] 12,000	7,000
Taiwan (Formosa)	191,850	[4] 250,000	[2] 365,803	[2] 253,948	[2] 175,063	274,766
Thailand (Siam)	137,601	[4] 150,000	[4] 200,000	[4] 150,000	[4] 200,000	250,000
Turkey:						
Rock salt	20,215	26,978	28,187	[2] 17,920	[2] 20,330	21,584
Other salt	186,088	249,865	238,755	[2] 298,425	[2] 284,912	249,970
Africa:						
Algeria	66,570	75,680	73,038	101,676	75,656	([3])
Anglo-Egyptian Sudan	40,982	36,992	36,238	[2] 43,029	40,754	46,215
Angola	61,657	38,783	53,423	41,286	40,473	49,764
Belgian Congo	[2] 639	[2] 768	[4] 1,000	[2] 813	550	583
Canary Islands	13,659	6,956	13,209	5,283	6,072	([3])
Cape Verde Islands	14,376	9,246	13,632	19,301	([3])	([3])
Egypt	[6] 226,090	[6] 622,629	[6] 359,823	349,878	[2] 539,016	687,038
Eritrea	40,967	45,722	60,963	85,760	53,922	[4] 60,000
Ethiopia: Rock salt [4]	10,000	10,000	10,000	10,000	10,000	10,000
French Morocco:						
Rock salt	8,570	10,480	[2] 10,772	34,100	60,000	45,971
Other salt	40,975	34,095	24,287			
French Somaliland	45,000	48,000	60,000	60,000	[4] 80,000	[4] 40,000
French West Africa	[4] 55,000	[4] 50,000	[4] 50,000	50,000	66,000	[4] 66,000
Italian Somaliland	114	715	([3])	3,000	1,500	2,000
Kenya	15,635	14,058	16,813	18,820	18,722	19,084
Libya:						
Cyrenaica	700	200	140	[4] 500	([3])	[4] 2,500
Tripolitania	2,350	3,000	6,000	[4] 6,000	[4] 9,000	([3])
Mauritius	3,165	3,991	3,404	5,200	2,606	([3])
Mozambique	7,210	8,663	10,100	11,004	([3])	([3])
South-West Africa:						
Rock salt	3,533	2,788	4,436	2,468	[2] 3,915	4,706
Other salt	10,590	9,861	10,414	13,730	[2] 12,903	39,880
Spanish Morocco [4]	254	254	254	254	254	([3])
Tanganyika	13,373	10,837	[2] 11,581	[2] 14,970	14,152	16,107
Tunisia	93,400	114,790	[2] 105,244	98,085	98,771	160,000
Uganda	5,679	7,003	7,011	7,400	7,413	([3])
Union of South Africa	[13] 143,677	([3])	[4] 172,000	[13] 162,936	[2] 106,396	149,795
Australia:						
South Australia	160,753	157,563	175,865	171,154	193,763	222,424
Australia, other	([3])	([3])	88,308	77,778	85,651	
Total (estimate)	38,335,000	40,500,000	[2] 44,000,000	[2] 43,000,000	48,000,000	53,500,000

[1] In addition to the countries listed, salt is produced in Afghanistan, Albania, Bolivia, British Somaliland, French Equatorial Africa, Gold Coast, Hungary, Leeward Islands, Madagascar, Nigeria, and U. S. S. R., but figures of production are not available. Russian production is known to exceed 4,000,000 metric tons annually. Estimates by senior author of chapter included in the total.

[2] Revised figure.

[3] Data not available; estimates by author of the chapter included in total.

[4] Estimate.

[5] Excludes Sub-Carpathia, ceded to Hungary and U. S. S. R.

[6] Exports.

[7] Incomplete data.

[8] Cochin-China only.

[9] Fiscal year ended March 20 of year following that stated.

[10] Fiscal year ended March 31 of year following that stated.

[11] Republic of Korea only.

[12] Included under India.

[13] Fiscal year ended June 30 of year stated.

NORTH AND CENTRAL AMERICA

Canada.—Apparent consumption of salt in Canada was about 1,103,500 tons in 1951.[16] The largest imports were those of salt in bulk, all from the United States. Effective April 1, 1951, Canadian Industries, Ltd., and Alberta Salt Co. were consolidated as the Canadian Salt Co. Brands such as Windsor and Cascade salt were to be marketed by the company. The Salt Division of Canadian Industries, Ltd., had a plant at Neepawa, Manitoba, originally built by the Neepawa Salt Co. in 1930. The Windsor plant of Canadian Industries and Neepawa plant, together with the plant of the Alberta Salt Co. at Lindbergh, Alberta, constituted the holdings of the new company.[17] A mineral survey in Nova Scotia in 1951 revealed the presence of a large deposit of salt, above and adjacent to which was a deposit of high-grade limestone. With a nearby fuel source in the Sydney, Nova Scotia, coal fields the situation was regarded as favorable for a soda-ash industry in the vicinity of Antigonish Harbor.[18]

Cuba.—Production of salt, estimated to have increased to 63,500 metric tons in 1951, was valued at $2,500,000.

Dominican Republic.—Following a bond issue of 3,000,000 pesos in 1950, orders were placed for modern equipment in the mechanization of the salt and gypsum deposits taken over by the Government Agricultural and Industrial Credit Bank. Underground development included 6 exploratory tunnels, from 2 of which rock salt was being extracted in 1951. Narrow-gage railroad cars transport the salt as mined to crushers on the same level, thence to open concrete storage bins awaiting loading into railroad cars on the main track to the port of Barahona, 25 miles east of the mine. A new wharf was constructed for handling salt exports. Two mobile diesel-electric cranes had been ordered for loading the salt on large vessels. Reserves were estimated by the engineer in charge at about 250 million metric tons, and it was expected that full-scale production would be at the rate of 1,000,000 tons annually. Reportedly a market for Dominican rock salt had been found in Japan, and large shipments would be made thereto when full-scale operation was reached, probably late in 1952.

Guatemala.—Production of sea salt, which had decreased slightly in 1950 because foreign prices were so much lower than domestic, increased somewhat in 1951. Some interest was shown in finding and exploiting new deposits of rock salt. However, no progress was evident and Guatemala continued to rely on sea salt, supplemented by imports.[19]

Netherlands Antilles.—Bonaire was the only one of this group of islands that supplied salt in 1951. Output data were not available, but exports totaled 474 tons gross weight valued at 73,492 Curaçao florins (about $19,300).

Panama.—Output of sea salt (the only source) in 1951, reported by the Agricultural, Livestock, and Industrial Banco, which is in charge of production and distribution, was about 50 percent greater

[16] Preliminary figures of Dominion Bureau of Statistics.
[17] Canadian Chemistry and Process Industries, C. I. L. Sells Salt Business: Vol. 35, No. 3, March 1951, p. 240.
[18] Chemical Engineering News, Nova Scotia Soda Ash: Vol. 29, No. 37, September 10, 1951, p. 3686.
[19] Bureau of Mines, Mineral Trade Notes: Vol. 34, No. 6, June 1952, p. 50.

than in 1950. Previously limited to 10 quintals (about 1,100 pounds) per deposit, the bank removed the restriction in 1951 because of floods caused by heavy rains. The 1952 production was to be limited to 5 quintals per deposit (beach area).[20] The bank expected to purchase the entire output at $1.50 per quintal.

SOUTH AMERICA

Brazil.—Production of Brazilian sea salt for 1950, figures for which became available at the end of 1951, increased about 75,000 tons. The project of installing a caustic soda plant based on local salt as the raw material was still in the planning stage at the end of 1951.

Venezuela.—There were no further developments in the project of establishing a plant in Venezuela to produce chlorine and caustic soda from local salt.

EUROPE

Austria.—Salt produced in 1951 included 94,838 tons of evaporated salt and 267,456 tons of salt content of brine (871,353 cubic meters). Although output of evaporated salt was 4 percent over the 1950 output and 118 percent of the 1937 level, it was below the peak war year 1940, when 108,719 tons was produced. Rock-salt output was insignificant.

Denmark.—All of the salt consumed in Denmark was imported. The deposits discovered in 1946 had not been developed. The broad details of salt consumption, imports and exports were given in a recent report.[21]

Germany, West.—The rate of production of dry salt—both rock and evaporated—increased so much in 1951 that a new postwar record was established.

Italy.—The salt industry of Italy, said to be the most highly developed of its kind in Europe, was described in a report.[22] Production, by the State Monopoly and by private concessions, has been from three sources; in order of their importance these were: Sea water, rock-salt deposits, and salt springs.

Spain.—Output of salt increased and exports more than doubled in 1951. Of the 355,193 tons exported valued at 4,478,000 gold pesetas (1 gold peseta, as a customs unit, in 1951 equaled about $0.3267 or 3.577 paper pesetas), Japan was supplied with 226,424 tons valued at 2,538,000 pesetas (28,296 tons at 287,000 pesetas in 1950), and Iceland ranked next with 35,800 tons valued at 541,000 pesetas (33,228 tons at 535,000 pesetas in 1950). The remainder was shipped to 13 other countries.

ASIA

Aden.—Production costs of salt in Aden in summer and winter were reported in 1951.[23]

Afghanistan.—As with all Afghan mineral resources except talc, salt mining is done by the Afghan Ministry of Mines, which realizes a considerable profit from it. Salt output in 1951 was from rock-

[20] Bureau of Mines, Mineral Trade Notes: Vol. 34, No. 4, April 1952, pp. 52–53.
[21] Bureau of Mines, Mineral Trade Notes: Vol. 32, No. 3, March 1951, pp. 49–50.
[22] Bureau of Mines, Mineral Trade Notes: Vol. 33, No. 3, September 1951, pp. 49–52.
[23] Bureau of Mines, Mineral Trade Notes: Vol. 32, No. 6, June 1951, p. 43.

salt works at Taliqan and Khalifghan; salt lakes at Andkhoi, Mazar-i-Sharif, Herat, and Mukur; salt wells at Kandahur; and salt springs at Ghorband. Studies had been made of modern methods of producing and marketing salt, but the Ministry had no definite plans for modernization of mining. Hand methods of mining salt in quarries and around lake shores were as primitive as when the deposits were first worked. The output was for domestic demand, and no large stocks were maintained.

India.—Production of salt in India was somewhat higher in 1951 than in 1950; and there were no imports, although 139,300 tons was imported in 1950. The Indian press stressed that, for the first time in 100 years, India achieved self-sufficiency in salt production. Output was expected to increase in 1952 so that substantial quantities could be exported. Japan offered market possibilities. The Ministry of Production reported rapidly increasing manufacture on the west coast, where salt of superior quality was being processed. Six new salt works were licensed in 1951. Cooperative organizations have been encouraged and from these and other unlicensed small manufacturers salt output increased from 48,518 tons in 1950 to 93,303 tons in 1951. On advice of an advisory committee, the Government of India decided that no salt should be released for human consumption in 1951 if its sodium chloride content was below 92 percent. The Government also decided that the standard for edible salt should be raised to 94 percent sodium chloride in 1952 and to 96 percent in 1953, the minimum content prescribed by the Indian Standards Institute.[24] In November 1951 the Council of Scientific and Industrial Research of India approved proposals to establish a research station at Sambhar Lake (Rajasthan) "to conduct investigations to improve the salt manufacturing process in the use and recovery of chemicals therefrom." [25]

Iran.—The output of salt in Iran is entirely rock salt from mines in most instances leased to private companies. As production is inadequate, some salt has to be imported. The industry was described recently.[26]

Japan.—Salt was needed by Japan for restoration of its large chemical industry, and research and experimentation were continued on methods of recovering industrial salt from sea water to compensate for lack of former supplies from China. Large quantities of salt have had to be imported. Japan's buyers searched the world for supplies, and much larger tonnages were obtained in 1951 than in 1950, chiefly from Egypt, Spain, Aden, and the United States, and some from Italy and India.

Pakistan.—A Sea-Salt Control Order (issued November 30, 1950) gave the Government's sea-salt controller complete control of the sale, stocking, and distribution of sea salt.[27] It was reported that the salt shortage in East Pakistan ended in November 1951.[28]

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[24] Bureau of Mines, Mineral Trade Notes: Vol. 33, No. 2, August 1951, pp. 41–42; Vol. 34, No. 1, January 1952, pp. 34–42.
[25] Bureau of Mines, Mineral Trade Notes: Vol. 33, No. 6, December 1951, pp. 48–49.
[26] Bureau of Mines, Mineral Trade Notes: Vol. 33, No. 6, December 1951, pp. 48–49.
[27] Bureau of Mines, Mineral Trade Notes: Vol. 32, No. 1, January 1951, pp. 43–44.
[28] Bureau of Mines, Mineral Trade Notes: Vol. 33, No. 6, December 1951, p. 49.

Taiwan (Formosa).—Salt production, marketing, and problems peculiar to the Taiwan salt industry were discussed in an abstract based on the Report on Survey of Taiwan Salt Production and Distribution, by the Mutual Security Agency Mission to China, covering 1946 to 1951, inclusive.[29]

Turkey.—The Monopolies Administration planned to increase salt production 200,000 tons by 1953 as a result of the installation of new equipment and other improvements at the salt mines of Camalti and Yavsan.

AFRICA

Angola.—Domestic consumption of salt in Angola increased slightly from 1949 to 1951, chiefly because of installation of new fish-processing plants. About 75 percent of Angola's salt was produced in the vicinity of Lobito by 6 enterprises, which processed and marketed through a quasi-governmental association.[30]

Belgian Congo.—The output of salt in Belgian Congo in 1951 was under 1,000 tons, of which about 62 percent was from the Katanga area. Belgian Congo and Ruanda-Urundi imported about 30,000 tons valued at 48,783,000 Belgian francs in 1950, of which about 25 percent came from Angola and the remainder from other countries.[31]

Egypt.—According to the American Embassy, Cairo, production of salt in Egypt is governed by foreign demand. Of the 607,000 tons reported produced in 1951, 346,882 tons was exported. Exports to Japan increased from 16,898 tons valued at $61,934 in 1950 to 149,252 tons valued at $480,304 in 1951. The largest producing company, the Société Egyptienne pour l'Exploitation des Salines de Port Said, S. A. E., was formed in 1950 with a 20-year concession to take over the activities of the former Port Said Association, Ltd. In 1951, 305,631 tons was produced by the Port Said firm. The second largest producer was the National Salt & Mining Co., Ltd., which held salt concessions at Mex, Alexandria, and Baltim in the Middle Delta. Production in 1951 by this company was 249,062 tons, of which 236,587 tons was from Mex. Also, limited operations were carried out by three other concessionnaires with outputs of 50,000, 2,000, and 340 tons, respectively. In addition to the foregoing licensed concessions, in the Damietta area a great number of individually owned solar salt beds of small area produced an aggregate output estimated at 40,000 tons not included in official production statistics.

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[29] Bureau of Mines, Mineral Trade Notes: Vol. 34, No. 6, June 1952, pp. 51–57.
[30] Bureau of Mines, Mineral Trade Notes: Vol. 33, No. 5, November 1951, pp. 31–32.
[31] Bureau of Mines, Mineral Trade Notes: Vol. 33, No. 4, October 1951, pp. 40–41.

Sand and Gravel

By Henry P. Chandler and Nan C. Jensen

GENERAL SUMMARY

PRODUCTION of sand and gravel in the United States in 1951 surpassed all previous records. The combined tonnage of these commodities increased 8 percent and the value 13 percent compared with 1950. The value of sales was approximately one-third of a billion dollars. All classifications except filter sand and noncommercial paving gravel gained over 1950. In commercial operations gains were substantial in almost every category, while in the Government-and-contractor operations the largest tonnage increases were reported under paving sand and building gravel. The output of sand was 37 percent and that of gravel 63 percent of the combined domestic production of these commodities during 1951, the same proportions as in 1950.

In this chapter the terms "production" and "sales" (sold or used by producers) are used interchangeably, inasmuch as stocks of sand and gravel are relatively small, and fairly constant from year to year.

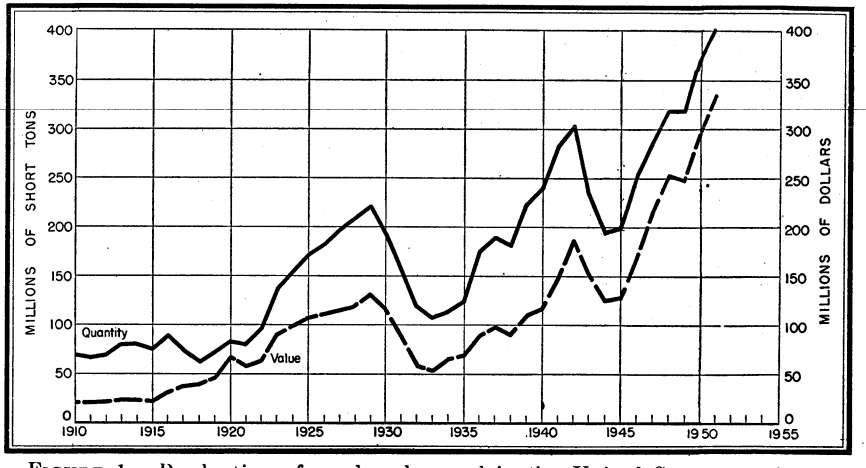

FIGURE 1.—Production of sand and gravel in the United States, 1910–51.

TABLE 1.—Sand and gravel sold or used by producers in the United States,[1] 1950–51, by class of operation and use

	1950			1951			Percent of change in—	
	Short tons	Value		Short tons	Value		Tonnage	Average value
		Total	Average		Total	Average		
COMMERCIAL OPERATIONS								
Sand:								
Glass	5,149,656	$12,815,511	$2.49	5,515,588	$14,412,339	$2.61	+7	+5
Molding	8,139,804	13,667,697	1.68	9,107,003	16,823,440	1.85	+12	+11
Building	67,804,295	55,862,325	.82	71,503,981	62,168,319	.87	+5	+6
Paving	36,562,509	29,406,951	.80	40,789,625	34,531,591	.85	+12	+6
Grinding and polishing [2]	1,299,760	2,670,791	2.05	1,476,912	3,111,649	2.11	+14	+3
Fire or furnace	372,890	522,875	1.40	471,540	791,682	1.68	+26	+20
Engine	1,999,176	2,001,707	1.00	2,208,903	2,339,753	1.06	+10	+6
Filter	277,134	533,312	1.92	202,739	484,724	2.39	−27	+24
Railroad ballast [3]	901,580	424,457	.47	1,087,669	604,841	.56	+21	+19
Other [4]	2,475,129	2,444,528	.99	2,793,226	3,102,669	1.11	+13	+12
Total commercial sand	124,981,933	120,350,154	.96	135,157,186	138,371,007	1.02	+8	+6
Gravel:								
Building	57,093,484	57,587,369	1.01	62,550,990	65,648,107	1.05	+10	+4
Paving	62,755,788	55,834,416	.89	72,335,348	65,944,983	.91	+15	+2
Railroad ballast [5]	9,451,187	5,249,241	.56	11,362,531	7,032,599	.62	+20	+11
Other [6]	3,274,239	2,303,464	.70	4,413,449	3,180,659	.72	+35	+3
Total commercial gravel	132,574,698	120,974,490	.91	150,662,318	141,806,348	.94	+14	+3
Total commercial sand and gravel	257,556,631	241,324,644	.94	285,819,504	280,177,355	.98	+11	+4
GOVERNMENT-AND-CONTRACTOR OPERATIONS [7]								
Sand:								
Building	2,759,000	1,675,000	.61	2,767,000	2,065,000	.75	------	+23
Paving	11,159,000	4,286,000	.38	12,452,000	4,764,000	.38	+12	------
Total Government-and-contractor sand	13,918,000	5,961,000	.43	15,219,000	6,829,000	.45	+9	+5
Gravel:								
Building	5,216,000	4,510,000	.86	7,665,000	6,906,000	.90	+47	+5
Paving	93,765,000	43,245,000	.46	92,917,000	39,914,000	.43	−1	−7
Total Government-and-contractor gravel	98,981,000	47,755,000	.48	100,582,000	46,820,000	.47	+2	−2
Total Government-and-contractor sand and gravel	112,899,000	53,716,000	.48	115,801,000	53,649,000	.46	+3	−4
ALL OPERATIONS								
Sand	138,900,000	126,311,000	.91	150,376,000	145,200,000	.97	+8	+7
Gravel	231,555,000	168,729,000	.73	251,244,000	188,626,000	.75	+9	+3
Grand total	370,455,000	295,040,000	.80	401,620,000	333,826,000	.83	+8	+4

[1] Includes Alaska, Hawaii, and Puerto Rico.
[2] Includes blast sand as follows—1950: 470,717 tons valued at $1,463,623; 1951: 549,955 tons, $1,875,775.
[3] Includes ballast sand produced by railroads for their own use as follows—1950: 188,470 tons valued at $35,790; 1951: 140,011 tons, $17,745.
[4] Includes some sand used by railroads for fills and similar purposes as follows—1950: 198,616 tons valued at $59,992; 1951: 263,997 tons, $78,686.
[5] Includes ballast gravel produced by railroads for their own use as follows—1950: 3,959,670 tons valued at $1,361,734; 1951: 4,100,872 tons, $1,709,860.
[6] Includes some gravel used by railroads for fills and similar purposes as follows—1950: 828,723 tons valued at $184,105; 1951: 904,402 tons, $244,119.
[7] Approximate figures for States, counties, municipalities, and other Government agencies directly or under lease.

DOMESTIC PRODUCTION

A production of 401,620,000 tons of sand and gravel recorded for 1951 represents an alltime high for the industry. Its value at the pit was $333,826,000. The quantity produced was 8 percent higher than in 1950 and the value 13 percent higher. These increases reflected the high level of construction activity throughout 1951.

In 1951 California was the largest producer, followed by Michigan, New York, Illinois, Ohio, Wisconsin, Texas, Minnesota, and Pennsylvania, in the order named. These 9 States, each with an output exceeding 15 million tons, accounted for 51 percent of the total production.

Tables 3 and 4 show details of production by States and uses in 1951.

TABLE 2.—Sand and gravel sold or used by producers in the United States,[1] 1947–51

Year	Sand		Gravel (including railroad ballast)		Total	
	Quantity (thousand short tons)	Value (thousand dollars)	Quantity (thousand short tons)	Value (thousand dollars)	Quantity (thousand short tons)	Value (thousand dollars)
1947	108,719	94,154	178,940	122,715	287,659	216,869
1948	118,661	107,915	200,605	144,583	319,266	252,498
1949	117,036	105,489	202,068	142,954	319,104	248,443
1950	138,900	126,311	231,555	168,729	370,455	295,040
1951	150,376	145,200	251,244	188,626	401,620	333,826

[1] Includes Alaska, Hawaii, and Puerto Rico.

TABLE 3.—Sand and gravel sold or used by producers in the United States in 1951, by States

State	Short tons	Value	State	Short tons	Value
Alabama	3,535,871	$2,806,540	Nevada	2,616,629	$2,657,654
Alaska	6,887,646	3,738,516	New Hampshire	2,260,410	517,927
Arizona	2,691,100	2,203,345	New Jersey	6,652,383	9,106,052
Arkansas	3,868,940	3,569,114	New Mexico	1,080,256	1,087,857
California	46,927,452	41,279,835	New York	21,008,701	19,285,299
Colorado	6,916,631	4,452,489	North Carolina	7,656,370	4,435,702
Connecticut	3,107,715	1,760,910	North Dakota	4,573,341	2,140,466
Delaware	654,563	363,643	Ohio	19,430,898	21,394,891
Florida	4,418,573	4,300,682	Oklahoma	3,183,251	2,321,653
Georgia	1,226,231	1,041,561	Oregon	10,504,339	9,117,343
Hawaii	2,561	5,710	Pennsylvania	15,737,464	21,488,540
Idaho	4,057,391	2,971,264	Puerto Rico	99,628	99,657
Illinois	20,130,567	19,146,502	Rhode Island	534,785	576,781
Indiana	11,030,814	8,763,936	South Carolina	320,195	139,258
Iowa	9,943,372	5,916,950	South Dakota	5,037,384	2,502,340
Kansas	7,676,888	4,747,544	Tennessee	4,645,041	5,186,617
Kentucky	2,801,639	2,434,799	Texas	18,488,463	15,651,531
Louisiana	6,384,328	7,419,570	Utah	2,971,268	2,268,750
Maine	5,366,694	1,817,317	Vermont	965,702	646,702
Maryland	7,054,488	8,170,851	Virginia	5,772,781	5,750,409
Massachusetts	7,232,088	5,592,640	Washington	10,546,949	7,595,837
Michigan	27,540,921	20,976,632	West Virginia	4,735,271	8,314,195
Minnesota	17,229,526	6,008,994	Wisconsin	19,391,772	12,392,464
Mississippi	3,012,152	2,279,034	Wyoming	2,347,078	1,730,900
Missouri	6,809,857	5,969,849			
Montana	9,582,843	6,201,888	Total	401,620,000	333,826,000
Nebraska	4,969,243	3,477,409			

TABLE 4.—Sand and gravel sold or used by producers in the United States in 1951, by State, use, and class of operation

[Commercial unless otherwise indicated]

State	Sand							
	Glass		Molding		Building			
					Commercial		Government-and-contractor	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama			65,134	$126,887	820,025	$676,710	625	$15
Alaska					(1)	(1)	223,346	268,741
Arizona					345,825	381,778		
Arkansas	(1)	(1)	(1)	(1)	576,000	360,442		
California	(1)	(1)	42,455	106,882	11,697,957	10,175,138	327,752	426,377
Colorado					234,889	262,886	45,513	60,294
Connecticut					678,447	522,403	897,306	64,093
Delaware					(1)	(1)		
Florida					2,478,889	2,165,104		
Georgia	(1)	(1)	(1)	(1)	557,170	299,779		
Hawaii								
Idaho					224,633	234,963	11,723	3,908
Illinois	(1)	(1)	1,315,753	2,698,109	4,536,449	3,355,565	13,471	4,041
Indiana			570,934	745,659	1,755,367	1,344,643		
Iowa			(1)	(1)	1,445,921	1,155,281	410	328
Kansas			(1)	(1)	2,636,024	1,821,055	2,317	652
Kentucky			(1)	(1)	677,898	621,214	27,000	25,000
Louisiana			19,368	17,216	1,050,433	815,265		
Maine					35,539	18,191	13,500	2,250
Maryland	(1)	(1)			1,318,669	1,495,992		
Massachusetts			(1)	(1)	1,944,013	1,381,625	54,496	100,550
Michigan	(1)	(1)	2,398,239	2,137,963	3,703,072	3,013,235		
Minnesota	5,084	$13,369	(1)	(1)	1,849,444	1,383,709	4,092	1,818
Mississippi					499,441	325,744		
Missouri	408,998	852,664	90,804	182,593	1,894,324	1,398,290		
Montana					161,593	231,974	812,389	820,562
Nebraska			360	242	608,400	424,076	27,925	2,185
Nevada	(1)	(1)	63,939	141,423	99,092	160,176	6,045	19,995
New Hampshire					45,605	38,050		
New Jersey	(1)	(1)	1,590,589	3,624,613	1,854,360	1,532,618		
New Mexico					316,932	281,758	801	1,515
New York			462,169	1,200,242	5,503,950	5,257,088	3,384	1,211
North Carolina					534,898	360,241	16,230	8,115
North Dakota					148,588	134,231	4,483	4,695
Ohio	(1)	(1)	756,901	2,140,996	3,907,495	3,849,910	945	700
Oklahoma	(1)	(1)	(1)	(1)	1,042,279	832,776		
Oregon			2,552	1,134	879,566	955,148	12,575	4,649
Pennsylvania	(1)	(1)	357,226	837,444	4,332,703	5,316,718		
Puerto Rico							1,253	1,263
Rhode Island			(1)	(1)	(1)	(1)		
South Carolina					196,954	63,068		
South Dakota					379,963	321,871	1,084	5,990
Tennessee	(1)	(1)	261,823	728,645	1,205,481	1,499,963		
Texas	(1)	(1)	(1)	(1)	3,296,388	2,459,296	21,962	26,360
Utah			(1)	(1)	224,388	184,397	540	200
Vermont			699	518	30,928	24,580		
Virginia	(1)	(1)	17,716	13,291	975,152	848,500		
Washington	(1)	(1)	(1)	(1)	1,388,242	1,085,093	141,146	105,036
West Virginia	(1)	(1)	(1)	(1)	695,436	1,043,383		
Wisconsin			(1)	(1)	2,458,999	1,807,546	72,605	45,868
Wyoming					47,341	51,619	21,871	59,074
Undistributed [1]	5,101,506	13,546,306	1,090,342	2,119,583	208,819	195,227		
Total	5,515,588	14,412,339	9,107,003	16,823,440	71,503,981	62,168,319	2,767,000	2,065,000

[1] Figures that may not be shown separately are combined as "Undistributed."

TABLE 4.—Sand and gravel sold or used by producers in the United States in 1951, by State, use, and class of operation—Continued

State	Sand—Continued							
	Paving				Grinding and polishing [2]		Fire or furnace	
	Commercial		Government-and-contractor					
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	395,306	$269,116	100,618	$81,792				
Alaska	(1)	(1)	(1)	(1)	(1)	(1)		
Arizona	264,532	272,021	101,207	95,015				
Arkansas	419,279	352,589	39,166	29,375	2,550	$1,830		
California	4,628,940	3,661,058	1,377,447	529,857	90,337	251,697		
Colorado	34,419	33,045	97,077	96,214				
Connecticut	390,263	265,592	37,773	7,053				
Delaware	(1)	(1)						
Florida	423,841	268,190	30,000	15,750	(1)	(1)		
Georgia	324,461	201,003			69,215	147,073		
Hawaii			954	2,127				
Idaho	14,347	11,345	240,407	221,289				
Illinois	2,229,892	1,682,674	10,560	8,486	140,224	486,724	(1)	(1)
Indiana	1,737,845	1,329,185	12,738	4,128			(1)	(1)
Iowa	474,178	348,492	592,252	243,543	(1)	(1)		
Kansas	1,660,090	1,127,223	440,552	185,959	(1)	(1)	(1)	(1)
Kentucky	346,852	315,110						
Louisiana	755,363	909,958						
Maine	(1)	(1)	(1)	(1)				
Maryland	1,555,010	1,872,046	271,972	118,064	(1)	(1)	(1)	(1)
Massachusetts	783,361	538,137	187,181	172,197				
Michigan	3,201,993	2,681,402	446,771	97,600	242,443	96,940		
Minnesota	638,706	422,713	329,615	28,534	(1)	(1)		
Mississippi	192,941	114,470	242,192	162,704				
Missouri	776,220	572,466	16,120	24,180	186,547	302,216	(1)	(1)
Montana	46,374	42,041	414,738	89,492				
Nebraska	111,019	75,470	41,684	20,828	675	450		
Nevada	17,246	35,118	39,731	20,153				
New Hampshire	79,650	41,050	302,061	44,381				
New Jersey	1,167,790	870,996	346	42	126,254	372,507	28,821	$51,997
New Mexico			42,382	154,028	1,076	1,180		
New York	5,221,207	4,312,898	177,596	38,684				
North Carolina	334,393	173,967	3,679,550	924,022	(1)	(1)		
North Dakota	55,310	49,013	226,808	101,073				
Ohio	3,099,025	2,755,791	19,568	10,161	(1)	(1)	66,486	209,456
Oklahoma	386,691	279,704	169,785	49,525	(1)	(1)		
Oregon	375,521	407,165	1,211	1,794				
Pennsylvania	2,454,991	3,059,517			334,915	675,615	(1)	(1)
Puerto Rico			(1)	(1)				
Rhode Island	82,681	74,101	(1)	(1)				
South Carolina	50,026	14,604	19,399	7,395	(1)	(1)		
South Dakota	373,594	391,971	303,541	138,022				
Tennessee	554,537	535,422	58,070	38,300	13,070	25,386	(1)	(1)
Texas	1,998,749	1,672,060	98,914	55,808	48,389	285,374		
Utah	132,550	109,499	59,202	24,746				
Vermont	61,566	35,108	87,000	23,000	37,561	13,781		
Virginia	904,666	470,568	74,463	38,227	(1)	(1)	(1)	(1)
Washington	363,795	249,093	161,554	81,823	(1)	(1)		
West Virginia	789,857	982,354			(1)	(1)	49,774	57,212
Wisconsin	709,924	493,193	1,063,827	398,513	(1)	(1)		
Wyoming	(1)	(1)	276,149	132,245				
Undistributed [1]	170,624	153,053	560,340	247,486	183,656	450,876	326,459	473,017
Total	40,789,625	34,531,591	12,452,000	4,764,000	1,476,912	3,111,649	471,540	791,682

[1] Figures that may not be shown separately are combined as "Undistributed."
[2] Includes 549,955 tons of blast sand valued at $1,875,775.

TABLE 4.—Sand and gravel sold or used by producers in the United States in 1951, by State, use, and class of operation—Continued

State	Sand—Continued							
	Engine		Filter		Railroad ballast [3]		Other [4]	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	(1)	(1)			(1)	(1)	22,409	$45,728
Alaska							(1)	(1)
Arizona	(1)	(1)					(1)	(1)
Arkansas	(1)	(1)			(1)	(1)	(1)	(1)
California	(1)	(1)	10,310	$65,199	(1)	(1)	433,406	260,833
Colorado	(1)	(1)			5,544	$5,251	(1)	(1)
Connecticut	3,511	$3,511	5,861	2,977			19,018	7,607
Delaware	58,434	31,090						
Florida	(1)	(1)			(1)	(1)	(1)	(1)
Georgia	39,860	16,767	(1)	(1)			109,449	119,318
Hawaii								
Idaho	5,600	4,200			14,000	7,000	18,050	11,500
Illinois	119,536	116,099	9,803	28,934	130,318	81,525	385,353	638,134
Indiana	131,732	83,768			207,335	126,591	(1)	(1)
Iowa	41,006	47,168	(1)	(1)	19,884	11,010	167,737	89,402
Kansas	136,275	102,356	(1)	(1)	240,185	77,416	82,989	32,786
Kentucky	96,093	86,339			(1)	(1)		
Louisiana	7,798	6,737			(1)	(1)	(1)	(1)
Maine	(1)	(1)						
Maryland	(1)	(1)					6,000	1,500
Massachusetts	30,860	18,513	23,824	14,390			55,659	37,767
Michigan	100,812	58,458			(1)	(1)	63,868	23,611
Minnesota	53,975	48,334	(1)	(1)	110,520	35,025	12,444	6,707
Mississippi	(1)	(1)					(1)	(1)
Missouri	19,623	12,719	1,500	1,500	(1)	(1)	(1)	(1)
Montana							17,370	7,751
Nebraska	73,594	37,742			4,560	1,824	20,270	6,251
Nevada							(1)	(1)
New Hampshire	(1)	(1)	(1)	(1)				
New Jersey	23,075	16,957	40,139	120,831			33,002	117,223
New Mexico							6,303	2,839
New York	78,162	59,303	34,745	18,325	33,273	16,636	183,700	112,382
North Carolina	22,113	22,113	(1)	(1)	(1)	(1)	33,769	29,880
North Dakota			1,709	8,544			2,421	627
Ohio	60,915	106,457	11,027	34,965	5,074	2,470	194,465	225,427
Oklahoma	49,099	31,321	(1)	(1)			56,753	57,653
Oregon	20,852	8,987					1,104	1,303
Pennsylvania	297,061	647,302	(1)	(1)			177,425	405,837
Puerto Rico								
Rhode Island								
South Carolina	5,365	2,147	(1)	(1)			(1)	(1)
South Dakota					2,842	2,558	3,067	3,067
Tennessee	23,242	27,363	(1)	(1)	19,197	39,287	26,809	31,939
Texas	57,573	38,853	26,371	77,950	2,606	1,081	6,222	6,586
Utah	(1)	(1)					(1)	(1)
Vermont	2,827	2,652					910	350
Virginia	(1)	(1)					91,425	74,493
Washington	15,281	12,525			662	745	54,568	39,751
West Virginia	239,413	399,487					120,664	332,057
Wisconsin	(1)	(1)	(1)	(1)	18,881	9,684	168,641	87,550
Wyoming	(1)	(1)						
Undistributed [1]	395,216	290,485	37,450	111,109	272,788	186,738	217,956	284,810
Total	2,208,903	2,339,753	202,739	484,724	1,087,669	604,841	2,793,226	3,102,669

[1] Figures that may not be shown separately are combined as "Undistributed."
[3] Includes 140,011 tons of ballast sand valued at $17,745, produced by railroads for their own use.
[4] Includes 263,997 tons of sand valued at $78,686, used by railroads for fills and similar purposes.

TABLE 4.—Sand and gravel sold or used by producers in the United States in 1951, by State, use, and class of operation—Continued

State	Gravel							
	Building				Paving			
	Commercial		Government-and-contractor		Commercial		Government-and-contractor	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	927,019	$884,665	675	$15	546,851	$489,029	348,205	$50,640
Alaska	(1)	(1)	(1)	(1)	(1)	(1)	5,005,112	2,316,249
Arizona	332,740	402,668			581,628	608,307	1,044,349	418,107
Arkansas	90,560	97,019			872,926	968,895	1,406,736	1,139,808
California	12,277,073	11,774,362	1,554,665	1,734,460	7,560,915	6,767,856	6,016,223	4,022,881
Colorado	535,114	498,747	399,955	388,645	523,952	365,795	5,008,634	2,704,768
Connecticut	384,904	372,740			521,960	433,580	107,328	38,175
Delaware	(1)	(1)			(1)	(1)	301,250	85,000
Florida	1,210,520	1,606,857			69,651	116,263	30,000	15,750
Georgia							7,000	1,000
Hawaii							1,607	3,583
Idaho	324,130	309,079	30,020	13,504	531,454	493,217	2,467,426	1,603,514
Illinois	4,722,169	3,930,203	90,393	38,775	3,791,025	2,621,023	388,710	213,937
Indiana	1,816,338	1,582,430			3,483,783	2,705,934	310,459	105,216
Iowa	693,955	994,802			2,089,910	1,482,671	4,147,267	1,061,866
Kansas	163,913	146,211	7,000	500	1,193,389	866,436	1,059,329	326,260
Kentucky	489,606	578,253			199,742	213,204	406,552	118,023
Louisiana	1,587,616	1,909,349			2,594,826	3,548,857	285,430	156,821
Maine	93,931	57,854	(1)	(1)	202,260	180,198	4,384,426	1,291,120
Maryland	1,297,636	1,745,366			1,876,209	2,548,508	549,979	158,409
Massachusetts	2,160,651	1,955,799	63,265	116,476	864,451	621,659	872,752	322,938
Michigan	3,345,704	3,170,750	143,784	10,129	7,332,500	5,786,039	5,693,620	2,559,045
Minnesota	1,041,830	1,441,733	5,327	429	2,095,526	1,239,241	9,936,645	846,978
Mississippi	752,777	729,522	15,000	22,500	838,397	676,195	350,377	203,246
Missouri	1,087,205	1,016,319	53,725	39,796	982,824	700,018	712,509	486,839
Montana	226,479	290,424	2,458,351	2,471,599	498,562	282,317	4,410,586	1,702,417
Nebraska	1,765,074	1,373,334	6,250	2,000	1,795,318	1,231,964	481,056	280,046
Nevada	37,813	72,647	10,537	30,809	73,597	127,859	1,803,473	1,101,965
New Hampshire	34,580	54,400			87,000	66,000	1,683,796	259,914
New Jersey	813,578	981,872			406,119	364,012	23,020	3,094
New Mexico	389,489	360,299	645	2,640	41,740	39,673	226,175	193,522
New York	3,399,137	3,997,114	53,847	5,238	3,951,563	3,704,561	1,465,342	307,693
North Carolina	346,125	485,262	54,665	19,133	1,948,163	1,678,178	527,470	565,426
North Dakota	418,583	622,857	4,778	249	360,439	418,766	2,935,340	685,804
Ohio	3,126,081	3,201,638			5,789,682	5,828,142	336,204	162,436
Oklahoma	108,218	92,564			277,991	281,271	849,084	168,418
Oregon	1,156,707	1,240,815	118,312	171,633	2,449,733	2,665,653	5,114,514	3,369,642
Pennsylvania	3,803,824	4,873,097			2,537,568	3,251,660	512,718	85,254
Puerto Rico			(1)	(1)			58,797	76,631
Rhode Island	50,230	46,936			136,441	201,697	13,000	15,000
South Carolina							34,349	15,585
South Dakota	32,125	32,830	84,883	15,006	1,086,851	750,363	2,701,075	812,914
Tennessee	673,076	904,540	53,188	12,274	958,618	843,904	513,190	213,992
Texas	4,546,934	5,419,777	1,032	1,326	3,361,716	3,676,833	3,709,114	792,936
Utah	331,474	270,539	17,604	16,713	472,043	426,152	1,608,288	1,158,908
Vermont	22,991	36,845			140,289	126,259	580,931	383,609
Virginia	1,215,396	1,831,915			1,625,387	2,003,599	658,819	240,913
Washington	1,991,081	1,640,812	417,074	337,977	1,005,336	992,147	3,282,950	2,233,978
West Virginia	816,147	1,088,374			613,357	846,096	185,104	128,215
Wisconsin	1,811,616	1,375,320	365,764	406,423	3,523,599	2,283,607	6,932,145	3,736,721
Wyoming	58,657	66,652	59,588	131,208	321,057	243,545	1,428,480	968,856
Undistributed [1]	40,184	82,516	1,594,367	916,375	119,000	177,800		
Total	62,550,990	65,648,107	7,665,000	6,906,000	72,335,348	65,944,983	92,917,000	39,914,000

[1] Figures that may not be shown separately are combined as "Undistributed."

TABLE 4.—Sand and gravel sold or used by producers in the United States in 1951, by State, use, and class of operation—Continued

State	Gravel—Continued				Sand and gravel			
	Railroad ballast [5]		Other [6]		Total commercial		Total Government-and-contractor	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	(1)	(1)	66,060	$67,167	3,085,748	$2,674,078	450,123	$132,462
Alaska			2,504	5,771	(1)	(1)	(1)	(1)
Arizona	1,114	$1,114	2,226	2,226	1,545,544	1,690,223	1,145,556	513,122
Arkansas	228,074	188,902	(1)	(1)	2,423,038	2,399,931	1,445,902	1,169,183
California	141,072	97,617	367,609	241,907	37,651,365	34,566,260	9,276,087	6,713,575
Colorado					1,365,452	1,202,568	5,551,179	3,249,921
Connecticut	51,344	37,179	10,000	6,000	2,065,308	1,651,589	1,042,407	109,321
Delaware					353,313	278,643	301,250	85,000
Florida	4,371	4,415	117,169	45,115	4,358,573	4,269,182	60,000	31,500
Georgia					1,219,231	1,040,561	7,000	1,000
Hawaii							2,561	5,710
Idaho	53,200	12,141	122,401	45,604	1,307,815	1,129,049	2,749,576	1,842,215
Illinois	1,014,124	546,136	31,060	15,637	19,627,433	18,881,263	503,134	265,239
Indiana	761,531	574,518	69,616	55,015	10,707,617	8,654,592	323,197	109,344
Iowa	88,318	46,932	26,586	38,410	5,203,443	4,611,213	4,739,929	1,305,737
Kansas	(1)	(1)	2,371	6,310	6,167,690	4,234,173	1,509,198	513,371
Kentucky	440,528	364,333			2,368,087	2,291,776	433,552	143,023
Louisiana	54,471	41,288			6,098,898	7,262,749	285,430	156,821
Maine	136,273	64,502	(1)	(1)	501,389	350,810	4,865,305	1,466,507
Maryland			75,975	47,558	6,232,537	7,894,378	821,951	276,473
Massachusetts	(1)	(1)	61,519	33,669	6,054,394	4,880,479	1,177,694	712,161
Michigan	534,509	481,721	32,164	25,943	21,256,746	18,309,858	6,284,175	2,666,774
Minnesota	986,644	460,193	150,417	53,942	6,953,847	5,131,235	10,275,679	877,759
Mississippi	103,479	34,971	8,026	4,730	2,404,583	1,890,584	607,569	388,450
Missouri	397,986	240,315	16,086	4,343	6,027,503	5,419,034	782,354	550,815
Montana	311,321	209,377	225,080	53,934	1,486,779	1,117,818	8,096,064	5,084,070
Nebraska	31,882	18,893	1,176	2,104	4,412,328	3,172,350	556,915	305,059
Nevada	270,102	232,590	7,210	6,298	756,843	1,484,732	1,859,786	1,172,922
New Hampshire	14,672	2,442			274,553	213,632	1,985,857	304,295
New Jersey	(1)	(1)	75,716	165,247	6,629,017	9,102,916	23,366	3,136
New Mexico	51,562	48,984	3,151	1,419	810,253	736,152	270,003	351,705
New York	39,740	41,194	400,886	212,730	19,308,532	18,932,473	1,700,169	352,826
North Carolina	122,702	99,807	28,507	36,982	3,378,455	2,919,006	4,277,915	1,516,696
North Dakota	345,099	85,044	69,783	29,563	1,401,932	1,348,645	3,171,409	791,821
Ohio	809,672	555,018	928,260	1,230,138	19,074,181	21,221,594	356,717	173,297
Oklahoma	8,000	1,875	2,520	2,709	2,164,382	2,103,710	1,018,869	217,943
Oregon	305,807	238,024	65,885	51,396	5,257,727	5,569,625	5,246,612	3,547,718
Pennsylvania	84,193	53,341	53,855	95,653	15,224,746	21,403,286	512,718	85,254
Puerto Rico							99,628	99,657
Rhode Island					(1)	(1)	(1)	(1)
South Carolina					266,447	116,278	53,748	22,980
South Dakota	66,844	27,488	1,515	260	1,946,801	1,530,408	3,090,583	971,932
Tennessee	255,240	209,716			4,020,593	4,922,051	624,448	264,566
Texas	1,116,712	817,661	36,212	42,502	14,657,441	14,775,101	3,831,022	876,430
Utah	85,979	46,690	27,303	19,124	1,285,634	1,068,183	1,685,634	1,200,567
Vermont					297,771	240,093	667,931	406,609
Virginia			1,157	1,157	5,039,499	5,471,269	733,282	279,140
Washington	995,688	417,008	711,425	324,920	6,544,225	4,837,023	4,002,724	2,758,814
West Virginia	92,336	86,411			4,550,167	8,185,980	185,104	128,215
Wisconsin	1,018,815	451,943	601,059	201,987	10,957,431	7,804,939	8,434,341	4,587,525
Wyoming	129,615	75,571			560,990	439,517	1,786,088	1,291,383
Undistributed [1]	209,512	117,245	10,960	3,189	533,223	746,346	6,889,208	3,568,951
Total	11,362,531	7,032,599	4,413,449	3,180,659	285,819,504	280,177,355	115,801,000	53,649,000

[1] Figures that may not be shown separately are combined as "Undistributed."
[5] Includes 4,100,872 tons of ballast gravel valued at $1,709,860, produced by railroads for their own use.
[6] Includes 904,402 tons of gravel valued at $244,119, used by railroads for fills and similar purposes.

Government-and-Contractor Production.—As indicated in figure 2, the output of sand and gravel from noncommercial or Government-and-contractor operations in 1951 was 29 percent of the total tonnage compared with 30 percent in 1950 and 28 percent in 1949. The value of this output was 16 percent of the total dollar value of production compared with 18 percent in 1950.

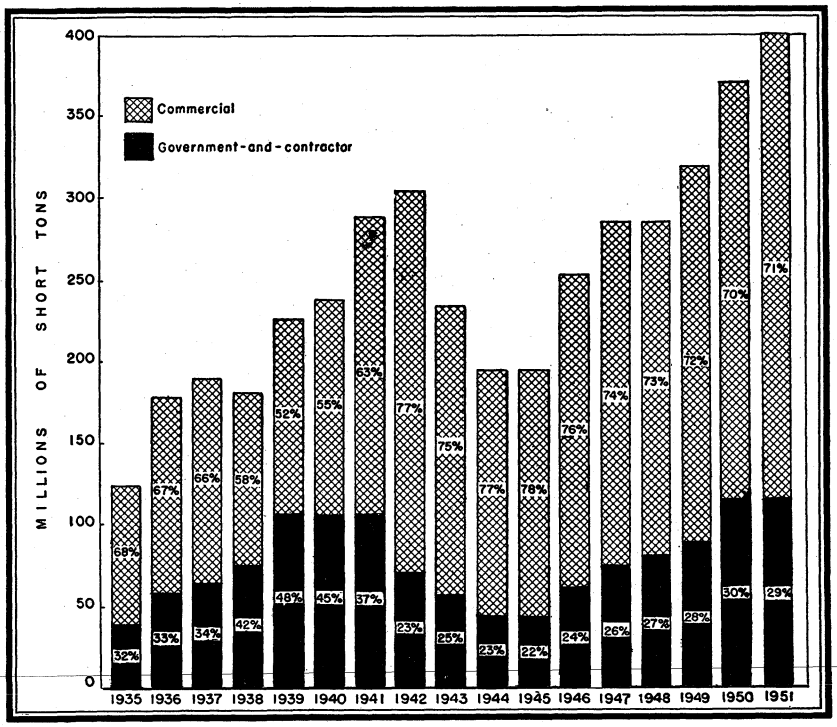

FIGURE 2.—Sand and gravel sold or used in the United States by producers, 1935–51, by class of operation.

TABLE 5.—Sand and gravel sold or used by Government-and-contractor producers in the United States,[1] 1947–51, by uses

Year	Sand				Gravel				Total Government-and-contractor sand and gravel	
	Building		Paving		Building		Paving			
	Quantity (thousand short tons)	Value (thousand dollars)	Quantity (thousand short tons)	Value (thousand dollars)	Quantity (thousand short tons)	Value (thousand dollars)	Quantity (thousand short tons)	Value (thousand dollars)	Quantity (thousand short tons)	Value (thousand dollars)
1947	1,551	717	6,049	2,316	2,208	1,541	65,289	29,923	75,097	34,497
1948	1,529	811	7,336	3,452	5,487	3,405	71,411	33,510	85,763	41,178
1949	1,604	959	7,424	2,820	3,133	2,235	75,738	31,093	87,899	37,107
1950	2,759	1,675	11,159	4,286	5,216	4,510	93,765	43,245	112,899	53,716
1951	2,767	2,065	12,452	4,764	7,665	6,906	92,917	39,914	115,801	53,649

[1] Includes Alaska, Hawaii, and Puerto Rico.

States reported 53 percent of the total Government-and-contractor output in 1951, counties 30, Federal agencies 15, and municipalities 2.

TABLE 6.—Sand and gravel sold or used by Government-and-contractor producers in the United States,[1] 1948–51, by type of producer

Type of producer	1948		1949		1950		1951	
	Thousand short tons	Average value per ton	Thousand short tons	Average value per ton	Thousand short tons	Average value per ton	Thousand short tons	Average value per ton
Construction and maintenance crews	42,531	$0.34	43,586	$0.31	48,742	$0.33	42,423	$0.35
Contractors	43,232	.62	44,313	.53	64,157	.59	73,378	.53
Total	85,763	.48	87,899	.42	112,899	.48	115,801	.46
States	45,166	.55	44,354	.44	61,798	.50	61,373	.43
Counties	32,260	.32	33,822	.31	37,841	.30	34,249	.37
Municipalities	1,881	.41	2,131	.40	2,109	.54	2,159	.47
Federal agencies	6,456	.83	7,592	.82	11,151	.89	18,020	.77
Total	85,763	.48	87,899	.42	112,899	.48	115,801	.46

[1] Includes Alaska, Hawaii, and Puerto Rico.

DEGREE OF PREPARATION

A large proportion of the output of commercial sand and gravel plants (89 percent in 1951), consists of prepared material, whereas Government-and-contractor production is chiefly an unprepared or bank-run product. As indicated in table 7, the latter group of producers used 61 percent of its output in unprepared form in 1951. The table shows that the relationship in both groups in 1951 varied in small degree from those of 1950.

TABLE 7.—Sand and gravel sold or used by producers in the United States,[1] 1950–51, by class of operation and degree of preparation

	1950			1951		
	Quantity		Average value per ton	Quantity		Average value per ton
	Short tons	Percent		Short tons	Percent	
Commercial operations:						
Prepared	232,761,019	90	$0.98	255,411,451	89	$1.03
Unprepared	24,795,612	10	.51	30,408,053	11	.53
Total	257,556,631	100	.94	285,819,504	100	.98
Government-and-contractor operations:						
Prepared	41,935,000	37	.87	45,488,000	39	.80
Unprepared	70,964,000	63	.24	70,313,000	61	.24
Total	112,899,000	100	.48	115,801,000	100	.46
Grand total	370,455,000		.80	401,620,000		.83

[1] Includes Alaska, Hawaii, and Puerto Rico.

SIZE OF PLANTS

The average plant output of commercial operators, except railroad plants, was about 120,000 short tons in 1951 compared with 101,000 in 1950 and 92,000 in 1949. Plants producing between 100,000 and 200,000 tons in 1951 supplied 20.1 percent of the total output. As in other recent years, this is the most productive group of plants. The number of small plants producing under 25,000 short tons decreased from 890 to 759, and those producing 25,000 to 50,000 tons decreased from 478 to 381. The trend toward larger producing units continued in 1951, when the number of plants with an output of over 1,000,000 tons increased from 22 to 27, with a total increase in output for this group exceeding 10,000,000 tons. Details of output, by size groups, are shown in table 8.

TABLE 8.—Comparison of number and production of commercial sand and gravel plants in the United States, 1950–51, by size group [1]

Size group, in short tons	1950				1951			
	Plants [2]		Production		Plants [2]		Production	
	Number	Percent of total	Thousand short tons	Percent of total	Number	Percent of total	Thousand short tons	Percent of total
Less than 25,000	890	35.6	8,952	3.6	759	32.5	7,604	2.7
25,000 to less than 50,000	478	19.1	17,242	6.8	381	16.3	13,734	4.9
50,000 to less than 100,000	439	17.6	31,058	12.3	435	18.6	31,006	11.1
100,000 to less than 200,000	367	14.7	51,733	20.5	394	16.8	56,318	20.1
200,000 to less than 300,000	147	5.9	35,676	14.1	146	6.2	35,538	12.7
300,000 to less than 400,000	73	2.9	24,999	9.9	81	3.5	27,694	9.9
400,000 to less than 500,000	31	1.2	13,933	5.5	49	2.1	21,528	7.7
500,000 to less than 600,000	22	.9	12,147	4.8	30	1.3	16,423	5.8
600,000 to less than 700,000	14	.6	8,745	3.5	17	.7	11,016	3.9
700,000 to less than 800,000	6	.2	4,388	1.7	10	.4	7,374	2.6
800,000 to less than 900,000	4	.1	3,386	1.4	5	.2	4,291	1.5
900,000 to less than 1,000,000	7	.3	6,775	2.7	4	.2	3,836	1.4
1,000,000 and over	22	.9	33,347	13.2	27	1.2	43,953	15.7
Total	2,500	100.0	252,381	100.0	2,338	100.0	280,315	100.0

[1] Excludes operations by or for States, counties, municipalities, and Federal Government agencies as follows—1950: 835 operations with an output of 112,899,000 tons of sand and gravel; 1951: 750 operations, 115,801,000 tons. Excludes operations by or for railroads as follows—1950: 142 operations with an output of 5,175,000 tons of sand and gravel; 1951: 131 operations, 5,504,000 tons. Includes Alaska.

[2] Includes a few companies operating more than 1 plant but not submitting separate returns for individual plants.

METHODS OF TRANSPORTATION

Of the total output of sand and gravel in 1951, 41 percent was moved by truck from commercial plants. Assuming the entire output of Government-and-contractor operations to be moved by truck, 70 percent of the domestic sand and gravel output was so transported, compared with 71 percent in 1950. Railroads carried 20 percent, the same as in 1950. Shipments by waterway, a method important in a few areas, remained at 6 percent, and unspecified transportation increased from 3 to 4 percent. As shown in table 9, at least 90 percent of the total tonnage shipped (commercial and Government-and-contractor) moved by truck or rail.

TABLE 9.—Sand and gravel sold or used in the United States,[1] 1949–51, by method of transportation

	1949		1950		1951	
	Thousand short tons	Percent of total	Thousand short tons	Percent of total	Thousand short tons	Percent of total
Commercial:						
Truck	131,725	41	150,892	41	166,992	41
Rail	70,035	22	72,489	20	80,062	20
Waterway	19,253	6	22,618	6	23,617	6
Unspecified	10,192	3	11,557	3	15,148	4
Total commercial	231,205	72	257,556	70	285,819	71
Government-and-contractor:[2] Truck	87,899	28	112,899	30	115,801	29
Grand total	319,104	100	370,455	100	401,620	100

[1] Includes Alaska, Hawaii, and Puerto Rico.
[2] Entire output of Government-and-contractor operations assumed to be moved by truck.

EMPLOYMENT AND PRODUCTIVITY

The total number of men employed in the sand and gravel industry in the United States during 1951 averaged about 27,000 compared with about 26,000 in 1950. The average number of days worked increased from 238 to 241. The average number of hours per man per day was the same in 1951 as in 1950, but the output per man per shift increased from 41 to 43.9 short tons. The highest production per man per shift was in the Michigan-Wisconsin area, followed in order by New York, California-Nevada, and the North Dakota-South Dakota-Minnesota areas. Table 10 gives a breakdown of employment and production of commercial sand and gravel plants, by regions.

TABLE 10.—Employment and average output per man in the commercial sand and gravel industry in the United States, 1947–51, by regions [1]

	Employment					Production (short tons)			
		Time employed					Average per man		Percent of commercial industry represented
	Average number of men	Average number of days	Total man-shifts	Man-hours		Commercial sand and gravel	Per shift	Per hour	
				Average man per day	Total				
1947	21,244	246	5,218,164	8.7	45,376,180	179,664,522	34.4	4.0	84.5
1948	21,895	246	5,389,167	8.6	46,103,345	200,706,763	37.2	4.4	86.0
1949	22,964	232	5,336,711	8.7	46,286,039	199,655,709	37.4	4.3	86.4
1950									
Maine, N. H., Vt., R. I., Mass., and Conn	937	217	203,067	8.5	1,731,961	9,312,123	45.9	5.4	94.9
N. Y	1,293	233	300,994	8.3	2,497,531	15,878,554	52.8	6.4	79.8
Pa., N. J., and Del	2,472	268	662,479	8.5	5,652,551	21,045,448	31.8	3.7	98.6
W. Va., Va., Md., and D. C.	1,712	254	434,436	9.0	3,916,817	10,858,056	25.0	2.8	84.1
S. C., Ga., Ala., Fla., and Miss	1,016	264	268,597	9.1	2,434,521	8,978,045	33.4	3.7	98.3
N. C., Ky., and Tenn	1,024	260	266,351	9.1	2,425,746	7,620,109	28.6	3.1	98.0
Ark., La., and Tex	2,386	279	665,735	9.2	6,133,414	22,285,420	33.5	3.6	95.0
Ohio	1,876	228	427,194	8.7	3,709,496	14,508,931	34.0	3.9	95.4
Ill. and Ind	2,233	235	525,549	8.4	4,423,427	25,239,236	48.0	5.7	93.8
Mich. and Wis	2,175	200	434,808	8.9	3,886,811	25,763,121	59.3	6.6	91.5
N. Dak., S. Dak., and Minn.	704	162	113,762	9.2	1,043,080	6,605,312	58.1	6.3	67.1
Nebr. and Iowa	744	211	157,329	9.4	1,482,332	7,911,238	50.3	5.3	88.8
Kans., Mo., and Okla	1,076	242	260,668	8.6	2,245,099	11,073,490	42.5	4.9	92.0
Wyo., Colo., N. Mex., Utah, and Ariz	629	208	130,871	8.5	1,110,598	4,732,405	36.2	4.3	89.4
Calif. and Nev	2,649	250	663,042	8.2	5,453,921	33,609,269	50.7	6.2	98.7
Mont., Wash., Oreg., and Idaho	1,350	190	256,958	8.2	2,103,427	10,999,531	42.8	5.2	85.8
Total	24,276	238	5,771,740	8.7	50,250,732	236,420,288	41.0	4.7	91.8
1951									
Maine, N. H., Vt., R. I., Mass., and Conn	839	222	186,173	8.7	1,611,343	9,126,864	49.0	5.7	94.7
N. Y	1,173	238	279,668	8.4	2,347,443	15,512,790	55.5	6.6	80.3
Pa., N. J., and Del	2,511	267	670,201	8.7	5,824,485	21,729,144	32.4	3.7	97.8
W. Va., Va., Md., and D. C.	1,623	264	428,898	8.9	3,800,624	11,634,653	27.1	3.1	73.5
S. C., Ga., Ala., Fla., and Miss	1,068	277	296,171	9.1	2,705,217	11,246,126	38.0	4.2	99.2
N. C., Ky., and Tenn	1,029	262	269,545	9.5	2,552,450	9,538,040	35.4	3.7	97.7
Ark., La., and Tex	2,215	263	581,552	9.1	5,296,383	20,029,109	34.4	3.8	86.4
Ohio	1,928	255	491,316	8.7	4,285,695	18,069,315	36.8	4.2	94.7
Ill. and Ind	2,200	250	549,788	8.5	4,649,775	28,846,950	52.5	6.2	95.1
Mich. and Wis	2,266	213	481,550	8.9	4,274,990	29,522,258	61.3	6.9	91.6
N. Dak., S. Dak., and Minn.	890	163	145,116	9.2	1,329,020	7,760,005	53.5	5.8	75.3
Nebr. and Iowa	684	217	148,619	9.5	1,410,108	7,762,284	52.2	5.5	80.7
Kans., Mo., and Okla	1,275	231	295,139	8.3	2,463,123	12,541,559	42.5	5.1	87.3
Wyo., Colo., N. Mex., Utah, and Ariz	583	200	116,635	8.3	966,856	4,940,508	42.4	5.1	88.7
Calif. and Nev	2,801	249	697,787	8.3	5,819,250	38,012,759	54.5	6.5	99.0
Mont., Wash., Oreg., and Idaho	1,290	190	245,449	8.3	2,031,167	12,063,618	49.1	5.9	82.6
Total	24,375	241	5,883,607	8.7	51,367,929	258,335,982	43.9	5.0	90.4

[1] Excludes plants operated by or directly for States, counties, municipalities, and Federal Government agencies.

CONSUMPTION

Sand and Gravel for Construction.—The demand for sand and gravel by the construction industry in 1951, as indicated by shipments from commercial plants, continued the upward trend that characterized 1950. Building sand sales increased 5 percent, paving sand 12 percent, building gravel 10 percent, and paving gravel 15 percent. These increases reflect an accelerating activity in building.

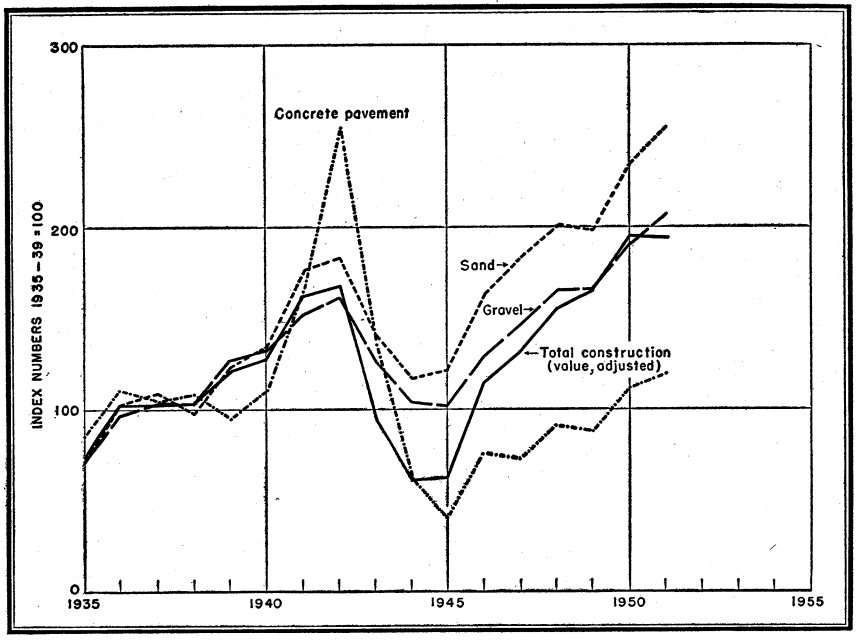

FIGURE 3.—Quantity of sand and gravel produced compared with total construction (value, adjusted to 1939 prices), and concrete pavements (contract awards, square yards) in the United States, 1935–51. Data on construction from Statistical Abstracts of the United States, and on pavements from Survey of Current Business.

Industrial Sands.—The output of nearly all classes of industrial sands increased in 1951: Molding sand 12 percent; glass sand 7 percent; grinding and polishing sand 14 percent; fire and furnace sand 26 percent; and engine sand 10 percent. Such advances were to be expected because of the high level of industrial activity. Sales of filter sand, however, declined 27 percent.

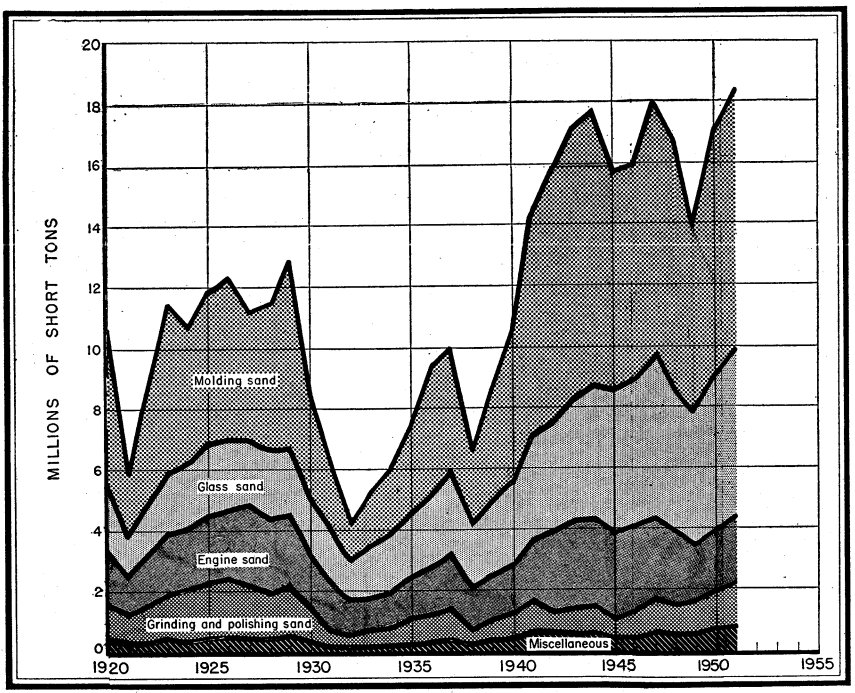

FIGURE 4.—Production of industrial sands in the United States, 1920–51.

PRICES

The average value for all shipments of sand and gravel in 1951, commercial and Government-and-contractor operations combined, increased 4 percent over the 1950 average. Moderate gains in unit values were recorded for most of the uses, but the increases for fire and furnace, filter, and railroad ballast sand ranged from 19 to 24 percent. The value per ton of total Government-and-contractor sales declined 4 percent.

FOREIGN TRADE [1]

Imports of sand and gravel in 1951 (omitting glass sand) were 8 percent greater in quantity and 18 percent higher in value than in 1950. Belgium furnished all but a small part of the glass sand, while Canada supplied 314,105 short tons of "other sand" and 149,766 tons of gravel. Importations from other countries were very small.

[1] Figures on imports compiled by M. B. Price and E. D. Page, of the Bureau of Mines, from records of the U. S. Department of Commerce.

TABLE 11.—Sand and gravel imported for consumption in the United States, 1942–51, by classes

[U. S. Department of Commerce]

Year	Sand				Gravel		Total	
	Glass sand [1]		Other sand [2]					
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1942	(3)	$5	408,825	$297,122	146,116	$60,389	554,941	$357.516
1943	18	363	296,262	206.145	86,924	63,381	383,204	269,889
1944	15	181	209,255	129,632	67,929	31,208	277,199	161,021
1945	(3)	148	200,280	126,102	80,861	43,976	281,141	170,226
1946	5,006	9,102	262,484	194.820	83,860	25,847	351,350	229,769
1947	7,804	12,532	297.481	283,884	177.244	100,665	482,529	397,081
1948	16,914	24,134	336,898	302,117	89,174	30,411	442.986	356,662
1949	11,491	20.152	287,452	277,564	135.227	19,194	434,170	316,910
1950	9,191	25,481	290,025	266,065	146,079	29,011	445,295	320,557
1951	[4] 6,278	[4] 91,424	319,584	317,205	149,766	31,189	475,628	439,818

[1] Classification reads: "Sand containing 95 percent or more silica and not more than 0.6 percent oxide of iron and suitable for manufacture of glass."
[2] Classification reads: 1942–47: "Sand, n. s. p. f."; 1948–51: "Sand, n. s. p. f., crude or manufactured."
[3] Less than 0.5 ton.
[4] Includes 71 short tons valued at $80,847 from West Germany, believed to consist of a special type of silica not ordinarily included with glass sand.

TECHNOLOGY

Rejection of all minus-2-inch pit-run material in order to eliminate most of the objectionable constituents was a unique characteristic of a North Dakota sand-and-gravel operation.[2] This plant was producing coarse aggregate for Garrison Dam. The fine aggregate was being produced at another plant using a new type of hydraulic classifier known as the Super Sorter. At this operation coarse gravel was being reduced to fine sizes with rod mills.[3]

Recovery of sand and gravel from an extensive, although thin-bedded deposit, using both portable and stationary equipment was described.[4] Equipment and methods used abroad contrasted with those employed in the United States were covered in a description of a sand-and-gravel plant at Leeds, England.[5]

A large-scale operation handling up to 17,000 tons a day was described.[6] Flexibility and efficiency in meeting diverse specifications are attained by using a radial, belt-conveyor stockpiling system at one midwestern plant.[7]

[2] Rock Products, Producing Quality Aggregates from Deposit Containing Questionable Materials: Vol. 54, No. 11, November 1951, pp. 74–77.
[3] Lenhart, Walter B., Producing Sand for Garrison Dam: Rock Products, vol. 54, No. 11, November 1951, pp. 78–80.
[4] London, Edward F., Variety of Equipment Produces Colorado River Gravel: Excavating Eng., vol. 45, No. 11, November 1951, pp. 22–27, 58–59.
[5] Maw, Clarence, Producing Sand and Gravel in England: Rock Products, vol. 54, No. 6, June 1951, pp. 98–102.
[6] Lenhart, Walter B., Handling Large Tonnages of Gravel: Rock Products, vol. 54, No. 7, July 1951, pp. 56–59, 92.
[7] Rock Products, Stockpiling Sand and Gravel is the Answer to Low-Cost Production: Vol. 54, No. 10, October 1951, pp. 118–124.

Aggregate producers were doubtless interested in the large-scale use of fly ash as an additive in concrete used at Hungry Horse Dam in Montana. Such use was described in an article on various phases of aggregate production.[8] The economy and convenience of maintaining a central repair and spare parts unit to serve a multiple plant were discussed.[9]

A unique method of ocean-bottom dredging, pipeline conveyance, and wet placement of sand fill without subsequent compacting was described.[10] The high degree of efficiency that may be obtained in a portable sand and gravel plant was exemplified by a South Dakota operation.[11] The use of crushed olivine rock as foundry sand was a new development in regions like Washington, where silica sands are scarce.[12]

The National Sand and Gravel Association continued its fundamental research on aggregates and related subjects. Work conducted in 1951 included freezing and thawing cycles for accelerated weathering tests, air-entraining problems, and effects of additions of crusher screenings to sands. A method was devised for predicting the approximate 28-day strength of concrete from a known 7-day strength. Some of the accomplishments were outlined in Technical Information Letter 87, issued by the National Sand and Gravel Association, 1325 E Street NW., Washington, D. C., to member companies on December 19, 1951.

[8] Lenhart, Walter B., Producing Sand-and-Gravel Aggregates for Hungry Horse Dam: Rock Products, vol. 54, No. 2, February 1951, pp. 98-105.
[9] Trauffer, Walter E., Preventive Maintenance Pays Off for Lyman-Richey: Pit and Quarry, vol. 43, No. 12, June 1951, pp. 82-86.
[10] Engineering News-Record, Sand Brought Back from Watery Grave Saves Money on Hydraulic Fill Jobs: Vol. 147, No. 11, Sept. 13, 1951, pp. 30-33.
[11] Excavating Engineer, Mobile Plant and Crew Make Gravel Pay: Vol. 45, No. 10, October 1951, pp. 20-22.
[12] Rock Products, Synthetic Foundry Sands: Vol. 54, No. 7, July 1951, p. 84.

Secondary Metals—Nonferrous

By Archie J. McDermid[1]

GENERAL SUMMARY

THE SCARCITY of nonferrous metals which had become acute in 1950 continued throughout 1951. Secondary production was limited only by the availability of scrap for processing. Increased receipts of lead and aluminum scrap resulted in higher recovery of those metals for 1951 compared with 1950, whereas less copper and zinc scrap was available in 1951 than in 1950, and the secondary recovery of each was correspondingly lower. To provide adequate supplies of metal for military purposes and essential civilian needs, Government controls initiated in 1950 were increased in 1951. As scrap metals became scarcer prices rose higher, making ceiling price regulations necessary. Price ceilings for refined metal were generally established by the General Ceiling Price Regulation, which set maximum prices at the highest prices received by individual producers between December 19, 1950, and January 25, 1951, inclusive. The large number of scrap items of different compositions and the great variability of scrap prices made it difficult to determine and enforce

TABLE 1.—Salient statistics of nonferrous secondary metals recovered from scrap processed in continental United States, 1950–51

Metal	From new scrap		From old scrap		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1950						
Aluminum	167,308	[1] $54,943,947	76,358	[1] $25,075,967	243,666	[1] $80,019,914
Antimony	3,091	1,818,126	18,771	11,041,102	21,862	12,859,228
Copper	492,028	204,683,648	485,211	201,847,776	977,239	406,531,424
Lead	54,755	14,783,850	427,520	115,430,400	482,275	130,214,250
Magnesium	[1] 4,042	[1] 1,780,905	[1] 5,434	[1] 2,394,220	[1] 9,476	[1] 4,175,125
Nickel	4,014	3,837,384	4,781	4,570,636	8,795	8,408,020
Tin	11,298	21,592,060	24,183	46,217,098	35,481	67,809,158
Zinc	251,933	71,548,972	74,097	21,043,548	326,030	92,592,520
Total		[1] 374,988,892		[1] 427,620,747		[1] 802,609,639
1951						
Aluminum	216,017	78,759,798	76,591	27,925,079	292,608	106,684,877
Antimony	4,007	3,539,784	19,936	17,611,462	23,943	21,151,246
Copper	474,158	229,492,472	458,124	221,732,016	932,282	451,224,488
Lead	76,452	26,452,392	441,658	152,813,668	518,110	179,266,060
Magnesium	5,366	2,629,340	6,160	3,018,400	11,526	5,647,740
Nickel	3,788	4,297,865	4,814	5,461,964	8,602	9,759,829
Tin	11,476	29,449,252	22,958	58,913,901	34,434	88,363,153
Zinc	246,203	89,617,892	68,174	24,815,336	314,377	114,433,228
Total		464,238,795		512,291,826		976,530,621

[1] Revised figure.

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Department of Commerce.

ceilings for scrap by means of the general regulation. Specific ceiling price regulations for most nonferrous scrap metals were therefore established during May and June. In addition to other measures used, the National Production Authority reinstituted the Controlled Materials Plan for copper, steel, and aluminum that had been in effect in World War II. Copper raw materials were placed under complete allocation, effective July 13, 1951.

TABLE 2.—Secondary metals recovered as unalloyed metal, in alloys, and in chemical compounds in the United States, 1947–51, in short tons

Metal	1947	1948	1949	1950	1951
Aluminum	344,837	286,777	180,762	243,666	292,608
Antimony	22,984	21,592	18,061	21,862	23,943
Copper	961,741	972,788	713,143	977,239	932,282
Lead	511,970	500,071	412,183	482,275	518,110
Magnesium	9,503	7,553	5,962	[1] 9,476	11,526
Nickel	9,541	8,850	5,680	8,795	8,602
Tin	30,054	30,124	24,901	35,481	34,434
Zinc	310,793	324,639	237,813	326,030	314,377

[1] Revised figure.

Increased generation of aluminum process scrap, together with about the same quantity of old scrap as in 1950, provided aluminum-scrap consumers with enough raw material to increase their 1951 recovery of secondary aluminum 20 percent over that for 1950 in spite of the decline in activity in the second half of the year. The rise in secondary lead output for 1951 was due to increased consumption of used battery plates and drosses. Scarcity of scrap, following establishment of price ceilings, depressed operations in copper and zinc scrap enough to lower total secondary recovery for each below that in 1950.

SCOPE OF REPORT

Table 3 classifies the plants canvassed in nonferrous secondary metal surveys by type of operation and kind of material consumed. Plants have been recorded in more than one column if they used scrap items of more than one base; some smelters are listed as lead smelters, aluminum smelters, and copper smelters because they consumed lead-, aluminum-, and copper-base scrap. In the same way, some foundries have been counted as both aluminum and brass foundries. The tabulation of plants in some categories is subject to limitations. The large number of foundries and the small size of many of them make it impossible to obtain reports from all units. On the other hand, a few large corporations operating more than one plant prefer to file consolidated reports, in which the number and location of plants are not given. As a rule, response by the larger plants is excellent, so that coverage of quantities of metals consumed is better than coverage of plants.

The increase in primary aluminum plants from 32 in 1950 to 51 in 1951 results both from better coverage of and an increase in fabricating plants. There was also better coverage of aluminum foundries in 1951. The 131 secondary aluminum smelters include 56 alloy-ingot makers classed by NPA as limited smelters because their

TABLE 3.—Number and classification of plants in the United States consuming nonferrous scrap metals, refined copper, and copper-alloy ingots in 1951

Kind of plant	Type of materials used				
	Aluminum	Copper	Lead and tin	Zinc	All nonferrous types
Primary plants	[1] 51	[2] 16	8		
Secondary smelters	[3] 131	[4] 115	265	122	
Distillers				[5] 31	
Chemical plants	15	42		24	
Brass mills		65			
Wire mills		[6] 16			
Foundries and miscellaneous manufacturers	[7] 1,000		30	[8] 81	[9] 2,800

[1] Includes 12 aluminum-reduction plants and 39 rolling mills and extrusion plants which consumed aluminum scrap or ingot.
[2] Primary refineries and smelters which consumed copper-base scrap.
[3] Includes 128 aluminum-alloy ingot makers and 3 military aluminum smelters.
[4] Includes 78 secondary copper smelters and 37 smelters using copper scrap in other than copper alloys.
[5] Includes 20 secondary plants, 10 of which are zinc-dust plants, and 11 primary producers which used scrap in addition to ore.
[6] Refers to companies operating wire mills. Some companies operate more than 1 plant.
[7] Includes foundries using either aluminum scrap or ingot.
[8] Includes galvanizers, die casters and zinc rolling mills.
[9] Chiefly brass foundries, but some iron foundries, steel plants, and miscellaneous manufacturers. Any or all types of nonferrous scrap were used by these consumers. Figure shown is the number of plants on Bureau of Mines mailing list. Reports received estimated to account for about 91 percent of the total foundry output.

function was to melt scrap into ingot without analysis for shipment to smelters, classed as approved, for use in making specification alloy. The number of copper-chemical plants declined from 52 in 1950 to 42 in 1951 partly because some plants were unable to obtain copper materials for chemical manufacture. Some foundries expanded their operations to include brass ingot making, and some secondary copper smelters added brass-mill facilities to their establishments.

The reports from industry, on which data in this chapter are based, are received monthly from smelters, brass and aluminum rolling mills, wire mills, primary producers and some foundries and manufacturers. All the brass foundries, some manufacturers, and a number of the smaller aluminum foundries are canvassed on an annual basis.

Detailed information on primary metals may be found in the chapters devoted to those metals.

Definitions of terms used in this chapter follow:

Secondary metals are metals or alloys recovered from scrap and residues. The term "secondary" applies only to the source of the metal and has no relation to the type of product recovered, as to quality, degree of purity, or physical characteristics.

Scrap metals are divided into three main categories: Old scrap, process (or plant) scrap, and defective finished or semifinished articles returned by purchasers to be reworked.

Old scrap consists of metal articles that have been discarded because of wear, damage, or obsolescence, usually after serving a useful purpose. Typical examples of old scrap are discarded trolley wire, battery plates, railroad-car boxes, fired-cartridge cases, automobile crank cases, used pipe, plumbing fixtures from building demolition, lithographers' plates, and obsolete military equipment (frequently unused).

Process scrap or *plant scrap* is that generated during the manufacture of articles for ultimate consumption. Typical examples of process scrap are clippings, turnings, borings, skimmings, slags, and drosses. Process scrap is divided into two classifications: *Home scrap*, consumed in the plant of generation, and *new scrap*, which is consumed elsewhere, either after sale to another company or shipment to another plant of the same company.

Defective articles, the third main class of scrap, are classed as new scrap for tabulation purposes.

In this chapter consumption of old and new scrap only is tabulated, no record being kept, in nonferrous metal canvasses, of home scrap. Scrap generated in a machine shop and consumed in a foundry at the same plant location is considered home scrap, and its consumption is not tabulated. Consumption of scrap is always measured at the point where it loses its identity as scrap and becomes secondary metal. Consumption of scrap treated for a toll or conversion charge is reported by the plant at which the scrap is consumed, not by the plant owning the material.

Borings and turnings and other items of process scrap, when consumed outside the plant where generated, are new scrap, whether clean, rusty, or oily and whether generated recently or long before reclamation. Residues are new scrap if generated in processing scrap or refined metal. For example, flue dust from smelting brass scrap is new scrap. Zinc-chemical residues resulting from the consumption of zinc dust in the manufacture of sodium hydrosulfite are also new scrap. On the other hand, residues generated in processing ore or concentrates are not scrap but "primary residue." Old mine tailings are primary residue because generated in processing ore. Aircraft plants melt zinc-die alloys and antimonial lead to make dies and remelt the dies to make new ones whenever necessary. The same material may be remelted several times during a year. In such cases the dies are not considered to be scrap. If, however, they are sold to a smelter for redistillation or remelting they are considered to be old scrap.

Purchased scrap is a term used in nonferrous-scrap-metal questionnaires to cover all scrap that should be reported. It includes new scrap, old scrap, and toll scrap, all of which have passed through commercial transactions. It also includes scrap generated at one plant and transferred to another plant of the same company for processing, which usually involves transportation charges. The term also includes scrap reclaimed in shipyard repair work and from line operations at railroad foundries, although no definite financial transaction may have resulted.

SECONDARY ALUMINUM

The recovery of secondary aluminum from scrap totaled 292,608 short tons in 1951, a 20-percent increase over the 243,666 tons reclaimed from scrap processed in 1950. Prices of the various grades of scrap and secondary ingot fluctuated widely during the year. The value of aluminum recovered from scrap, computed on the basis of average prices received by primary producers for virgin pig, was $106,684,877. The average value of primary pig increased from 16.42

cents per pound in 1950 to 18.23 cents in 1951. The recoverable aluminum-alloy content of new nonferrous scrap consumed in 1951 increased 29 percent from 1950 to 216,017 short tons. Recovery from old scrap, however, remained about the same, totaling 76,591 tons compared with 76,358 tons in 1950.

TABLE 4.—Aluminum recovered from scrap processed in the United States, 1950–51, in short tons

Recoverable aluminum-alloy content of scrap processed			Aluminum recovered [1] from scrap processed		
Kind of scrap	1950	1951	Form of recovery	1950	1951
New scrap:					
Aluminum-base [2]	166,891	215,753	As metal	2,140	5,341
Copper-base	134	84	Aluminum alloys	239,577	283,938
Zinc-base	135	122	In brass and bronze	270	385
Magnesium-base	148	58	In zinc-base alloys	868	1,204
			In magnesium alloys	480	346
Total	167,308	216,017	In chemical compounds	331	1,394
			Grand total	243,666	292,608
Old scrap:					
Aluminum-base [3]	75,616	75,942			
Copper-base	104	129			
Zinc-base	429	238			
Magnesium-base	209	282			
Total	76,358	76,591			
Grand total	243,666	292,608			

[1] In accordance with common usage, the term "aluminum" covers aluminum alloys, and the figures include all constituents of the alloys recovered from aluminum-base scrap.
[2] Recoverable aluminum content of new aluminum-base scrap was 156,978 tons in 1950 and 201,563 tons in 1951.
[3] Recoverable aluminum content of old aluminum-base scrap was 70,981 tons in 1950 and 70,713 tons in 1951.

Despite a partial interruption of aluminum-scrap flow beginning in August, due to a price rollback ordered in June by the Office of Price Stabilization, consumption for 1951 increased to 332,296 tons compared with 273,192 tons in 1950. The increase was partly due to the previously mentioned increased coverage of foundries. Consumption of old scrap decreased, and the large increase in new scrap consumption was partly due to the increased usage of aluminum during 1950 and 1951. Apparent consumption of primary aluminum was 898,336 tons in 1950 and 975,244 in 1951 compared with 635,956 in 1949. A considerable part of the process scrap generated from the 1950 consumption was remelted in 1951, and it was expected that 1952 new-scrap consumption would reflect the high 1951 usage of primary aluminum.

Price ceilings for aluminum scrap and secondary ingot, established June 29, 1951, were below world prices, and scrap normally coming into the United States was diverted to foreign markets during the last half of the year. Competition for scrap between rolling mills and secondary smelters was keen throughout 1951. After establishment of price ceilings process scrap tended to return to the source of the ingot or sheet from which the scrap was generated. Production of primary ingot was so much greater than that of secondary ingot that if all process scrap was returned to the mill or smelter that supplied the raw material, secondary smelters would receive only a small percentage of the total. To correct the situation a section was added

TABLE 5.—Stocks and consumption of new and old aluminum scrap at secondary smelters in the United States in 1951, gross weight in short tons [1]

Scrap item	Stocks, beginning of year [2]	Receipts	Consumption			Stocks, end of year
			New scrap	Old scrap	Total	
2S and 3S sheet and utensils	952	21,574	11,815	9,148	20,963	1,563
Castings and forgings	2,268	37,247	12,982	26,123	39,105	410
Alloy sheet	1,219	44,332	35,944	8,572	44,516	1,035
Borings and turnings	1,439	53,856	54,271	----------	54,271	1,024
Grindings and sawings	227	1,981	2,117	----------	2,117	91
Dross and skimmings	657	27,120	26,582	----------	26,582	1,195
Foil and wire	350	5,108	726	4,429	5,155	303
Aircraft	991	13,001	----------	13,425	13,425	567
Pistons	125	3,324	----------	3,372	3,372	77
Irony aluminum	627	12,016	----------	12,383	12,383	260
Miscellaneous	360	11,137	10,450	----------	10,450	1,047
Total	9,215	230,696	154,887	77,452	232,339	7,572

[1] Excludes secondary smelters owned by primary aluminum companies.
[2] Revised.

TABLE 6.—Stocks and consumption of new and old aluminum scrap at primary producers and fabricators in the United States in 1951, gross weight in short tons

Scrap item	Stocks, beginning of year [1]	Receipts	Consumption			Stocks, end of year
			New scrap	Old scrap	Total	
2S and 3S sheet and utensils	1,029	13,975	14,139	289	14,428	576
Castings and forgings	167	2,951	2,920	182	3,102	16
Alloy sheet	6,481	43,831	48,740	328	49,068	1,244
Borings and turnings	102	7,325	7,057	----------	7,057	370
Dross and skimmings	25	33	28	----------	28	30
Foil and wire	44	1,237	321	928	1,249	32
Aircraft	427	505	----------	789	789	143
Miscellaneous	364	4,705	2,487	2,255	4,742	327
Total	8,639	74,562	75,692	4,771	80,463	2,738

[1] Revised.

TABLE 7.—Stocks and consumption of aluminum scrap at foundries and miscellaneous manufacturers in the United States in 1951, gross weight in short tons

Scrap item	Stocks, beginning of year [1]	Receipts	Consumption			Stocks, end of year
			New scrap	Old scrap	Total	
2S and 3S sheet and utensils	367	2,865	1,435	1,646	3,081	151
Castings and forgings	284	5,680	2,246	3,595	5,841	123
Alloy sheet	58	1,849	1,545	301	1,846	61
Borings and turnings	34	4,583	4,562	----------	4,562	55
Dross and skimmings	----------	4,012	2,582	----------	2,582	1,430
Foil and wire	201	157	13	102	115	243
Aircraft	----------	511	----------	502	502	9
Pistons	----------	209	----------	200	200	9
Miscellaneous	1	931	294	471	765	167
Total	945	20,797	12,677	6,817	19,494	2,248

[1] Revised.

to National Production Authority Order M–22, Distribution and Use of Aluminum Scrap, in an amendment effective December 17, 1951. The new section provided that NPA might issue specific directives to any person as to source, destination, consignee, or amount of scrap to be delivered or acquired by such person. The amendment, however, took effect too late to affect the flow of scrap in 1951.

The aluminum-alloy ingot produced by the secondary smelters is used chiefly by the foundries and die casters, and these plants also use some primary ingot and scrap as an auxiliary raw material. The independent secondary smelters consumed 70 percent, primary producers and independent fabricators 24 percent, and foundries and miscellaneous manufacturers 6 percent of the total aluminum-base scrap used in 1951; these percentages were virtually the same in 1950. The term "fabricators" includes aluminum rolling mills and extrusion plants, but not manufacturers of finished products.

Effective August 1, 1951, the Bureau of Mines report form for secondary aluminum smelters was changed to bring the classification of ingot up to date and to coincide as nearly as possible with the classification used by the industry. It is therefore necessary to show production for the first 7 months under the old and that for the last

TABLE 8.—Production of secondary aluminum and aluminum-alloy products in the United States, 1949–51, gross weight in short tons

Product	1949	1950	1951 [1]	
			January–July	August–December
Secondary aluminum ingot: [2]				
Pure aluminum (98.5 percent)	326	2,105	2,422	2,916
Silicon (Cu max., 1 percent)	7,376	10,393	10,930	
Aluminum-silicon (Cu max., 0.6 percent) alloys				5,048
Silicon (Cu, 1 to 2.5 percent)	3,532	5,395	3,678	
Aluminum-silicon (Cu, 0.6 to 2 percent) alloys				3,028
No. 12 alloy and variations	10,605	18,063	9,263	6,534
Other copper alloys (Si max., 2.5 percent)	[3] 1,955	[4] 6,043	[4] 2,594	
Aluminum-copper (Si max., 1.5 percent) alloys				[4] 2,225
Copper-silicon (each over 2.5 percent) alloys	52,900	90,639	62,177	
No. 319 alloy and variations				13,838
AXS 679 alloy and variations				13,226
Aluminum-silicon-copper-nickel alloys	5,152	7,466	7,433	3,062
Deoxidizing and other dissipative uses	23,828	39,886	24,708	15,801
Aluminum-base hardeners	2,209	4,697	3,399	2,253
Aluminum-magnesium and aluminum-zinc alloys	2,731	4,907	3,292	
Aluminum-magnesium alloys				331
Aluminum-zinc alloys				1,342
Miscellaneous	6,892	[5]—10,347	1,288	881
Total	117,506	179,247	131,184	70,485
Secondary aluminum recovered by primary producers and independent fabricators [6]	61,990	64,667	77,377	
Aluminum powder [7]	17	35		
Aluminum-alloy castings	3,872	11,439	15,394	
Aluminum in chemicals	441	331	1,394	

[1] Classification of ingot for reporting to the Bureau of Mines was changed Aug. 1, 1951.
[2] Gross weight, including copper, silicon and other alloying elements at independent secondary smelters; total secondary aluminum and aluminum-alloy ingot contained 2,206 tons of primary aluminum in 1949; 5,339 tons in 1950; and 12,353 tons in 1951.
[3] Includes 1,785 tons produced at Naval Air Stations.
[4] Of the totals, 1,810 tons was produced in 1950; 641 tons in January–July, 1951; and 797 tons in August–December 1951, at Naval Air Stations and United States Air Force Bases.
[5] Negative production indicates consumption of this material at smelters greater than production.
[6] Includes aluminum rolling mills and extrusion plants, but not manufacturers of final products.
[7] Does not include production measured as ingot for graining, powder, atomizing, or chemical purposes.

5 months under the new classification. Total production of secondary aluminum-base ingot as reported to the Bureau of Mines was 201,669 short tons (an increase of 13 percent) compared with 179,247 tons produced in 1950. Shipments of aluminum castings were 275,217 short tons, according to data published by the Bureau of the Census. Assuming that production equaled shipments and that all of the 201,669 tons of secondary ingot produced was consumed in making castings, the other seventy-odd-thousand tons of castings was made from scrap and from ingot supplied by primary producers.

Imports of aluminum scrap, most of which were actually in pig form, in 1951 were 20,009 tons compared with 67,959 tons in 1950. Exports were 1,460 tons in 1951 and 800 tons in 1950.

The monthly average price paid by dealers for cast-aluminum scrap was 15.75 cents a pound in January and 17.25 cents in May and June but dropped to 7.75 cents in July and remained there for the rest of 1951. Ceiling prices for aluminum scrap and secondary aluminum ingot were established on June 29, 1951. The monthly average price for new aluminum clippings was 19.25 cents in January, reached 21.75 cents in May and June, and averaged 10.50 cents for the remainder of 1951.

The monthly average price of secondary aluminum ingot (No. 12 alloy, at New York, as quoted by the American Metal Market) was 30.14 cents a pound in January, rose to 31.12 in April and May, was 30.57 cents in June, and was quoted at 19.50 cents for the remaining months of the year, following establishment of secondary aluminum ingot ceiling prices. The price of primary aluminum pig (New York, American Metal Market) was 19 cents a pound throughout the year.

SECONDARY ANTIMONY

Recovery of secondary antimony in 1951 from lead- and tin-base scrap totaled 23,943 short tons valued at $21,151,246, an increase of 10 percent in quantity and 64 percent in value over the 21,862 tons valued at $12,859,228 recovered in 1950. The values are computed at 29.41 cents per pound for 1950 and 44.17 cents for 1951, the average New York selling price in each year.

Secondary copper and lead smelters recovered 20,446 tons (85 percent of the total), primary lead smelters 2,060 tons (9 percent), and manufacturers 1,437 tons (6 percent).

Consumption of battery plates increased 19 percent over 1950 and yielded 55 percent of all antimony reclaimed. Antimony reclaimed in antimonial lead increased 26 percent, but recovery declined in other lead alloys and in tin-base alloys.

Data on consumption of scrap from which antimony was recovered may be found in the tables on consumption of lead- and tin-base scrap in the Lead-Scrap Consumers Reports published monthly by the Bureau of Mines. Products in which antimony was recovered are included in the lead- and tin-products table in the secondary lead section of this chapter. So far as known, all secondary antimony was reclaimed in lead and tin alloys, none being recovered as unalloyed metal.

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TABLE 9.—Antimony recovered from scrap processed in the United States, 1950–51, in short tons

Recoverable antimony content of scrap processed			Antimony recovered from scrap processed		
Kind of scrap	1950	1951	Form of recovery	1950	1951
New scrap:					
Lead-base	3,091	4,006	In antimonial lead	13,326	16,747
Tin-base		1	In other lead alloys	8,299	7,033
Total	3,091	4,007	In tin-base alloys	237	163
Old scrap:			Grand total	21,862	23,943
Lead-base	18,602	19,768			
Tin-base	169	168			
Total	18,771	19,936			
Grand total	21,862	23,943			

The price of domestic antimony for carlots, New York, equivalent of the f. o. b. Laredo base, averaged 37.24 cents a pound in January 1951, increased to 43.78 cents in February, remained near that price through October, and increased to 46.63 cents in November and to 51.85 cents in December, the average for the year being 44.17 cents.

SECONDARY COPPER AND BRASS

Recovery of copper from all classes of nonferrous scrap totaled 932,282 short tons valued at $451,224,488 in 1951, a 5-percent decrease in quantity and an 11-percent increase in value from the 977,239 tons valued at $406,531,424 recovered in 1950. These values are computed at the average weighted price for all grades of refined copper sold by producers in the 2 years, that is, 20.8 cents per pound in 1950 and 24.2 cents in 1951.

TABLE 10.—Copper recovered from scrap processed in the United States, 1950–51, in short tons

Recoverable copper content of scrap processed			Copper recovered from scrap processed		
Kind of scrap	1950	1951	Form of recovery	1950	1951
New scrap:			As unalloyed copper:		
Copper-base	485,054	464,226	At primary plants	189,746	135,023
Aluminum-base	6,765	9,595	At other plants	70,958	51,439
Nickel-base	203	331	Total	260,704	186,462
Lead-base			In brass and bronze	679,849	702,416
Zinc-base	6	6	In alloy iron and steel	2,381	3,066
Total	492,028	474,158	In aluminum alloys	16,621	17,230
Old scrap:			In other alloys	271	203
Copper-base	481,449	454,447	In chemical compounds	17,413	22,905
Aluminum-base	2,299	2,693	Total	716,535	745,820
Nickel-base	1,362	853			
Lead-base	2	32	Grand total	977,239	932,282
Tin-base	97	97			
Zinc-base	2	2			
Total	485,211	458,124			
Grand total	977,239	932,282			

The decline was due chiefly to lowered scrap operations of the primary copper producers, who recovered 144,000 tons of secondary copper in 1951 and 195,000 in 1950. Secondary smelters and brass mills reclaimed 325,000 and 315,000 tons of copper respectively in 1951, which in each case was not far below the figure for 1950. Foundries reported recovery of 123,000 tons of copper from scrap in 1951, 6,000 more than in 1950, but the increase probably reflected better coverage of foundries by the 1951 canvass rather than actual greater recovery. Reporting on consumption of copper materials was made mandatory in 1951 after having been on a voluntary basis previously, except for the World War II period. The mandatory feature of the reports and the greater willingness of respondents to report were largely responsible for the increased coverage of all consumers in 1951, although all the primary producers reported in both 1950 and 1951. The total published recovery of copper by brass mills and secondary smelters in 1950 included estimated tonnages for those that did not report, but no such estimate was made for foundries.

The decreased consumption of copper-base scrap and the resultant lower secondary production by primary producers in 1950 were ascribed to the relationship between prices for virgin metals and scrap. Theoretically, establishment of ceiling prices for scrap, which

TABLE 11.—Copper recovered as refined copper, in alloys, and in other forms from copper-base scrap processed in the United States, 1950–51, in short tons

	From new scrap		From old scrap		Total	
	1950	1951	1950	1951	1950	1951
By secondary copper smelters	74,719	77,844	251,861	247,172	326,580	325,016
By primary copper producers	88,298	86,345	107,143	57,491	195,441	143,836
By brass mills	298,112	275,002	19,310	39,848	317,422	314,850
By foundries	23,269	23,878	93,498	99,331	116,767	123,209
By chemical plants	656	1,157	9,637	10,605	10,293	11,762
Total	485,054	464,226	481,449	454,447	966,503	918,673

TABLE 12.—Stocks and consumption of new and old copper scrap at secondary smelters in the United States in 1951, gross weight in short tons

Scrap item	Stocks, beginning of year [1]	Receipts	Consumption			Stocks, end of year
			New scrap	Old scrap	Total	
No. 1 wire and heavy	2,029	40,518	2,213	39,092	41,305	1,242
No. 2 wire, mixed heavy, and light	3,711	61,342	4,701	58,345	63,046	2,007
Composition or red brass	5,664	108,791	52,866	59,284	112,150	2,305
Railroad-car boxes	170	535		636	636	69
Yellow brass	5,970	79,878	17,274	65,193	82,467	3,381
Cartridge cases	379	2,489	16	2,731	2,747	121
Auto radiators (unsweated)	2,580	52,236		53,411	53,411	1,405
Bronze	1,468	32,028	5,702	26,809	32,511	985
Nickel silver	853	3,695	270	3,794	4,064	484
Low brass	172	2,862	2,660	261	2,921	113
Aluminum bronze	158	937	60	828	888	207
Low-grade scrap and residues	6,065	62,458	39,608	22,552	62,160	6,363
Total	29,219	447,769	125,370	332,936	458,306	18,682

[1] Revised.

took place in the middle of 1951, should have allowed each group of consumers to obtain the same proportion of the available scrap as in the period before restrictions of any kind were imposed. However, the competitive position of the primary producers, which should have been improved, deteriorated, as indicated in the previous paragraph. The scarcity of scrap is also indicated in the inventory figures. Stocks of copper-base scrap held by primary producers were 57 percent less at the end of 1951 than at the beginning, those of the secondary smelters 36 percent less, those of the foundries 30 percent less, and those of the brass mills 6 percent less. Monthly inventories fell below monthly consumption in the latter part of 1949. In the latter half of 1950 and during 1951, stocks on hand were considerably less than an average month's consumption, or 30 days' supply.

One reason for the scrap shortage was the decline in imports of copper and brass scrap to 13,315 tons in 1951 from 71,779 tons in 1950. In the absence of statistics on the generation of scrap, it was not clear whether lower generation or withholding of scrap by speculators, Government agencies, generators, or others, or both of these conditions were also causes of the short supply. Consumers' stocks and receipts of scrap are known, but in the absence of data on generation, stocks held by others than consumers cannot be determined.

In 1951, as in 1950, slightly over half of the total secondary copper recovery was from new scrap. Recovery increased in 1951 in all forms except unalloyed copper and in the minor item of alloys other

TABLE 13.—Stocks and consumption of new and old copper scrap at plants of primary producers in the United States in 1951, gross weight in short tons

Scrap item	Stocks, beginning of year [1]	Receipts	Consumption			Stocks, end of year
			New scrap	Old scrap	Total	
No. 1 wire and heavy	1,337	35,643	27,112	8,850	35,962	1,108
No. 2 wire, mixed heavy and light	1,285	48,623	36,465	12,003	48,468	1,440
Refinery brass	12,502	34,275	13,759	26,638	40,397	6,380
Low-grade scrap and residues	27,288	98,831	50,462	66,225	116,687	9,432
Total	42,412	217,372	127,798	113,716	241,514	18,270

[1] Revised.

TABLE 14.—Stocks and consumption of new and old copper scrap at brass mills in the United States in 1951, gross weight in short tons

Scrap item	Stocks, beginning of year [1]	Receipts	Consumption			Stocks, end of year
			New scrap	Old scrap	Total	
No. 1 wire and heavy	1,073	34,139	26,989	7,038	34,027	1,185
No. 2 wire, mixed heavy and light	1,983	32,604	27,302	6,684	33,986	601
Yellow brass	11,028	310,959	311,803	1,853	313,656	8,331
Cartridge cases	854	38,650	----------	35,688	35,688	3,816
Bronze	82	1,435	1,379	----------	1,379	138
Nickel silver	723	10,917	10,657	98	10,755	885
Low brass	532	18,449	18,213	384	18,597	384
Aluminum bronze	65	415	413	----------	413	67
Total	16,340	447,568	396,756	51,745	448,501	15,407

[1] Revised.

TABLE 15.—Stocks and consumption of new and old copper scrap at foundries, chemical plants, and other manufacturers in the United States in 1951, gross weight in short tons

Scrap item	Stocks, beginning of year [1]	Receipts	Consumption			Stocks, end of year
			New scrap	Old scrap	Total	
No. 1 wire and heavy	3,097	21,011	6,579	15,972	22,551	1,557
No. 2 wire, mixed heavy and light	2,006	11,919	3,790	8,572	12,362	1,563
Composition or red brass	2,870	33,969	12,731	21,326	34,057	2,782
Railroad-car boxes	5,094	69,212	----------	71,761	71,761	2,545
Yellow brass	1,935	14,927	6,426	9,068	15,494	1,368
Cartridge cases	372	−155	----------	215	215	2
Auto radiators (unsweated)	6	715	----------	685	685	36
Bronze	1,750	10,767	648	10,058	10,706	1,811
Nickel silver	14	93	68	27	95	12
Low brass	345	2,342	541	1,899	2,440	247
Aluminum bronze	192	755	300	247	547	400
Low-grade scrap and residues	165	2,388	----------	2,305	2,305	248
Total	17,846	167,943	[2] 31,083	[2] 142,135	[2] 173,218	12,571

[1] Revised.
[2] Of the totals shown, chemical plants reported the following: Unalloyed copper scrap, 1,273 tons of new and 10,815 tons of old; copper-base alloy scrap, no new and 470 tons of old.

than copper, aluminum, and iron. Total copper recovered from old copper-base scrap decreased somewhat in 1951, but that recovered by brass mills increased over 20,000 tons or more than 100 percent because of increased consumption of fired cartridge cases. Brass mills use chiefly process scrap but can treat fired cartridge cases without difficulty if they have been detonated and are free from steel shells. Cartridge-case scrap was channeled to brass mills in 1951 by the National Production Authority because that scrap is most economically used in making cartridge brass, a brass-mill product.

Use of unalloyed copper scrap by all groups declined in 1951, but operations of the secondary smelters were affected less than those of other groups. This scrap is sought by all groups, by the primary producers because it is easily refined, and by the others for use in place of refined copper as an alloying ingredient. Nearly all the worn-out railroad-car boxes consumed as scrap were used by the railroad foundries and bearing companies (62,236 tons in 1950 and 71,761 in 1951), which remelt them to make new bearings. The smelters find difficulty in using them for alloying purposes because the antimony in the bearing metal is difficult to remove entirely and is regarded as an impurity in copper-base alloys. Brass mills consumed most of the nickel-silver scrap, which, for tabulation purposes, includes cupronickel. The latter is used to make the best grade of condenser tubes for use especially in warships. A total of 221,549 tons of refinery brass, low-grade scrap, and residues was used in 1951 compared with 319,234 tons in 1950. The primary producers consumed 71 percent of the total in 1951 and 85 percent in 1950, with the secondary smelters using nearly all of the remainder. The primary producers generally smelt their raw material, both scrap and primary, in blast furnaces or reverberatories to make a matte, which is then changed in a converter to blister copper. This equipment is better suited to the use of slags, irony brass, and other low-grade residues than the reverberatories and melting furnaces employed

TABLE 16.—Analysis and production of secondary copper and copper-alloy products in the United States, 1950–51

Item produced from scrap	Approximate analysis (percent)						Gross weight produced (short tons)	
	Cu	Sn	Pb	Zn	Ni	Al	1950	1951
Unalloyed copper products:								
Refined copper (electrolytic grade)	100						186,122	143,520
Casting copper	99						20,439	12,012
Copper sheet, rod, tubing, etc	99						48,421	23,576
Copper powder	98						4,376	3,680
Copper castings	98						1,346	3,674
Total							260,704	186,462
Brass and bronze ingots:								
Tin bronze	88	10		2			19,193	23,534
Leaded-tin bronze	88	6	1.5	4.5			18,936	25,901
Leaded red brass	85	5	5	5			125,461	123,544
Leaded semired brass	81	3	7	9			68,718	67,457
High-leaded-tin bronze	80	10	10				26,648	29,061
Do	84	6	8	2			9,668	14,367
Do	75	5	20				6,615	9,816
Leaded yellow brass	66	1	3	30			28,105	25,330
Manganese bronze	62			27		5	12,666	19,835
Aluminum bronze	89					10	5,018	5,996
Nickel silver	58	2	17	18	14		4,276	3,470
Do	65	4	3	5	22			
Low brass	80			20			2,895	1,761
Silicon bronze	92			4			3,240	3,392
Conductor bronze	94	2	2	2			584	814
Hardeners and special alloys	81						8,664	11,476
Total [1]							340,687	365,754
Brass-mill billets made by ingot makers							2,828	5,786
Brass and bronze sheet, rod, tubing, etc.[2]							418,571	424,077
Brass and bronze castings [3]							131,963	137,895
Brass powder							906	1,171
Copper in chemical products (content)							17,413	22,905

[1] Gross weight of brass and bronze ingot. Includes 276,646 tons of copper, 11,726 tons of lead, 659 tons of nickel, 10,321 tons of tin, 37,266 tons of zinc, 103 tons of aluminum, and 3,966 tons of primary metals in 1950; and 285,480 tons of copper, 12,159 tons of lead, 575 tons of nickel, 10,202 tons of tin, 38,655 tons of zinc, 121 tons of aluminum, and 18,562 tons of primary metal in 1951.

[2] Gross weight of secondary brass and bronze in commercial shapes. Includes 298,900 tons of copper, 2,904 tons of nickel, 4,646 tons of lead, 467 tons of tin, 111,499 tons of zinc, and 125 tons of aluminum in 1950; and 298,014 tons of copper, 2,340 tons of nickel, 5,060 tons of lead, 415 tons of tin, 118,203 tons of zinc, and 45 tons of aluminum in 1951.

[3] Gross weight of secondary metal in brass and bronze castings. Includes 104,709 tons of copper, 74 tons of nickel, 13,735 tons of lead, 5,591 tons of tin, 7,812 tons of zinc, and 42 tons of aluminum in 1950; and 108,617 tons of copper, 15,146 tons of lead, 5,525 tons of tin, 8,545 tons of zinc, 47 tons of aluminum, and 15 tons of nickel in 1951.

by most of the secondary smelters. A few of the larger secondary smelters and foundries, however, used blast furnaces or cupolas in 1951.

The largest increase in production of brass ingot in 1951 was 7,169 tons of manganese bronze, the best grades of which are made from refined metal only. It is used for propellers and other castings in which high corrosion resistance is needed.

Table 17, Consumption of Copper Materials by Principal Consuming Group, should be considered with table 3, in the General Summary section of this chapter, which gives number and classification of consuming plants. Although about 2,800 brass foundries, including a few miscellaneous manufacturers, are listed as respondents, those reporting totaled 2,300. Of these, 845 reported consumption of copper-base scrap, 1,465 consumption of copper-alloy ingot, and 273 use of nonferrous scrap other than copper-base. It will be seen that the material consumed by the primary producers, which includes

TABLE 17.—Consumption of copper and brass materials in the United States 1950–51, by principal consuming group, in short tons

Item consumed	Primary producers	Brass mills	Wire mills	Foundries and other manufacturers [3]	Secondary smelters
1950					
Copper-base scrap	385,660	446,987		151,124	446,664
Primary material	[1] 1,239,834				
Refined copper [2]		675,100	713,354	26,649	6,209
Brass ingot		1,936	1,834	343,428	
Slab zinc		129,535			
Miscellaneous		1,193			16,143
1951					
Copper-base scrap	241,514	448,501		160,660	458,306
Primary material	[1] 1,206,988				
Refined copper [2]		650,967	710,199	38,732	13,744
Brass ingot		7,815	842	355,020	
Slab zinc		129,798			
Miscellaneous		559			20,744

[1] Recoverable copper content; gross weight not available.
[2] Detailed information on consumption of refined copper is given in the Copper chapter of this volume.
[3] Excludes chemical plants.

imported blister copper refined in this country, is approximately adequate to provide the refined copper shown as consumed by the other groups. The brass ingot shown as consumed by the brass mills, wire mills, and foundries represents the output of the secondary copper smelters, except for about 35,000 tons of refined copper and chemicals in 1951 and 50,000 in 1950.

Consumption of brass ingot actually reported by foundries responding to Bureau of Mines questionnaires was 19 percent greater in 1951 than in 1950, totaling 325,786 short tons compared with 273,433 tons. In addition to the 325,786 tons reported by the foundries, 8,657 tons was consumed by brass and wire mills, and 2,077 tons was exported. Data on imports of brass ingot are not available. Brass-ingot makers shipped 370,267 tons of brass ingot to foundries in 1951 and 343,959 tons in 1950. On the assumption that shipments equal domestic consumption plus exports, the foundry-consumption survey achieved 91 percent coverage in 1951 compared with 80 percent in 1950. Over 3,000 plants were canvassed both years.

In table 18 the ingot consumption reported in the 1951 foundry survey has been classified by nine general types, and by States and geographic divisions. Similar breakdowns for earlier years have been published in past Minerals Yearbooks.

The 1951 increases in consumption were more apparent than real. Reporting on consumption of brass ingot and other copper materials was made mandatory in 1951, after having been on a voluntary basis for the period between World War II and the Korean conflict. The mandatory feature of the reports and the greater willingness of respondents to report increased the number of reports received and the reported consumption. Actual consumption of ingot by the foundries in 1951 probably increased about 8 percent, or the same as the increase in shipments of ingot by ingot makers.

Dealers' buying prices for No. 1 composition scrap increased from an average of 17.25 cents a pound in January to 22.50 cents in May, then declined to an average of 18.42 cents in August. From Sep-

TABLE 18.—Foundry consumption of brass ingot in the United States in 1951, by geographic division and State, in short tons

Geographic division and State	Tin bronze	Leaded tin bronze	Leaded red brass	High-leaded tin bronze	Leaded yellow brass	Manganese bronze	Hardeners	Nickel silver	Low brass	Total
New England:										
Connecticut	362	4,629	4,261	742	2,705	264	4	2	394	13,363
Maine	34	13	107	108	8	103	35	-------	22	430
Massachusetts	712	3,225	6,100	752	441	606	13	31	214	12,094
New Hampshire	3	28	779	108	687	82	-------	42	8	1,737
Rhode Island	43	417	722	76	7	11	4	-------	51	1,331
Vermont	4	-------	97	-------	29	-------	1	-------	-------	131
Total	1,158	8,312	12,066	1,786	3,877	1,066	57	75	689	29,086
Middle Atlantic:										
New Jersey	3,449	1,652	4,152	484	612	769	11	17	160	11,306
New York	2,140	5,686	12,231	3,460	395	2,878	151	348	575	27,864
Pennsylvania	3,345	5,465	23,216	2,168	1,671	4,329	1,634	373	1,519	43,720
Total	8,934	12,803	39,599	6,112	2,678	7,976	1,796	738	2,254	82,890
East North Central:										
Illinois	1,827	4,871	26,710	1,295	403	1,665	335	205	1,627	38,938
Indiana	197	299	11,265	988	124	264	379	24	52	13,592
Michigan	389	5,975	14,368	1,046	1,630	834	889	6	157	25,294
Ohio	3,341	10,913	29,705	7,790	754	1,320	259	155	1,200	55,437
Wisconsin	866	1,633	7,509	2,075	2,675	437	66	427	189	15,877
Total	6,620	23,691	89,557	13,194	5,586	4,520	1,928	817	3,225	149,138
West North Central:										
Iowa	2	58	1,424	116	1,172	90	-------	7	1	2,870
Kansas	79	4	135	-------	244	21	1	-------	-------	484
Minnesota	388	819	2,364	235	289	92	5	1	27	4,220
Missouri	691	674	2,792	562	1,189	100	73	1	325	6,407
Nebraska	1	181	391	27	-------	3	5	-------	-------	608
Total	1,161	1,736	7,106	940	2,894	306	84	9	353	14,589
South Atlantic:										
Delaware	33	30	518	27	30	19	-------	-------	2	659
Florida	5	6	37	5	-------	6	-------	-------	-------	59
Georgia	11	395	106	-------	-------	-------	-------	-------	1	513
Maryland and District of Columbia	113	404	757	118	-------	46	9	136	97	1,680
North Carolina	2	-------	45	23	222	1	1	-------	-------	294
South Carolina	36	37	5	4	-------	14	-------	-------	-------	96
Virginia	256	262	109	186	60	129	14	-------	1	1,017
West Virginia	2	106	4,625	-------	463	4	-------	-------	-------	5,200
Total	458	1,240	6,202	363	775	219	24	136	101	9,518
East South Central:										
Alabama	68	462	4,432	132	648	508	4	25	167	6,446
Kentucky	5	232	591	13	5,259	1	27	2	4	6,134
Mississippi	14	-------	7	5	-------	-------	-------	-------	-------	26
Tennessee	30	733	920	718	47	194	4	-------	-------	2,646
Total	117	1,427	5,950	868	5,954	703	35	27	171	15,252
West South Central:										
Arkansas	2	-------	21	-------	-------	-------	-------	-------	-------	23
Louisiana	21	11	82	22	-------	12	-------	-------	1	149
Oklahoma	396	505	120	83	4	9	1	-------	-------	1,118
Texas	143	200	1,819	143	17	319	6	1	101	2,749
Total	562	716	2,042	248	21	340	7	1	102	4,039
Mountain:										
Colorado and New Mexico	107	159	177	21	6	46	1	-------	4	521
Idaho	5	-------	-------	-------	-------	-------	-------	-------	-------	5
Montana	-------	-------	-------	-------	-------	-------	4	-------	-------	4
Utah	-------	21	13	-------	-------	-------	-------	-------	-------	34
Total	112	180	190	21	6	46	5	-------	4	564
Pacific:										
California	815	1,094	13,511	1,026	2,682	575	21	72	392	20,188
Oregon	22	14	28	-------	12	2	-------	-------	-------	78
Washington	47	73	190	1	1	117	15	-------	-------	444
Total	884	1,181	13,729	1,027	2,695	694	36	72	392	20,710
Grand total	20,006	51,286	176,441	24,559	24,486	15,870	3,972	1,875	7,291	325,786

tember to the end of 1951, inclusive, 18.25 cents was the average paid. The price of No. 1 heavy copper scrap averaged 20 cents a pound in January, increased each month reaching 26 cents in May, then declined to 19 cents in August, remaining at that level for the remainder of 1951. Ceiling prices for copper-base scrap were established on June 26 but did not become fully effective for several weeks. They applied to consumers, but dealers were not required to abide by ceiling prices for scrap metals in 1951.

NPA Order M–16, which became effective December 18, 1950, contained rules to insure the continuous flow of copper-base scrap into normal channels of distribution. As amended, effective July 13, 1951, it was expanded to control acceptance and delivery of all copper raw materials including refined copper, copper-base alloys and intermediate shapes, as well as copper-base scrap.

TABLE 19.—Brass and copper scrap imported into and exported from the United States, 1947–51, in short tons

	1947	1948	1949	1950	1951
Imports for consumption:					
Brass scrap	112,393	59,984	23,486	[1] 37,537	6,523
Scrap copper	5,957	9,334	6,765	[1] 34,242	6,792
Exports:					
Brass scrap	3,157	6,584	13,963	[1] 9,054	4,857
Scrap copper	969	2,266	8,284	9,445	7,701

[1] Revised figure.

SECONDARY LEAD

The quantity of secondary lead recovered increased 7 percent in 1951 to 518,110 tons, valued at $179,266,060, compared with 482,275 tons, valued at $130,214,250, in 1950. Approximately the same coverage of the industry was obtained in the survey for both years, and greater demand for lead was responsible for the increased recovery rather than additional reporting companies. The value of lead recovered has been computed for both years on the basis of the yearly average weighted prices of all grades of refined lead sold by producers, or 13.5 cents a pound in 1950 and 17.3 cents in 1951. For the sixth consecutive year, recovery of lead from scrap was greater than domestic mine production.

Shipment of secondary lead as metal increased from 135,178 tons with a secondary lead content of 129,313 tons in 1950 to 171,907 tons with a secondary content of 168,916 tons in 1951—a gain of 31 percent in lead content. Secondary antimonial lead products shipped totaled 261,157 tons with a secondary lead content of 229,963 tons—a slight increase over 1950—but lead recovered in solder, type metals, and lead babbitt declined 13, 14, and 1 percent, respectively. Total output of the secondary lead industry, including the primary metals added to scrap, was 6 percent greater than in 1950. Primary metals so used, however, dropped from an average of about 12,000 tons a month in 1950 to 8,500 tons in 1951. Secondary smelters consumed 103,668 tons of primary metal during the year, of which 74,465 tons was soft lead, 8,288 tons antimonial lead, 14,447 tons primary and detinners' brand tin, 6,108 tons primary antimony in metal and in ore, and 360 tons miscellaneous metals, such as arsenic and bismuth.

TABLE 20.—Lead recovered from scrap processed in the United States, 1950–51, in short tons

Recoverable lead content of scrap processed			Lead recovered from scrap processed		
Kind of scrap	1950	1951	Form of recovery	1950	1951
New scrap:			As metal:		
Lead-base	46,370	68,064	At primary plants	5,455	3,893
Copper-base	8,385	8,388	At other plants	123,858	165,023
Total	54,755	76,452	Total	129,313	168,916
Old scrap:					
Battery lead plates	242,213	282,630	In antimonial lead [1]	225,640	229,963
All other lead-base	163,398	135,109	In other lead alloys	107,635	95,516
Copper-base	21,886	23,897	In copper-base alloys	18,695	23,044
Tin-base	23	22	In tin-base alloys	992	671
Total	427,520	441,658	Total	352,962	349,194
Grand total	482,275	518,110	Grand total	482,275	518,110

[1] Includes 38,383 tons of lead recovered in antimonial lead from secondary sources at primary plants in 1950 and 34,303 tons in 1951.

TABLE 21.—Shipments [1] of secondary lead, tin, and lead- and tin-alloy products in the United States in 1951, gross weight in short tons

Product	Gross weight of products [2]	Secondary metal content			
		Lead	Tin	Antimony	Copper
Refined pig lead	132,363	132,363			
Remelt lead	37,503	36,247			
Lead foil	2,041	306			
Total	171,907	168,916			
Refined pig tin	3,543		3,543		
Remelt tin	445		149		
Tin foil	28		3		
Total	4,016		3,695		
Lead and tin alloys:					
Antimonial lead	261,157	229,963	285	16,747	
Common babbitt	35,618	25,923	1,412	2,631	22
Genuine babbitt	1,740	172	324	69	18
Other tin babbitts	1,856	499	357	94	36
Solder	119,695	34,560	5,591	341	6
Type metals	41,847	33,414	1,932	3,947	
Miscellaneous lead-tin alloys	2,772	1,327	101	112	
Total	464,685	325,858	10,002	23,941	82
Composition foil	468	292	60	2	
Tin content of chemical products	542		542		

[1] Most of the figures herein represent shipments rather than production of the items involved. However, it has been necessary to record actual production figures in some instances where the information is procured from reports on that basis.

[2] Difference between gross weight of products and secondary metal content represents added primary metals or impurity content.

Primary lead refiners reclaimed 38,196 tons of lead from scrap in 1951 or 7 percent of the total. Of this quantity, 3,893 tons was refined soft lead and 34,303 in antimonial lead; antimony content of the antimonial lead was 2,060 tons.

Smelters and foundries consumed 673,780 tons of lead-base scrap during 1951—an increase of 10 percent over 1950. The increase was due almost entirely to a 19-percent gain in battery plates treated and a

49-percent gain in the use of drosses and residues. Consumption of soft lead scrap declined 4 percent, antimonial lead 45 percent, cable lead 37 percent, and solder 34 percent. Smelter operations were highest in the first and last quarters of 1951 and reached the lowest point in September.

TABLE 22.—Stocks and consumption of new and old lead scrap at smelters and refiners in the United States in 1951, gross weight in short tons

Scrap item	Stocks, beginning of year [1]	Receipts	Consumption			Stocks, end of year
			New scrap	Old scrap	Total	
Soft lead	2,943	58,367	----------	58,208	58,208	3,102
Hard lead	2,314	16,400	----------	15,990	15,990	2,724
Cable lead	525	18,518	----------	18,726	18,726	317
Battery-lead plates	27,864	410,205	----------	416,612	416,612	21,457
Mixed common babbitt	970	7,934	----------	8,300	8,300	604
Solder and tinny lead	727	13,074	----------	13,307	13,307	494
Type metals	1,030	24,648	----------	24,422	24,422	1,256
Dross and residues	24,511	99,527	99,230	----------	99,230	24,808
Total	60,884	648,673	99,230	555,565	654,795	54,762

[1] Revised.

Owing to the expanding national-defense program and a decline in the available supply, lead was brought under inventory control on February 16 through the National Production Authority Order M–38. On June 29 the Office of Price Stabilization issued Ceiling Price Regulation 53 rolling back prices on scrap and secondary lead to 15.25 and 17.00 cents per pound, respectively, and established a ceiling on battery-plate smelting at $40 a ton. The move was deemed necessary to correct the "abnormal price relationship" between primary and secondary metal. The 17-cent ceiling price for primary lead had been effective since January 26, but uncontrolled secondary lead and even scrap lead were often selling well above the ceiling price for primary metal. According to the Statement of Considerations in CPR 53, some sellers were obtaining 21 cents a pound or more for secondary lead during the December 1950–January 1951 general price-freeze period compared with the primary lead price of 17 cents a pound. Ordinarily high-grade secondary refined lead sells at about the same price as primary lead. On October 2 a ceiling of 19.00 cents was authorized for primary lead, but the corresponding adjustment for scrap and secondary lead was not made until October 22. No further price change occurred during the remainder of 1951. Keen competition for battery plates during the first two-thirds of 1951 kept the smelting charge well below the $40 limit. In January the most quoted charge was from $30 to $35, decreasing to $20 by March 31 and then dropping by June 22 to "nil to $5." By the middle of August the rate had again advanced to the $40 ceiling, where it remained through December 31.

Percentage and remelt metals circulated inside the secondary lead industry totaled 33,365 tons in 1951, consisting of 4,168 tons of solder, 3,981 of lead babbitt, 7,657 of soft lead, 15,341 of antimonial lead, 1,509 of type metals, 288 of cable lead, 377 of tin babbitt, 38 of remelt tin, and 6 of pewter. In addition, smelters shipped to consumers

TABLE 23.—Stocks and consumption of new and old lead scrap at foundries and other manufacturers in the United States in 1951, gross weight in short tons

Scrap item	Stocks, beginning of year [1]	Receipts	Consumption			Stocks, end of year
			New scrap	Old scrap	Total	
Soft lead	486	1,690	62	1,969	2,031	145
Hard lead	39	664	26	641	667	36
Cable lead	37	147	----------	120	120	64
Battery-lead plates	17	111	----------	5	5	123
Mixed common babbitt	655	15,090	361	14,399	14,760	985
Solder and tinny lead	----------	1,172	1,103	69	1,172	----------
Type metals	4	182	----------	181	181	5
Dross and residues	5	45	49	----------	49	1
Total	1,243	19,101	1,601	17,384	18,985	1,359

[1] Revised.

467,005 tons of these metals during the year and held in inventory 27,548 tons on December 31.

General imports of lead scrap totaled 9,082 short tons (lead content) in 1951 compared with 20,085 tons (lead content) in 1950.

SECONDARY MAGNESIUM

Secondary magnesium recovered from scrap in 1951 totaled 11,526 short tons (valued at $5,647,740) compared with 9,476 (revised) tons (valued at $4,175,125) in 1950. Values have been calculated at 22.03 cents a pound for 1950 and 24.5 cents for 1951, the average prices for magnesium ingot (98.5 percent), f. o. b. Freeport, Tex., for the 2 years. Primary production in 1951 was 40,881 tons. Of this a little over half was produced at the Dow Chemical Co. Freeport, Tex. plant, and the remainder at six Government-owned plants which were reactivated during the year.

TABLE 24.—Magnesium recovered from scrap processed in the United States, 1950–51, in short tons

Recoverable magnesium-alloy content of scrap processed			Magnesium recovered [1] from scrap processed		
Kind of scrap	1950	1951	Form of recovery	1950	1951
New scrap:			Magnesium-alloy ingot [2] (gross weight)	3,682	5,662
Magnesium base	2,770	3,727	Magnesium-alloy castings (gross weight)	2,504	1,675
Aluminum-base	[3] 1,272	1,639	Magnesium-alloy shapes	281	25
Total	[3] 4,042	5,366	In aluminum alloys	[3] 2,546	3,393
Old scrap:			In zinc and other alloys	57	55
Magnesium-base	4,798	5,366	Chemical and other dissipative uses	95	101
Aluminum-base	[3] 636	794	Cathodic protection	311	615
Total	[3] 5,434	6,160	Grand total	[3] 9,476	11,526
Grand total	[3] 9,476	11,526			

[1] Includes alloying elements.
[2] Figures include secondary magnesium incorporated in primary magnesium ingot.
[3] Revised figure.

Magnesium-scrap consumption increased from 8,367 tons in 1950 to 10,388 tons in 1951 (24 percent). Consumption of primary magnesium and the magnesium content of primary alloy rose from 18,051 tons in 1950 to 35,710 in 1951 (98 percent). It would seem that the increased use of primary material in 1951 would have been reflected in increased consumption of process scrap to a greater degree than reported. However, most Government-owned plants did not attain full production until late in 1951, so that most of the scrap generated by fabricators in processing ingot received from the Government-owned plants and processed for defense in 1951 did not return to remelters before 1952. Two-thirds of the total scrap used in both 1950 and 1951 was consumed by five large companies, all of which operated smelters and some of which operated foundries and fabricating plants as well.

Small foundries can use their magnesium home scrap, but it is not practicable for them to use purchased scrap unless they know the composition because, unlike brass scrap, its composition cannot be identified by its color but must be determined by laboratory analysis. It is more economical for such plants to buy ingot of specified composition than to mix and analyze their own alloys.

Foundries used about 3,000 tons of primary unalloyed magnesium ingot, 10,000 of primary magnesium alloy ingot, 4,000 of secondary magnesium ingot, and 2,000 of magnesium scrap in magnesium castings in 1951. In comparison, brass foundries used about 39,000 tons of refined copper, 355,000 of brass ingot and 161,000 of scrap. Scrap constituted 11 percent of the raw material used in magnesium castings and 29 percent of the raw material used in brass and bronze castings.

TABLE 25.—Stocks and consumption of magnesium scrap in the United States in 1951, gross weight in short tons

Scrap item	Stocks, beginning of year	Receipts	Consumption			Stocks, end of year
			New scrap	Old scrap	Total	
Cast scrap	[1] 2,308	6,094	682	6,139	6,821	1,581
Solid wrought scrap	156	2,863	2,910	----------	2,910	109
Borings, grindings, drosses, etc.	[1] 41	755	657	----------	657	139
Total	[1] 2,505	9,712	4,249	6,139	10,388	1,829

[1] Revised figure.

Of the 11,526 tons of secondary magnesium recovered in 1951, 5,662 tons (49 percent) was reclaimed by melting scrap to make magnesium-alloy ingot, some of which was classed as primary ingot because more primary material than scrap was used in making it. Consumption of secondary magnesium ingot totaled 5,059 tons, including, in addition to 3,888 tons used in castings, 1,074 in aluminum alloys and 97 in cathodic protection. The figures for magnesium recovered from aluminum scrap show large increases because Bureau of Mines magnesium percentages of several types of aluminum scrap were revised upward to allow for increased use of magnesium in aluminum alloys.

Although magnesium was on the critical list of defense materials, mandatory Government control was not exercised in 1951. The

National Production Authority directed distribution of all primary magnesium produced at the Government-owned plants for defense. By cooperative agreement the Dow Chemical Co., the only private producer of the primary metal, gave first priority to delivery of magnesium on defense orders.

The price of primary magnesium remained at 24.5 cents a pound throughout the year, whereas remelt magnesium ingot was quoted at 32 cents. These prices were in effect during the base period at the end of 1950 for determining maximum prices under the General Ceiling Price Regulation.

SECONDARY NICKEL

The recovery of secondary nickel from nonferrous scrap in 1951 totaled 8,602 short tons, valued at $9,759,829, a decrease of 2 percent in quantity from the 8,795 tons, valued at $8,408,020, recovered in 1950. The values have been calculated at 56.73 cents a pound for 1951 and 47.80 cents for 1950, the average spot-delivery prices of Grade F nickel ingots and shot in 10,000-pound lots at New York.

TABLE 26.—Nickel recovered from scrap processed in the United States, 1950–51, in short tons

Recoverable nickel content of scrap processed			Nickel recovered from scrap processed		
Kind of scrap	1950	1951	Form of recovery	1950	1951
New scrap:			As metal	535	684
Nickel-base	636	1,143	In nickel-base alloys	1,336	1,096
Copper-base	2,796	1,875	In copper-base alloys	3,522	2,554
Aluminum-base	582	770	In aluminum-base alloys	874	1,125
			In lead-base alloys	39	26
Total	4,014	3,788	In cast iron and steel [1]	1,824	2,149
			In chemical compounds	665	968
Old scrap:					
Nickel-base	3,835	3,896	Grand total	8,795	8,602
Copper-base	657	563			
Aluminum-base	289	353			
Lead-base		2			
Total	4,781	4,814			
Grand total	8,795	8,602			

[1] Includes only nonferrous nickel scrap added to cast iron and steel.

As in 1950, more secondary nickel was recovered in copper-base alloys in 1951 than in any other way, but the percentage of the total so recovered decreased from 40 in 1950 to 30 in 1951. Nickel recovered from nonferrous scrap in iron and steel, which had risen from 1,201 tons in 1949 to 1,824 tons in 1950, increased to 2,149 tons in 1951. Nickel recovered in nickel-base alloys declined 18 percent in 1951 to 1,096 tons, or to about the same quantity as in 1949.

In addition to 14,914 tons of nickel-silver scrap, a copper-base item, 7,164 tons of nickel-base scrap were consumed in 1951. The corresponding figures for 1950 were 21,060 and 6,441 tons, respectively. The recoverable nickel content of the 14,914 tons consumed in 1951 was calculated to be 2,438 tons, and this was the total recovery of nickel from old and new copper-base scrap as shown in the recovery table. This is close to the quantity of nickel reported as recovered

TABLE 27.—Stocks and consumption of new and old nickel scrap at smelters and refiners in the United States in 1951, gross weight in short tons

Scrap item	Stocks, beginning of year [1]	Receipts	Consumption			Stocks, end of year
			New scrap	Old scrap	Total	
Unalloyed nickel	64	793	22	799	821	36
Monel metal	687	1,127	306	1,325	1,631	183
Nickel silver [2]	853	3,695	270	3,794	4,064	484
Miscellaneous nickel alloys	15	129	128		128	16
Nickel residues	27	62		52	52	37
Total	1,646	5,806	726	5,970	6,696	756

[1] Revised.
[2] Copper-base scrap, and so tabulated except in this table and table 28.

in copper-base alloys, as shown in the same table. These proportions obtained for previous years as well, indicating that all or nearly all the nickel-silver scrap and little if any nickel-base scrap were used in copper-base alloys. The nickel silver shown as consumed in the manufacturers and foundries scrap table was used chiefly by brass mills. The increased reported consumption of nickel residues as indicated in this table was due to better coverage of plants reclaiming nickel from spent nickel catalyst.

TABLE 28.—Stocks and consumption of new and old nickel scrap at foundries and plants of other manufacturers in the United States in 1951, gross weight in short tons

Scrap item	Stocks, beginning of year [1]	Receipts	Consumption			Stocks, end of year
			New scrap	Old scrap	Total	
Unalloyed nickel	206	692	354	435	789	109
Monel metal	390	1,562	399	1,158	1,557	395
Nickel silver [2]	737	11,010	10,725	125	10,850	897
Miscellaneous nickel alloys	16	740	2	661	663	93
Nickel residues	143	1,657	410	1,113	1,523	277
Total	1,492	15,661	11,890	3,492	15,382	1,771

[1] Revised.
[2] Copper-base scrap, and so tabulated except in this table and table 27.

Distribution and use of nickel and use of nickel scrap were controlled during the first 7½ months of 1951 by means of National Production Authority Order M–14. In M–80, which replaced M–14 on August 15, the provisions of the latter order were continued, and control was expanded. The use of nickel and nickel scrap for nickel-plating many products was prohibited, and the primary metal was placed under complete allocation. In Ceiling Price Regulation 29, issued May 3, 1951, maximum prices for nickel scrap, including nickel-bearing steel scrap, were established.

During the first 4 months of 1951, while the price of primary nickel was 53.80 cents a pound, prices quoted by dealers at New York were 45 cents a pound for nickel clippings and 33 cents for monel clippings. On May 8 ceiling prices for nickel scrap were established, including

40.5 cents for nickel clippings and 33 cents for monel clippings; these prices were in force for the remainder of 1951. On June 2 the price of primary nickel was raised to 58.83 cents, but ceiling prices for nickel scrap were not changed.

Imports of nickel scrap in 1949, 1950, and 1951 were 1,429 tons, 625, and 791, respectively. Exports in 1951 totaled 3,992 tons, compared with 2,838 in 1950.

SECONDARY TIN

Secondary tin recovered in 1951 totaled 34,434 tons, valued at $88,363,153, a 3-percent decrease in quantity from the 35,481 tons, valued at $67,809,158, reclaimed in 1950. Values are computed at 95.557 cents for 1950 and 128.308 cents for 1951, the average New York selling price of Straits tin in each year.

At detinner plants and secondary smelters and in the forms of metal and in alloys (with the exception of copper-base alloys), secondary tin recovered was less than in 1950. Detinners produced 3,529 tons of pig tin from old tin cans and new tin-plate clippings, and secondary smelters reclaimed an additional 166 tons. The total tin reclaimed as metal (3,695 tons) was 9 percent under that recovered as metal in 1950. Recovery in solder, babbitts, chemical compounds, and lead-base alloys all declined considerably, but recovery of tin in brass and bronze increased 30 percent. Shipments of secondary tin and lead-tin alloys are presented in the section on Secondary Lead in this chapter.

Secondary smelters and foundries consumed 6,211 tons of tin-base scrap, an increase of 12 percent over the quantity of scrap treated in 1950. However, the greatest increase was in residues treated, which yield a comparatively low quantity of metal and did not therefore raise total recovery proportionately.

TABLE 29.—Tin recovered from scrap processed in the United States, 1950–51, in short tons

Recoverable tin content of scrap processed			Tin recovered from scrap processed		
Kind of scrap	1950	1951	Form of recovery	1950	1951
New scrap:			As metal:		
Tin plate	4,221	3,826	At detinning plants	3,766	3,529
Tin-base	1,314	1,505	At other plants	283	166
Lead-base	2,116	2,682			
Copper-base	3,647	3,463	Total	4,049	3,695
Total	11,298	11,476	In solder	9,195	5,591
			In tin babbitt	873	681
Old scrap:			In chemical compounds	701	542
Tin cans	120	166	In lead-base alloys	5,148	3,790
Tin-base	2,874	3,128	In brass and bronze	15,515	20,135
Lead-base	8,888	6,985			
Copper-base	12,301	12,679	Total	31,432	30,739
Total	24,183	22,958	Grand total	35,481	34,434
Grand total	35,481	34,434			

Late in 1950 inventory control of alloys and other materials containing tin had been effected and limits set on nondefense uses, by means of National Production Authority Order M–8, the order applying to scrap and secondary tin as well as primary. On January 9, 1951, the order was amended permitting smelters and refiners of secondary tin maximum use of tin scrap in the production of pig tin, alloys, and chemicals. The amendment was designed to encourage conversion of tin-bearing scrap to usable metal. Another amendment to M–8 on January 27 further restricted the end use of tin (including secondary tin); on March 2 the metal was placed under complete allocation.

The average monthly price of scrap tin pipe was 90 cents a pound in January, rose to $1.19 in February, and gradually declined thereafter to 90 cents in December, following the trend of prices for primary metal.

Exports of tin-base scrap totaled 6,182 short tons in 1951, almost double the quantity exported in 1950, and consisted mostly of drosses and residues.

Secondary tin recovered by detinning plants, as metal and in chemical compounds, decreased 9 percent in 1951 compared with 1950. The total tin recovered was 4,071 short tons in 1951 against 4,467 in 1950. Tin-plate clippings and old cans were the source of 3,992 tons in 1951, of which 3,529 were reclaimed as metal in the form of pigs, and 463 tons in the form of tin compounds. During 1950 the usage of such material provided 4,341 tons, comprising 3,697 tons of metal

TABLE 30.—Stocks and consumption of new and old tin scrap at smelters and refiners in the United States in 1951, gross weight in short tons

Scrap item	Stocks, beginning of year [1]	Receipts	Consumption			Stocks, end of year
			New scrap	Old scrap	Total	
Block-tin pipe, scrap, and foil	31	1,166		994	994	203
Tin scruff and dross	624	2,144	1,992		1,992	776
No. 1 pewter	18	114		118	118	14
High-tin babbitt	332	2,231		2,342	2,342	221
Residues	177	759	651		651	285
Total	1,182	6,414	2,643	3,454	6,097	1,499

[1] Revised.

TABLE 31.—Stocks and consumption of new and old tin scrap at foundries and other manufacturers in the United States in 1951, gross weight in short tons

Scrap item	Stocks, beginning of year [1]	Receipts	Consumption			Stocks, end of year
			New scrap	Old scrap	Total	
Block-tin pipe, scrap, and foil	1	40	9	32	41	
Tin scruff and dross						
No. 1 pewter						
High-tin babbitt	3	70	10	63	73	
Residues						
Total	4	110	19	95	114	

[1] Revised.

TABLE 32.—Tin recovered from scrap processed at detinning plants in the United States, 1950–51

		1950	1951
Scrap treated:			
Clean tin-plate clippings	long tons	469,417	481,443
Old tin-coated containers	do	16,818	22,131
Total	do	486,235	503,574
Tin recovered:			
From new tin-plate clippings	short tons	4,221	3,826
From old tin-coated containers	do	120	166
Total	do	4,341	3,992
Form of recovery:			
As metal	do	[1] 3,697	[1] 3,529
In compounds	do	644	463
Total	do	[2] 4,341	[2] 3,992
Weight of tin compounds produced	do	1,375	958
Average quantity of tin recovered per long ton of clean tin-plate scrap used	pounds	17.98	15.89
Average quantity of tin recovered per long ton of old tin-coated containers used	pounds	14.30	14.98
Average delivered cost of clean tin-plate scrap	per long ton	$30.00	$41.28
Average delivered cost of old tin-coated containers	do	$20.97	$32.45

[1] Includes a small tonnage of pig tin of less than standard purity and consequently subject to further refining or alloying.

[2] Recovery from tin-plate clippings and old containers only. In addition, detinners recovered 69 tons of tin as metal and 57 tons of tin in compounds from tin-base scrap and residues in 1950 and 79 tons of tin in compounds from these sources in 1951.

and 644 in compounds. The treatment of other tin-bearing materials accounts for the remaining production of 79 tons in 1951 and 126 in 1950.

The industry reported treating 481,443 long tons of tin-plate clippings in 1951. This was the largest tonnage of record and exceeded the previous peak reached in 1950 by nearly 3 percent. The average cost of such clippings delivered at plants increased from $30 a long ton in 1950 to $41.28 in 1951. Steel scrap is one of the products of the detinning industry, being sold to open-hearth mills. The average quoted composite price of No. 1 Heavy-Melting steel scrap was $43.15 in 1951—the highest on record. Ceiling prices for steel scrap were established by the Office of Price Stabilization, effective February 7, 1951. Old cans processed increased 32 percent to 22,131 long tons in 1951, compared with 16,818 tons in 1950; this was a small tonnage, however, in comparison with the record use of 175,870 tons in 1943. Tin recovered from tin-plate clippings in 1951 was 3,826 tons, 9 percent less than 1950, while that from old cans, 166 tons (mostly in the form of pig tin), increased 38 percent.

The average quantity of tin recovered per long ton of tin-plate scrap treated was 15.89 pounds in 1951 compared with 17.98 pounds in 1950. Before the introduction of electrolytic tin plate and wartime restrictions on the weight of tin on the hot-dipped product recoveries averaged about 37 pounds per ton of material detinned. Lower recoveries have for several years continued to reflect the treatment of a larger proportion of electrolytic tin plate carrying a much thinner coating of tin than the hot-dipped product. The average quantity of tin recovered per long ton of old tin-coated containers increased slightly from 14.30 pounds in 1950 to 14.98 pounds in 1951.

TABLE 33.—Tin-plate scrap imported into the United States, 1950–51, by countries, in long tons

[U. S. Department of Commerce.]

Country	1950	1951
Australia	8,094	11,169
Canada	21,690	23,364
Cuba	1,302	2,039
French Morocco	3,321	2,716
New Zealand	156	2,028
Sweden	528	2,323
Union of South Africa	5,247	6,187
All others	2,056	1,745
Total	42,394	51,571

Imports of tin-plate scrap were 51,571 long tons in 1951 against 42,394 in 1950 (detinned, this material would yield about 400 tons of tin). In 1951 exports of tin-plate scrap were 810 long tons (562 in 1950), mostly to Mexico and Japan.

SECONDARY ZINC

Secondary zinc recovered in 1951 from purchased scrap and residues totaled 314,377 short tons, with a value of $114,433,228, representing a decrease in quantity of 4 percent from the 326,030 tons, valued at $92,592,520, recovered in 1950. In comparison, mine production of recoverable zinc in the United States was 681,189 tons, valued at $247,952,796 in 1951, and 623,375 tons, valued at $177,038,500 in 1950. The values have been calculated at the average weighted price for all grades of refined zinc sold by producers, which was 14.2 cents in 1950 and 18.2 cents in 1951.

TABLE 34.—Zinc recovered from scrap processed in the United States, 1950–51, in short tons

Recoverable zinc content of scrap processed			Zinc recovered [1] from scrap processed		
Kind of scrap	1950	1951	Form of recovery	1950	1951
New scrap:			As metal:		
Zinc-base	132,827	127,901	By distillation:		
Copper-base	118,524	117,532	Slab zinc	66,322	48,067
Aluminum-base	582	770	Zinc dust	26,961	29,002
			By remelting	10,775	8,044
Total	251,933	246,203			
			Total	104,058	85,113
Old scrap:					
Zinc-base	34,185	20,018	In zinc-base alloys	16,197	9,840
Copper-base	39,704	47,871	In brass and bronze	161,393	177,565
Aluminum-base	208	285	In aluminum-base alloys	689	1,099
			In chemical products:		
Total	74,097	68,174	Zinc oxide (lead-free)	14,025	9,711
			Zinc sulfate	4,677	4,933
Grand total	326,030	314,377	Zinc chloride	12,600	13,121
			Lithopone	11,558	12,013
			Miscellaneous	833	982
			Total	221,972	229,264
			Grand total	326,030	314,377

[1] Zinc content.

Recovery of zinc from zinc-base scrap decreased to 147,919 tons in 1951 from 167,012 in 1950, whereas recovery of zinc from copper-base scrap increased 5 percent, or to 165,403 tons. This increase was caused chiefly by the brass mills, which used only about 1,500 tons more of copper-base scrap in 1951 than in 1950, but the zinc content of the scrap used was 5,000 tons greater in 1951. The lowered recovery of zinc from zinc scrap may be attributed in part to the general nonferrous scrap shortage and to the decreased use of slab zinc in galvanizing to 400,000 tons in 1951 from 442,000 in 1950. All the dross (the principal zinc-scrap item), all the sal skimmings, and a large part of the dry skimmings generated come from galvanizing operations.

TABLE 35.—Production of secondary zinc and zinc-alloy products in the United States, 1947–51, gross weight in short tons

Products	1947	1948	1949	1950	1951
Redistilled slab zinc	59,542	62,320	55,041	66,970	48,657
Zinc dust	28,334	29,932	21,243	27,507	29,754
Remelt spelter [1]	7,443	7,796	6,045	7,243	4,454
Remelt die-cast slab	8,595	10,543	8,266	12,647	5,596
Zinc-die and die-casting alloys	2,698	3,377	3,873	5,233	4,919
Galvanizing stock	774	580	406	354	198
Rolled zinc	2,341	2,778	2,775	3,589	3,474
Secondary zinc in chemical products	55,525	48,995	37,424	43,693	40,760

[1] Contains small tonnages of bars, anodes, etc.

TABLE 36.—Stocks and consumption of new and old zinc scrap at smelters and distillers in the United States in 1951, gross weight in short tons

Scrap item	Stocks, beginning of year [1]	Receipts	Consumption			Stocks, end of year
			New scrap	Old scrap	Total	
Clippings	97	2,003	1,928		1,928	172
Sheet and strip	283	3,788		3,842	3,842	229
Engravers' plates	95	1,139		1,047	1,047	187
Skimmings and ashes	5,857	36,107	38,481		38,481	3,483
Sal skimmings	3,192	32	2,510		2,510	714
Die-cast skimmings	930	12,811	12,835		12,835	906
Dross	4,429	59,659	60,195		60,195	3,893
Die castings	1,158	18,653		18,098	18,098	1,713
Rod and die scrap	33	684		608	608	109
Flue dust	1,392	5,585	5,926		5,926	1,051
Chemical residues	349	10,926	10,351		10,351	924
Total	17,815	151,387	132,226	23,595	155,821	13,381

[1] Revised.

Foundries do not consume much zinc scrap; most of the scrap, including all of the residues, as reported in the table for stocks and consumption of scrap by chemical plants, foundries, and other manufacturers was consumed by chemical plants. A few zinc-distillation plants have chemical departments. In such cases consumption of residues is credited to distillers. Some skimmings were roasted by smelters before being used by the chemical plants. The dry skimmings consist of zinc oxide and metallic zinc and are roasted to convert the metallic zinc to oxide which is more easily dissolved. If sal ammoniac

or zinc ammonium chloride flux is used in galvanizing, the dry skimmings will contain some chlorine; that is, they will be contaminated to some extent with sal skimmings, which contain zinc oxychloride as explained in the zinc section of the Secondary Metals chapter in the 1950 Minerals Yearbook. The chlorine is vaporized as zinc chloride in the roasting operation and is lost in the exhaust gases. Sal skimmings can, however, be used by the chemical plants in making zinc chloride without previous roasting. The price paid for sal skimmings to be shipped to the Philadelphia area in 1951 was $30 to $35 a ton f. o. b. shipping point.

TABLE 37.—Stocks and consumption of new and old zinc scrap at chemical plants, foundries and other manufacturers in the United States in 1951, gross weight in short tons

Scrap item	Stocks, beginning of year [1]	Receipts	Consumption			Stocks, end of year
			New scrap	Old scrap	Total	
Clippings	185	4,235	4,345		4,345	75
Sheet and strip	23	347		357	357	13
Engravers' plates	4	214		212	212	6
Skimmings and ashes	610	12,160	12,442		12,442	328
Sal skimmings	3,794	24,084	26,640		26,640	1,238
Die-cast skimmings		3	3		3	
Die castings	24	1,623	1,263	356	1,619	28
Flue dust	650	3,926	4,015		4,015	561
Chemical residues	1,222	14,056	13,714		13,714	1,564
Total	6,512	60,648	62,422	925	63,347	3,813

[1] Revised.

Total consumption of zinc byproduct residues, excepting dross but including skimmings, flue dust, and chemical residues, increased to 127,000 tons in 1951 from 126,000 tons in 1950, but recovery of secondary zinc in chemicals declined 3,000 tons. However, some of the residues in each year were distilled with primary zinc concentrates to produce slab zinc. One plant reported production of redistilled slab zinc from skimmings which were not mixed with concentrates.

Of the zinc scrap consumed in 1951, only 11 percent (24,520 tons) was classified as old scrap; the largest use of zinc is in galvanizing, from which there is, at present, slight old-scrap salvage. Consumption of old galvanized iron and steel scrap gives steel-furnace flue dust a small zinc content, some of which is recovered by treating the flue dust. The brass scrap used by the brass mills is mostly new scrap and has a high zinc content, which accounts for the high zinc recovery from new copper-base scrap, 117,532 tons, compared with 47,871 tons from old copper-base scrap.

Dealers' buying prices for new zinc clippings averaged 14.27 cents a pound in 1951 compared with 10.38 in 1950 and 7.28 in 1949. The monthly average was 14.75 cents in January 1951 and then increased until it reached 17.75 cents in May. Ceiling prices for zinc scrap became effective June 6. Dealers' prices declined to an average of 12.37 cents for July, August, and September and increased to 12.84 cents in October and to 13.37 cents in December. The changes in the last quarter of 1951 reflected an increase in the ceiling price of

new clippings from 14.5 cents to 15.5 cents on October 22 occasioned by an increase in the ceiling price of slab zinc from 17.50 to 19.50 cents a pound on October 2. Average prices for old zinc scrap were 11.12 cents a pound in January, increased to 12.75 cents in May, and declined to 9.64 cents in June with the advent of ceiling prices. The monthly average during the third quarter was 9.12 cents and increased to 10.12 cents in December. The ceiling price for old zinc scrap was increased on October 22 from 11.25 cents to 12.25 cents.

United States imports of old zinc scrap totaled 146 short tons in 1951 compared with 1,633 (revised) tons in 1950. Imported drosses and residues totaled 6,457 tons in 1951 compared with 1,229 tons in 1950. Large quantities of fume from a primary plant in Canada were imported by one company for the manufacture of zinc sulfate and lithopone; the zinc reclaimed from this material was not recorded as secondary zinc, but as recovered from material other than scrap. Exports of zinc scrap were 4,613 tons in 1951 and 6,212 tons in 1950.

Slag—Iron Blast-Furnace

By Oliver S. North

GENERAL SUMMARY

A RECORD output of 29,327,434 short tons was established by the iron blast-furnace slag industry in 1951. Construction of roads, streets, and major airports continued at a high level throughout the year. Screened air-cooled slag used in bituminous construction increased from 4,435,928 short tons in 1950 to 5,973,795 short tons in 1951. Marked increases in tonnages were also shown by screened air-cooled slag aggregates used in highway and airport construction and by expanded slag used as an aggregate for concrete-block manufacture.

Inasmuch as processed-slag stocks are relatively small and constant from year to year, production virtually equals sales, and therefore those terms are used interchangeably in this chapter.

New slag-processing plants at Rockwood, Tenn., and at Duluth, Minn., began operation in 1951. These plants are the only slag-processing facilities active in their respective States.

As shown in table 1, screened air-cooled slag, the principal type used in highway construction, showed an increase in average value of 5 cents (or 4 percent) per ton compared with 1950. This compares to an increase of 8 percent from 1950 to 1951 in overall costs of highway materials.[1]

TABLE 1.—Iron blast-furnace slag processed in the United States, 1947–51, by types

[National Slag Association]

Year	Air-cooled						Granulated		Expanded		
	Screened			Unscreened						Value	
	Short tons	Value		Short tons	Value		Short tons	Value [1]	Short tons	Total	Average per ton
		Total	Average per ton		Total	Average per ton					
1947	16,712,177	$17,045,020	$1.02	447,908	$257,683	$0.58	1,290,958	$95,087	1,130,636	$2,127,692	$1.88
1948	17,656,200	19,254,900	1.09	604,100	370,000	.61	1,517,500	184,700	1,353,200	2,550,400	1.88
1949	17,769,330	21,090,445	1.19	727,595	372,727	.51	1,885,428	416,632	1,199,026	2,698,908	2.25
1950	20,047,844	24,444,231	1.22	1,005,436	639,499	.64	2,168,365	647,665	1,704,388	3,749,463	2.20
1951	23,276,692	29,531,983	1.27	1,732,969	969,975	.56	2,249,281	888,644	2,068,492	4,917,091	2.38

[1] Excludes value of slag used for hydraulic cement manufacture.

[1] Bureau of Public Roads, Annual Report, Fiscal Year 1951, p. 1.

PRODUCTION

The output of slag from iron blast furnaces in 1951 amounted to 38,977,191 short tons compared with 35,886,165 tons reported for the preceding year.

The quantity and value of slag processed for commercial use in 1951, according to reports of processors to the National Slag Association, reached new record highs of 29,327,434 short tons valued at $36,307,693. These totals are 18 and 23 percent above the preceding year's figures of 24,926,033 short tons valued at $29,480,858. The output in 1951 came from 43 companies operating 68 plants for processing air-cooled slag and from 16 plants producing expanded slag. Fourteen plants reported production of granulated slag.

During 1951, iron blast-furnace slag was processed in the following States: Alabama, California, Colorado, Illinois, Indiana, Kentucky, Maryland, Michigan, Minnesota, New York, Ohio, Pennsylvania, Texas, and West Virginia. The majority of the plants are east of the Mississippi River; as in 1950 and other recent years, output in Ohio was greater than in any other State. Alabama and Pennsylvania follow in order. These three States supplied 66 percent of the total tonnage reported for 1951.

TABLE 2.—Iron blast-furnace slag processed in the United States in 1951, by States

[National Slag Association]

	Screened air-cooled			All types		
	Quantity		Value	Quantity		Value
	Short tons	Percent of total		Short tons	Percent of total	
Alabama	5,157,552	22	$5,352,752	6,156,745	21	$6,791,654
Ohio	5,675,671	24	8,025,708	8,078,142	28	9,781,764
Pennsylvania	4,130,577	18	6,119,694	5,071,810	17	7,332,495
Other States [1]	8,312,892	36	10,033,829	10,020,737	34	12,401,780
Total	23,276,692	100	29,531.983	29,327,434	100	36,307,693

[1] California, Colorado, Illinois, Indiana, Kentucky, Maryland, Michigan, Minnesota, New York, Tennessee, Texas and West Virginia.

PREPARATION

Processed blast-furnace slag is marketed in air-cooled screened, air-cooled unscreened, granulated, or expanded form. About four-fifths of the total is sold as screened air-cooled material, which is produced by allowing molten slag to flow into pits adjacent to the furnace or by transporting it to a slag bank or modified pit and permitting it to solidify under atmospheric conditions. It is then processed in the same manner as are other mineral aggregates.

The remaining one-fifth of the total output is divided about evenly among the other types. Unscreened air-cooled slag is a crushed, ungraded material. Granulated slag is the granular product formed

when molten slag is suddenly chilled by immersion in water; it is made by three general methods—pit, jet, and dry granulation processes. Expanded slag is a foamed product formed when molten slag is expanded by applying a limited quantity of water.

TRANSPORTATION

As in past years, virtually the entire tonnage of processed slag in 1951 was moved by rail and truck, with waterway transportation accounting for only 2 percent of the total. As shown in table 3, railroads handled 47 percent and trucks 51 percent—the third successive year that these figures have remained unchanged.

TABLE 3.—Shipments of iron blast-furnace slag in the United States, 1950–51, by method of transportation

[National Slag Association]

Method of transportation	1950		1951	
	Short tons	Percent of total	Short tons	Percent of total
Rail	11,426,470	47	12,752,189	44
Truck	12,487,059	51	15,706,078	54
Waterway	499,157	2	469,840	2
Total shipments	24,412,686	100	28,928,107	100
Interplant handling [1]	513,347		399,327	
Total processed	24,926,033		29,327,434	

[1] This tonnage is used by the processor locally in making such products as concrete block, asphaltic concrete, etc.

CONSUMPTION

Screened air-cooled slag was the major type processed by the industry and constituted 79 percent of the total output of processed slag in 1951. Granulated slag comprised 8 percent, expanded slag 7 percent, and uncreened air-cooled slag 6 percent.

Screened Air-Cooled Slag.—Consumption of screened air-cooled slag again established a new high of 23,276,692 short tons valued at $29,531,983—over 3 million tons more than in 1950, although it represented a slightly smaller percentage of the total slag processed. The use of screened air-cooled slag as aggregate in portland-cement concrete construction, bituminous construction, and highway and airport construction other than portland-cement and bituminous and as railroad ballast consumed 21,076,059 short tons or 91 percent of the total of this type of slag. Other important uses for the material were in the manufacture of concrete block, mineral wool, and built-up roofing and roofing granules.

Unscreened Air-Cooled Slag.—In 1951 the quantity of unscreened air-cooled slag processed totaled 1,732,969 short tons valued at $969,975—increases of 72 and 52 percent, respectively, over the 1950 figures. Approximately half of this material was used as aggregate in highway and airport construction.

TABLE 4.—Air-cooled iron blast-furnace slag sold or used by processors in the United States in 1951, by uses

[National Slag Association]

Use	Screened		Unscreened	
	Short tons	Value	Short tons	Value
Aggregate in:				
Portland-cement concrete construction	2,367,983	$3,145,684		
Bituminous construction (all types)	5,973,795	8,321,401		
Highway and airport construction [1]	8,033,436	10,707,112	877,725	$566,498
Manufacture of concrete block	746,462	937,495		
Railroad ballast	4,700,845	4,399,072	228,224	80,694
Mineral wool	467,714	619,573	108	108
Roofing (cover material and granules)	431,182	793,828		
Sewage trickling filter medium	41,075	72,789		
Agricultural slag, liming	18,274	25,067		
Other uses	495,926	509,962	626,912	322,675
Total	23,276,692	29,531,983	1,732,969	969,975

[1] Other than in portland-cement concrete and bituminous construction.

Granulated Slag.—The consumption of granulated slag in 1951 amounted to 2,249,281 short tons—an increase of 4 percent as compared to the 1950 figure. Of this quantity, 53 percent was utilized as a raw material in the manufacture of hydraulic cement, 34 percent was used as road fill, and 7 percent as an aggregate in concrete block.

Expanded Slag Aggregate.—The consumption of expanded slag in 1951 reached 2,068,492 short tons valued at $4,917,091—gains of 21 and 31 percent, respectively, compared to 1950. The bulk of this output was used in concrete-block manufacture, and a small percentage found application as an aggregate in lightweight concrete.

TABLE 5.—Granulated and expanded iron blast-furnace slag sold or used by processors in the United States in 1951, by uses

[National Slag Association]

Use	Granulated		Expanded	
	Short tons	Value	Short tons	Value
Road fill, etc	765,362	$577,467		
Agricultural slag, liming	47,786	61,690		
Manufacture of hydraulic cement	1,193,585	[1]		
Aggregate for concrete-block manufacture	166,454	210,665	2,015,530	$4,776,353
Aggregate in lightweight concrete			46,667	122,588
Other uses	76,094	38,822	6,295	18,150
Total	2,249,281	[2] 888,644	2,068,492	4,917,091

[1] Data not available.
[2] Excludes value of slag used for hydraulic cement manufacture.

PRICES

Average values per ton for the various types of processed slag in 1951 are shown in table 6. Values for screened air-cooled slag ranged from 94 cents per short ton for railroad ballast to $1.84 for slag used in the roofing industry. Unscreened air-cooled slag values ranged from 35 cents for railroad ballast to $1.00 for material used in the manufacture of mineral wool. Available data on values of granulated

slag show a low of 51 cents for "other uses" and a high of $1.29 for agricultural slag. Expanded-slag values ranged from $2.37 when used as an aggregate in concrete block to $2.88 for the "other uses" classification.

TABLE 6.—Average value per short ton of iron blast-furnace slag sold or used by processors in the United States in 1951, by uses

[National Slag Association]

Use	Air-cooled		Granulated	Expanded
	Screened	Unscreened		
Aggregate in:				
Portland-cement concrete construction	$1.33			[1] $2.63
Bituminous construction (all types)	1.39			
Highway and airport construction [2]	1.33	$0.65		
Manufacture of concrete block	1.26		$1.27	2.37
Railroad ballast	.94	.35		
Mineral wool	1.32	1.00		
Roofing (cover material and granules)	1.84			
Sewage trickling filter medium	1.77			
Agricultural slag, liming	1.37		1.29	
Road fill, etc			.75	
Other uses	1.03	.51	.51	2.88

[1] Lightweight concrete.
[2] Other than in portland-cement concrete and bituminous construction.

IRON RECOVERY

The recovery of iron by slag processors during 1951 amounted to 368,526 short tons—an increase of 24 percent over the preceding year's figure. Iron is recovered from slag either by magnetic methods or by hand picking; and the material is returned to the furnaces, where it becomes a useful contribution to the iron and steel industry.

EMPLOYMENT

An average per active day of 2,100 plant and yard personnel worked 5,369,000 man-hours in producing processed slag during 1951. This compares with 5,399,500 man-hours and an average per active day of 2,015 plant and yard employees in 1950.

TECHNOLOGY

The Lackawanna plant of the Buffalo Slag Co., Inc., Buffalo, N. Y., utilizes a surge pile between the primary crushing section and subsequent operations to eliminate delays caused by variations in the nature of the rough slag and in the occurrence of iron, necessitating removal before loading transportation equipment.[2]

Slag is being crushed and graded into 10 sizes for use in sand blasting.[3]

Most of the cement being used in constructing a major dam in central France is a slag-base cement manufactured on the job. The slag is shipped dry from Lorraine steel mills, stored in silos, and fed into ball-grinding kilns containing water. These kilns turn out 10 tons per hour of slag ground extremely fine. The material is stored

[2] Nordberg, B., New Slag Plant of Flexible Design: Rock Products, vol. 54, No. 1, January 1951, pp. 114–117.
[3] Pit and Quarry, vol. 43, No. 8, February 1951, p. 55.

as paste and later pumped to mixers where it is combined with portland cement and the stone aggregates. It is reported to have a low heat of hydration.[4]

A bulletin issued in Scotland described utilization of blast-furnace slags in Europe.[5] Points of interest cited included the use in England of 4 million tons of slag concrete aggregate and railroad ballast in 1949, the latest year for which figures were available. In the same year production of foamed slag was estimated at 60,000 tons and of granulated slag, 40,000 tons. Other highlights mentioned were greater utilization in Germany of granulated material and the wide use in France of slag aggregate in prestressed concrete sections.

Slag-processing plants are in operation at Sydney, Nova Scotia, and Port Colborne, Ontario, Canada. The latter plant, which specializes in expanded slag aggregates, is near Buffalo, N. Y.

[4] Bowman, Waldo G., The French Touch in Dams: Eng. News-Record, vol. 146, No. 19, May 10, 1951, pp. 28–33.
[5] Parker, T. W., Blast-Furnace Slag Building Materials: Trans. Eng. and Shipbuilders in Scotland, Paper 1139, Glasgow, Scotland, 1951, 41 pp.

Slate

By Oliver Bowles and Nan C. Jensen

GENERAL SUMMARY

PRODUCTION of slate in the United States during 1951 was considerably lower than in 1950. The decline was primarily in sales of granules and flour. Sales of roofing slate gained 4 percent in quantity and 6 percent in value. Gains were confined to the Pennsylvania operations; sales in other regions declined. The average value per square in 1951 was $21.24 compared with $20.75 in 1950.

Mill-stock sales declined slightly in quantity and value from the high record of 1950. The principal decline was in sales of blackboards and bulletin boards. Sales of structural and sanitary slate, electrical slate, billiard-table tops, and vaults and covers increased substantially. School-slate sales declined in quantity but increased in value. Flagstones, including slate employed for walkways, stepping stones, and miscellaneous uses, declined 1 percent in quantity but gained 13 percent in value.

Slate granules and flour are included as part of the slate industry, although they have little connection with dimension slate. Waste slate from quarries producing roofing and mill stock is used to a very limited extent for making granules and flour. Nearly all of the latter products are derived from independent quarries and from rock unsuited for dimension-slate uses. The principal use of granules is for surfacing prepared roofing. Slate flour is used as a filler in paint, roofing mastic, linoleum, and other products.

Sales of granules and flour declined 14 percent in quantity and 21 percent in value in 1951 compared with 1950. The quantity sold was somewhat lower than the average of recent years. The average value per ton was also considerably lower. Figures for sales of all types of granules, including slate, appear in a table in the chapter of this volume on Stone.

TABLE 1.—Salient statistics of the slate industry in the United States, 1950–51

	1950			1951				
	Quantity		Value	Quantity		Value	Percent of change in—	
	Unit of measurement	Approximate equivalent short tons		Unit of measurement	Approximate equivalent short tons		Quantity (unit as reported)	Value
Domestic production (sales by producers):								
Roofing slate	*Squares* 197,570	74,060	$4,098,842	*Squares* 205,120	77,500	$4,357,412	+4	+6
Mill stock:								
Electrical slate	*Sq. ft.* 285,600	2,070	424,879	*Sq. ft.* 326,090	2,350	470,179	+14	+11
Structural and sanitary slate	1,031,180	8,200	768,602	1,250,810	9,910	836,492	+21	+9
Grave vaults and covers	2,730	20	2,507	12,880	110	10,681	+372	+326
Blackboards and bulletin boards	1,420,960	3,290	829,510	1,133,770	2,660	667,011	−20	−20
Billiard-table tops	161,030	1,190	95,996	207,490	1,560	131,081	+29	+37
School slates	[1] 279,100	370	8,936	[1] 237,500	300	11,943	−15	+34
Total mill stock	3,180,600	15,140	2,130,430	3,168,540	16,890	2,127,387		
Flagstones, etc.[2]	12,346,248	79,440	1,342,053	12,183,280	76,760	1,522,911	−1	+13
Total slate as dimension stone		168,640	7,571,325		171,150	8,007,710	+1	+6
Granules and flour		761,730	7,476,156		654,550	5,888,001	−14	−21
Grand total domestic production		930,370	15,047,481		825,700	13,895,711	−11	−8

[1] Square feet approximate. Number of pieces: 1950, 389,087; 1951, 395,000.
[2] Includes slate used for walkways, stepping stones, and miscellaneous uses.

SALES

Dimension Slate.—Roofing and mill stock, which are cut to specified sizes and shapes, together with flagging and related products, are classed as dimension slate. Table 2 shows sales of these products for the latest 5-year period.

TABLE 2.—Dimension slate sold by producers in the United States, 1947–51

Year	Roofing			Mill stock		Other [1]		Total	
	Squares	Approximate equivalent short tons	Value	Approximate short tons	Value	Approximate short tons	Value	Approximate short tons	Value
1947	170,590	64,350	$3,094,780	13,550	$1,444,835	34,610	$537,705	112,510	$5,077,320
1948	218,650	82,090	4,566,056	11,950	1,600,019	46,490	700,477	140,530	6,866,552
1949	181,490	68,260	3,759,564	12,730	1,727,649	51,000	912,503	131,990	6,399,716
1950	197,570	74,060	4,098,842	15,140	2,130,430	79,440	1,342,053	168,640	7,571,325
1951	205,120	77,500	4,357,412	16,890	2,127,387	76,760	1,522,911	171,150	8,007,710

[1] Includes flagstones, walkways, stepping stones, and miscellaneous slate.

Roofing slate is used chiefly in residential building. It might be expected, therefore, that the sales of this product would follow the trend of construction of new dwelling units. As indicated in figure 1, there was an approximate parallelism from 1935 to 1945, except for the comparative lag in roofing-slate sales from 1939 to 1942. Since 1945 roofing-slate sales have failed to keep pace with the tremendous growth in building construction.

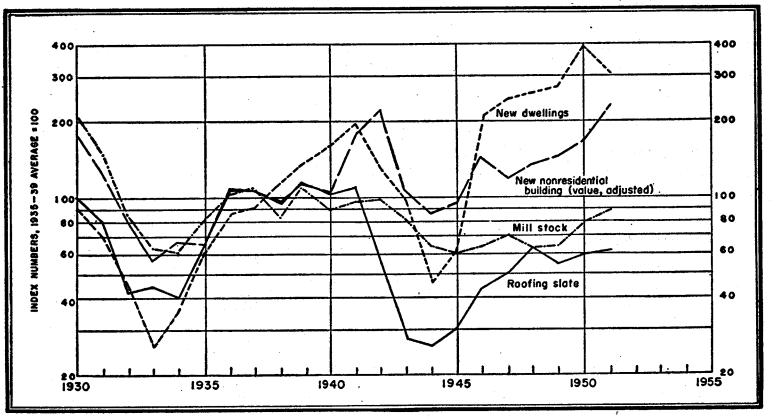

FIGURE 1.—Sales of roofing slate and mill stock compared with number of new dwelling units and value of new nonresidential building, 1930–51. Data on number of new dwelling units (actual starts) in nonfarm areas from U. S. Department of Labor; on value of nonresidential building (adjusted to 1939 prices) from U. S. Department of Commerce and U. S. Department of Labor.

Mill-stock slate is used for blackboards in schools, and for steps, baseboards, and other units in office buildings and other nonresidential structures. Mill-stock sales followed the general trend of nonresidential building construction from 1930 to 1939. As indicated in figure 1, since 1944 mill-stock sales have fluctuated moderately, while nonresidential building activity has advanced and in 1951 exceeded all previous records. Slate evidently is losing ground in the competitive field.

Figure 2 is a graphic presentation of the value of slate sold from 1920 to 1951, by principal uses. Two peaks were reached during this period, one in 1925 and the other in 1950. The two troughs reflect the unfavorable conditions of the depression and World War II.

Granules and Flour.—Sales of granules in 1951 dropped 15 percent in quantity below the alltime high of 1950. The value of sales declined 22 percent. The average sales value per ton f. o. b. plant ($10.35) was 99 cents lower than in 1950. Sales of slate flour declined 11 percent in quantity and value. Granules and flour were produced in Arkansas, California, Georgia, New York, Pennsylvania, and Vermont. Granules but no flour were sold in Maryland and Virginia.

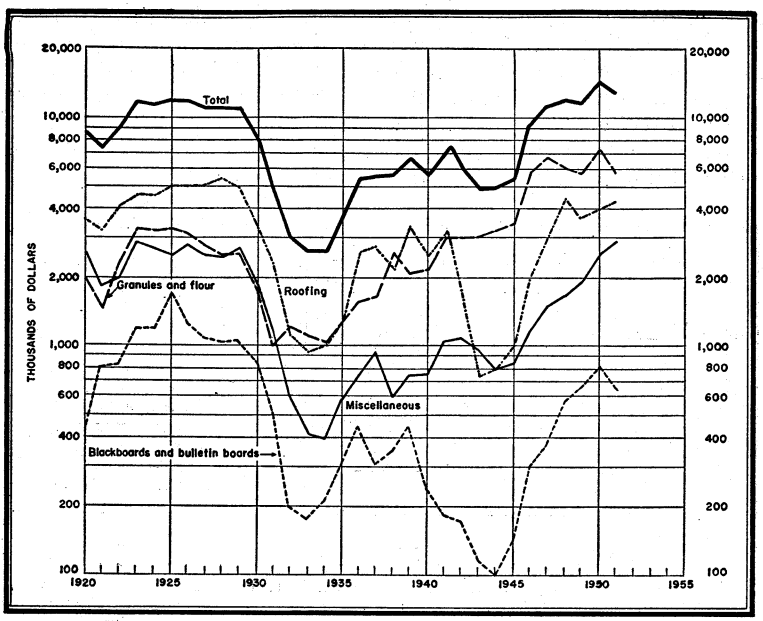

FIGURE 2.—Value of slate sold in the United States, 1920–51, by uses.

Sales of these products for the latest 5-year period are shown in table 3.

TABLE 3.—Crushed slate (granules and flour) sold by producers in the United States, 1947–51

Year	Granules		Flour		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1947	593, 560	$5, 911, 151	169, 940	$697, 083	763, 500	$6, 608, 234
1948	499, 440	5, 306, 568	159, 430	707, 809	658, 870	6, 014, 377
1949	463, 290	5, 136, 992	144, 980	627, 568	608, 270	5, 764, 560
1950	595, 200	6, 747, 325	166, 530	728, 831	761, 730	7, 476, 156
1951	506, 770	5, 242, 946	147, 780	645, 055	654, 550	5, 888, 001

REVIEW BY STATES

As shown in table 1, total production of slate in the United States declined 11 percent in quantity in 1951 compared with 1950. Seventy-seven operators reported production in 1951, a decline of 17 from 1950. Table 4 shows sales of slate in 1951, by State and use.

Maine.—Electrical slate is the principal product of the Maine quarries, which are situated near Monson, Piscataquis County. As in 1950, only one company was active in 1951.

TABLE 4.—Slate sold by producers in the United States, 1947–51, by State and use

	Operators	Roofing		Mill stock		Other uses (value) [1]	Total value
		Squares (100 square feet)	Value	Square feet	Value		
1947	76	170,590	$3,094,780	2,549,080	$1,444,835	$7,145,939	$11,685,554
1948	83	218,650	4,566,056	2,541,250	1,600,019	6,714,854	12,880,929
1949	80	181,490	3,759,564	2,741,040	1,727,649	6,677,063	12,164,276
1950	94	197,570	4,098,842	3,180,600	2,130,430	8,818,209	15,047,481
1951							
Arkansas	1					174,329	174,329
California	2					(2)	(2)
Georgia	1					(2)	(2)
Maryland	1					431,053	431,053
New York	19	450	19,580			1,445,089	1,464,669
Pennsylvania	25	134,180	2,681,072	2,589,090	1,416,657	1,591,141	5,688,870
Vermont and Maine	23	46,650	1,019,558	579,450	710,730	2,856,203	4,586,491
Virginia	5	23,840	637,202			(2)	(2)
Undistributed						913,097	1,550,299
Total	77	205,120	4,357,412	3,168,540	2,127,387	7,410,912	13,895,711

[1] Flagging and similar products, granules, and flour.
[2] Included with "Undistributed" to avoid disclosure of individual company operations.

New York.—There were 2 slate operators less in 1951 than in 1950, and the value of sales declined 29 percent. Flagging, granules, and flour were the principal products.

Pennsylvania.—Lehigh and Northampton Counties are the most productive slate areas in the United States. All types of slate products are made because the "soft-vein," blue-black slate characteristic of these areas is suitable for making blackboards, structural slate, and all other mill-stock types, as well as roofing. Slate produced in York County in the Peach Bottom district on the Maryland-Pennsylvania border in the vicinity of Cardiff, Md., and Delta, Pa., may not be shown separately and therefore is included with Northampton County in table 5, which presents detailed figures for Pennsylvania.

The total value of all slate products sold in Pennsylvania in 1951 increased 3 percent compared with 1950. Gains in roofing and electrical slate, vaults and covers, and billiard-table tops were substantial both in quantity and value. Blackboard and bulletin-board production declined both in quantity and value. Structural and sanitary products gained in quantity but declined in value. Conversely, school slates declined in quantity but increased in value. Other products (principally granules and flour) declined in value. The percentage changes in these items in 1951 compared with 1950 were as follows: Roofing slate, increase of 8 percent in quantity and 15 percent in value; electrical slate, increase of 25 percent in quantity and 34 percent in value; structural and sanitary slate, increase of 16 percent in quantity but a decline of 5 percent in value; blackboards and bulletin boards, decline of 20 percent in both quantity and value; billiard-table tops, increase of 29 percent in quantity and 37 percent in value; school slates, decline of 15 percent in quantity but a gain of 34 percent in value. Vaults and covers is a small item that made

TABLE 5.—Slate sold by producers in Pennsylvania in 1951, by county and use

County	Operators	Roofing slate		Mill stock					
		Squares (100 square feet)	Value	Electrical		Structural and sanitary		Vaults and covers	
				Square feet	Value	Square feet	Value	Square feet	Value
Lehigh	4	6,710	$110,470	13,830	$16,167	983,930	$580,119	12,570	$10,336
Northampton and York [1]	21	127,470	2,570,602						
Total: 1951	25	134,180	2,681,072	13,830	16,167	983,930	580,119	12,570	10,336
1950	27	124,280	2,341,127	11,050	12,044	849,970	611,004	2,340	2,097

County	Mill stock—Continued						Other uses (value)	Total value
	Blackboards and bulletin boards		Billiard-table tops		School slates			
	Square feet	Value	Square feet	Value	Square feet	Value		
Lehigh	296,120	$139,940			237,500	$11,943	$12,400	$309,282
Northampton and York [1]	837,650	527,071	207,490	$131,081			1,578,741	5,379,588
Total: 1951	1,133,770	667,011	207,490	131,081	237,500	11,943	1,591,141	5,688,870
1950	1,420,960	829,510	161,030	95,996	279,100	8,936	1,645,300	5,546,014

[1] York County produced granules and flour only; included with Northampton County to avoid disclosure of individual company operations.

large gains. Slate for other uses declined 3 percent in value. There was a decrease of two in the number of active operators.

Vermont.—To avoid revealing the production of an individual firm, Maine has been included with Vermont in table 4. The total value of slate products sold in these two States in 1951 was 6 percent less than in 1950. Roofing-slate sales declined 1 percent in quantity and 3 percent in value. Mill stock increased 27 percent in quantity and 25 percent in value. The value of slate for other uses declined 12 percent. There was a decline of 9 in the number of operators.

Virginia.—Roofing slate was the principal product of the quarries near Arvonia and Ore Bank, Buckingham County. Small quantities of flagging but no mill stock were made. Roofing-slate sales declined 7 percent in quantity and 4 percent in value in 1951 compared with 1950. Granules were produced in substantial quantities during the year, but details cannot be given without revealing the figures of individual producers.

Other States.—Granules and flour were produced in Montgomery County, Ark., near Glenwood; near Placerville, El Dorado County, Calif.; and near Fairmount, Bartow County, Ga. Granules but no flour were produced near Whiteford, Harford County, Md. Flagging and other products were sold in Mariposa County, Calif.

PRICES

The average value of roofing slate f. o. b. quarry or mill, as reported to the Bureau of Mines, increased 49 cents per square in 1951 to $21.24.

In Pennsylvania it was $19.98 per square, in New York $43.51, in Vermont and Maine $21.86, and in Virginia $26.73.

The average value of mill stock was 67 cents per square foot, the same as in 1950. The average value of electrical slate declined 5 cents (to $1.44); structural and sanitary slate declined 8 cents (to $0.67); and vaults and covers declined 9 cents (to $0.83). Blackboards and bulletin boards remained virtually unchanged at $0.59. The average sales value per short ton of granules declined 99 cents (to $10.35), while flour declined 2 cents (to $4.36).

Price History.—The trend in yearly average value of roofing slate and mill stock compared with wholesale prices of all building materials since 1915 is indicated in figure 3. Since 1933 mill-stock prices have followed closely the price trend of all building materials. Roofing-slate prices also maintained a close correspondence with those of all building materials until 1945, but since that date they have advanced much beyond the general average. The contrast between the trend in prices shown in figure 3 and the trend in volume of sales indicated in figure 1 seem to indicate that the relative decline in the quantity of

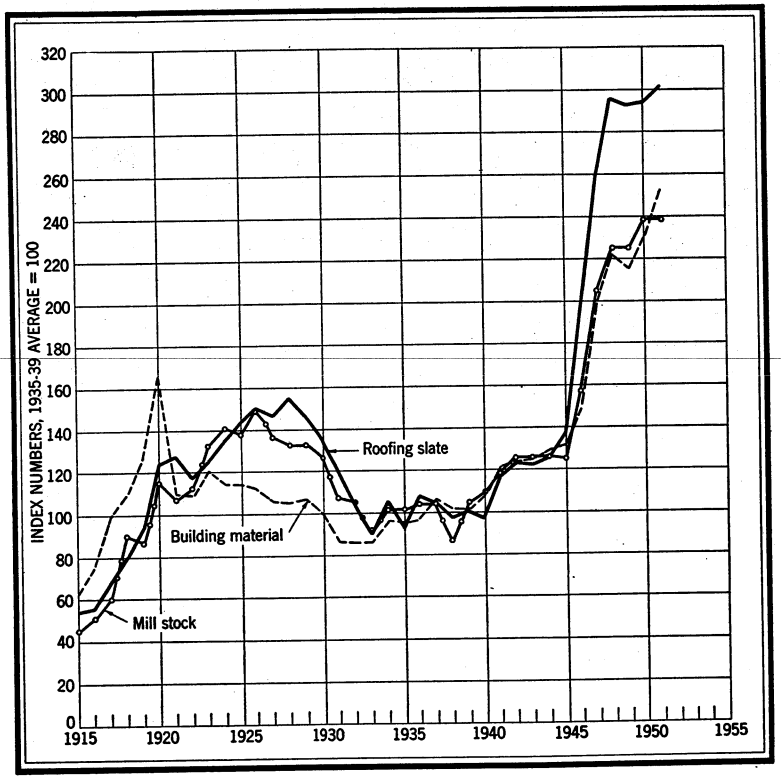

FIGURE 3.—Average value of slate compared with wholesale prices of building materials in general, 1915–51. Wholesale prices from U. S. Department of Labor.

roofing slate sold since 1945 is in a large measure related to the relative increase in its price compared to that of other building materials.

FOREIGN TRADE[1]

Imports.—The value of slate imported for consumption, which made remarkable gains in 1950, continued its strong upward trend. As indicated in table 6, the value of imports in 1951 was more than 2½ times as great as in 1950. Most of the imports consisted of school slates from Italy and Portugal. Many of them are imported unframed and are framed in the United States. A factor that may have contributed to this greatly increased movement was the reduction, effective May 30, 1950, of the import duty from 25 percent to 12½ percent ad valorem.

Exports.—Table 7 gives the value of exports of slate products for the latest 5-year period, as reported by shippers to the Bureau of Mines. The total value of exports was 23 percent less in 1951 than in 1950.

TABLE 6.—Slate imported for consumption in the United States, 1947–51, by countries

[U. S. Department of Commerce]

Country	1947	1948	1949	1950	1951
Australia					$70
Canada	$16	$1,078	$1,125		10,257
China	39	66	9	$123	
Germany				1	8,241
Italy	5,688	11,584	17,589	66,548	187,702
Japan		89	51	288	295
Norway		10		967	
Portugal		317	1,549	27,320	45,561
Spain		424			
Switzerland		31	406	328	64
United Kingdom	4	53	24	2,172	12
Total	5,747	13,652	20,753	97,747	252,202

TABLE 7.—Slate exported from the United States, 1947–51, by uses[1]

Use	1947	1948	1949	1950	1951
Roofing	$13,748	$4,476	$9,503	$19,824	$4,138
School slates[2]	30,436	25,846	16,601	8,138	3,891
Electrical	3,164	4,245	10,151	14,635	13,819
Blackboards	47,899	65,314	65,052	107,466	51,056
Billiard tables	43,161	58,692	79,687	47,000	88,669
Structural (including floors and walkways)	466,736	428,755	414,029	417,148	311,282
Slate granules and flour					
Total	605,144	587,328	595,023	614,211	472,855

[1] Figures collected by the Bureau of Mines from shippers of products named.
[2] Includes slate used for pencils and educational toys.

[1] Figures on imports compiled by M. B. Price and E. D. Page, of the Bureau of Mines, from records of the U. S. Department of Commerce.

TECHNOLOGY

New milling facilities were constructed in Pennsylvania. One roofing-slate mill was modernized by introducing a conveyor-belt system for delivering slate to the various operations.

Pennsylvania State College conducted a time study of unit processes in the Pennsylvania slate industry as a guide toward increasing the efficiency of operations.[2] This college also reviewed the status of slate technology and urged operators to take active measures toward reducing the cost of quarrying and manufacture.[3]

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[2] Mullen, Williard F., A Production Analysis of the Pennsylvania Slate Industry: Pennsylvania State College, 1951, 186 pp.

[3] Stickler, C. W., Mullen, W. F., and Bitner, Wayne, Industrial Studies of Pennsylvania Slate Production: Pennsylvania State College, Mineral Industry Exp. Sta., Bull. 58, 1951, 43 pp.

Stone

By Henry P. Chandler and Nan C. Jensen

GENERAL SUMMARY

COMBINED sales of dimension and crushed stone in 1951 were at a record figure of 286 million short tons valued at $438 million. These sales represented a gain of 14 percent in tonnage and 12 percent in value over the preceding year. In the dimension-stone industry during 1951 the gain in sales over 1950 amounted to less than 1 percent in tonnage and 3 percent in value. In the crushed- and broken-stone industry, sales increased 14 percent, both in tonnage and value; gains occurred in nearly all classes of material.

The tables in this chapter give the quantities of stone sold or used by producers (also referred to as sales) and the values f. o. b. quarries and mills. Stone made into abrasives, such as grindstones, and stone used in making cement and lime, are, however, not included herein. They are reported in terms of finished products in the Abrasive Materials, Lime, and Cement chapters. Dimension stone and crushed stone are considered separately, except in introductory tables 1 to 4, which show total sales of stone by kinds, uses, and States.

TABLE 1.—Stone sold or used by producers in the United States,[1] 1947–51, by kinds

Year	Granite		Basalt and related rocks (traprock)		Marble		Limestone	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1947	12,443,320	$34,123,460	19,616,020	$25,755,314	227,880	$10,252,522	150,408,820	$186,548,286
1948	13,685,880	38,807,266	20,654,580	29,916,965	276,000	10,421,254	166,742,390	215,451,016
1949	16,944,050	42,566,336	21,386,260	30,486,257	239,440	12,292,822	163,746,260	222,513,012
1950	22,553,180	52,220,660	22,894,830	34,372,735	267,220	10,932,234	180,918,910	252,755,827
1951	21,089,043	51,240,439	29,404,512	42,914,706	256,339	10,641,219	205,479,815	287,675,332

Year	Sandstone		Other stone [2]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1947	6,809,080	$16,586,504	18,049,670	$16,078,896	207,554,790	$289,344,482
1948	7,289,950	18,048,947	16,886,590	16,339,123	225,535,390	328,984,571
1949	6,954,660	19,906,326	14,755,900	13,676,892	224,026,570	341,441,645
1950	9,100,890	23,787,019	16,378,020	16,513,622	252,113,050	390,582,097
1951	8,792,232	24,979,317	21,320,568	20,332,981	286,342,509	437,783,994

[1] Includes Alaska, Hawaii, and Puerto Rico.
[2] Includes mica schist, conglomerate, argillite, various light-color volcanic rocks, serpentine not used as marble, soapstone sold as dimension stone, etc.

TABLE 2.—Stone sold or used by producers in the United States,[1] 1950–51, by uses

Use	1950		1951	
	Quantity	Value	Quantity	Value
Dimension stone:				
Building stone:				
Rough construction—short tons	253,940	$1,133,133	239,385	$1,148,161
Cut stone, slabs, and mill blocks[2]—cubic feet	12,896,640	35,531,864	13,201,354	37,679,144
Approximate equivalent in short tons	974,750		997,474	
Rubble—short tons	247,210	615,241	252,991	590,925
Monumental stone—cubic feet	2,962,830	17,824,882	2,851,687	16,851,224
Approximate equivalent in short tons	243,960		234,753	
Paving blocks—number	347,590	51,294	430,550	51,999
Approximate equivalent in short tons	3,740		3,270	
Curbing—cubic feet	950,040	2,429,816	1,006,140	2,871,881
Approximate equivalent in short tons	78,040		82,481	
Flagging—cubic feet	712,580	877,953	640,543	976,518
Approximate equivalent in short tons	57,560		51,335	
Total dimension stone (quantities approximate, in short tons)	1,859,200	58,464,183	1,861,689	60,169,852
Crushed and broken stone:				
Riprap—short tons	6,898,050	7,807,200	6,989,284	8,437,614
Crushed stone—do	165,721,710	209,813,417	190,926,318	237,710,272
Furnace flux (limestone)—do	35,969,820	37,932,388	39,929,957	45,622,125
Refractory stone[3]—do	2,158,000	5,848,591	2,365,804	7,810,013
Agricultural (limestone)—do	19,348,820	30,393,075	19,400,610	31,051,933
Other uses—do	20,157,450	40,323,243	24,868,847	46,982,185
Total crushed and broken stone—do	250,253,850	332,117,914	284,480,820	377,614,142
Grand total (quantities approximate, in short tons)	252,113,050	390,582,097	286,342,509	437,783,994

[1] Includes Alaska, Hawaii, and Puerto Rico.
[2] To avoid disclosure of individual outputs, dimension stone for refractory use is included with building stone. Sawed building stone includes: 1950—470,100 cubic feet (34,100 tons) of stone for refractory use valued at $946,337; 1951—539,940 cubic feet (39,167 tons), $1,304,561.
[3] Ganister (sandstone), mica schist, soapstone, and dolomite.

TABLE 3.—Stone sold or used by noncommercial producers in the United States,[1] 1950–51, by uses

[Included in total production]

Use	1950		1951	
	Short tons	Value	Short tons	Value
Building stone	15,680	$106,049	9,866	$73,315
Rubble	57,520	66,318	63,227	80,060
Riprap	2,139,220	2,033,854	2,508,343	2,297,375
Crushed stone	16,130,420	19,374,778	18,770,495	21,627,615
Agricultural (limestone)	455,540	714,171	484,312	739,123
Other uses	2,361,410	2,274,698	4,480,789	5,167,482
Total	21,159,790	24,569,868	26,317,032	29,984,970

[1] Includes Alaska and Puerto Rico.

TABLE 4.—Stone sold or used by producers in the United States, 1950–51, by States

State	1950		1951	
	Short tons	Value	Short tons	Value
Alabama	2,587,500	$6,038,220	2,818,421	$7,254,671
Arizona	228,490	139,810	308,881	353,872
Arkansas	3,952,720	7,419,110	2,535,746	3,216,426
California	11,764,630	13,998,432	12,537,344	14,714,524
Colorado	[1] 1,679,960	[1] 2,776,331	1,470,123	2,334,376
Connecticut	[1] 1,860,700	[1] 2,789,532	2,278,466	3,360,378
Delaware	77,050	190,113	99,201	245,002
Florida	5,313,400	6,885,394	8,032,966	9,419,682
Georgia	[1] 6,144,980	[1] 11,917,482	6,025,809	15,768,204
Idaho	[1] 644,020	[1] 861,290	1,457,182	1,811,422
Illinois	17,911,480	21,970,537	19,298,968	23,474,516
Indiana	6,994,670	20,686,160	[1] 8,641,670	[1] 23,729,433
Iowa	[1] 8,425,490	[1] 10,668,427	9,261,317	12,170,082
Kansas	7,630,300	8,920,207	7,191,483	9,058,512
Kentucky	[1] 7,417,200	[1] 8,865,913	7,048,771	8,609,609
Louisiana	[2]	[2]		
Maine	[1] 309,740	[1] 2,214,164	644,594	2,582,541
Maryland	1,975,690	3,459,605	3,181,434	5,983,380
Massachusetts	[1] 3,284,470	[1] 8,484,999	[1] 3,225,839	[1] 9,172,425
Michigan	19,095,540	15,391,366	20,851,733	17,514,720
Minnesota	[1] 1,953,450	[1] 5,334,028	[1] 1,906,407	[1] 5,613,157
Mississippi	100,000	115,000	171,131	168,933
Missouri	10,300,400	14,406,627	11,294,227	15,255,427
Montana	919,090	949,545	871,508	986,327
Nebraska	[1] 736,660	[1] 1,042,035	942,967	1,437,899
Nevada	[1] 274,460	[1] 269,478	834,807	959,815
New Hampshire	[1] 15,760	[1] 383,667	[1] 62,355	[1] 349,606
New Jersey	[1] 4,672,050	[1] 9,119,251	6,457,248	10,987,705
New Mexico	364,930	243,841	1,022,901	592,179
New York	13,121,850	19,728,957	15,559,372	24,326,118
North Carolina	7,711,580	11,894,745	[1] 8,612,967	[1] 13,292,690
North Dakota	193,250	135,698	281,219	213,061
Ohio	20,466,350	28,628,678	[1] 25,190,277	[1] 36,436,081
Oklahoma	5,021,660	4,848,223	6,966,676	6,917,548
Oregon	[1] 3,836,550	[1] 5,559,010	8,721,799	10,831,483
Pennsylvania	25,493,230	42,205,691	[1] 27,399,564	[1] 46,668,590
Rhode Island	239,400	798,186	239,248	651,931
South Carolina	[1] 2,557,510	[1] 3,836,056	[1] 2,828,868	[1] 3,690,114
South Dakota	[1] 1,205,910	[1] 4,860,858	1,263,322	4,660,074
Tennessee	7,978,590	13,802,288	[1] 8,838,796	[1] 14,765,988
Texas	[1] 4,893,150	[1] 5,580,463	[1] 7,351,069	[1] 7,626,122
Utah	929,410	880,667	1,226,710	1,291,118
Vermont	447,310	8,038,892	450,980	7,253,824
Virginia	9,272,740	16,434,602	9,277,252	16,621,116
Washington	4,930,820	5,734,563	5,029,735	5,664,433
West Virginia	[1] 5,367,510	[1] 7,825,653	[1] 5,754,378	[1] 8,472,639
Wisconsin	6,999,630	14,494,750	7,609,323	14,671,858
Wyoming	1,841,400	2,214,037	1,645,475	1,857,267
Undistributed	1,701,560	4,867,957	226,648	1,842,438
Total	250,844,240	387,910,538	284,947,177	434,879,316
Alaska, Hawaii, Puerto Rico	1,268,810	2,671,559	1,395,332	2,904,678
Grand total	252,113,050	390,582,097	286,342,509	437,783,994

[1] To avoid disclosing confidential information certain State totals are incomplete, the portion not included being combined with "Undistributed." The class of stone omitted from such State totals is noted in the State tables in the Statistical Summary chapter of this volume.
[2] Included with "Undistributed."

DIMENSION STONE

The term "dimension stone," as used in this chapter, is applied to blocks and slabs of natural stone, most of which are cut to definite shapes and sizes. Dimension stone is used principally for constructing masonry walls and memorials. Crushed and broken stone consists primarily of irregular fragments sized chiefly by mechanical screening and is used mainly as concrete aggregate, railroad ballast, furnace flux, and agricultural limestone.

Dimension-stone producers may be divided into three main groups on the basis of method of operation. The first group quarries stone and sells it as rough blocks or slabs; the second quarries stone and also manufactures it into finished products; and the third buys sawed slabs or rough blocks of stone and manufactures them into finished products. The Bureau of Mines statistical canvass covers the first and second groups but not the third. Bureau of Mines statistics are compiled from reports of quantities and values of original sales and include some material sold as rough blocks and some sold as finished products.

Total sales of dimension stone (including slate) in 1951 made a very slight increase in quantity and a 3-percent increase in value compared with 1950. These overall figures include slate, but detailed statistics of that branch of the industry appear in the Slate chapter.

TABLE 5.—Dimension stone sold or used by producers in the United States,[1] 1950–51, by kind and use

Kind and use	1950	1951	
		Amount	Percent of change from 1950
Granite:			
Building stone:			
Rough construction, short tons	77,640	74,214	−4
Value	$437,332	$500,133	+14
Average per ton	$5.63	$6.74	+20
Cut stone, slabs, and mill blocks, cubic feet	754,180	825,882	+10
Value	$4,734,777	$5,061,985	+7
Average per cubic foot	$6.28	$6.13	−2
Rubble, short tons	118,180	94,043	−20
Value	$318,304	$291,702	−8
Monumental stone, cubic feet	2,666,710	2,609,134	−2
Value	$14,946,508	$14,606,453	−2
Average per cubic foot	$5.60	$5.60	
Paving blocks, number	347,590	430,550	+24
Value	$51,294	$51,999	+1
Curbing, cubic feet	900,620	944,389	+5
Value	$2,278,495	$2,709,935	+19
Total:			
Quantity, approximate short tons	554,990	531,857	−4
Value	$22,766,710	$23,222,207	+2
Basalt and related rocks (traprock):			
Building stone:			
Rough construction, short tons	26,730	32,746	+23
Value	$99,466	$114,225	+15
Average per ton	$3.72	$3.49	−6
Rubble, short tons	10,610	205	−98
Value	$7,532	$100	−99
Total:			
Quantity, short tons	37,340	32,951	−12
Value	$106,998	$114,325	+7

For footnotes, see end of table.

TABLE 5.—Dimension stone sold or used by producers in the United States,[1] 1950–51, by kind and use—Continued

Kind and use	1950	1951	
		Amount	Percent of change from 1950
Marble:			
Building stone (cut stone, slabs, and mill blocks)—cubic feet	755,070	783,861	+4
Value	$6,528,013	$6,659,913	+2
Average per cubic foot	$8.65	$8.50	−2
Monumental stone—cubic feet	296,120	242,553	−18
Value	$2,878,374	$2,244,771	−22
Average per cubic foot	$9.72	$9.25	−5
Total:			
Quantity—approximate short tons	89,290	87,191	−2
Value	$9,406,387	$8,904,684	−5
Limestone:			
Building stone:			
Rough construction—short tons	117,440	101,244	−14
Value	$422,698	$375,826	−11
Average per ton	$3.60	$3.71	+3
Cut stone, slabs, and mill blocks—cubic feet	8,233,220	8,096,710	−2
Value	$17,061,008	$17,630,077	+3
Average per cubic foot	$2.07	$2.18	+5
Rubble—short tons	66,750	94,628	+42
Value	$207,142	$194,640	−6
Flagging—cubic feet	197,670	175,527	−11
Value	$113,537	$126,580	+11
Total:			
Quantity—approximate short tons	807,590	806,842	
Value	$17,804,385	$18,327,123	+3
Sandstone:			
Building stone:			
Rough construction—short tons	32,130	31,181	−3
Value	$173,637	$157,977	−9
Average per ton	$5.40	$5.07	−6
Cut stone, slabs, and mill blocks—cubic feet	2,433,430	2,811,207	+16
Value	$5,037,374	$6,071,863	+21
Average per cubic foot	$2.07	$2.16	+4
Rubble—short tons	10,350	11,921	+15
Value	$38,488	$48,478	+26
Curbing—cubic feet	49,420	61,751	+25
Value	$151,321	$161,946	+7
Flagging—cubic feet	486,180	441,756	−9
Value	$735,062	$806,652	+10
Total:			
Quantity—approximate short tons	265,500	291,253	+10
Value	$6,135,882	$7,246,916	+18
Miscellaneous stone:[2]			
Building stone—cubic feet	720,740	683,694	−5
Value	$2,170,692	$2,255,306	+4
Average per cubic foot	$3.01	$3.30	+10
Rubble—short tons	41,320	52,194	+26
Value	$43,775	$56,005	+28
Flagging—cubic feet	28,730	23,260	−19
Value	$29,354	$43,286	+47
Total:			
Quantity—approximate short tons	104,490	111,595	+7
Value	$2,243,821	$2,354,597	+5
Total dimension stone, excluding slate:			
Quantity—approximate short tons	1,859,200	1,861,689	
Value	$58,464,183	$60,169,852	+3
Slate as dimension stone[3]—approximate short tons	168,640	171,150	+1
Value	$7,571,325	$8,007,710	+6
Total dimension stone, including slate:			
Quantity—approximate short tons	2,027,840	2,032,839	
Value	$66,035,508	$68,177,562	+3

[1] Includes Puerto Rico.
[2] Includes soapstone, mica schist, volcanic rocks, argillite, and other varieties that cannot be classified in the principal groups.
[3] Details of production, by uses, are given in the Slate chapter of this volume.

BUILDING STONE

The largest use of dimension stone is for building purposes. New construction calling for the use of dimension stone in 1951 remained at almost the same level as the previous year. The different kinds of dimension stone used also changed but little. Table 6 gives the quantity and value of the major types of building stone sold or used in 1951.

TABLE 6.—Building stone sold or used by producers in the United States [1] in 1951, by kinds

Kind	Rough				Finished				Total	
	Construction		Architectural		Sawed		Cut		Cubic feet	Value
	Cubic feet	Value	Cubic feet	Value	Cubic feet	Value	Cubic feet	Value		
Granite	893,755	$500,133	252,880	$513,745	329,408	$1,690,875	243,594	$2,857,365	1,719,637	$5,562,118
Basalt	389,245	114,225							389,245	114,225
Marble			284,382	1,043,578	150,965	880,999	348,514	4,735,336	783,861	6,659,913
Limestone	1,218,603	375,826	2,974,089	3,190,344	3,596,607	5,900,851	1,526,014	8,538,882	9,315,313	18,005,903
Sandstone	397,835	157,977	970,893	1,411,276	1,757,386	4,009,842	82,928	650,745	3,209,042	6,229,840
Miscellaneous					683,694	[3] 2,255,306			683,694	2,255,306
Total	2,899,438	1,148,161	4,482,244	6,158,943	[3] 6,518,060	[3] 14,737,873	2,201,050	16,782,328	16,100,792	38,827,305

[1] Includes Puerto Rico.
[2] Sawed stone corresponds to dressed stone for construction work (walls, foundations, bridges) and cut stone to architectural stone for high-class buildings.
[3] Rough and cut miscellaneous stone included with sawed stone.

GRANITE

Sales of granite in the form of blocks and slabs during 1951 decreased slightly in tonnage, but increased slightly in total value over 1950. The increases occurred in the sales of dressed building material, dressed monumental granite, paving blocks, and curbing, while the sales of rough building and monumental material and rubble decreased. The average value of the granite produced in 1951 was $43.66 a short ton, a 6-percent increase over 1950.

Tables 8 and 9 show sales of monumental granite in the Barre district, Vermont, exclusive of small quantities of Barre granite sold as construction or crushed stone.

TABLE 7.—Granite (dimension stone) sold or used by producers in the United States in 1951, by State and use

State	Active plants	Building								Monumental				Paving blocks		Curbing		Total	
		Rough				Dressed		Rubble		Rough		Dressed							
		Construction		Architectural										Number	Value	Cubic feet	Value	Short tons (approximate)	Value
		Short tons	Value	Cubic feet	Value	Cubic feet	Value	Short tons	Value	Cubic feet	Value	Cubic feet	Value						
California	14	625	$5,150	(1)	(1)	(1)	(1)	5,011	$12,240	21,822	$87,074	11,125	$154,000	-------	-------	1,387	$3,300	8,719	$340,231
Colorado	2	201	503	-------	-------	-------	-------	182	830	-------	-------	-------	-------	-------	-------	-------	-------	383	1,333
Connecticut	6	2,324	6,998	3,242	$7,511	14,202	$48,183	1,741	21,606	10,678	81,224	1,192	21,804	-------	-------	5,328	13,488	6,940	200,814
Georgia	15	1,800	2,700	-------	-------	(1)	(1)	(1)	(1)	639,444	1,415,964	163,653	1,254,923	(1)	(1)	(1)	(1)	122.567	3,230,887
Maine	9	(1)	(1)	77,760	133,509	92,822	891,003	7,225	14,264	27,165	53,397	6,918	69,037	(1)	(1)	(1)	(1)	41,995	1,318,514
Maryland	4	18,500	182,000	48,780	40,000	-------	-------	24,500	82,200	-------	-------	-------	-------	-------	-------	26,829	19,900	49,200	324,100
Massachusetts	6	5,418	80,543	84,895	257,205	(1)	(1)	3,976	9,806	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	94,506	4,011,613
Minnesota	14	-------	-------	-------	-------	36,000	519,000	-------	-------	39,199	90,432	151,981	1,756,101	-------	-------	-------	-------	18,856	2,365,533
Missouri	1	-------	-------	-------	-------	-------	-------	862	6,957	40,952	156,401	-------	-------	-------	-------	-------	-------	4,281	163,358
Montana	3	-------	-------	-------	-------	-------	-------	-------	-------	512	1,174	-------	-------	-------	-------	-------	-------	41	1,174
New Hampshire	3	150	1,406	-------	-------	17,096	214,319	165	600	1,500	4,500	2,400	11,400	-------	-------	7,379	22,289	2,656	254,514
New York	1	-------	-------	25,667	55,000	7,000	50,000	2,860	15,200	-------	-------	-------	-------	-------	-------	1,667	3,500	5,693	123,700
North Carolina	6	(1)	(1)	(1)	(1)	(1)	(1)	2,564	14,809	25,866	66,263	(1)	(1)	(1)	(1)	(1)	(1)	23,458	1,309,981
Oklahoma	5	-------	-------	-------	-------	-------	-------	-------	-------	3,250	12,500	48,475	515,000	-------	-------	-------	-------	4,267	527,500
Pennsylvania	7	26,294	109,578	-------	-------	5,989	48,606	3,800	11,890	-------	-------	15,529	159,291	-------	-------	-------	-------	31,901	329,365
Rhode Island	1	-------	-------	-------	-------	-------	-------	(1)	(1)	(1)	(1)	-------	-------	-------	-------	-------	-------	(1)	(1)
South Carolina	1	-------	-------	-------	-------	-------	-------	-------	-------	(1)	(1)	-------	-------	-------	-------	-------	-------	(1)	(1)
South Dakota	9	-------	-------	(1)	(1)	(1)	(1)	-------	-------	61,718	306,389	198,942	2,160,869	-------	-------	-------	-------	22,806	2,689,058
Texas	1	-------	-------	-------	-------	-------	-------	-------	-------	(1)	(1)	-------	-------	-------	-------	-------	-------	(1)	(1)
Vermont	3	-------	-------	-------	-------	-------	-------	-------	-------	853,963	4,100,912	-------	-------	-------	-------	-------	-------	69,171	4,100,912
Virginia	1	-------	-------	-------	-------	2,990	38,490	-------	-------	-------	-------	2,640	24,640	-------	-------	-------	-------	465	63,130
Washington	3	10	50	150	175	-------	-------	250	1,000	1,800	13,000	-------	-------	-------	-------	3,394	7,180	701	21,405
Wisconsin	8	-------	-------	-------	-------	2,600	57,000	-------	-------	26,004	82,963	72,944	1,150,907	-------	-------	-------	-------	8,378	1,290,870
Undistributed	-------	18,892	111,205	12,386	20,345	394,303	2,681,639	40,907	100,300	157,370	536,984	22,092	319,304	430,550	$51,999	898,405	2,640,278	14,873	554,215
Total	123	74,214	500,133	252,880	513,745	573,002	4,548,240	94,043	291,702	1,911,243	7,009,177	697,891	7,597,276	430,550	51,999	944,389	2,709,935	531,857	23,222,207
Average unit value	-------	-------	$6.74	-------	$3.10	-------	$7.94	-------	$3.10	-------	$3.67	-------	$10.89	-------	$0.12	-------	$2.87	-------	$43.66
Short tons (approximate)	-------	(2)	-------	20,874	-------	47,340	-------	-------	-------	156,681	-------	57,455	-------	3,270	-------	77,980	-------	-------	-------

[1] Included with "Undistributed" to avoid disclosure of individual company operations.
[2] 893,755 cubic feet (approximate).

TABLE 8.—Monumental granite sold by quarrymen in the Barre district, Vermont, 1942–51

Year	Cubic feet	Value	Year	Cubic feet	Value
1942	612, 220	$2, 035, 327	1947	937, 400	$3, 534, 798
1943	635, 350	2, 267, 777	1948	1, 039, 580	3, 952, 622
1944	733, 500	2, 553, 681	1949	890, 080	3, 528, 756
1945	713, 050	2, 308, 506	1950	917, 310	3, 868, 351
1946	990, 160	3, 461, 801	1951	853, 963	4, 100, 912

TABLE 9.—Estimated output of monumental granite in the Barre district, Vermont, 1949–51

[Barre Granite Association, Inc.]

	1949	1950	1951
Total quarry output, rough stock.....cubic feet	894, 240	917, 685	863, 265
Shipped out of Barre district in rough.....do	178, 848	183, 537	172, 653
Manufactured in Barre district.....do	715, 392	734, 148	690, 612
Light stock consumed in district.....do	596, 160	489, 432	460, 408
Dark stock consumed in district.....do	298, 080	244, 716	230, 204
Number of cutters in district	1, 748	1, 748	1, 748
Average daily wage	$13. 50	$13. 90	$15. 00
Average number of days worked	248	248	248
Total pay roll for year	$5, 852, 304	$6, 025, 706	$6, 502, 560
Estimated overhead	2, 926, 152	3, 012, 853	3, 251, 280
Estimated value of light stock	2, 950, 892	2, 938, 460	2, 859, 765
Estimated value of dark stock	1, 550, 016	1, 590, 654	1, 495, 326
Estimated polishing cost	1, 799, 658	1, 846, 840	1, 737, 220
Estimated sawing cost	1, 408, 428	1, 445, 354	1, 359, 642
Total value of granite	16, 487, 450	16, 859, 867	17, 205, 793

BASALT AND RELATED ROCKS (TRAPROCK)

Because of their dark color, basalt and related rocks are used to a limited extent as building stone. Sales for rough construction increased and rubble dropped in 1951 from the previous year, the total tonnage declining 12 percent. However, the total value increased 7 percent, and the average value per unit 21 percent. Basalt and related rocks, such as syenites and diorites, are used to some extent for memorials but are classed in the trade as "black granite" and are therefore included with the figures for monumental granite.

TABLE 10.—Basalt and related rocks (traprock) (dimension stone) sold or used by producers in the United States in 1951, by State and use

State	Active plants	Building stone				Total	
		Rough construction		Rubble		Short tons	Value
		Short tons	Value	Short tons	Value		
California	1			140	$50	140	$50
Connecticut	1	(1)	(1)			(1)	(1)
Oregon	2	(1)	(1)	65	50	(1)	(1)
Pennsylvania	1	28, 549	$94, 633			28, 549	94, 633
Undistributed		4, 197	19, 592			4, 262	19, 642
Total	5	[2] 32, 746	114, 225	205	100	32, 951	114, 325
Average unit value			$3. 49		$0. 49		$3. 47

[1] Included with "Undistributed" to avoid disclosure of individual company operations.
[2] 389,245 cubic feet (approximate).

MARBLE

Total sales of marble declined slightly during 1951 in quantity and value over the preceding year. Although small increases were noted in the quantity and value of building stone, material for monuments declined. There was also a 3-percent decrease in unit value. Tables 11 and 12 give sales data on marble, by uses and States.

The Georgia Marble Co., Tate, Ga., announced the purchase by its subsidiary, the Alabama Limestone Co., of the entire physical assets of the Rockwood Alabama Stone Co., 25 miles south of Muscle Shoals, Ala.[1]

TABLE 11.—Marble (dimension stone) sold by producers in the United States, 1950–51, by uses

Use	1950		1951	
	Cubic feet	Value	Cubic feet	Value
Building stone:				
Rough:				
Exterior	9,140	$36,326	10,030	$40,900
Interior	300,240	1,141,665	274,352	1,002,678
Finished:				
Exterior	96,230	939,670	115,154	1,071,897
Interior	349,460	4,410,352	384,325	4,544,438
Total exterior	105,370	975,996	125,184	1,112,797
Total interior	649,700	5,552,017	658,677	5,547,116
Total building stone	755,070	6,528,013	783,861	6,659,913
Monumental stone:				
Rough, Finished	296,120	2,878,374	242,553	2,244,771
Total monumental stone	296,120	2,878,374	242,553	2,244,771
Total building and monumental	1,051,190	9,406,387	1,026,414	8,904,684
Approximate short tons	89,290		87,191	

TABLE 12.—Marble (dimension stone) sold by producers in the United States in 1951, by State and use

State	Active plants	Building		Monumental		Total		
						Quantity		Value
		Cubic feet	Value	Cubic feet	Value	Cubic feet	Short tons (approximate)	
Alabama	2	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Arkansas	1	15,000	$94,200			15,000	1,275	$94,200
Colorado	1	5,932	17,796			5,932	504	17,796
Georgia	1	56,018	848,343	148,513	$1,598,609	204,531	17,385	2,446,952
Maryland	1	7,459	58,012			7,459	634	58,012
Minnesota	1	4,691	27,000			4,691	345	27,000
Missouri	2	(1)	(1)	(1)	(1)	(1)	(1)	(1)
North Carolina	1	(1)	(1)			(1)	(1)	(1)
Tennessee	7	445,019	3,373,980	4,575	69,130	449,594	38,215	3,443,110
Vermont	6	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Undistributed		249,742	2,240,582	89,465	577,032	339,207	28,833	2,817,614
Total	23	783,861	6,659,913	242,553	2,244,771	1,026,414	87,191	8,904,684
Average unit value			$8.50		$9.25			[2] $8.68
Short tons (approximate)		66,574		20,617				

[1] Included with "Undistributed" to avoid disclosure of individual company operations.
[2] Average value per cubic foot.

[1] Manufacturers Record, vol.120, No. 12, December 1951, p. 62.

LIMESTONE

Limestone blocks cut to definite shapes and sizes are used almost exclusively for building purposes, such as interiors and exteriors of public buildings and commercial structures. The total of all types of dimension limestone sold during 1951 changed but little from the previous year. Tonnage declined slightly, while the total and unit values each increased 3 percent. Rough architectural material and rubble gained in tonnage sold, while sales of rough construction material, finished building material, and flagging declined.

The Bedford-Bloomington area, Indiana, continued to produce most of the dimension limestone in the United States, its output being 82 percent of the total rough architectural and finished (sawed and cut) limestone by volume and 76 percent by value. Tables 14 to 16 show production in the Bedford-Bloomington, Ind., and Carthage, Mo., areas over a 5-year period.

SANDSTONE

Sales of sandstone in 1951 increased 10 percent in tonnage and 18 percent in value over 1950. The average unit price also increased 8 percent. Sales of rough architectural stone, sawed dressed building stone, rubble, and curbing gained over the previous year. Losses were noted in rough construction stone, cut dressed building stone, and flagging.

Ohio continued to be the largest producing State, contributing 56 percent of the total. Other States, in order of production, were Tennessee, Pennsylvania, Colorado, and New York.

Table 18 presents the sales of bluestone in 1942–51. Bluestone is a type of sandstone that splits into thin, uniform slabs. It is particularly adapted for flagging but is also used for building stone and curbing. The output in 1951 declined 35 percent in tonnage and 23 percent in value from the previous year.

TABLE 13.—Limestone (dimension stone) sold or used by producers in the United States in 1951, by State and use

State	Active plants	Building								Flagging		Total	
		Rough				Finished (cut and sawed)		Rubble					
		Construction		Architectural									
		Short tons	Value	Cubic feet	Value	Cubic feet	Value	Short tons	Value	Cubic feet	Value	Short tons (approximate)	Value
Alabama	1			48,704	$47,227	(1)	(1)					(1)	(1)
Arkansas	1							323	$1,970			323	$1,970
California	4	2,559	$12,709					1,359	4,346			3,918	17,055
Colorado	1							52	354			52	354
Connecticut	1	280	1,078									280	1,078
Illinois	8	9,357	9,443					7,303	26,431	19,360	$14,541	18,306	50,415
Indiana	17	192	571	2,517,714	2,591,339	4,136,524	$10,891,953	2,795	5,825	3,185	6,237	485,650	13,495,925
Iowa	2					5,880	15,000	2,000	5,350	23,525	7,350	4,499	27,700
Kansas	16	2,933	10,851	94,146	53,003	224,553	594,884	6,284	14,154	8,945	4,696	37,067	677,588
Kentucky	3	300	600					120	138			420	738
Michigan	3	(1)	(1)			(1)	(1)	1,494	3,894	(1)	(1)	4,627	43,138
Minnesota	6			83,766	137,500	175,916	662,320	5,612	22,269	26,250	18,000	28,487	840,089
Missouri	10	19,263	108,092			45,310	333,311	45,535	71,429	12,373	20,693	69,701	533,525
Montana	1							160	1,000			160	1,000
New York	1	(1)	(1)							(1)	(1)	(1)	(1)
Ohio	2							3,100	2,990			3,100	2,990
Pennsylvania	3	50,970	138,957									50,970	138,957
Puerto Rico	5	5,582	53,147					7,795	11,766			13,377	64,913
Tennessee	2	150	150					932	685			1,082	835
Texas	4	(1)	(1)	106,608	139,692	(1)	(1)					23,131	725,402
West Virginia	1	(1)	(1)									(1)	(1)
Wisconsin	15	4,215	18,192	123,151	221,583	191,576	497,223	9,642	20,819	69,414	47,643	44,588	805,460
Wyoming	1							122	1,220			122	1,220
Undistributed		5,443	22,036			342,862	1,445,042			12,475	7,420	16,982	896,771
Total	108	101,244	375,826	2,974,089	3,190,344	5,122,621	14,439,733	94,628	194,640	175,527	126,580	806,842	18,327,123
Average unit value			$3.71		$1.07		$2.82		$2.06		$0.72		$22.71
Short tons (approximate)		(2)		218,472		378,096				14,402			

[1] Included with "Undistributed" to avoid disclosure of individual company operations.
[2] 1,218,603 cubic feet (approximate).

TABLE 14.—Limestone sold by producers in the Indiana oolitic limestone district, 1947–51, by classes

Year	Construction					
	Rough block		Sawed and semi-finished		Cut	
	Cubic feet	Value	Cubic feet	Value	Cubic feet	Value
1947	2,082,330	$1,492,620	1,398,440	$1,563,008	470,620	$1,834,447
1948	2,328,180	1,914,559	1,974,730	2,312,829	682,480	3,205,984
1949	1,896,780	1,742,517	2,215,940	2,805,866	803,140	3,377,699
1950	2,192,140	2,309,303	3,213,160	4,669,493	1,191,200	5,682,062
1951	2,517,714	2,591,339	3,159,924	4,990,385	976,600	5,901,568

Year	Construction—Continued			Other uses		Total	
	Total						
	Cubic feet	Short tons (approximate)	Value	Short tons	Value	Short tons (approximate)	Value
1947	3,951,390	286,480	$4,890,075	90,440	$306,784	376,920	$5,196,859
1948	4,985,390	361,440	7,433,372	165,400	328,656	526,840	7,762,028
1949	4,915,860	356,400	7,926,082	48,320	149,753	404,720	8,075,835
1950	6,596,500	478,250	12,660,858	276,620	441,797	754,870	13,102,655
1951	6,654,238	482,432	13,483,292	156,084	281,102	638,516	13,764,394

TABLE 15.—Purchased Indiana limestone sold by mills in the Indiana oolitic limestone district, 1947–51, by classes

Year	Sawed and semi-finished		Cut		Total	
	Cubic feet	Value	Cubic feet	Value	Cubic feet	Value
1947	68,020	$72,594	994,510	$3,583,166	1,062,530	$3,655,760
1948	357,080	491,898	845,850	3,558,754	1,202,930	4,050,652
1949	117,270	166,809	1,016,050	5,365,837	1,133,320	5,532,646
1950	141,510	198,859	921,900	4,674,820	1,063,410	4,873,679
1951	127,159	179,946	742,745	4,579,979	869,904	4,759,925

TABLE 16.—Limestone and marble sold by producers in the Carthage district, Jasper County, Mo., 1947–51, by classes

Year	Dimension stone (rough and dressed)							Other uses		Total	
	Building		Monumental		Total						
	Cubic feet	Value	Cubic feet	Value	Cubic feet	Short tons (approximate)	Value	Short tons	Value	Short tons (approximate)	Value
1947	58,220	$487,799	2,980	$24,357	61,200	5,200	$512,156	300,680	$513,273	305,880	$1,025,429
1948	64,510	532,905	5,380	29,636	69,890	5,940	562,541	230,540	396,006	236,480	958,547
1949	84,810	934,036	4,530	26,772	89,340	7,590	960,808	238,250	420,833	245,840	1,381,641
1950	75,630	805,532	2,430	17,185	78,060	6,640	822,717	252,960	467,926	259,600	1,290,643
1951	135,715	872,264	1,850	12,509	137,565	11,693	884,773	257,609	440,496	269,302	1,325,269

TABLE 17.—Sandstone (dimension stone) sold or used by producers in the United States in 1951, by State and use

State	Active plants	Building								Rubble		Curbing		Flagging		Total	
		Rough construction		Rough architectural		Dressed											
						Sawed		Cut									
		Short tons	Value	Cubic feet	Value	Cubic feet	Value	Cubic feet	Value	Short tons	Value	Cubic feet	Value	Cubic feet	Value	Short tons (approximate)	Value
Arizona	1	378	$1,400													378	$1,400
California	2	2,241	17,201	1,413	$1,462											2,351	18,663
Colorado	2	812	10,565	108,692	107,065					2,285	$11,425			32,051	$22,500	14,075	151,555
Indiana	1					(1)	(1)									(1)	(1)
Kansas	1									563	450					563	450
Massachusetts	1							(1)	(1)							(1)	(1)
Michigan	1	73	584							740	2,482			2,138	1,710	984	4,776
Missouri	1	(1)	(1)													(1)	(1)
New Jersey	1			5,625	4,500					173	865					623	5,365
New Mexico	1									70	55					70	55
New York (bluestone)	7	156	1,092	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	1,400	$743	103,876	146,293	12,271	315,418
Ohio	9	2,501	5,628	192,830	352,825	1,731,813	$3,921,606	64,257	$459,208	3,336	7,507	59,069	160,003	118,248	237,998	162,888	5,144,775
Oklahoma	1	100	1,000													100	1,000
Pennsylvania [2]	14	20,965	93,257	21,936	12,145					4,029	12,894	1,282	1,200	94,740	152,570	34,647	272,066
Tennessee	2			(1)	(1)									(1)	(1)	(1)	(1)
Texas	1	55	1,050													55	1,050
Virginia	1	(1)	(1)											(1)	(1)	(1)	(1)
Washington	1			60,833	192,435			5,645	59,828							5,318	252,263
Wisconsin	2			950	1,500			1,500	6,000	(1)	(1)			(1)	(1)	210	7,590
Undistributed		3,900	26,200	578,614	739,344	25,573	88,236	11,526	125,709	725	12,800			90,703	245,581	56,720	1,070,490
Total	50	31,181	157,977	970,893	1,411,276	1,757,386	4,009,842	82,928	650,745	11,921	48,478	61,751	161,946	441,756	806,652	291,253	7,246,916
Average unit value			$5.07		$1.45		$2.28		$7.85		$4.07		$2.62		$1.83		$24.88
Short tons (approximate)		(3)		74,876		127,626		6,183				4,501		34,965			

[1] Included with "Undistributed" to avoid disclosure of individual company operations.
[2] Includes 108,710 cubic feet of bluestone (approximately 9,186 tons) valued at $148,782 sold for rough building and flagging.
[3] 397,835 cubic feet (approximate).

TABLE 18.—Bluestone (dimension stone) sold or used in the United States, 1942–51 [1]

Year	Cubic feet	Value	Year	Cubic feet	Value
1942	183,470	$166,787	1947	274,680	$326,168
1943	99,840	92,059	1948	325,940	462,716
1944	156,160	108,732	1949	395,500	533,727
1945	109,330	89,448	1950	390,460	604,137
1946	273,720	274,517	1951	253,935	464,200

[1] New York and Pennsylvania were the only producing States.

MISCELLANEOUS STONE

Types of stone other than those included in the major groups already discussed are covered in table 19. The principal types in this classification are mica schist, argillite, light-color volcanic rocks (such as rhyolite), soapstone, and greenstone. The quantity sold increased 7 percent in tonnage and 5 percent in value over 1950, but the unit value declined slightly.

TABLE 19.—Miscellaneous varieties of stone (dimension stone) sold or used by producers in the United States in 1951, by State and use

State	Active plants	Building				Flagging		Total	
		Rough and dressed		Rubble					
		Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
California	4	456	$15,677	2,952	$7,908	1,142	$25,018	4,550	$48,603
Colorado	1			1,016	409			1,016	409
Maryland	4	10,895	73,903	150	300	146	2,044	11,191	76,247
Montana	1			80	500			80	500
New York	2	(1)	(1)					(1)	(1)
Pennsylvania	2	(1)	(1)					(1)	(1)
Virginia	2	(1)	(1)			680	16,224	(1)	(1)
Washington	1	450	2,500					450	2,500
Wyoming	1			47,996	46,888			47,996	46,888
Undistributed		45,632	2,163,226					46,312	2,179,450
Total	18	[2] 57,433	2,255,306	52,194	56,005	[3] 1,968	43,286	111,595	2,354,597
Average unit value			$39.27		$1.07		$21.99		$21.10

[1] Included with "Undistributed" to avoid disclosure of individual company operations.
[2] Approximately 683,694 cubic feet.
[3] Approximately 23,260 cubic feet.

TRENDS IN USE OF DIMENSION STONE

Figure 1 presents a 36-year history of the output of dimension stone, by kinds. The industry declined greatly during depression and war years, but after 1944 the trend was upward. Conditions were substantially the same in 1951 as in 1950.

Figure 2 traces, for a 37-year period, the history of building-stone production as a whole and of the chief variety, limestone, in their relation to nonresidential building, the class of construction using stone most extensively. In peacetime building-stone sales generally follow the trend of nonresidential building, but in 1951 they failed to pace construction, much of which was of types that use stone sparingly.

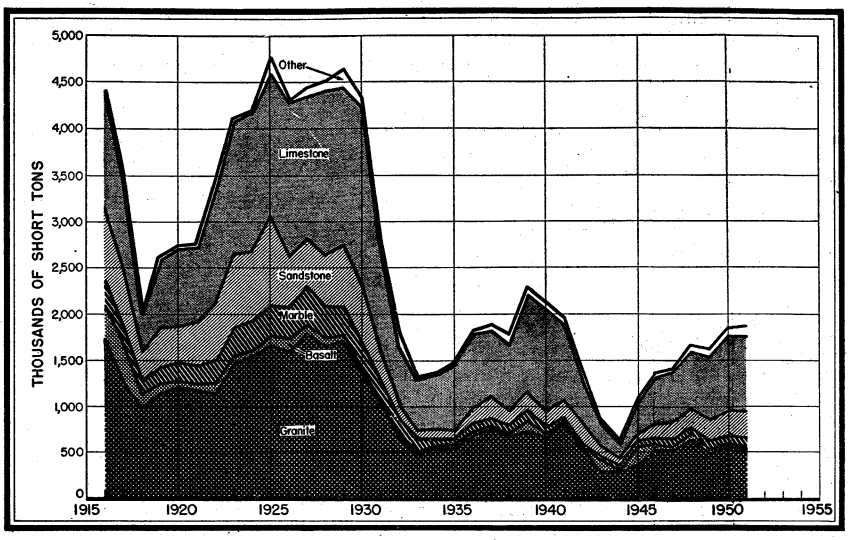

FIGURE 1.—Sales of dimension stone in the United States, 1916–51, by kinds.

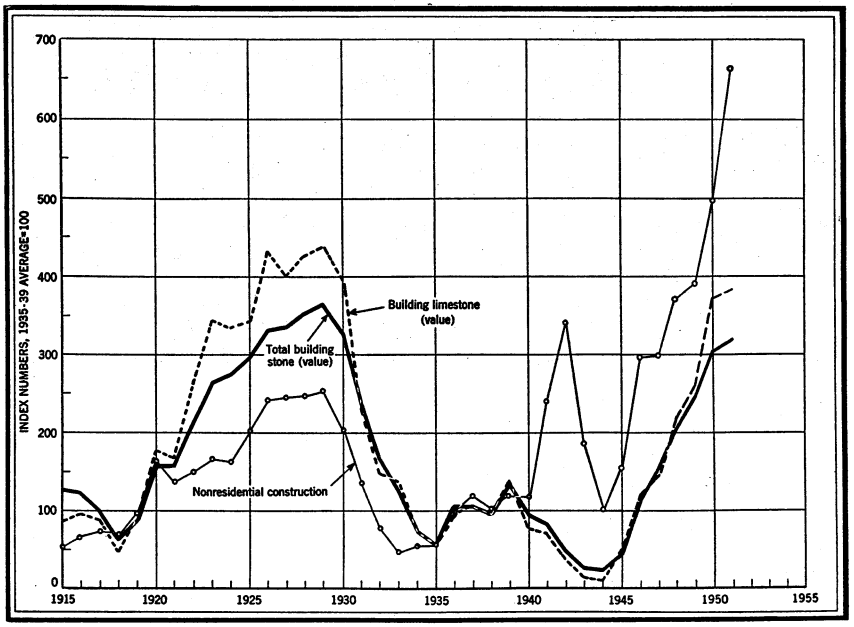

FIGURE 2.—Sales of all building stone and building limestone compared with nonresidential construction (public and private), 1915–51. Data on nonresidential-building construction from Survey of Current Business.

TECHNOLOGY

An exposure test wall of virtually every commercial type of natural stone used in construction was being studied at the National Bureau of Standards.[2]

[2] American Society for Testing Materials, Bull. 171, January 1951, p. 10.

The effects of fire on building stones were studied and described.[3] New types of quarrying machinery used in Europe was the subject of a recent article.[4]

Limestone dominates the building-stone industry of Indiana, and granites occupy a leading position in the dimension-stone industry of Minnesota. The stone deposits of these States were described.[5]

CRUSHED AND BROKEN STONE

Sales of crushed and broken stone, in addition to that used for making cement and lime, continued to show an increase in 1951 over 1950, the total being over 284 million short tons at an average value of $1.33 a ton. This represented a 14-percent increase both in tonnage and value over the preceding year. The average unit price remained unchanged.

Tonnage increases were noted for all uses except material for sugar factories, where only a small reduction occurred.

Table 20 shows the quantity sold and the value of the output during 1950 and 1951, by uses. Detailed data on asphaltic stone and slate granules and flour are given in the Asphalt and Slate chapters of this volume.

Tables 21 and 22 show the tonnage and value of stone used for concrete and road metal and for railroad ballast for a series of years and by States for 1951.

TABLE 20.—Crushed and broken stone sold or used by producers in the United States,[1] 1950–51, by principal use

Use	1950			1951		
	Short tons	Value		Short tons	Value	
		Total	Average		Total	Average
Concrete and road metal	147,107,670	$192,293,884	$1.31	169,557,766	$217,373,404	$1.28
Railroad ballast	18,614,040	17,519,533	.94	21,368,552	20,336,868	.95
Metallurgical	35,969,820	37,932,388	1.05	39,929,957	45,622,125	1.14
Alkali works	6,174,350	5,869,819	.95	7,708,686	7,207,496	.93
Riprap	6,898,050	7,807,200	1.13	6,989,284	8,437,614	1.21
Agricultural	19,348,820	30,393,075	1.57	19,400,610	31,051,933	1.60
Refractory (ganister, mica schist, dolomite, soapstone)	2,158,000	5,848,591	2.71	2,365,804	7,810,013	3.30
Asphalt filler	750,050	2,777,973	3.70	1,047,223	3,159,714	3.02
Calcium carbide works	749,930	782,993	1.04	888,628	903,816	1.02
Sugar factories	717,620	1,608,097	2.24	563,064	1,369,475	2.43
Glass factories	769,680	1,720,504	2.24	793,896	1,906,751	2.40
Paper mills	431,940	942,439	2.18	445,861	943,300	2.12
Other uses	10,563,880	26,621,418	2.52	13,421,489	31,491,633	2.35
Total	250,253,850	332,117,914	1.33	284,480,820	377,614,142	1.33
Portland and natural cement and cement rock [2]	59,361,000	(3)	----------	64,284,000	(3)	----------
Lime [4]	14,980,000	(3)	----------	16,511,000	(3)	----------
Grand total	324,595,000	(3)	----------	365,276,000	(3)	----------
Asphaltic stone	1,184,676	3,522,308	2.97	1,378,434	4,159,259	3.02
Slate granules and flour	761,730	7,476,156	9.81	654,550	5,888,001	9.00

[1] Includes Alaska, Hawaii, and Puerto Rico.
[2] Value reported as cement in chapter on Cement.
[3] No value available for stone used in manufacture of cement and lime.
[4] Value reported as lime in chapter on Lime.

[3] Kieslinger, Alois, Effects of Fire on Building Stones: Quarry Man. Jour. (London), vol. 35, No. 4, October 1951, pp. 187–193.
[4] Stone Trades Journal (London), Modernization of Quarries in France: Vol. 70, No. 6, June 1951, pp. 47–51.
[5] Rock Products, vol. 54, No. 4, April 1951, p. 124.

TABLE 21.—Crushed stone for concrete and road metal and railroad ballast sold or used by producers in the United States,[1] 1947–51

Year	Concrete and road metal		Railroad ballast		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1947	107,077,590	$125,753,455	16,350,260	$13,566,869	123,427,850	$139,320,324
1948	121,542,170	149,879,694	18,180,990	16,315,834	139,723,160	166,195,528
1949	124,367,210	158,357,911	17,054,180	15,376,880	141,421,390	173,734,791
1950	147,107,670	192,293,884	18,614,040	17,519,533	165,721,710	209,813,417
1951	169,557,766	217,373,404	21,368,552	20,336,868	190,926,318	237,710,272

[1] Includes Alaska, Hawaii, and Puerto Rico.

TABLE 22.—Crushed stone for concrete and road metal and railroad ballast sold or used by producers in the United States in 1951, by States

State	Concrete and road metal		Railroad ballast		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	261,840	$383,491			261,840	$383,491
Arizona	[1] 104,606	[1] 156,013	117	$175	[1] 104,723	[1] 156,188
Arkansas	[1] 335,725	[1] 759,892	[1] 1,378	[1] 1,102	[1] 337,103	[1] 760,994
California	8,489,478	8,321,258	543,667	407,358	9,033,145	8,728,616
Colorado	[1] 166,439	[1] 335,488	(2)	(2)	[1] 166,439	[1] 335,488
Connecticut	2,029,267	2,676,964	138,770	152,645	2,168,037	2,829,609
Delaware	93,201	233,002			93,201	233,002
Florida	6,440,940	7,715,744	51,094	55,736	6,492,034	7,771,480
Georgia	4,496,132	6,748,459	374,799	436,232	4,870,931	7,184,691
Idaho	[1] 899,976	[1] 1,147,143	(2)	(2)	1,360,182	1,618,422
Illinois	11,463,190	13,084,901	1,194,639	1,174,315	12,657,829	14,259,216
Indiana	5,433,962	6,347,465	371,882	434,376	5,805,844	6,781,841
Iowa	7,462,684	9,247,025	4,000	4,500	7,466,684	9,251,525
Kansas	4,707,711	6,059,887	1,304,674	680,785	6,012,385	6,740,672
Kentucky	5,847,847	7,203,539	377,955	407,190	6,225,802	7,610,729
Maine	523,109	1,005,304			523,109	1,005,304
Maryland	[1] 2,223,391	[1] 3,500,351	603,528	885,419	[1] 2,826,919	[1] 4,385,770
Massachusetts	2,632,840	3,791,345	183,302	219,050	2,816,142	4,010,395
Michigan	2,631,819	2,458,552	334,240	428,252	2,966,059	2,886,804
Minnesota	1,206,913	1,542,060	401,407	422,896	1,608,320	1,964,956
Mississippi			37,131	14,833	37,131	14,833
Missouri	6,649,750	8,306,208	1,430,220	529,079	8,079,970	8,835,287
Montana	78,134	99,740	553,105	571,725	631,239	671,465
Nebraska	329,917	498,092			329,917	498,092
Nevada	[1] 1,950	[1] 4,500			[1] 1,950	[1] 4,500
New Hampshire	[1] 59,699	[1] 95,092			[1] 59,699	[1] 95,092
New Jersey	5,847,784	8,990,215	224,500	387,075	6,072,284	9,377,290
New Mexico	291,233	76,186	727,698	513,450	1,018,931	589,636
New York	[1] 11,449,924	[1] 17,770,031	[1] 949,072	[1] 1,095,424	[1] 12,398,996	[1] 18,865,455
North Carolina	7,539,108	10,574,510	616,782	790,311	8,155,890	11,364,821
North Dakota	11,243	2,270	214,642	206,692	225,885	208,962
Ohio	[1] 11,394,089	[1] 13,238,234	1,319,604	1,427,415	[1] 12,713,693	[1] 14,665,649
Oklahoma	4,356,088	4,221,056	1,836,134	1,073,548	6,192,222	5,294,604
Oregon	[1] 6,926,317	[1] 9,208,915	46,257	49,169	[1] 6,972,574	[1] 9,258,084
Pennsylvania	[1] 12,498,604	[1] 18,140,874	918,225	1,416,790	[1] 13,416,829	[1] 19,557,664
Rhode Island	203,733	407,131			203,733	407,131
South Carolina	2,151,996	2,906,886	407,356	540,962	2,559,352	3,447,848
South Dakota	1,011,910	1,636,659	[1] 1,500	[1] 3,000	[1] 1,013,410	[1] 1,639,659
Tennessee	6,961,831	8,619,908	680,561	642,731	7,642,392	9,262,639
Texas	4,642,108	4,366,841	[1] 607,840	[1] 538,555	[1] 5,249,948	[1] 4,905,396
Utah	544,915	247,823	57,548	127,702	602,463	375,525
Vermont	[1] 93,652	[1] 117,556	19,466	26,981	[1] 113,118	[1] 144,537
Virginia	[1] 5,765,552	[1] 8,382,204	[1] 738,949	[1] 840,644	6,604,246	9,394,597
Washington	3,598,253	3,766,698	835,870	621,256	4,434,123	4,387,954
West Virginia	[1] 1,110,466	[1] 1,832,281	495,388	496,931	[1] 1,605,854	[1] 2,329,212
Wisconsin	[1] 4,764,099	[1] 5,143,307	231,289	248,752	[1] 4,995,388	[1] 5,392,059
Wyoming	[1] 68,345	[1] 135,202	1,301,162	1,189,068	[1] 1,369,507	[1] 1,324,270
Undistributed	2,514,680	3,225,716	1,225,631	1,264,544	3,180,360	3,847,232
Total	168,316,450	214,732,018	21,361,382	20,326,668	189,677,832	235,058,686
Alaska, Hawaii, Puerto Rico	1,241,316	2,641,386	7,170	10,200	1,248,486	2,651,586
Grand total	169,557,766	217,373,404	21,368,552	20,336,868	190,926,318	237,710,272

[1] To avoid disclosing confidential information, total is somewhat incomplete, the figures not included being combined as "Undistributed."
[2] Included with "Undistributed."

COMMERCIAL AND NONCOMMERCIAL OPERATIONS

In contrast with strictly commercial operations, noncommercial operations represent tonnages reported by States, counties, municipalities, and other Government units as being produced by themselves or by contractors for their own consumption. Table 23 shows the production of crushed stone for concrete and road metal during recent years by both types of operations. Noncommercial operations during 1951 gained 16 percent over 1950 compared with a 15-percent gain for commercial ones, continuing the trend of the previous year.

TABLE 23.—Crushed stone for concrete and road metal sold or used by commercial and noncommercial operators in the United States,[1] 1947–51

[Figures for "noncommercial operations" represent tonnages reported by States, counties, municipalities, and other Government agencies, produced either by themselves or by contractors expressly for their consumption, often with publicly owned equipment; they do not include purchases from commercial producers. Figures for "commercial operations" represent tonnages reported by all other producers.]

Year	Commercial operations				Noncommercial operations				Total	
	Short tons	Average value per ton	Percent of change in quantity from preceding year	Percent of total quantity	Short tons	Average value per ton	Percent of change in quantity from preceding year	Percent of total quantity	Short tons	Percent of change in quantity from preceding year
1947	95,178,440	$1.19	+13	89	11,899,150	$1.09	+84	11	107,077,590	+19
1948	108,029,360	1.23	+14	89	13,512,810	1.25	+14	11	121,542,170	+14
1949	111,094,390	1.27	+3	89	13,272,820	1.27	−2	11	124,367,210	+2
1950	130,977,250	1.32	+18	89	16,130,420	1.20	+22	11	147,107,670	+18
1951	150,787,271	1.30	+15	89	18,770,495	1.15	+16	11	169,557,766	+15

[1] Includes Alaska, Hawaii, and Puerto Rico.

GRANULES

The output of granules for roofing purposes has been canvassed since 1942. Table 24 shows total production and value for the past 5 years. Separate figures for slate granules are given in the Slate chapter of this volume.

TABLE 24.—Roofing granules[1] sold or used in the United States, 1947–51, by kinds

Year	Natural		Artificially colored		Brick		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1947	504,980	$4,166,810	1,133,870	$17,559,227	56,570	$998,434	1,695,420	$22,724,471
1948	448,150	3,828,307	1,002,430	16,563,351	35,110	586,173	1,485,690	20,977,831
1949	352,846	3,088,402	977,934	16,489,253	23,425	400,919	1,354,205	19,978,574
1950	489,794	4,312,531	1,294,275	22,276,565	13,660	263,752	1,797,729	26,852,848
1951	430,235	3,474,385	[2]1,184,544	[2]20,809,752	(2)	(2)	1,614,779	24,284,137

Manufactured from stone, slate, slag, and brick.
[2] A small quantity of brick included with artificially colored granules.

SIZE OF PLANTS

Although the number of crushed-stone plants in the United States declined some 5 percent during 1951, the average plant production increased 19 percent over the 1950 output to approximately 168,000 tons. During 1951, 416 plants producing annually less than 25,000 tons each supplied less than 2 percent of the output. On the other hand, the 43 plants that produced over 900,000 tons each contributed nearly 30 percent of the total. Table 25 shows additional details of the size pattern of the industry.

TABLE 25.—Number and production of commercial crushed-stone plants in the United States in 1950–51, by size of output [1]

Size of output	1950				1951			
	Number of plants	Total production of plants (short tons)	Percent of total	Cumulative total (short tons)	Number of plants	Total production of plants (short tons)	Percent of total	Cumulative total (short tons)
Less than 1,000 tons	49	22,950	0.01	22,950	48	18,249	0.01	18,249
1,000 to 25,000	471	5,044,040	2.20	5,066,990	368	4,204,412	1.63	4,222,661
25,000 to 50,000	251	9,190,720	4.01	14,257,710	224	8,098,050	3.14	12,320,711
50,000 to 75,000	185	11,387,660	4.97	25,645,370	182	11,115,485	4.31	23,436,196
75,000 to 100,000	140	12,058,880	5.27	37,704,250	125	10,722,285	4.15	34,158,481
100,000 to 200,000	236	33,563,530	14.66	71,267,780	243	34,302,878	13.29	68,461,359
200,000 to 300,000	103	25,020,380	10.93	96,288,160	128	31,112,151	12.06	99,573,510
300,000 to 400,000	72	24,903,960	10.88	121,192,120	73	25,388,587	9.84	124,962,097
400,000 to 500,000	31	13,852,520	6.05	135,044,640	44	19,632,484	7.61	144,594,581
500,000 to 600,000	15	8,346,320	3.64	143,390,960	19	10,311,283	3.99	154,905,864
600,000 to 700,000	15	9,593,000	4.19	152,983,960	14	9,051,448	3.51	163,957,312
700,000 to 800,000	12	9,042,710	3.95	162,026,670	15	11,478,521	4.45	175,435,833
800,000 to 900,000	10	8,753,870	3.82	170,780,540	8	7,009,068	2.71	182,444,901
900,000 tons and over	32	58,208,790	25.42	228,989,330	43	75,622,832	29.30	258,067,733
Total	1,622	228,989,330	100.00	228,989,330	1,534	258,067,733	100.00	258,067,733

[1] Exclusive of marble which is primarily a dimension-stone industry. Includes Alaska, Hawaii, and Puerto Rico.

METHODS OF TRANSPORTATION

Transportation methods used by the crushed-stone industry in 1951 changed very little from the preceding year, only a slight increase percentagewise being noted in the tonnage moved by rail. Waterways provide relatively minor but locally important transportation facilities.

TABLE 26.—Crushed stone sold or used in the United States [1] in 1951, by method of transportation

Method of transportation	Commercial operations		Commercial and noncommercial [2] operations	
	Short tons	Percent of total	Short tons	Percent of total
Truck	128,666,074	50	154,910,013	54
Rail	90,356,658	35	90,356,658	32
Waterway	27,447,464	11	27,447,464	10
Unspecified	11,766,685	4	11,766,685	4
Total	258,236,881	100	284,480,820	100

[1] Alaska, Hawaii, and Puerto Rico.
[2] Entire output of noncommercial operations assumed to be moved by truck.

GRANITE

Although the tonnage of crushed and broken granite sold in 1951 declined 7 percent and its value 5 percent from 1950, the average unit price advanced 2 cents a ton to $1.36. The material assigned to "other uses" gained, but all other uses reported losses both in tonnage and value. North Carolina was the principal producing State, followed by Georgia, South Carolina, California, and Virginia, in that order.

BASALT AND RELATED ROCKS (TRAPROCK)

Commercial traprock normally includes basalt, gabbro, diorite, and other dark igneous rocks. It is widely used for concrete, road metal, and railroad ballast, and to a lesser extent for riprap and such "other uses" as fill material, roofing granules, etc. The sales of crushed and broken traprock in 1951 were 28 percent greater in quantity and 25 percent greater in value than in 1950. Sales of riprap and of material assigned to "other uses" declined both in tonnage and value, while sales of crushed material for concrete and road metal and for railroad ballast increased. The average value declined slightly from the preceding year to $1.46 a short ton. New Jersey was the leading producer, followed by Oregon, Washington, and Pennsylvania, in that order.

MARBLE

Large quantities of waste material, consisting either of defective blocks or cuttings and spalls from marble-dressing operations, accumulate in the processing of marble blocks. This byproduct material is marketed for a great variety of uses (*see* footnote 1, table 27). The average value varies from State to State, because in certain States a large proportion of this material is marketed for such high-priced products as terrazzo or marble flour, whereas in other States a considerable amount is sold for roadstone, concrete aggregate, or other relatively low-priced uses. The average unit value for crushed and broken marble was $10.27, an increase of $1.69 over the preceding year.

TABLE 27.—Marble (crushed and broken stone) sold by producers in the United States in 1951, by States [1]

State	Active plants	Short tons	Value	State	Active plants	Short tons	Value
Alabama	2	[2]	[2]	Tennessee	4	21,444	$145,438
Arkansas	1	250	$1,000	Texas	1	10,675	303,500
California	1	8,435	171,083	Utah	1	7,233	78,050
Georgia	1	9,851	75,748	Virginia	1	[2]	[2]
Maryland	1	9,254	163,044	Washington	4	2,481	23,290
Missouri	1	6,000	120,000	Undistributed		89,300	556,600
New Jersey	1	3,750	97,500				
New York	1	[2]	[2]	Total	21	169,148	1,736,535
North Carolina	1	475	1,282	Average unit value			$10.27

[1] Includes stone used for agriculture, asphalt filler, cast stone, composition flooring, crushed stone, magnesia, mineral food, plaster, poultry grit, shingles, stucco, terrazzo, tile, whiting (excluding marble whiting made by companies that purchase their marble), and unspecified uses.
[2] Included with "Undistributed" to avoid disclosure of individual company operations.

TABLE 28.—Granite (crushed and broken stone) sold or used by producers in the United States in 1951, by State and use

State	Riprap		Crushed stone				Other uses [1]		Total	
			Concrete and road metal		Railroad ballast					
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alaska			[2]	[2]					[2]	[2]
Arizona	[2]	[2]	[2]	[2]					[2]	[2]
California	83,546	$39,537	1,172,767	$1,185,120	[2]	[2]	[2]	[2]	1,901,588	$1,748,736
Colorado	172,106	258,937	[2]	[2]	[2]	[2]			225,538	360,096
Connecticut	[2]	[2]							[2]	[2]
Delaware			93,201	233,002			6,000	$12,000	99,201	245,002
Georgia	[2]	[2]	4,188,614	6,273,074	347,649	$409,082	[2]	[2]	4,915,063	6,993,677
Maine	5,324	7,927	2,430	5,010					7,754	12,937
Maryland	[2]	[2]	[2]	[2]					95,909	211,050
Massachusetts	[2]	[2]	427,423	754,545			[2]	[2]	449,320	837,932
Minnesota	40,784	42,203	77,580	107,722	399,607	419,746	8,000	48,000	525,971	617,671
Missouri	3,553	5,249							3,553	5,249
Montana	23,510	10,237							23,510	10,237
New Hampshire	[2]	[2]	[2]	[2]			[2]	[2]	[2]	[2]
New Jersey			429,978	620,078					429,978	620,078
North Carolina	10,084	21,745	4,986,066	7,231,921	606,782	779,311	398,000	570,581	6,000,932	8,603,558
North Dakota	55,334	4,099							55,334	4,099
Oregon			[2]	[2]			[2]	[2]	[2]	[2]
Pennsylvania	3,256	6,882	106,000	158,000					109,256	164,882
Puerto Rico			20,600	20,600					20,600	20,600
Rhode Island	[2]	[2]							[2]	[2]
South Carolina	[2]	[2]	1,958,770	2,643,124	407,356	540,962	[2]	[2]	2,528,473	3,242,140
South Dakota			61,000	41,000					61,000	41,000
Vermont			[2]	[2]					[2]	[2]
Virginia	120,000	210,000	1,460,121	2,351,171	230,137	283,161	91,133	110,017	1,901,391	2,954,349
Washington	1,182	1,122	[2]	[2]	39,654	36,279	[2]	[2]	117,732	205,089
Wisconsin			[2]	[2]					[2]	[2]
Wyoming	32,888	51,165	27,678	35,151	622,873	591,729	3,710	4,125	687,149	682,170
Undistributed	234,269	396,724	481,371	603,763	195,171	169,993	921,679	724,138	397,934	437,680
Total	785,836	1,055,827	15,493,599	22,263,281	2,849,229	3,230,263	1,428,522	1,468,861	20,557,186	28,018,232
Average unit value		$1.34		$1.44		$1.13		$1.03		$1.36

[1] Includes stone used for fill material, poultry grit, road base, stone sand, and unspecified uses.
[2] Included with "Undistributed" to avoid disclosure of individual company operations.

TABLE 29.—Basalt and related rocks (traprock) (crushed and broken stone) sold or used by producers in the United States in 1951, by State and use

State	Riprap		Crushed stone				Other uses [1]		Total	
			Concrete and road metal		Railroad ballast					
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alaska			(2)	(2)					(2)	(2)
California	221,384	$347,825	1,412,829	$1,555,878	8,000	$10,000	9,961	$7,774	1,652,174	$1,921,477
Connecticut	25,810	22,974	2,028,960	2,676,052	138,770	152,645			2,193,540	2,851,671
Hawaii	5,031	4,528	589,374	1,276,028	145	130			594,550	1,280,686
Idaho			837,774	1,125,372					837,774	1,125,372
Maine			(2)	(2)					(2)	(2)
Maryland	766	1,205	608,550	1,066,705	185,686	295,784			795,002	1,363,694
Massachusetts	12,009	11,977	1,993,524	2,737,155	183,302	219,050	1,044	3,132	2,189,879	2,971,314
Minnesota			50,153	100,077					50,153	100,077
Montana	27,202	16,090			103,342	126,607	26,253	3,848	156,797	146,545
Nevada	2,088	313	1,950	4,500					4,038	4,813
New Jersey	108,145	204,453	5,397,404	8,321,962	224,500	387,075			5,730,049	8,913,490
New York	153	153	1,746,453	3,282,937	106,552	159,257			1,853,158	3,442,347
North Carolina			75,164	94,648					75,164	94,648
Oregon	214,352	186,453	4,561,821	5,901,516	23,194	22,060	10,046	13,388	4,809,413	6,123,417
Pennsylvania	273	410	1,751,330	2,965,401	(2)	(2)	(2)	(2)	2,417,606	4,632,529
Puerto Rico			2,851	4,120	2,025	3,070			4,876	7,190
Rhode Island	(2)	(2)							(2)	(2)
Texas	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Virginia			654,348	1,067,196					654,348	1,067,196
Washington	237,666	287,254	3,237,966	3,246,204	796,216	584,977	7,548	926	4,279,396	4,119,361
Wisconsin	488	1,054	72,986	138,888	9,845	17,721	(2)	(2)	(2)	(2)
Undistributed	2,607	3,909	849,944	1,580,746	638,113	1,005,222	165,664	1,553,732	1,073,644	2,634,554
Total	857,974	1,088,598	25,873,381	37,145,385	2,419,690	2,983,598	220,516	1,582,800	29,371,561	42,800,381
Average unit value		$1.27		$1.44		$1.23		$7.18		$1.46

[1] Includes stone sold for fill material, roofing granules, and unspecified uses.
[2] Included with "Undistributed" to avoid disclosure of individual company operations.

LIMESTONE

Because of its wide distribution, chemical and physical properties, and relatively moderate production cost, limestone is used in the United States more than any other type of stone. Sales of limestone were reported to the Bureau of Mines from 44 States and 2 Territories in 1951. In 1951 limestone (excluding that used in manufacturing cement and lime) constituted 72 percent of the total crushed and broken stone produced in the United States. Sales of riprap decreased slightly, but sales of all other classifications of limestone increased during 1951, the tonnage of the total sales being nearly 14 percent higher than in 1950. The total average unit value increased 2 cents a ton to $1.32.

Details by States and uses are shown in table 30, and the quantities and values of limestone applied to miscellaneous uses are indicated in table 31.

TABLE 30.—Limestone (crushed and broken stone) sold or used by producers in the United States in 1951, by State and use

State	Riprap		Fluxing stone		Crushed stone				Agriculture		Miscellaneous		Total	
					Concrete and road metal		Railroad ballast							
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	71,968	$82,250	1,832,605	$2,298,861	261,840	$383,491			227,220	$286,816	306,431	$2,052,440	2,700,064	$5,103,858
Arizona			6,259	9,164	68,181	78,913	117	$175			1,006	3,167	75,563	91,419
Arkansas	2,500	3,750	428,328	398,345	335,725	759,892	1,378	1,102	48,697	77,550	9,945	55,545	826,573	1,296,184
California	878	523	220,642	456,608	182,590	147,814			339	1,629	750,632	2,819,779	1,155,081	3,426,353
Colorado			445,100	862,983	91,304	199,286					64,346	163,477	600,750	1,225,746
Connecticut			(1)	(1)	307	912			56,646	212,656	(1)	(1)	76,888	303,831
Florida	44	133			6,440,940	7,715,744	51,094	55,736	207,726	562,803	1,333,162	1,085,266	8,032,966	9,419,682
Georgia			(1)	(1)	305,018	471,635	27,150	27,150	293,882	510,693	(1)	(1)	956,443	3,014,190
Hawaii											55,544	56,788	55,544	56,788
Idaho			(1)	(1)	(1)	(1)					(1)	(1)	(1)	(1)
Illinois	394,173	490,174	1,105,728	1,456,409	11,463,190	13,084,901	1,194,639	1,174,315	3,536,027	4,479,613	1,586,249	2,726,314	19,280,006	23,411,726
Indiana	59,484	81,020	223,504	267,313	5,414,774	6,339,623	371,882	434,376	1,905,034	2,519,747	162,154	583,587	8,136,332	10,225,666
Iowa	115,740	159,845	23,009	34,431	7,462,684	9,247,025	4,000	4,500	1,568,222	2,235,474	83,163	461,107	9,256,818	12,142,382
Kansas	529,868	689,068			4,580,960	5,882,748	87,242	95,031	562,368	755,673	26,598	184,451	5,787,036	7,606,971
Kentucky	27,084	35,691			5,802,171	7,135,025	377,955	407,190	792,465	958,851	3,000	3,600	7,002,675	8,540,357
Maine	(1)	(1)			2,645	5,290			(1)	(1)	(1)	(1)	73,661	252,936
Maryland					1,614,841	2,433,646	417,842	589,635	64,567	197,946	122,714	565,726	2,219,964	3,786,953
Massachusetts	3,478	4,491	24,365	51,880	10,393	17,395			125,916	446,522	81,482	515,278	245,634	1,035,566
Michigan	45,679	58,866	11,936,581	8,978,302	2,613,491	2,434,751	334,240	428,252	701,213	902,502	5,196,590	4,640,332	20,827,794	17,443,005
Minnesota	41,953	33,910	1,500	2,625	1,079,180	1,334,261	1,800	3,150	119,278	170,898	38,884	117,943	1,282,595	1,662,787
Mississippi									134,000	154,100			134,000	154,100
Missouri	528,454	670,317	32,357	50,406	5,856,271	7,927,913	70,743	132,646	1,698,687	2,688,128	600,582	1,529,822	8,787,094	12,999,232
Montana	2,849	1,619	(1)	(1)	50,134	70,240	868	1,097			(1)	(1)	193,761	334,719
Nebraska	192,461	256,232			321,649	485,690			19,711	98,555	388,828	566,945	922,649	1,407,422
Nevada			(1)	(1)							(1)	(1)	(1)	(1)
New Jersey			(1)	(1)	20,402	48,175			(1)	(1)	(1)	(1)	292,848	1,351,272
New Mexico					122,255	26,407	278,479	202,715					400,734	229,122
New York	155,684	253,776	167,868	201,442	9,703,471	14,487,094	842,520	936,167	491,790	1,493,224	2,071,549	2,673,347	13,432,882	20,045,050
North Carolina					2,146,950	2,911,274	10,000	11,000	11,175	14,059	13,885	10,221	2,182,010	2,946,554
Ohio	77,294	97,868	8,107,937	8,596,607	11,394,089	13,238,234	1,319,604	1,427,415	2,146,650	3,348,630	1,854,573	3,577,486	24,900,147	30,286,240
Oklahoma	75,699	82,181	500	455	3,702,320	4,011,425	439,229	386,067	254,758	312,362	292,913	486,821	4,765,419	5,279,311
Oregon	1,313	1,300			118,750	166,250			45,417	95,702	255,840	286,600	421,320	549,852
Pennsylvania	146,923	252,995	10,175,056	15,407,829	9,591,717	13,196,600	201,232	272,141	1,030,212	2,828,090	1,569,390	3,324,127	22,714,530	35,281,782
Puerto Rico					201,145	455,575	5,000	7,000			38,699	58,473	244,844	521,048
Rhode Island									32,400	162,000			32,400	162,000
South Carolina					192,981	263,603			107,169	184,212			300,150	447,815
South Dakota	(1)	(1)			464,647	737,165	1,500	3,000			(1)	(1)	475,047	757,465
Tennessee	166,659	175,901	63,912	85,691	6,961,831	8,619,908	680,561	642,731	595,247	792,679	309,845	859,695	8,778,055	11,176,605

For footnote, see end of table.

TABLE 30.—Limestone (crushed and broken stone) sold or used by producers in the United States in 1951, by State and use—Continued

State	Riprap		Fluxing stone		Crushed stone				Agriculture		Miscellaneous		Total	
					Concrete and road metal		Railroad ballast							
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Texas	136,171	$173,064	325,167	$310,140	4,095,599	$3,923,093	572,554	$500,051	106,094	$78,942	669,424	$753,316	5,905,009	$5,738,606
Utah			523,772	601,964	483,152	202,269	2,092	1,247			57,639	155,083	1,066,655	960,563
Vermont	(1)	(1)	(1)	(1)	68,152	82,556	19,466	26,981	84,188	413,873	111,153	937,244	331,151	1,524,595
Virginia	60,164	118,313	232,873	335,915	3,577,644	4,890,398	508,812	557,483	878,453	1,415,578	1,133,173	2,467,034	6,391,119	9,784,721
Washington			(1)	(1)	(1)	(1)			50,916	186,888	134,989	371,314	252,958	621,383
West Virginia	3,000	9,000	3,476,645	4,370,091	1,110,466	1,832,281	495,388	496,931	121,566	180,420	177,762	561,401	5,384,827	7,450,124
Wisconsin	251,273	296,988	174,035	189,435	4,687,916	4,999,501	221,444	231,031	1,214,176	1,730,817	73,453	130,191	6,622,297	7,577,963
Wyoming	5,544	5,781	(1)	(1)	(1)	(1)	546,175	518,656			(1)	(1)	735,927	947,255
Undistributed	5,133	7,742	402,214	655,229	115,275	105,548			168,401	554,301	863,283	3,918,911	412,253	767,010
Total	3,101,470	4,042,798	39,929,957	45,622,125	112,717,050	140,353,551	9,085,006	9,574,971	19,400,610	31,051,933	20,438,880	38,702,831	204,672,973	269,348,209
Average unit value		$1.30		$1.14		$1.25		$1.05		$1.60		$1.89		$1.32

[1] Included with "Undistributed" to avoid disclosures of individual company operations.

TABLE 31.—Limestone (crushed and broken stone) sold or used by producers in the United States [1] for miscellaneous uses, 1950–51

Use	1950		1951	
	Short tons	Value	Short tons	Value
Alkali works	6,174,350	$5,869,819	7,708,686	$7,207,496
Calcium carbide works	749,930	782,993	888,628	903,816
Coal-mine dusting	341,170	1,320,342	384,905	1,523,306
Filler (not whiting substitute):				
Asphalt	750,050	2,777,973	1,047,223	3,159,714
Fertilizer	616,840	1,160,535	630,016	1,198,395
Other	294,180	1,178,761	345,963	1,344,858
Filter beds	89,020	158,205	193,432	306,169
Glass factories	769,680	1,720,504	793,896	1,906,751
Limestone sand	773,010	787,547	799,980	962,244
Limestone whiting [2]	676,410	4,875,667	710,348	6,702,207
Magnesia works (dolomite) [3]	236,480	409,852	363,883	725,791
Mineral food	463,050	2,252,857	546,074	3,006,227
Mineral (rock) wool	18,290	23,551	39,412	52,675
Paper mills	431,940	942,439	445,861	943,300
Poultry grit	95,100	893,298	98,625	523,896
Refractory (dolomite)	1,040,530	1,216,933	1,112,186	1,519,831
Road base	1,344,400	1,157,231	1,484,602	1,309,597
Stucco, terrazzo, and artificial stone	73,130	762,889	80,244	800,266
Sugar factories	717,620	1,608,097	563,064	1,369,475
Other uses [4]	1,031,270	1,550,805	1,395,343	2,201,926
Use unspecified	394,690	529,164	806,509	1,034,891
Total	17,081,140	31,979,462	20,438,880	38,702,831

[1] Includes Hawaii and Puerto Rico.
[2] Includes stone for filler for calcimine, caulking compounds, ceramics, chewing gum, explosives, floor coverings, foundry compounds, glue, grease, insecticides, leather goods, paint, paper, phonograph records, picture-frame moldings, plastics, pottery, putty, roofing, rubber, toothpaste, wire coating, and unspecified uses. Excludes limestone whiting made by companies from purchased stone.
[3] Includes stone for refractory magnesia.
[4] Includes stone for acid neutralization, athletic-field marking, carbon dioxide, chemicals (unspecified), concrete blocks and pipes, fill material, oil-well drilling, patching plaster, rayons, roofing granules, spalls and water treatment.

Dolomite (calcium-magnesium carbonate) has a variety of uses, some quite distinct from those of high-calcium limestone. Dead-burned dolomite is used as a refractory lining for metallurgical furnaces; statistical data on this product (which is closely allied to lime) are given in the Lime chapter of this volume. Raw dolomite is also used as a refractory, particularly for patching furnace floors.

Sales of dolomite and its primary calcined product, dolomitic lime, are listed by consuming industry, in table 32.

TABLE 32.—Dolomite and dolomitic lime sold or used by producers in the United States for specified purposes, 1950–51

	1950		1951	
	Short tons	Value	Short tons	Value
Dolomite for—				
Basic magnesium carbonate [1]	236,480	$409,852	363,883	$725,791
Refractory uses	1,040,530	1,216,933	1,112,186	1,519,831
Dolomitic lime for—				
Refractory (dead-burned dolomite)	1,759,440	21,725,560	1,966,460	26,375,313
Paper mills	55,000	642,000	46,000	584,000
Total (calculated as raw stone) [2]	4,906,000	----------	5,501,000	----------

[1] Includes dolomite for refractory magnesia.
[2] 1 ton of dolomitic lime is equivalent to 2 tons of raw stone.

Table 33 shows the tonnages and values of fluxing stone sold for use in various metallurgical operations.

TABLE 33.—Sales of fluxing limestone in the United States, 1947–51, by uses

Year	Blast furnaces		Open-hearth plants		Other smelters [1]		Other metallurgical [2]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1947	25, 817, 270	$22, 000, 942	6, 059, 440	$5, 862, 292	512, 880	$593, 811	180, 680	$230, 905	32, 570, 270	$28, 687, 950
1948	26, 339, 790	24, 721, 052	7, 873, 410	8, 695, 137	503, 490	609, 354	185, 250	224, 465	34, 901, 940	34, 250, 008
1949	23, 768, 970	24, 127, 897	5, 922, 020	6, 929, 134	728, 960	835, 962	332, 370	374, 649	30, 752, 320	32, 267, 642
1950	28, 397, 710	29, 222, 700	6, 936, 900	7, 948, 041	457, 630	587, 643	177, 580	174, 004	35, 969, 820	37, 932, 388
1951	32, 007, 284	35, 941, 217	6, 784, 102	8, 279, 021	842, 877	992, 651	295, 694	409, 236	39, 929, 957	45, 622, 125

[1] Includes flux for copper, gold, lead, zinc, and unspecified smelters.
[2] Includes flux for foundries and for cupola and electric furnaces.

The statistics of the lime and cement industries are presented in separate chapters of Minerals Yearbook and are not covered in the Stone chapter; however, a commodity review of limestone would be incomplete without suitable recognition of the large tonnage of limestone consumed by these industries. Consequently, table 34 shows the total tonnage consumed for all purposes.

TABLE 34.—Limestone sold or used for all purposes in the United States,[1] 1949–51, in short tons

Use	1949	1950	1951
Limestone (as given in this report) (approximate)	163, 746, 000	180, 919, 000	205, 480, 000
Portland and natural cement and cement rock [2]	55, 219, 000	59, 361, 000	64, 284, 000
Lime [3]	12, 637, 000	14, 980, 000	16, 511, 000
Total	231, 602, 000	255, 260, 000	286, 275, 000

[1] Includes Hawaii and Puerto Rico.
[2] Reported in terms of cement in Cement chapter of this volume.
[3] Reported in terms of lime in Lime chapter of this volume.

SANDSTONE

Although the sales of crushed and broken sandstone in 1951 decreased 4 percent in tonnage from the previous year, the total value increased slightly, and the average unit value increased 9 cents a ton to $2.09. Decreases were noted in the sales of sandstone for riprap and concrete and road metal, while increases occurred in the sales of refractory stone, railroad ballast, and the material assigned to "other uses."

MISCELLANEOUS STONE

Crushed and broken stone, other than the five principal varieties already discussed, includes light-color volcanic rocks, schists, boulders from river beds, serpentine, chats, and flint. Table 36 shows the total sales of all these miscellaneous kinds of stone by their end uses. Sales during 1951 increased 30 percent in tonnage and 26 percent in value compared with 1950, but the average unit value decreased 3 cents to 85 cents a ton. California was the largest producer in 1951, followed by Oregon, Missouri, and Oklahoma, in that order.

TABLE 35.—Sandstone (crushed and broken stone) sold or used by producers in the United States in 1951, by State and use

State	Refractory stone (ganister)		Riprap		Crushed stone				Other uses [1]		Total	
					Concrete and road metal		Railroad ballast					
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	(2)	(2)									(2)	(2)
Arizona					(2)	(2)					(2)	(2)
California	4,566	$50,226	(2)	(2)	1,094,912	$1,156,475	(2)	(2)	(2)	(2)	1,506,144	$1,530,338
Colorado	8,025	24,834	525	$1,290	46,374	114,916			489,000	$293,700	543,924	434,740
Georgia			2,000	3,000							2,000	3,000
Idaho					(2)	(2)	(2)	(2)			(2)	(2)
Illinois	656	12,375									656	12,375
Indiana					438	342					438	342
Kansas			250	250	86,961	161,154	189,672	$282,254			276,883	443,658
Kentucky					45,676	68,514					45,676	68,514
Maine			(2)	(2)	(2)	(2)					(2)	(2)
Massachusetts					1,500	2,250					1,500	2,250
Michigan					60	120					60	120
Minnesota			(2)	(2)							(2)	(2)
Missouri			149	121							149	121
Montana			17,710	16,567	28,000	29,500	277,291	271,146	2,554	2,064	325,555	319,277
Nebraska			12,050	18,075	8,268	12,402					20,318	30,477
Nevada			18,900	11,280							18,900	11,280
New Mexico			3,900	2,488	132,035	26,407	449,219	310,735			585,154	339,630
New York			(2)	(2)							(2)	(2)
Ohio	76,795	885,553	34,268	103,495					13,079	13,028	124,142	1,002,076
Oklahoma			13,400	13,400					132,817	199,225	146,217	212,625
Pennsylvania	723,102	3,457,481	200	600	1,049,557	1,820,873	114,166	177,931	3,000	3,000	1,890,025	5,459,885
South Dakota	33,023	84,694	(2)	(2)	436,263	828,494	(2)	(2)			654,469	1,142,551
Texas			130	50	154,372	156,397			222,400	119,350	376,902	275,797
Utah	13,172	47,369			56,100	32,640					69,272	80,009
Virginia	(2)	(2)			(2)	(2)	(2)	(2)	(2)	(2)	219,351	498,070
Washington			422	4,618							422	4,618
West Virginia	(2)	(2)	50	50	(2)	(2)					369,551	1,022,515
Wisconsin	(2)	(2)	1,517	2,370					(2)	(2)	570,422	3,835,167
Wyoming			1,500	1,000	23,946	67,500					25,446	68,500
Undistributed	373,960	1,621,219	276,172	326,071	709,146	1,324,726	394,551	410,547	723,180	3,158,235	727,403	934,466
Total	1,233,299	6,183,751	383,143	504,725	3,873,608	5,802,710	1,424,899	1,452,613	1,586,030	3,788,602	8,500,979	17,732,401
Average unit value		$5.01		$1.32		$1.50		$1.02		$2.39		$2.09

[1] Includes sandstone for fill material, filter stone, road base, roofing granules, spalls, stone sand, and unspecified uses.
[2] Included with "Undistributed" to avoid disclosure of individual company operations.

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TABLE 36.—Miscellaneous varieties of stone (crushed and broken stone) sold or used by producers in the United States in 1951, by State and use

State	Riprap		Crushed stone				Other uses [1]		Total	
			Concrete and road metal		Railroad ballast					
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	2,186	$2,952							2,186	$2,952
Alaska			(2)	(2)					(2)	(2)
Arizona			36,425	$77,100					36,425	77,100
Arkansas	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	1,707,325	1,823,072
California	118,656	226,907	4,626,380	4,275,971	349,251	$242,122	1,199,957	$746,935	6,294,244	5,491,935
Colorado	55,120	121,061	28,761	21,286					83,881	142,347
Georgia			2,500	3,750					2,500	3,750
Hawaii	(2)	(2)	(2)	(2)					(2)	(2)
Idaho			62,202	21,771					62,202	21,771
Indiana			18,750	7,500					18,750	7,500
Kansas [3]			39,790	15,985	1,027,760	303,500	22,384	10,360	1,089,934	329,845
Maine			3,589	4,486					3,589	4,486
Maryland							280	280	280	280
Massachusetts	45,000	33,750	200,000	280,000					245,000	313,750
Michigan			18,268	23,681					18,268	23,681
Mississippi					37,131	14,833			37,131	14,833
Missouri [3]			793,479	378,295	1,359,477	396,433	265,251	134,494	2,418,207	909,222
Montana					171,604	172,875			171,604	172,875
Nevada			(2)	(2)					(2)	(2)
New Hampshire			59,699	95,092					59,699	95,092
New Mexico			36,943	23,372					36,943	23,372
New York			(2)	(2)	(2)	(2)			(2)	(2)
North Carolina			330,928	336,667					330,928	336,667
North Dakota			11,243	2,270	214,642	206,692			225,885	208,962
Ohio			(2)	(2)					(2)	(2)
Oklahoma [3]			653,768	209,631	1,396,905	687,481			2,050,673	897,112
Oregon	1,159,056	875,329	2,245,746	3,141,149	23,063	27,109			3,427,865	4,043,587
Pennsylvania			(2)	(2)			(2)	(2)	122,080	294,491
Rhode Island			(2)	(2)					(2)	(2)
South Carolina			245	159					245	159
South Dakota			50,000	30,000					50,000	30,000
Texas	(2)	(2)	(2)	(2)	(2)	(2)	592,890	274,280	1,035,297	581,767
Utah	22,431	33,127	5,663	12,914	55,456	126,455			83,550	172,496
Vermont			25,500	35,000					25,500	35,000
Virginia			73,439	73,439			15,689	31,829	89,128	105,268
Washington	132,909	63,259	226,994	348,104			10,374	3,161	370,277	414,524
Wisconsin			3,197	4,918			3,871	8,052	7,068	12,970
Wyoming			16,721	32,551	132,114	78,683			148,835	111,234
Undistributed	325,503	389,281	2,029,898	2,353,386	822,325	839,240	47,560	119,427	953,474	1,276,284
Total	1,860,861	1,745,666	11,600,128	11,808,477	5,589,728	3,095,423	2,158,256	1,328,818	21,208,973	17,978,384
Average unit value		$0.94		$1.02		$0.55		$0.62		$0.85

[1] Includes stone used for agriculture, fill material, refractory, road base, roofing granules, spalls, and unspecified uses.
[2] Included with "Undistributed" to avoid disclosure of individual company operations.
[3] Chats; figures collected by Amarillo, Tex., office of the Bureau of Mines. Also includes small quantity of stone.

MARKETS

As crushed stone is used principally as an aggregate in concrete, its sales tend to parallel cement shipments and the area of concrete pavements. These relationships are indicated in figure 3. Although construction declined slightly in 1951 compared with 1950, the sale of crushed stone for all purposes continued its advance, as in the previous 5 years.

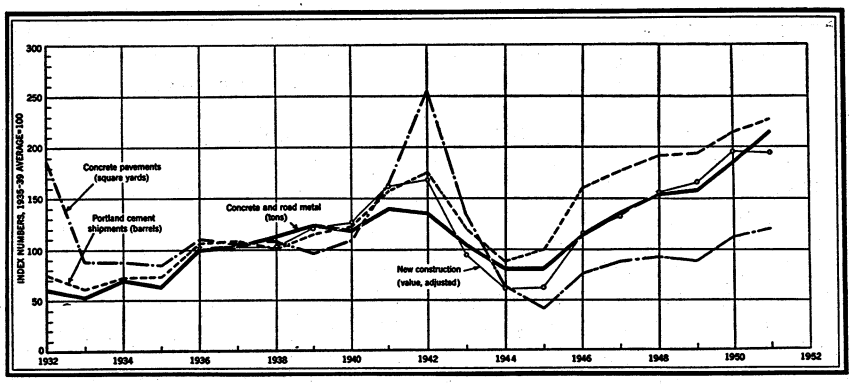

FIGURE 3.—Crushed-stone aggregates (concrete and road metal) sold or used in the United States compared with shipments of portland cement, new construction (value, adjusted to 1939 prices), and concrete pavements (contract awards, square yards), 1932–51. Data on construction and concrete pavements from Survey of Current Business.

The metallurgical industries in 1951 operated at a higher level than in 1950, and 1951 was a record year in the total sales of fluxing limestone, as shown in figure 4.

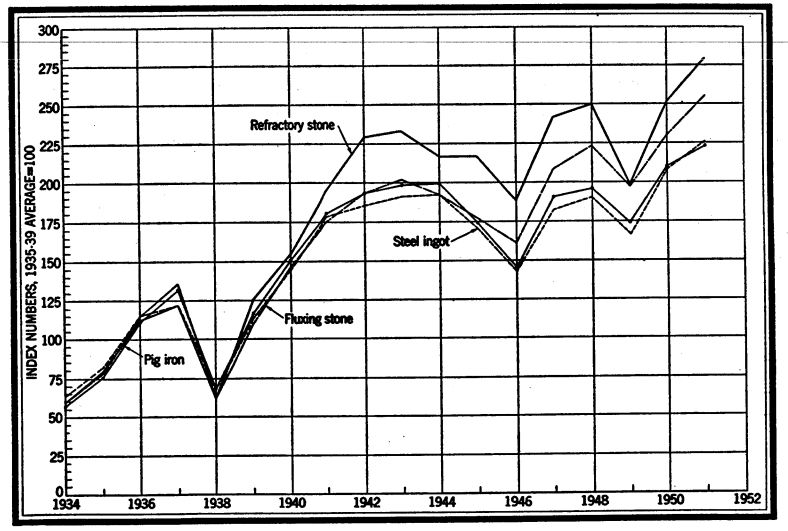

FIGURE 4.—Sales (tons) of fluxing stone and refractory stone (including that used in making lime) compared with production of steel ingot and pig iron, 1934–51. Statistics of steel-ingot production compiled by American Iron and Steel Institute.

TECHNOLOGY

Mining methods received considerable attention in the technical press. One article described underground limestone mining.[6] Another gave operating details designed to increase production of smaller quarries and portable crushing plants.[7] New methods of mining and transporting crushed and broken stone were the subject of a recent publication.[8] Recovery of fines from a limestone crushing plant assures a new source of agricultural limestone.[9]

Much has been written on the chemical and physical characteristics of limestones and dolomites. Some recent contributions in this field of study have been summarized.[10] Spectrographic analyses are important aids in such investigations.[11]

A method was devised for freeze-proofing agricultural limestone to facilitate spreading during cold weather.[12]

Descriptions, illustrated with maps, of limestone deposits in certain Eastern and Midwestern States, were published.[13]

Several new operations were described. A high-grade sandstone suitable for glass manufacture was being developed 10 miles south of Ottawa, Canada.[14] A high-calcium limestone deposit was being quarried near Batesville, Ark., to supply the Alcoa alumina plant at Bauxite, Ark.[15] Modern methods employed in producing and transporting the output of a large metallurgical limestone deposit were described.[16]

FOREIGN TRADE[17]

The importation of stone into the United States in 1951 increased in total value 49 percent over 1950. Increases in both quantity and value occurred in nearly every classification.

Export trade in 1951, covering marble and other building and monumental stone, increased 61 percent in volume and 55 percent in value over 1950. "Other manufactures of stone" decreased 20 percent in value.

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[6] Corre, H. A., Stope Mining of Limestone: Rock Products, vol. 54, No. 1, January 1951, pp. 128–130.
[7] Rock Products, vol. 54, No. 12, December 1951, p. 117.
[8] Excavating Engineer, vol. 45, No. 9, September 1951, pp. 17–23, 56.
[9] Avery, William M., Independent Circuit Assures Peak Production of Fines for Agstone: Pit and Quarry, vol. 44, No. 5, November 1951, pp. 114–115, 119.
[10] Rockwood, Nathan C., Physical and Chemical Characteristics of Limestones and Dolomites: Rock Products, vol. 54, No. 4, April 1951, p. 102.
[11] Pit and Quarry, vol. 43, No. 12, June 1951, p. 86; Ceramic Bulletin, vol. 30, No. 3, March 1951, p. 100.
[12] Pit and Quarry, vol. 43, No. 11, May 1951, pp. 125, 128.
[13] Baltimore & Ohio Railroad, Traffic Department, Baltimore 1, Md., High-Calcium Limestones in the Area Served by the Baltimore & Ohio Railroad: 1951, 105 pp.
[14] Ceramic Industries, vol. 56, No. 3, March 1951, p. 44; Pit and Quarry, vol. 43, No. 9, March 1951, p. 81.
[15] Pit and Quarry, vol. 44, No. 2, August 1951, p. 51; Rock Products, vol. 54, No. 9, September 1951, p. 113.
[16] Rock Products, Twenty Thousand Tons of Stone Daily: Vol. 54, No. 5, May 1951, pp. 64–70.
[17] Figures on imports and exports compiled by M. B. Price and E. D. Page, of the Bureau of Mines, from records of the U. S. Department of Commerce.

TABLE 37.—Stone and whiting imported for consumption in the United States, 1950–51, by classes

[U. S. Department of Commerce]

Class	1950		1951	
	Quantity	Value	Quantity	Value
Marble, breccia, and onyx:				
Sawed or dressed, over 2 inches thick...cubic feet	1,521	$5,990	1,960	$13,729
In blocks, rough, etc...do	131,557	587,894	175,106	805,453
Slabs or paving tiles...superficial feet	464,493	301,684	647,780	436,702
All other manufactures		331,293		419,844
Total		1,226,861		1,675,728
Granite:				
Dressed...cubic feet	34,404	126,452	76,934	236,388
Rough...do	102,737	251,643	85,665	306,861
Paving blocks, wholly or partly manufactured...number	4,831	25,986	3,491	6,525
Total		404,081		549,774
Quartzite...short tons	196,040	509,455	275,778	786,523
Travertine stone...cubic feet	48,141	74,010	63,466	106,110
Stone (other):				
Dressed		14,840		293,262
Rough (monumental or building stone)...cubic feet	4,664	5,044	4,385	22,942
Rough (other)...short tons	55,317	124,817	67,273	193,969
Marble chip or granite...do	41,195	112,663	16,517	158,020
Crushed or ground, n. s. p. f.		2,225		2,263
Total		259,589		670,456
Whiting:				
Chalk or whiting, precipitated...short tons	1,000	36,270	1,029	48,708
Whiting, dry, ground, or bolted...do	[1] 12,003	[1] 150,321	9,407	121,512
Whiting, ground in oil (putty)...do	[2]	105	3	587
Total		[1] 186,696		170,807
Grand total		[1] 2,660,692		3,959,398

[1] Revised figure.
[2] Less than 0.5 ton.

TABLE 38.—Stone exported from the United States, 1947–51

[U. S. Department of Commerce]

Year	Marble and other building and monumental stone		Other manufactures of stone (value)
	Cubic feet	Value	
1947	320,016	$583,826	$549,591
1948	345,697	584,050	430,862
1949	211,334	523,171	436,705
1950	142,955	378,645	338,207
1951	230,239	585,499	271,461

Sulfur and Pyrites

By G. W. Josephson and F. M. Barsigian [1]

GENERAL SUMMARY

DURING 1951 the sulfur industry was concerned primarily with solving the shortage problem that had become acute in 1950. Production of Frasch sulfur increased to a record 5,278,000 long tons—2 percent more than in 1950. Sales, however, were lower than in 1950 because producers' stocks had been reduced in 1950 to such a point that further drafts upon them were considered to be unwise. During 1951, however, it was possible to add to such stocks, and they increased 7 percent.

TABLE 1.—Salient statistics of the sulfur industry in the United States, 1935–39 (average) and 1948–51, in long tons

	1935–39 (average)	1948	1949	1950	1951
Native sulfur:					
Production (from Frasch mines)	2,175,057	4,869,210	4,745,014	5,192,184	5,278,249
Apparent sales	[1] 1,986,597	5,015,230	4,870,723	5,636,959	5,095,347
Imports	3,982	38	32	25	2,377
Exports:					
Crude	566,361	1,262,913	1,430,916	1,440,996	1,287,773
Treated	16,374	32,630	30,135	37,526	24,044
Apparent consumption	1,407,845	3,719,725	3,409,704	4,158,462	3,785,907
Producers' stocks at end of year	[2] 3,560,000	3,225,014	3,099,305	2,654,530	2,837,432
Pyrites:					
Production	544,144	928,531	888,388	931,163	1,017,769
Imports	433,485	107,411	120,937	208,766	221,487
Recovery as byproduct:					
Production of byproduct sulfuric acid (basis, 100 percent) at Cu, Zn, and Pb plants	504,280	572,719	511,854	661,529	736,672
Production of recovered elemental sulfur (basis, 100 percent S)	[3]	44,369	56,781	142,475	184,013
Other byproduct sulfur compounds (basis, 100 percent S)	[4]	25,792	37,935	[5] 41,963	59,613

[1] Represents mine shipments.
[2] Mine stocks only.
[3] Data not available. In 1939, 4,307 long tons was produced.
[4] Data not available. In 1939, 13,000 long tons was recovered.
[5] Revised figure.

Domestic production of pyrites increased during 1951, as did the output from the various other sources of primary sulfur. Pyrite (sulfur content) increased 10 percent; smelter acid, 11 percent; recovered elemental sulfur, 29 percent, and other byproduct-sulfur compounds, 42 percent. Total United States sulfur production increased from 5,986,000 long tons in 1950 to 6,197,000 in 1951.

International trade continued to be an important factor in the sulfur industry. As foreign demand was greater than United States

[1] Figures on imports and exports compiled by M. B. Price and E. D Page, of the Bureau of Mines, rom records of the U. S. Department of Commerce.

sources could supply, a sulfur committee was established in the International Materials Conference to assist in arranging for equitable distribution. Exports declined from 1,479,000 long tons in 1950 to 1,312,000 in 1951.

To assist and encourage the development of new production capacity, the Government, under the provisions of the Defense Production Act, offered incentives such as rapid tax amortization, various types of loans, and priorities on scarce materials. Prices were under the control of the Office of Price Stabilization. Both exports and domestic consumption were placed under direct control of Government agencies.

The year 1951 was particularly noteworthy for the vigorous production-expansion programs that were initiated, both in the United States and abroad. Progress was made on the development of several new Frasch mines and a large number of sulfur-recovery plants processing petroleum gases. A number of new projects were also in progress that would increase the output of pyrites, smelter acid, and other sulfur raw materials. These projects, if all brought to completion, would contribute several million tons of additional production capacity. There was no doubt that a considerable fraction of these projects would actually be completed; however, announcement of new Frasch mines, particularly the large deposit at Garden Island Bay in Louisiana, discouraged development of some of the more marginal projects. The cost disadvantages of most of the alternative sulfur materials continued to retard their rates of development.[2]

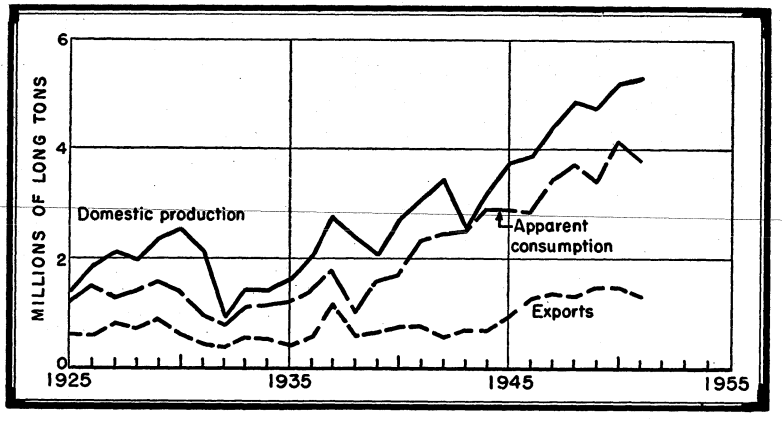

FIGURE 1.—Domestic production, apparent consumption, and exports of native sulfur, 1925-51.

SULFUR

DOMESTIC PRODUCTION

United States production of native sulfur from Frasch process mines in 1951 increased to a new record, 2 percent greater than in 1950, the previous record year. As shown in table 2, a small tonnage of native sulfur was also produced from shallow deposits that cannot

[2] Mining Engineering, Sulfur: Vol. 3, No. 5, May 1951, pp. 403-409.
Chemical and Engineering News, Vol. 29, No. 14, Apr. 2, 1951, p. 1360; Pyrites Process Can Compete If Sulfur Prices Go Up: Vol. 29, No. 14, Apr. 2, 1951, pp. 1310-1313; Vol. 29, No. 19, May 7, 1951, p. 1811.

be mined by the Frasch process. This material is generally of lower grade than crude Frasch sulfur and is used principally for treating alkaline soils. Of the total production of United States native sulfur, Texas contributed 75 percent and Louisiana almost 25 percent; minor quantities came from California, Nevada, and Wyoming.

The development of new sulfur production capacity was encouraged by the United States Government through various incentives, such as rapid tax amortization, purchase contracts, priority assistance, exploration loans, and other forms of loans that could be provided under the Defense Production Act by a number of agencies, including the Defense Production Administration, the National Production Authority, the Petroleum Administration for Defense, and the Defense Minerals Administration. During the year the responsibilities of the Defense Minerals Administration were divided between two new organizations. Exploration activities were assigned to the Defense Minerals Exploration Administration, and development and purchase responsibilities were placed under the Defense Materials Procurement Agency.

TABLE 2.—Production of sulfur and sulfur-containing raw materials by producers in the United States, 1950–51, in long tons

	1950		1951	
	Gross weight	Sulfur content	Gross weight	Sulfur content
Native sulfur or sulfur ore:				
From Frasch-process mines	5,192,184	5,192,184	5,278,249	5,278,249
From other mines	3,327	1,072	3,945	1,365
Total native sulfur	5,195,511	5,193,256	5,282,194	5,279,614
Recovered elemental sulfur:				
Brimstone	139,731	139,352	182,495	181,935
Paste	6,452	3,123	4,614	2,078
Total recovered elemental sulfur	146,183	142,475	187,109	184,013
Pyrites (including coal brasses)	931,163	392,788	1,017,769	432,819
Byproduct sulfuric acid (basis, 100 percent) produced at Cu, Zn, and Pb plants	661,529	216,000	736,672	240,800
Other byproduct sulfur compounds [1]	[2] 46,977	[2] 41,963	70,257	59,613
Total equivalent sulfur		[2] 5,986,482		6,196,859

[1] Hydrogen sulfide and liquid sulfur dioxide. In addition, a quantity of acid sludge was converted to H_2SO_4 but is excluded from the above figures.
[2] Revised figure.

TABLE 3.—Sulfur produced and shipped from Frasch mines in the United States, 1947–51

Year	Produced (long tons)			Shipped	
	Texas	Louisiana	Total	Long tons	Approximate value
1947	3,561,214	880,000	4,441,214	4,828,103	$85,200,000
1948	3,867,545	1,001,665	4,869,210	4,978,912	89,600,000
1949	3,610,829	1,134,185	4,745,014	4,789,311	86,200,000
1950	3,949,164	1,243,020	5,192,184	5,504,714	104,000,000
1951	3,966,956	1,311,293	5,278,249	4,988,101	107,300,000

TABLE 4.—Sulfur ore (10–70 percent S) produced and shipped for agricultural use in the United States, 1947–51, in long tons [1]

Year	Produced (long tons)	Shipped	
		Long tons	Value
1947	4,082	4,303	$65,124
1948	1,832	1,700	30,220
1949	5,678	5,392	101,991
1950	3,327	3,247	60,115
1951	3,945	3,945	75,609

[1] 1947–48: California, Colorado, Nevada, and Texas; 1949–51: California, Colorado (1949 only), Nevada and Wyoming.

Several firms were conducting research on processes for recovering high-purity sulfur from native sulfur ores that cannot be processed by the Frasch method.[3]

California.—The only sulfur production in California in 1951 came from the Crater deposit in the Last Chance Mountains in Inyo County. The deposit was operated by R. E. Kitching (Inyo Soil Sulphur Co.), 310 Pacific St., Bakersfield, Calif. The Anaconda Copper Mining Co., 25 Broadway, New York, N. Y., prepared to begin production of elemental sulfur at the Leviathan mine in Alpine County. Sulfur from this deposit was to be used by this company in a new copper operation in Nevada. A report on sulfur reserves and production in the State had been published in 1950 by the California Division of Mines.[4]

Louisiana.—Frasch-sulfur production in Louisiana attained a new record of 1,311,293 long tons in 1951, of which 1,271,805 was produced at the Grande Ecaille mine by the Freeport Sulphur Co. In June 1951 Jefferson Lake Sulphur Co. brought Starks Dome into production, and during the year output from this new operation totaled 39,488 long tons. Freeport Sulphur Co. announced that exploration had proved the existence of a large deposit of sulfur at Garden Island Bay Dome at the mouth of the Mississippi River. The company began preparing to construct a sulfur-mining plant having a capacity of 500,000 tons of sulfur annually. Completion of the plant was scheduled for 1953. This company also made progress in the construction of a sulfur mining plant at Bay Ste. Elaine Dome, about 60 miles southwest of New Orleans. Both of these domes are in coastal marsh land, and a large part of the sulfur area of Bay Ste. Elaine is under water. A marine form of mining was to be used at Bay Ste. Elaine.

Nevada.—Native sulfur ore was produced at the Vitallo mine, owned by W. S. Peterson, at Sulphur in Humboldt County. This property was leased during the year to the Black Rock Desert Minerals Co.

Texas.—Sulfur was produced in Texas in 1951 by Duval Sulphur & Potash Co. at Orchard Dome, Fort Bend County; Freeport Sul-

[3] Chemical and Engineering News, New Sulphur Refining Process Competitive with Frasch: Vol. 29, No. 7, Feb. 12, 1951, p. 560.
Chemical Engineering, New Sulfur Recovery Process: Vol. 58, No. 3, March 1951, pp. 128, 183.
[4] Vernon, J. W., Sulfur: Mineral Commodities of California, State of California, Department of Natural Resources, Division of Mines, Bull. 156, 1950, pp. 273–275.

phur Co. at Hoskins Mound, Brazoria County; Jefferson Lake Sulphur Co., Inc., at Clemens Dome, Brazoria County, and Long Point Dome, Fort Bend County; and Texas Gulf Sulphur Co. at Boling Dome, Wharton County, and Moss Bluff Dome, Liberty County. By the end of 1951 construction of a new sulfur plant by Texas Gulf Sulphur Co. at Spindletop Dome near Beaumont, Tex., was nearing completion, and expansion of capacity at Moss Bluff Dome had been initiated. Freeport conducted a drilling program at Nash Dome and established the existence of a small deposit of sulfur on the property.

TABLE 5.—Sulfur produced in Texas in 1951, by companies, in long tons

Company	First quarter	Second quarter	Third quarter	Fourth quarter	Total
Texas Gulf Sulphur Co	800, 244	738, 272	835, 677	772, 608	3, 146, 801
Freeport Sulphur Co	70, 765	69, 055	75, 820	68, 280	283, 920
Jefferson Lake Sulphur Co., Inc	62, 618	84, 927	83, 347	85, 343	316, 235
Duval Sulphur & Potash Co	55, 805	54, 150	50, 700	59, 345	220, 000
Total	989, 432	946, 404	1, 045, 544	985, 576	3, 966, 956

Utah.—No production of sulfur was reported by Western Sulphur Industries at Sulphurdale in 1951, but this firm was preparing to bring the deposit into production.

Wyoming.—Wyoming Gulf Sulphur Co. produced sulfur ore near Cody, Park County. It was reported that this company took possession of the Cody Sulphur Co. property in February 1951. The Continental Sulphur & Phosphate Corp. continued its exploration of the sulfur deposit in Sunlight Valley. A sulfur deposit at Thermopolis, Wyo., was explored by Kenneth L. Porter.

RECOVERY AS BYPRODUCT

As shown in table 2, the bulk of United States supplies of sulfur comes from deposits of native sulfur and pyrites. The native-sulfur and much of the pyrites tonnage is produced as a primary product; but byproduct pyrites, recovered as flotation concentrates in the milling of copper, zinc, and lead ores, constitutes a substantial fraction of the supply. A relatively small tonnage of coal brasses is also obtained as a byproduct at a midwestern coal-washing plant. This byproduct pyrite is included in the statistics of the pyrites section of this chapter.

At metal sulfide smelters, where large volumes of sulfur-bearing gases are released, a portion is recovered in the form of sulfuric acid. Smelter acid produced in 1951 contained 240,800 long tons of sulfur, 11 percent more than in 1950. Table 6 shows the output of acid at smelters during the past 5 years. Further expansions of smelter acid capacity were planned by American Smelting & Refining Co. at Garfield, Utah; Corpus Christi, Tex.; and Amarillo, Tex.; and by the American Zinc, Lead, & Smelting Co. at Fairmont City, Ill., and Dumas, Tex.

Many other industrial operations also produce sulfurous fumes, and in some instances they are sufficiently concentrated to permit commer-

TABLE 6.—Byproduct sulfuric acid [1] (basis, 100 percent) produced at copper, zinc, and lead plants in the United States, 1947–51, in short tons

	1947	1948	1949	1950	1951
Copper plants [2]	126,494	111,967	96,344	131,342	189,125
Zinc plants	598,703	529,478	476,932	609,571	635,948
Total	725,197	641,445	573,276	740,913	825,073

[1] Includes acid from foreign materials.
[2] Includes acid produced at a lead smelter. Excludes acid made from pyrites concentrates in Montana and Tennessee.

cial recovery of a sulfur byproduct. The sulfur shortage provided a strong impetus to the increase of sulfur recovery operations. Table 1 indicates the progress that had been made in recent years, and in 1951 additional plants were either in the planning or construction stage.[5] By the end of 1951 about 20 plants for the recovery of natural and refinery gases were projected. A number of operations that process coke-oven and other coal gases were active, but there was little interest in new projects. A total of 184,013 long tons of elemental sulfur was recovered in 1951 at gas-processing plants. Shipments totaled 193,780 long tons, of which 191,155 tons was in the form of brimstone and 2,625 in the form of paste. In addition, 59,613 tons of equivalent sulfur was recovered in the form of sulfur dioxide and of hydrogen sulfide, which were used principally for making sulfuric acid.

CONSUMPTION AND USES

Demand for sulfur, particularly of the Frasch variety, was considerably greater than supply in 1951. In the first 5 months of the year suppliers reduced shipments to consumers, in some instances as much as 20 percent below the 1950 rate. The shortage caused a great furor, both in the United States and abroad, as consuming firms became concerned over their current supply positions and future

TABLE 7.—Apparent consumption of native sulfur in the United States, 1947–51, in long tons

	1947	1948	1949	1950	1951
Apparent sales to consumers [1]	4,839,548	5,015,230	4,870,723	5,636,959	5,095,347
Imports	15	38	32	25	2,377
Total	4,839,563	5,015,268	4,870,755	5,636,984	5,097,724
Exports:					
Crude	1,299,060	1,262,913	1,430,916	1,440,996	1,287,773
Refined	50,477	32,630	30,135	37,526	24,044
Total	1,349,537	1,295,543	1,461,051	1,478,522	1,311,817
Apparent consumption	3,490,026	3,719,725	3,409,704	4,158,462	3,785,907

[1] Production adjusted for net change in stocks during the year.

prospects. At first the principal reaction was one of loud protest, but as it became evident that the shortage was real many thorough investigations of the problem were conducted by individual companies, industry groups, and Government organizations.[6]

[5] Oil and Gas Journal, Oils Sulfur Boomlet: Vol. 50, No. 36, Jan. 14, 1952, pp. 61–64.
[6] Chemical and Engineering News, vol. 29, No. 34, Aug. 20, 1951, p. 3473.
Fertilizer and Farm Machinery, Hearings Before the Subcommittee on Fertilizer and Farm Machinery of the Committee on Agriculture, House of Representatives, 82d Congress, 1st sess., Feb. 20–23, 1951, 185 pp.

TABLE 8.—Apparent consumption of sulfur in all forms in the United States, 1947–51, in long tons[1]

	1947	1948	1949	1950	1951
Native sulfur	3,490,000	3,719,700	3,409,700	4,158,500	3,785,900
Recovered sulfur shipments	43,400	54,300	42,300	78,600	193,800
Pyrites:					
Domestic production	392,700	388,400	378,500	392,800	432,800
Imports	60,800	51,600	58,000	100,200	106,300
Total pyrites	453,500	440,000	436,500	493,000	539,100
Smelter acid production	212,000	187,000	167,000	216,000	240,800
Other production[2]	20,600	25,800	37,900	[3] 42,000	59,600
Total	4,219,500	4,426,800	4,093,400	[3] 4,988,100	4,819,200

[1] Crude sulfur or sulfur content.
[2] 1947–49, hydrogen sulfide; 1950–51, hydrogen sulfide and liquid sulfur dioxide. In addition, a quantity of acid sludge was converted to H_2SO_4, but is excluded from the above figures.
[3] Revised figure.

One of the most serious aspects of the problem was achievement of equitable distribution of available supplies, which became a subject of top diplomatic negotiation. In the circumstances, Government control of both exports and domestic consumption became necessary in the United States. Domestic consumption was placed under control by the National Production Authority.

From June 1, 1951, until the end of 1951, Order M–69 limited domestic consumption to 100 percent of the 1950 rate, with certain exceptions. The exceptions to this order were for special defense and essential civilian requirements that had to be supported at higher levels and for the relief of unusual cases of hardship. On November 9, 1951, consumers were limited to a 25-day inventory. At the end of the year (January 1, 1952) Order M–69 was amended to restrict sulfur consumption to 90 percent of 1950 usage.

As indicated in tables, 7, 8, and 9, the general result of the conditions prevailing in 1951 was lower consumption than in 1950. A portion of the decline shown in tables 7 and 8 was due to stockpiling of relatively small quantities by consumers during 1950.

In spite of the shortage, sulfur-consuming capacity was expanded considerably during 1951, because many high-priority projects required additional acid that could be supplied most efficiently from new acid-production facilities.

Although it was generally agreed that the real solution of the shortage lay in the development of new sulfur-production capacity, conservation and alternate raw materials also received much attention.[7] For the first time, the fertilizer industry gave really serious consideration to the possibility of installing large capacity for superphosphate production by methods in which nitrogen compounds are substituted for sulfuric acid. Development of such a trend on a major scale could very substantially modify the markets for sulfur over a period of years.[8]

Consumption statistics compiled by the National Production Authority for 1950 and 1951 provide somewhat greater detail on use

[7] Chemical Engineering, vol. 58, No. 2, February 1951, p. 121.
[8] Turrentine, J. W., Phosphate Production Without Sulfuric Acid: Chem. and Eng. News, vol. 29, No. 4, Aug. 20, 1951, pp. 3454–3456.

patterns than is available for previous years. These data are tabulated in tables 9 and 10.

The geographic distribution of sulfur consumption is indicated in table 11 which gives data on sulfuric acid production compiled by the United States Department of Commerce. Approximately three-quarters of the total sulfur is converted into sulfuric acid.

TABLE 9.—Sulfur consumed in nonacid uses in the United States, 1950–51, in long tons

[U. S. Department of Commerce, National Production Authority]

Use	1950	1951	Use	1950	1951
Carbon disulfide	191,000	216,000	Miscellaneous	63,000	63,000
Pulp and paper	402,000	387,000			
Crude ground	291,000	270,000	Total	1,042,000	1,030,000
Other chemicals	95,000	94,000			

TABLE 10.—Sulfuric acid [1] (basic, 100 percent) consumed in the United States, 1950–51, by industries, in thousands of short tons

[U. S. Department of Commerce, National Production Authority]

Industry	1950	1951	Industry	1950	1951
Fertilizers:			Rayon and cellulose film	669	685
Superphosphate	3,790	3,943	Synthetic detergents	201	218
Ammonium sulfate	1,510	1,156	Dyes	195	201
Chemicals	2,072	2,507	Textile finishing	37	31
Petroleum and its products	1,679	1,868	Miscellaneous	1,284	1,495
Pigments (Pb, Zn, and Ti)	1,325	1,332			
Iron and steel	1,026	952	Total	13,999	14,632
Other metallurgical	211	244			

[1] Includes virgin, fortified, and spent acid. Fortified and spent acids totaled 2,006,000 short tons in 1950 and 2,433,000 tons in 1951.

TABLE 11.—Production of new sulfuric acid (100 percent H_2SO_4), 1948–51, by geographical division and State, in short tons

[U. S. Department of Commerce]

Division and State	1948	1949	1950	1951
New England [1]	188,243	158,675	201,281	210,324
Middle Atlantic:				
Pennsylvania	735,467	619,923	772,103	808,334
New York and New Jersey	1,311,898	1,136,654	1,357,087	1,348,451
Total Middle Atlantic	2,047,365	1,756,577	2,129,190	2,156,785
North Central:				
Illinois	964,596	868,235	993,759	1,073,223
Indiana	429,025	415,766	464,680	464,896
Ohio	665,478	617,673	672,190	654,321
Other [2]	555,344	618,032	741,998	798,472
Total North Central	2,614,443	2,519,706	2,872,627	2,990,912
South:				
Alabama	307,393	309,385	290,494	298,404
Florida	370,078	459,369	526,273	535,719
Georgia	218,463	232,005	223,949	247,307
North Carolina	155,159	163,446	159,466	160,087
South Carolina	212,704	204,203	188,993	206,779
Virginia	540,502	486,720	560,644	549,918
Kentucky and Tennessee	774,042	795,728	853,475	835,310
Texas	613,447	880,330	972,260	947,916
Delaware and Maryland	(3)	(3)	1,354,643	1,340,009
Louisiana	(3)	(3)	(3)	435,335
Other [4]	1,958,879	2,050,983	980,179	489,988
Total South	5,150,667	5,582,169	6,110,376	6,046,772
West [5]	736,217	709,849	829,317	984,075
Total United States	10,736,935	10,726,976	12,142,791	12,388,868

[1] Includes data for plants in Connecticut, Maine, Massachusetts, and Rhode Island.
[2] Includes data for plants in Iowa (1949–51 only), Kansas (1950–51 only), Michigan, Missouri, and Wisconsin.
[3] Included with "Other."
[4] Includes data for plants in Arkansas, Delaware (1948–49 only), Louisiana (1948–50 only), Maryland (1948–49 only), Mississippi, Oklahoma, and West Virginia.
[5] Includes data for plants in Arizona, California, Colorado, Montana, Utah, Washington, and Wyoming.

STOCKS

After declining steadily since 1942, producers' stocks in 1950 had reached a level lower than was desirable from the standpoint of national defense and industry operating practice. High production rates and consumption-control regulations combined to permit an increase in stocks of approximately 180,000 tons during 1951. At the end of the year producers' stocks totaled 2,837,432 long tons, of which 2,678,261 tons was held at mines.

PRICES

In 1951 sulfur prices were frozen by the Office of Price Stabilization, under the provisions of the General Ceiling Price Regulation, at levels prevailing during the base period (December 19, 1950, to January 25, 1951). For domestic consumption Frasch sulfur was priced between $21 and $24 f. o. b. mines. Export prices ranged from about $25 to $27 at the port.

Recovered sulfur prices varied widely. At a few locations that were in production during the base period prices were frozen at the base level. For example, one plant had an f. o. b. price of $27.50. The Office of Price Stabilization permitted new plants that were not

in production during the base period to quote delivered prices at figures that would equal $21 per long ton plus the cost of transportation from the appropriate Frasch mine to the consumer's plant. These prices, therefore, were competitive with the cheapest Frasch sulfur.

In contrast to the above figures, prices in many foreign countries skyrocketed. Many sales at over $100 per ton were reported, and there were rumors of some sales that exceeded $200.

In view of the shortage, it is not surprising that considerable upward pressure on prices developed during 1951. The existence of some black-market activity was indicated by a few rumors of domestic sales at prices ranging up to $100 per ton. However, the tonnage involved apparently was insignificant, and in general the controlled price structure was observed in the United States.[9]

The price of sulfur had not risen as much as has the general level of retail and wholesale prices since 1935–39. The industry felt the need for a readjustment upward, part of the justification being that an increase in crude-sulfur prices would help to stimulate production from marginal sources of supply.[10]

FOREIGN TRADE

As indicated in the section on consumption, foreign demand for Frasch sulfur was very active in 1951. Before the United States Government established quotas, the rate of export was so far below demand that it had become a diplomatic problem.

A Sulphur Committee was organized as a unit of the International Materials Conference to achieve equitable distribution of available supplies during the period of shortage and encourage expansion of production capacity. The committee collected statistical information from all Free World producing and consuming countries to determine overall supplies and requirements. After a system of factoring had been applied the proposed quotas for each of the importing nations were determined, as well as the exports that would be needed from each of the supplying nations. In general, the distribution patterns proposed by the committee were followed by the exporting countries. The first report of the committee estimated that world demand exceeded world supply by about 1,000,000 tons and called for a general increase of production capacity throughout the world. Conservation also was stressed as being a possible means of improving the situation.

As shown in table 12 and 13, crude-sulfur exports from the United States were 11 percent lower in 1951 than in 1950, and exports of processed sulfur were also much lower.

Imports of sulfur, shown in table 12, were very small.

An agreement was reached between Texas Gulf Sulphur Co. and Freeport Sulphur Co., to terminate the activities of the Sulphur Export Corp. After shipments to fulfill allocations for the first quarter of 1952 were completed, exports were to be handled directly by the individual companies.

[9] Chemical and Engineering News, Keep the Market Clean: Vol. 29, No. 12, March 1951, p. 1079.
[10] Chemical and Engineering News, Pyrites Process Can Compete If Sulfur Prices Go Up: Vol. 29, No. 14, Apr. 2, 1951, pp. 1310–1313.

TABLE 12.—Sulfur imported into and exported from the United States, 1947–51

[U. S. Department of Commerce]

Year	Imports for consumption				Exports			
	Ore		In any form, n. e. s.		Crude		Crushed, ground, refined, sublimed, and flowers	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
1947			15	$5,014	1,299,060	$25,388,093	50,477	$2,318,956
1948			38	13,299	1,262,913	26,779,444	32,630	1,774,358
1949	5	$89	27	5,768	1,430,916	30,489,876	30,135	1,682,965
1950			25	6,172	1,440,996	30,950,531	37,526	2,249,311
1951	1,974	100,196	403	57,431	1,287,773	31,760,539	24,044	1,947,860

TABLE 13.—Sulfur exported from the United States, 1950–51, by country of destination

[U. S. Department of Commerce]

Country	Crude				Crushed, ground, refined, sublimed, and flowers			
	1950		1951		1950		1951	
	Long tons	Value	Long tons	Value	Pounds	Value	Pounds	Value
North America:								
Canada	354,501	$7,099,009	334,146	$7,891,831	5,209,337	$199,499	7,853,485	$308,270
Central America	139	4,548	139	3,850	896,469	31,530	640,908	28,881
Mexico	2,160	62,598	957	26,147	16,899,020	484,398	10,665,295	355,794
West Indies	35,499	772,978	25,900	646,939	431,781	16,631	408,454	17,964
Total North America	392,299	7,939,133	361,142	8,568,767	23,436,607	732,058	19,568,142	710,909
South America:								
Argentina	24,097	548,770	4,800	119,500	31,000	6,737	790,306	32,961
Brazil	59,979	1,362,378	40,879	1,057,726	13,418,373	403,782	4,823,414	215,813
Colombia	2,412	83,971	557	16,153	628,190	20,492	340,477	17,687
Ecuador	50	1,600	72	2,772	162,765	6,067	11,000	484
Peru			9	640	1,789,943	43,814	1,112,396	31,732
Uruguay			1,200	30,000				
Venezuela	130	4,816	27	1,031	230,354	15,140	79,030	10,278
Other South America			139	3,850	236,110	7,100	68,143	6,503
Total South America	86,668	2,001,535	47,683	1,231,672	16,496,735	503,132	7,224,766	315,458
Europe:								
Austria	23,617	528,119	13,900	361,800				
Belgium-Luxembourg	56,582	1,252,491	54,300	1,371,880	557,626	10,476	460,344	13,952
France	95,350	2,141,699	73,555	1,914,185				
Germany	25,133	563,076	21,538	555,438			55,000	11,735
Greece					14,705,410	282,206	14,178,914	382,538
Netherlands	500	11,000	975	24,605	491,427	9,698	491,492	14,010
Norway	39	1,877			10,400	2,496	67,440	6,607
Portugal	200	4,900	194	5,593	15,200	4,994	12,600	2,959
Sweden	7,690	171,780	2,850	74,490	115,800	3,603	37,500	8,300
Switzerland	15,900	359,100	19,300	496,005	495,438	25,396	371,360	31,144
Turkey							548,344	13,063
United Kingdom	420,024	8,902,084	424,007	10,332,658	3,000	717	88,250	6,955
Yugoslavia							2,204,000	55,000
Other Europe	5,000	110,000	4,000	100,000	4,400	1,045	277,700	13,395
Total Europe	650,035	14,046,126	614,619	15,236,654	16,398,701	340,631	18,792,944	559,658

TABLE 13.—Sulfur exported from the United States, 1950–51, by country of destination—Continued

[U. S. Department of Commerce]

Country	Crude				Crushed, ground, refined, sublimed, and flowers			
	1950		1951		1950		1951	
	Long tons	Value	Long tons	Value	Pounds	Value	Pounds	Value
Asia:								
Ceylon					947,141	$21,118	8,700	$652
China	639	$17,819			3,100,729	63,375		
Hong Kong	389	9,163			941,057	18,948	1,500	135
India	44,796	1,039,166	33,357	$867,372	8,461,243	232,360	3,885,464	164,668
Indonesia	4,950	110,250	7,920	193,084	1,621,106	42,777	1,185,420	39,898
Israel	956	21,606	4,000	105,000	2,946,875	64,543	833,000	21,877
Korea					2,204,600	37,258		
Lebanon			71	3,287	350,486	7,131		
Pakistan	645	16,796	423	11,688	416,447	10,407		
Philippines					189,200	5,969	132,320	6,050
Syria					396,828	10,565	349,797	7,643
Taiwan (Formosa)					2,818,360	31,104		
Other Asia	39	1,936	2,664	109,289	1,120	192	26,720	4,399
Total Asia	52,414	1,216,736	48,435	1,289,720	24,395,192	546,247	6,422,921	245,322
Africa:								
Algeria	16,170	355,700	11,275	290,695				
Belgian Congo					111,830	3,049		
Egypt	4,184	120,322	3,225	87,285	2,410,299	53,208	835,846	21,078
French Morocco	4,542	99,924	3,125	93,750				
Mozambique			99	2,750				
Tunisia	10,300	226,600	2,000	50,350				
Union of South Africa	76,925	1,692,350	58,600	1,433,050	673,839	60,747	652,080	71,068
Other Africa			100	2,765				
Total Africa	112,121	2,494,896	78,424	1,960,645	3,195,968	117,004	1,487,926	92,146
Oceania:								
Australia	68,299	1,502,585	70,735	1,791,391	58,400	4,677	75,400	7,512
New Zealand	79,160	1,749,520	66,735	1,681,690	76,198	5,562	285,678	16,855
Total Oceania	147,459	3,252,105	137,470	3,473,081	134,598	10,239	361,078	24,367
Grand total	1,440,996	30,950,531	1,287,773	31,760,539	84,057,801	2,249,311	53,857,777	1,947,860

WORLD REVIEW

The shortage stimulated a great deal of discussion, planning, and actual development of new facilities for the production of sulfur throughout the world.

To preserve available stocks and new supplies for the most important uses in each country most Federal Governments maintained a system of control over the distribution and consumption of sulfur.

As shown in table 14, the bulk of world native sulfur output comes from only a few countries, but small quantities are produced in many others. It is estimated that the world output totaled over 5,800,000 long tons in 1951.

In addition to the native sulfur, it is estimated that the ouput of other elemental sulfur, principally from gas-purification operations and pyrites processing, exceeded 400,000 long tons. World ouput of elemental sulfur therefore totaled well over 6,200,000 tons in 1951.

TABLE 14.—World production of native sulfur, 1946–51, by countries, in long tons[1]

[Compiled by Helen L. Hunt]

Country [1]	1946	1947	1948	1949	1950	1951
Argentina	[2] 10,070	[2] 10,871	8,388	[2] 10,048	[2] 7,785	(3)
Bolivia (exports)	468	2,275	[2] 2,685	4,398	4,307	9,100
Chile	[2] 8,979	[2] 11,659	[2] 13,124	6,924	15,228	(3)
Colombia			592	793	1,461	2,273
Ecuador	26	23	43	16	[4] 27	1
France (content of ore)	2,083	8,427	6,648	9,587	14,500	26,600
Greece	1,000		(3)			(3)
Italy (crude) [5]	140,765	146,310	170,904	[2] 198,274	209,767	197,382
Japan	21,046	28,670	40,120	61,414	90,940	139,364
Mexico	(3)	3,200	2,100	(3)	(3)	(3)
Peru	363	779	971	271	98	[4] 1,000
Spain	4,000	3,600	2,500	5,000	[2] 6,800	(3)
Taiwan (Formosa)	280	508	1,719	344	72	2,608
Turkey (refined)	2,970	2,620	2,556	3,046	5,708	7,101
United States	3,859,642	4,441,214	4,869,210	4,745,014	5,192,184	5,278,249
Total (estimate)	4,200,000	4,800,000	5,300,000	5,200,000	5,700,000	5,800,000

[1] Native sulfur believed to be produced also in China (continental), Egypt, Guatemala, Indonesia, Israel-Jordan, and U. S. S. R., but complete data are not available; estimates by senior author of chapter included in total.
[2] Revised figure.
[3] Data not available; estimate by author of chapter included in total.
[4] Estimate.
[5] In addition the following tonnages of ground sulfur rock (30 percent S) were produced and used as an insecticide: 1946, 12,592 tons; 1947, 18,716 tons; 1948, 15,176 tons; 1949, 19,213 tons; 1950, 15,778 tons; 1951, 22,120 tons.

Canada.—Canada need not suffer a sulfur shortage for any extended period because very large resources are available within its own borders. Various processes and sources of supply were being developed.[11] Native sulfur deposits were being investigated by Sunbeam Sulphur, Ltd., a subsidiary of Dominion Tar & Chemical Co., about 100 miles north of Edmonton in Alberta.[12]

Shell Oil Co. was proceeding with development of a plant to recover about 10,000 tons of sulfur annually from sour gas in the Jumping Pound field of Alberta.

Canadian Industries, Ltd., was constructing a plant at Copper Cliff, Ontario, to recover liquid sulfur dioxide from the stack gases of a new flash-smelting copper furnace of International Nickel Co. As the ore is smelted with oxygen the resulting gases are rich in sulfur dioxide.[13] Noranda Mines, Ltd., continued to develop its process for recovering elemental sulfur, sulfuric acid, and iron sinter from pyrite, and a thorough study was being made to determine the best means of applying the process commercially.

Chile.—Sulfur from the Andes is relatively expensive to produce. However, during the shortage demand and prices increased, and many companies investigated the possibilities of installing new production capacity.[14]

Colombia.—Sulfur mining and processing facilities at the Purace deposit were being modernized by installation of a new plant in which sulfur would be processed by a combination of autoclaving, flotation, melting, and filtration of the sulfur.

[11] Canadian Chemistry and Process Industries, Solution of Canada's Sulphur Shortage: Vol. 35, No. 4, April 1951, pp. 291–295; Chemical Age, vol. 45, No. 1691, Dec. 8, 1951, p. 777.
[12] Chemical and Engineering News, vol. 29, No. 26, June 25, 1951, p. 2540.
[13] Bonham, W. M., Canada's Sulphur Supplies: Canadian Min. Jour., vol. 72, No. 1, January 1951, pp. 47–50; Chemical Age, vol. 64, No. 1665, June 9, 1951, p. 894.
[14] Chemical and Engineering News, vol. 29, No. 31, July 30, 1951, p. 3100; Pit and Quarry, vol. 44, No. 5, November 1951, p. 82.

Ecuador.—The Chemical Plants Corp. announced plans for large-scale mining operations of the sulfur mine at Tixan, Ecuador.[15]

Italy.—Production of sulfur was lower in Italy in 1951 than it was in 1950 in spite of the high worldwide demand for this product. Similarly, exports were lower. A considerable part of the decline in exports is explained by the fact that large tonnages of sulfur, accumulated in previous years, were exported in 1950, principally to Australia and France.[16] The price of Italian sulfur for export was reported to be 60,000 lire per ton in 1951.

The Italian sulfur industry was conscious of the need for improving mining and processing methods, and some progress was reported. The Economic Cooperation Administration was supplying some funds to support this work. The Italian Government appropriated 950 million lire for exploration of sulfur deposits and 9 billion lire for modernization of mines and plants. Part of the funds was earmarked for developing new mines. A description of the history and current situation of the Italian sulfur industry was published during the year.[17]

Mexico.—In 1951 the Mexican Gulf Sulphur Co. made progress in its efforts to bring San Cristobol Dome into production. This dome is located on the Isthmus of Tehuantepec. An exploration program had been carried on over a period of years. During the year a loan of $1,875,000 was arranged by the company with the Export-Import Bank to be used in developing this property. Indications were that a plant would be constructed having a capacity of 200,000 tons per year.

The Pan American Sulphur Co. continued its exploration at Jaltipan Dome on the Isthmus of Tehuantepec, and a large enough deposit had been discovered to warrant commercial development. The company was arranging for financing of the plant construction and development program.

The sulfur-recovery plant of Petroleos Mexicanos at the Poza Rica field was reported to be in operation.[18]

United Kingdom.—Britain embarked upon a program of developing additional sources of sulfur supply, both at home and abroad. New facilities to use spent oxide, gypsum, and pyrite were included in the program.[19]

PYRITES

DOMESTIC PRODUCTION

Although pyrites is in a less favorable competitive position than before World War II, output in the United States has been relatively stable in recent years and under the compulsion of the sulfur shortage increased moderately in 1951. Table 15 contains pyrites production statistics for the period 1946–51. Virtually the entire pyrites supply is consumed in producing sulfuric acid, predominantly in "captive" operations. In 1951, producing companies consumed 758,926 long tons and sold only 234,625 long tons.

[15] Pit and Quarry, vol. 44, No. 5, November 1951, p. 77.
[16] Mineral Trade Notes, vol. 34, No. 3, March 1952, p. 47.
[17] Gerbella, Luigi, Sviluppi produttivi dell'industria solfifera italiana: Riv. ing., No. 2, February 1951. 4 pp.
[18] Oil, Paint and Drug Reporter, vol. 160, No. 5, July 30, 1951, p. 7.
[19] Canadian Chemical and Process Industries, vol. 35, No. 4, April 1951, p. 276; Chemical and Engineering News, vol. 29, No. 19, May 7, 1951, p. 1811; Mining Journal, vol. 237, No. 6059, Oct. 5, 1951, p. 348; Mining World and Engineering Record, vol. 160, No. 4177, Apr. 21, 1951, p. 257; Oil, Paint and Drug Reporter, vol. 160, No. 17, Oct. 22, 1951, p. 44.

Many firms gave serious consideration to converting their acid plants from elemental sulfur to a pyritic raw material, and a few applied for and received certificates of necessity under the Government sulfur-expansion program. On the other hand, the price structure was so disadvantageous to the use of pyrite that most companies were quickly discouraged, and it was clear that any large-scale conversion to pyrites would not come about until prices of crude sulfur had increased substantially as compared to pyrites.

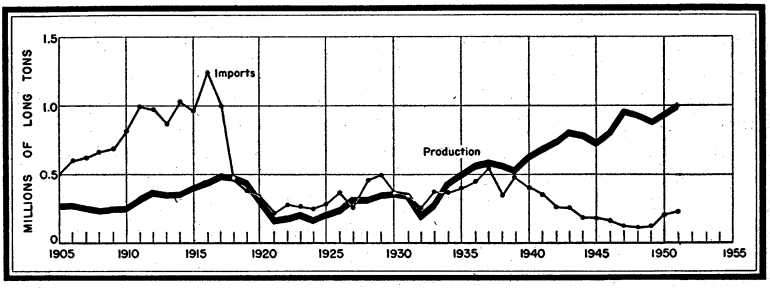

FIGURE 2.—Domestic production and imports of pyrites, 1905–51.

One prospective source of pyrites that received attention in 1951 was the high-sulfur coal of the Midwest. Large tonnages might be recovered from the waste, and thorough engineering studies were under way.[20]

TABLE 15.—Pyrites (ores and concentrates) produced in the United States, 1946–51

Year	Quantity		Value	Year	Quantity		Value
	Gross weight (long tons)	Sulfur content (percent)			Gross weight (long tons)	Sulfur content (percent)	
1946	813,372	41.5	$3,228,000	1949	888,388	42.6	$3,904,000
1947	940,652	41.7	4,070,000	1950	931,163	42.2	4,059,000
1948	928,531	41.8	3,950,000	1951	1,017,769	42.5	4,656,000

California.—The Mountain Copper Co., Ltd., more than doubled its production of pyrites from the Iron Mountain mines (formerly Hornet mine) in Shasta County, making California the second-largest producing State in 1951.

Colorado.—The Empire Zinc Division of the New Jersey Zinc Co., Eagle County, and Climax Molybdenum Co., Lake County, increased production of pyrites in Colorado in 1951.

Indiana.—Output of pyrites (coal brasses) by the Snow Hill Coal Corp. at the Talleydale mine, Vigo County, decreased somewhat in 1951.

Minnesota.—The Bureau of Mines conducted an investigation of pyrite deposits in Aitkin County, Minn., and found that a substantial deposit exists at this location.

[20] Chemical Engineering, vol. 58, No. 6, June 1951, p. 78.

Montana.—Byproduct pyrites was produced at the copper-plant operations of Anaconda Copper Mining Co., Anaconda, Deer Lodge County. Montana was the fourth-largest producing State in 1951.

New York.—Pyrites output at the Balmat mine of St. Joseph Lead Co. in St. Lawrence County, N. Y., increased slightly in 1951.

Pennsylvania.—The Bethlehem Cornwall Corp. produced pyrites at its concentrator in Lebanon County, Pa.

Tennessee.—The Tennessee Copper Co. in the Ducktown area, Polk County, continued to be the largest producer of pyrites in the United States. The pyrites concentrate was used by the company in producing sulfuric acid and sinter.

Vermont.—Vermont Copper Co. prepared to supply byproduct pyrites to the Brown Co. for use in its paper mill in New Hampshire. Approximately 9,000 tons of sulfur equivalent was to be used annually in the production of paper mill liquors. This pyrites was to be burned in a fluosolids kiln.

Virginia.—Pyrites was produced by the General Chemical Co. at the Gossan mines to supply its sulfuric acid plant at Pulaski. Virginia was the third-largest pyrites-producing State in 1951. The Freeport Sulphur Co. acquired mineral rights to a pyrite deposit in Carroll County, Va., from the Virginia Iron Coal & Coke Co. This property was not slated for early development but was available when needed.

PRICES

Transportation costs between the mine and acid plant are a very large factor in determining the prices that can be paid for pyrites at the mine. Consequently, f. o. b. mine valuations vary greatly. In 1951 producers reported f. o. b. mine evaluations ranging from $1.12 to $6.83 a long ton. The average value of all domestic output was $4.57, and the average value of the tonnage sold was $5.14. Spanish pyrites was quoted nominally at $8 per ton c. i. f. Atlantic ports by the Oil, Paint and Drug Reporter. In the early part of 1951 E&MJ Metal and Mineral Markets quoted Spanish pyrites nominally at $0.14 to $0.16 per unit, but later in the year Spanish quotations were suspended. In December domestic and Canadian pyrites per long ton was quoted nominally at $9 to $11 f. o. b. point of shipment. Average value of imports in 1951 was $2.06 per long ton.

FOREIGN TRADE

As indicated in tables 16 and 17, the only foreign pyrites that could compete in the United States market in 1951 was material produced in eastern Canada. Demand was good, even though the price trend was upward, and imports increased about 6 percent. Exports of pyrites are not separately classified in foreign-trade statistics of the United States Department of Commerce.

TABLE 16.—Pyrites, containing more than 25 percent sulfur, imported for consumption in the United States, 1947–51, by countries

[U. S. Department of Commerce]

Country	1947		1948		1949		1950		1951	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
Australia							22	$242		
Canada	85,094	$266,698	75,248	$169,551	107,951	$215,290	208,725	411,823	221,487	$457,365
Malta, Gozo, Cyprus							19	57		
Portugal	300	2,664								
Spain	41,159	106,136	32,163	89,994	12,986	36,331				
Total	126,553	375,498	107,411	259,545	120,937	251,621	208,766	412,122	221,487	457,365

TABLE 17.—Pyrites, containing more than 25 percent sulfur, imported for consumption in the United States, 1947–51, by customs district, in long tons

[U. S. Department of Commerce]

Customs district	1947	1948	1949	1950	1951
Buffalo	36,610	66,385	106,862	208,569	221,391
Chicago				36	
Connecticut	34	37			
Duluth and Superior					46
Michigan				5	
New York	300			41	
Philadelphia	89,609	40,989	14,075		
Rochester					50
Vermont				115	
Total	126,553	107,411	120,937	208,766	221,487

WORLD REVIEW

Pyrites is a more important source of sulfur in many European and Asiatic countries than it is in the United States, and therefore expansion of its output received greater attention in those countries. It was estimated that world output of pyrites increased to about 12,600,000 metric tons in 1951.

Australia.—Formation of a company in Adelaide, called Nairne Pyrites, Ltd., was announced. The company intended to acquire and explore five mineral properties at Nairne, South Australia, at which preliminary drilling indicated a large tonnage of pyrite ore.[21]

Reserves of ore in the Iron King mine were estimated at about 1,073,000 long tons. Production in 1950 was reported to have been 58,300 tons of ore, and the company was planning to increase production within 3 years to a rate of 25,000 tons per month.[22]

[21] Chemistry and Industry, vol. 22, June 2, 1951, p. 418.
[22] Chemical Engineering and Mining Review, Pyrite Production at Norseman, Western Australia: Vol. 44, Oct. 10, 1951, pp. 11–15.

TABLE 18.—World production of pyrites (including cupreous pyrites), 1947–51, by countries, in metric tons [1]

[Compiled by Helen L. Hunt]

Country [1]	1947		1948		1949		1950		1951	
	Gross weight	Sulfur content	Gross weight	Sulfur content	Gross weight	Sulfur content	Gross weight	Sulfur content	Gross weight	Sulfur content
Algeria	35,295	14,745	35,900	14,360	32,705	13,082	25,075	[2] 10,030	31,450	12,580
Australia	110,410	51,547	90,848	42,230	87,923	41,021	113,973	53,887	154,182	72,768
Austria	6,139	2,047	7,871	2,942	11,624	4,064	12,489	3,133	9,756	2,645
Brazil	3,600	[3] 1,500	3,600	[3] 1,500	(4)	(4)	(4)	(4)	(4)	(4)
Canada	161,718	74,967	166,985	79,039	227,227	106,667	283,597	136,519	(4)	(4)
China	64,876	29,200	42,907	19,300	(4)	(4)	(4)	(4)	(4)	(4)
Cyprus	611,800	293,664	589,772	283,091	942,808	452,548	[2] 829,889	[2] 398,347	959,838	460,722
Czechoslovakia	6,002	[3] 2,200	3,195	[3] 1,200	(4)	(4)	(4)	(4)	(4)	(4)
Finland	152,268	66,891	177,512	79,170	180,040	80,409	[2] 162,050	[2 3] 72,300	232,546	[3] 103,700
France	196,180	76,417	181,683	82,238	205,909	[2] 90,600	247,642	108,962	280,600	[3] 124,000
French Morocco			70	34	202	95	[2] 1,473	[2] 692	1,949	877
Germany, West	321,000	128,400	383,100	153,245	431,963	173,582	525,400	[3] 210,200	533,530	194,616
Greece	58,185	28,000	16,236	[3] 7,800	15,785	[3] 7,600	87,678	[3] 42,000	181,263	88,819
Italy	[2] 642,674	[2] 292,802	[2] 836,245	[2 3] 385,000	[2] 852,896	[2 3] 392,000	895,459	[3] 412,000	898,023	[3] 404,000
Japan	[2] 875,921	[2] 371,391	1,138,782	489,676	[2] 1,542,360	[2] 663,200	[2] 1,928,750	[2] 786,930	2,250,784	904,815
Norway	720,015	310,079	[2] 735,021	[2] 314,940	[2] 744,762	[2] 317,920	749,363	[2] 336,950	696,217	313,300
Poland	39,659	[3] 15,900	58,100	[3] 25,000	81,000	[3] 36,000	(4)	(4)	(4)	(4)
Portugal	388,827	174,972	561,136	[3] 252,500	622,925	[3] 280,300	613,522	276,085	729,611	328,325
Rumania	(4)	(4)	(4)	(4)	[3] 5,000	(4)	(4)	(4)	(4)	(4)
Southern Rhodesia	17,144	[3] 7,115	13,224	[3] 5,500	16,968	6,787	13,810	5,524	28,269	12,156
Spain	1,217,442	[3] 584,400	1,463,912	[3] 702,700	[2] 1,559,044	[2 3] 748,300	[2] 1,453,032	[2] 697,500	1,630,711	[3] 782,700
Sweden	310,571	147,602	392,033	181,987	424,007	205,085	406,800	[3] 195,300	420,000	[3] 201,600
Tunisia	6,345	2,855	2,851	1,297	2,920	[3] 1,300	1,150	[3] 500	----------	----------
Turkey	5,000	(4)	----------	----------	----------	----------	----------	----------	----------	----------
Union of South Africa	34,820	15,166	35,992	15,456	35,527	15,274	36,026	[2] 15,623	33,378	14,474
United Kingdom	10,106	4,100	[2] 10,800	[2 3] 4,300	[2] 17,191	[2 3] 6,900	13,501	[3] 5,400	(4)	(4)
United States	955,749	398,975	943,434	394,583	905,746	385,518	946,108	399,092	1,034,104	439,766
Yugoslavia	76,000	31,800	[2] 91,000	[2] 38,400	73,000	32,300	117,187	[3] 54,000	143,779	[3] 67,000
Total (estimate)	8,700,000	3,700,000	9,700,000	4,000,000	[2] 11,000,000	[2] 4,600,000	[2] 11,600,000	[2] 4,900,000	12,600,000	5,300,000

[1] In addition to countries listed, East Germany, Kenya, Korea, and U.S.S.R. produce or have produced pyrites, but production data are not available; estimates by senior author of chapter included in total.

[2] Revised figure.
[3] Estimate.
[4] Data not available; estimate by author of chapter included in total.

A new sulfuric acid plant at Port Pirie designed to produce 60,000 tons of acid per year for the fertilizer industry was to use sulfur dioxide gases from the Broken Hill Associated Smelters.[23]

Canada.—Arnora Gold Mines concluded an agreement with Freeport Sulphur Co. for the sale of a group of five claims in Joannes Township, Northwestern Quebec.[24] Exploratory drilling of a pyrite deposit was being conducted by this company in Languedoc Township, Quebec, about 30 miles north of Noranda mines.[25]

Stratford Metals, Ltd., was preparing to drill for pyrites in Stratford Township, Wolfe County, Quebec. The deposit is approximately 7 miles from St. Gerard on the Quebec Central Railway.[26]

China.—The problems involved in the development of sulfuric acid production capacity based on local pyrites in the Orient were described in a recent article.[27]

Cyprus.—Ore reserves were estimated at 5,741,000 tons at the Lumni property of Cyprus Copper & Sulphur Co., Ltd. Of this total about 1,000,000 tons was said to represent oxidized ore which overlies the main sulfide ore body.[28]

Finland.—Milling practice at the Outokumpu mill, where pyrite is recovered as a byproduct of zinc and copper operations, was described in a trade article.[29]

Greece.—Production of pyrite in Greece increased sharply in 1951. Of the total production (somewhat over 180,000 tons) 150,167 tons valued at $1,431,028 was exported.[30]

Norway.—It was reported that the Gravdal mine in Western Norway, which had been idle since the last war was to be rehabilitated and put back into production. Projected output was to be 15,000 tons a year.[31]

India.—As part of the Point IV Program a survey of sulfur resources in India was made by F. E. Hilburn, a representative of the United States Government. His report (unpublished) indicated that the most promising source of sulfur is the smelter of the Indian Copper Corp. at Moubhandar in southeastern Bihar. Thorough investigation of the pyrite resources of the country also was recommended. Among the deposits mentioned are the following: Amjor in northwestern Bihar, Karwar in southern Bombay, Chitaldrug in the State of Mysore, the Pandalur-Devale-Madghani region in western Madras, and Simla in the Keonthral State. The Amjor deposit appears to be the most promising at present. This deposit is about 20 miles south of Dehri-on-Sohne in western Bihar. A study of the possible utilization of gypsum for the production of sulfuric acid also was

[23] Mining Magazine, vol. 85, No. 6, December 1951, p. 356.
[24] Northern Miner, vol. 37, No. 20, Aug. 9, 1951, p. 19.
[25] Northern Miner, vol. 37, No. 30, Oct. 18, 1951, p. 11.
[26] Northern Miner, vol. 37, No. 40, Dec. 27, 1951, p. 11.
[27] Stepanek, Joseph E., and Prien, Charles H., Small Chemical Industries for China, Sulfuric Acid Manufacturer: Chem. and Eng. News, vol. 28, No. 47, Nov. 20, 1950, p. 4062.
[28] Mining World and Engineering Record, Esperanza Copper & Sulphur: Vol. 160, No. 4168, Feb. 17 1951, p. 110.
[29] Mine and Quarry Engineering, vol. 17, No. 4, April 1951, pp. 126–127.
[30] Bureau of Mines, Mineral Trade Notes, vol. 34, No. 4, April 1952, pp. 50–51.
[31] Mining World, vol. 13, No. 9, August 1951, p. 56.

recommended. The gypsums available have certain disadvantages, such as high silica content and remoteness of location from the consuming areas.

The Sindhri fertilizer plant was to use gypsum from the Bikaner deposits in the Rajasthan desert in western India for the production of ammonium sulfate. Utilization of gypsum in India for the production of either fertilizer or sulfuric acid is hampered by the distance between the deposits and the consuming areas.

Portugal.—In 1951 the pyrite industry fared very well in Portugal. Demand was firm, and both prices and production increased. Production of elemental sulfur by the Orkla process totaled 14,124 tons in 1951, and the plant was operated at full capacity. A program of modernization and expansion of pyrites production was under way at the Louzal and Aljustrel mines during the year. The Mina de San Domingos, operated at about one-half of capacity, but proved ore reserves were not adequate to warrant a higher production rate. Exploration programs were being conducted by all three companies.[32]

Spain.—A number of companies indicated interest in developing additional pyrites-production capacity in Spain and optimistic statements appeared in the press regarding the anticipated increase.[33] The mining industry encountered a number of problems that made expansion of pyrite capacity difficult; but overall output increased considerably during the year, even though it did not ultimately attain the anticipated rates of production.

[32] Bureau of Mines, Mineral Trade Notes, vol. 34, No. 4, April 1952, pp. 51-52.
[33] Mining World, vol. 13, No. 7, June 1951, p. 64.

Talc and Pyrophyllite

By Bertrand L. Johnson and F. P. Uswald

GENERAL SUMMARY

MARKED increases over 1950 to record highs distinguished the 1951 mine production of talc, pyrophyllite, and ground soapstone and the quantity and value of these commodities sold or used. Total imports were less in quantity, but higher in value, in 1951 than in 1950. Exports of crude and ground talc, steatite, soapstone, and pyrophyllite were greater in both quantity and value in 1951 than in the preceding year. Exports of talcum powders also rose considerably in total value in 1951.

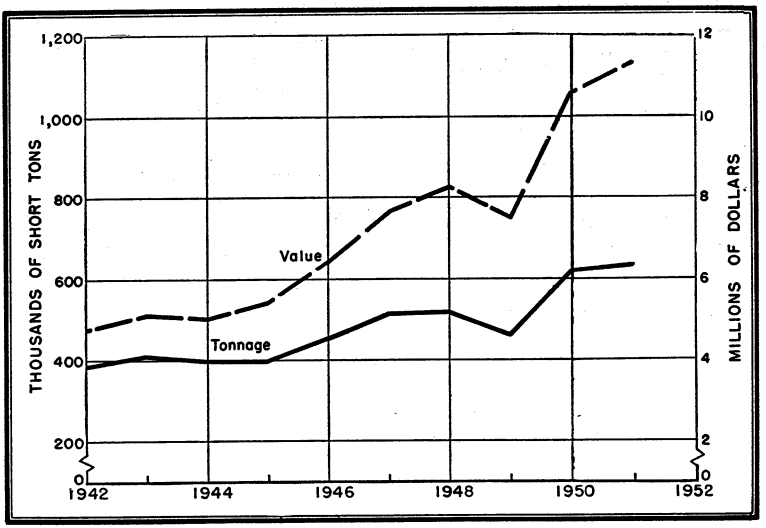

FIGURE 1—Sales of domestic talc, pyrophyllite, and ground soapstone, 1942–51.

TABLE 1.—Salient statistics of talc, pyrophyllite, and ground soapstone in the United States, 1950–51

	1950		1951	
	Short tons	Value	Short tons	Value
Mined	616,680	(1)	640,456	(1)
Used by producers	564,067	(1)	570,821	(1)
Sold by producers:				
Crude	58,136	$517,941	71,581	$642,780
Sawed and manufactured	805	312,776	1,097	375,141
Ground [2]	561,809	9,790,026	563,390	10,304,909
Total sales	620,750	10,620,743	636,068	11,322,830
Imports for consumption: [3]				
Crude and unground	177	10,052	109	20,326
Cut and sawed	156	44,364	127	42,033
Ground, washed, or pulverized	23,054	637,262	20,404	631,707
Total imports	23,387	691,678	20,640	694,066
Exports:				
Talc, steatite, soapstone, and pyrophyllite, crude and ground [4]	20,644	586,244	23,009	705,805
Powders—talcum (in packages), face, and compact	(1)	[5] 1,233,609	(1)	1,463,010
Total exports		[5] 1,819,853		2,168,815

[1] Figure not available.
[2] Includes some crushed material.
[3] Exclusive of "Manufactures, n. s. p. f. (not specially provided for), except toilet preparations," as follows: 1950: $7,574; 1951: $2,178. Quantities not available.
[4] Includes "Manufactures, n. e. s."
[5] Revised figure.

On June 20, 1951, the National Production Authority published a List of Basic Materials and Alternates in which Indian block talc was stated to be in such short supply that alternates should be used wherever possible; ground talc (including steatite) was in tight supply, so expanded use should be avoided by industry; and pyrophyllite was in fair supply and therefore should be used as a substitute for block and ground talc wherever possible.

Two reports on California talc deposits appeared in 1951.[1]

PRODUCTION AND SALES

Both the quantity and value of domestic talc, pyrophyllite, and ground soapstone sold in 1951 (636,068 short tons valued at $11,322,830) were higher than in 1950 and constituted new records. The mine production of pyrophyllite and the quantity and value of that mineral sold were at new highs.

[1] Page, B. M., Talc Deposits of Steatite Grade, Inyo County, Calif.: California Dept. Nat. Res., Div. Mines, San Francisco, Calif., Special Rept. 8, 1951, 35 pp.
Norman, L. A., Jr., and Stewart, R. M., Mines and Mineral Resources of Inyo County (Calif.): California Jour. Mines and Geol., vol. 47, No. 1, January 1951, pp. 17–223.

TABLE 2.—Talc, pyrophyllite,[1] and ground soapstone sold by producers in the United States 1947–51, by classes

Year	Crude [1]			Sawed and manufactured		
	Short tons	Value at shipping point		Short tons	Value at shipping point	
		Total	Average		Total	Average
1947	47,925	$389,535	$8.13	1,018	$239,407	$235.17
1948	49,124	408,186	8.31	920	227,963	247.79
1949	49,706	435,571	8.76	636	253,704	398.91
1950	58,136	517,941	8.91	805	312,776	388.54
1951	71,581	642,780	8.98	1,097	375,141	341.97

Year	Ground			Total		
	Short tons	Value at shipping point		Short tons	Value at shipping point	
		Total	Average		Total	Average
1947	467,151	$7,053,539	$15.10	516,094	$7,682,481	$14.89
1948	468,702	7,629,214	16.28	518,746	8,265,363	15.93
1949	[2] 411,554	6,834,203	16.61	461,896	7,523,478	16.29
1950	[2] 561,809	9,790,026	17.43	620,750	10,620,743	17.11
1951	[2] 563,390	10,304,909	18.29	636,068	11,322,830	17.80

[1] Includes pinite, although there were no sales of this material in 1949–51.
[2] Includes some crushed material.

TABLE 3.—Pyrophyllite [1] produced and sold by producers in the United States, 1947–51

Year	Production (short tons)	Sales					
		Crude		Ground		Total	
		Short tons	Value	Short tons	Value	Short tons	Value
1947	108,450	6,204	$27,626	97,536	$1,135,100	103,740	$1,162,726
1948	107,885	5,175	25,766	102,152	1,313,266	107,327	1,339,032
1949	90,920	5,927	31,489	82,934	1,070,838	88,861	1,102,327
1950	116,800	5,690	30,016	112,119	1,504,141	117,809	1,534,157
1951	120,031	4,446	23,741	114,398	1,664,058	118,844	1,687,799

[1] Exclusive of pinite.

REVIEW BY STATES

In 1951 the talc alone sold by producers in New York still exceeded both in tonnage and value, by a large margin, the combined talc, pyrophyllite, and ground soapstone sold by producers in any other State; tonnage sales in New York, however, fell sharply. California was second and North Carolina third. Sales in California, Georgia, Maryland and Virginia, and Vermont were higher in 1951 than in 1950. Sales of pyrophyllite increased slightly in 1951 over 1950.

TABLE 4.—Talc, pyrophyllite, and ground soapstone, sold by producers in the United States, 1949–51, by States

State	1949		1950		1951	
	Short tons	Value	Short tons	Value	Short tons	Value
California	83,359	$1,434,046	109,747	$2,069,211	126,784	$2,269,771
Georgia	49,338	580,405	70,749	774,148	77,895	823,133
Maryland and Virginia	32,256	268,423	41,206	355,075	45,399	431,579
Nevada	8,837	147,148	8,581	170,736	6,919	152,878
New York	115,636	2,658,774	163,974	4,039,973	152,652	4,170,987
North Carolina	86,208	1,344,767	116,895	1,855,163	113,950	1,982,927
Vermont	64,508	788,341	72,135	906,396	78,694	998,792
Other States [1]	21,754	301,574	37,463	450,041	33,775	492,763
Total	461,896	7,523,478	620,750	10,620,743	636,068	11,322,830

[1] Includes Montana, Texas, and Washington.

CONSUMPTION AND USES

Six industries—ceramic, paint, insecticide, rubber, roofing, and paper—purchased 86 percent of the domestically produced talc, pyrophyllite, and ground soapstone sold in 1951, according to reports from the producers. There were substantial increases over 1950 in sales to the ceramic, insecticide, and roofing industries. A noteworthy change has occurred among the leading consuming industries since 1949. The ceramic industry became an increasingly important consumer, taking 27 percent of total sales compared with 24 percent in 1950, and the paint industry, which took 23 percent in 1950, fell to only 19 percent in 1951.

TABLE 5.—Talc, pyrophyllite, and ground soapstone sold by producers in the United States, 1949–51, by uses [1]

Use	1949		1950		1951	
	Short tons	Percent of total	Short tons	Percent of total	Short tons	Percent of total
Paint	100,100	22	145,000	23	122,557	19
Ceramics	94,700	20	148,500	24	170,521	27
Rubber	53,400	12	75,900	12	70,970	11
Insecticides	61,100	13	77,000	12	90,418	14
Roofing	44,200	10	55,400	9	64,768	10
Paper	25,300	5	29,600	5	27,974	5
Toilet preparations	8,400	2	11,700	2	7,946	1
Foundry facings	5,300	1	7,800	1	7,986	1
Crayons	560	[2]	600	[2]	738	[2]
Other uses [3]	47,300	10	48,000	8	56,675	9
Unclassified	21,536	5	21,250	4	15,515	3
Total	461,896	100	620,750	100	636,068	100

[1] Partly estimated.
[2] Less than 0.5 percent.
[3] Refractory, textile, asphalt filler, plaster, and miscellaneous other uses.

PRICES

The trend in the average value per ton of domestic talc, pyrophyllite, and ground soapstone sold has been steadily upward in recent years. It rose in 1951 to $17.80 per short ton from $17.11 in 1950.

The prices of talc, pyrophyllite, and ground soapstone were included under the general price freeze order (General Ceiling Price Regulation—GCPR—January 26, 1951), in which prices were set at the highest level reached in the base period between December 19, 1950, and January 25, 1951. The following table shows the prices of ground talc and pyrophyllite at the beginning of 1950 and 1951 and at the end of the latter year, as quoted by the Oil, Paint, and Drug Reporter. No change is shown in the prices for ground talc during 1951, but pyrophyllite prices rose after the early price freeze, so that, at the end of the year, they stood at a considerably higher level than during the base period.

TABLE 6.—Prices quoted on talc and pyrophyllite, carlots, 1950–51, per short ton

[Oil, Paint and Drug Reporter]

Mineral and grade	Jan. 1, 1950	Jan. 8, 1951	Dec. 31, 1951
GROUND TALC (BAGGED)			
Domestic, f. o. b. works:			
Ordinary:			
California	$25.00–$35.00	$25.00–$35.00	$25.00–$35.00
Vermont	14.00	14.00	[1] 14.00
Fibrous (New York)	[2]	[2]	25.00–30.00
Off color	24.00	24.00	[2]
325-mesh:			
98.5–99.5 percent	23.00–28.00	25.00	[2]
99.5 percent	[2]	[2]	27.00
Imported (Canadian)	12.50–35.00	12.50–35.00	15.25–35.00
PYROPHYLLITE			
Standard, bulk, mines: [3]			
200-mesh	11.00–11.50	11.00–11.50	12.50
230-mesh	12.00	12.00–12.50	13.50
325-mesh	15.00	15.75	16.75
No. 3: 200-mesh, bulk, mines [3]	9.50	9.50	11.00
Insecticide grade: 200-mesh, bags, mines	12.00–12.50	12.00–12.50	13.50–14.00
Rubber grade: 140-mesh, bags, mines	10.00–10.50	10.00–10.50	13.50

[1] Off color.
[2] Not quoted.
[3] In paper bags, $3 to $3.50 per ton extra.

FOREIGN TRADE [2]

Imports.—The total quantity of unmanufactured talc, steatite or soapstone, and French chalk imported for consumption in the United States decreased 11 percent (2,747 short tons) in 1951 from 1950; and dropped to 20,640 short tons. The value of the imports, however, rose slightly to $694,066. The quantity of "crude and unground" material imported fell from 177 tons to 109, but the value doubled. There were decreases in both quantity and value of the imports of other classifications of the unmanufactured material. As usual, the greater part of

[2] Figures on imports and exports compiled by M. B. Price and E. D. Page, of the Bureau of Mines, from records of the U. S. Department of Commerce.

TABLE 7.—Talc, steatite or soapstone, and French chalk imported for consumption in the United States, by class in 1947–49 and by class and country in 1950–51

[U. S. Department of Commerce]

Country	Crude and unground		Ground, washed, powdered, or pulverized, except toilet preparations		Cut and sawed		Total unmanufactured		Manufactures n. s. p. f. except toilet preparations (value)
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	
1947	48	$1,962	17,629	$414,726	27	$8,235	17,704	$424,923	$13,525
1948	85	4,835	18,194	484,857	98	29,133	18,377	518,825	14,773
1949	47	4,981	18,648	537,061	121	35,072	18,816	577,114	9,013
1950									
Afghanistan	84	3,000					84	3,000	
Canada			4,135	48,998	5	971	4,140	49,969	
China	(1)	35					(1)	35	6,786
Egypt	14	296					14	296	
France			2,149	34,343	7	1,272	2,156	35,615	474
Hong Kong									4
India	79	6,721	168	5,337			247	12,058	5
Italy			16,602	548,584	122	35,575	16,724	584,159	
Japan									114
Norway					22	6,546	22	6,546	
United Kingdom									191
Total	177	10,052	23,054	637,262	156	44,364	23,387	691,678	7,574
1951									
Canada			3,484	43,402	1	628	3,485	44,030	99
China			(1)	241			(1)	241	2,045
Egypt			55	3,600			55	3,600	
France			1,855	35,645	12	7,888	1,867	43,533	
Germany									5
Hong Kong			(1)	26			(1)	26	18
India	75	10,834	832	28,938			907	39,772	
Italy	34	9,492	14,178	519,855	98	28,469	14,310	557,816	
Japan					3	1,476	3	1,476	
Norway					13	3,572	13	3,572	
United Kingdom									11
Total	109	20,326	20,404	631,707	127	42,033	20,640	694,066	2,178

[1] Less than 0.5 ton.

the unmanufactured imports was "ground, washed, powdered or pulverized, except toilet preparations," of which 20,404 tons valued at $631,707 was imported in 1951. Most of the ground material came from Italy, with Canada in second place and France third. Imports of the manufactured material (n. s. p. f., except toilet preparations) declined in value to only $2,178. The manufactures came principally from China.

Exports.—Both the quantity and value of "talc, soapstone, and pyrophyllite" exported from the United States in 1951 reached new highs. The quantity of crude and ground exports increased 2,310 short tons to 22,903 tons and the value rose $84,465, a greater percentage increase, to the new record of $645,217. Exports of "manufactures, n. e. s.," while still relatively small, more than doubled. The value of exports of "powders-talcum (in packages), face and compact" increased nearly a quarter of a million dollars above that of 1950 to $1.5 million.

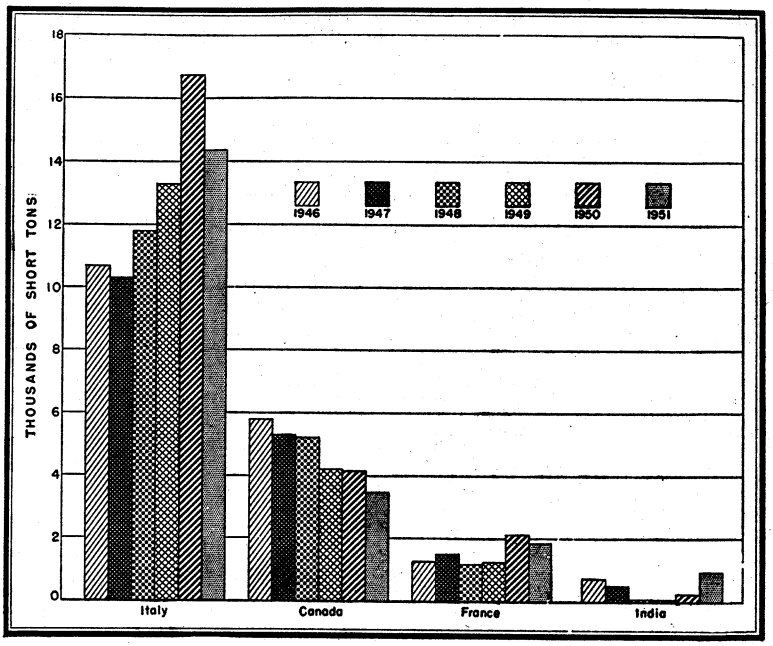

FIGURE 2.—Unmanufactured talc, steatite or soapstone, and French chalk imported for consumption in the United States, 1946–51, by principal countries.

TABLE 8.—Talc, pyrophyllite and talcum powders exported from the United States, 1947–51

[U. S. Department of Commerce]

Year	Talc, steatite, soapstone, and pyrophyllite				Powders—talcum (in packages), face and compact (value)
	Crude and ground		Manufactures, n. e. s.		
	Short tons	Value	Short tons	Value	
1947	[1] 17,557	[1] $429,803	([2])	([2])	$4,252,161
1948	16,327	432,176	([2])	([2])	2,228,956
1949	15,840	439,686	1	$455	1,636,505
1950	20,593	560,752	51	25,492	[3] 1,233,609
1951	22,903	645,217	106	60,588	1,463,010

[1] Excludes 599 short tons, valued at $30,589, sent to Japan under the Army Civilian Supply Program.
[2] Not separately classified before January 1949.
[3] Revised figure.

WORLD REVIEW

The production of talc, pyrophyllite, and ground soapstone in various countries in recent years is shown in table 9.

TABLE 9.—World production of talc, pyrophyllite, and soapstone, 1946–51, by countries, in metric tons [1]

[Compiled by Helen L. Hunt]

Country [1]	1946	1947	1948	1949	1950	1951
Argentina	3,760	(2)	(2)	(2)	(2)	(2)
Australia	5,838	5,929	6,198	8,717	[3] 9,851	11,987
Austria	21,600	24,500	47,300	52,144	53,625	66,574
Brazil	4,183	9,500	10,743	7,221	(2)	(2)
Canada (shipments)	27,288	24,450	26,109	24,423	[3] 29,578	26,478
Chile	640	1,085	270	110	142	(2)
Egypt	4,760	4,630	5,521	5,573	3,731	3,754
Finland	300	(2)	237	(2)	4,000	(2)
France	63,350	69,785	91,520	99,650	95,500	120,000
Germany, West	13,800	[4] 20,484	[5] 28,214	30,968	13,314	19,500
Greece	500	200	1,800	1,700	2,500	2,623
India	96,220	20,823	[3] 18,386	21,535	25,894	32,314
Italy	36,356	50,260	70,139	60,210	[3] 67,616	75,827
Japan	111,562	183,129	243,737	262,433	283,566	400,626
Kenya	490	297	322	590	334	337
Korea, Republic of	300	700	72	2,773	(2)	(2)
Norway	[3] 42,316	[3] 54,623	[3] 57,226	[3] 53,993	[3] 64,099	60,000
Rumania	267	(2)	(2)	(2)	(2)	(2)
Spain [6]	30,665	31,616	29,984	38,208	25,131	36,034
Sweden	14,010	10,710	11,703	11,293	13,843	(2)
Union of South Africa	3,680	2,700	4,897	5,386	3,978	5,663
United Kingdom	3,437	3,379	4,000	2,616	(2)	(2)
United States [7]	414,641	468,190	470,596	419,023	563,132	577,028
Uruguay	1,818	2,675	2,984	660	681	959
Total (estimate)	[3] 960,000	[3] 1,060,000	1,200,000	[3] 1,180,000	[3] 1,340,000	1,550,000

[1] In addition to countries listed, talc or pyrophyllite is reported for Afghanistan, China, Portugal, and U. S. S. R., but data on production are not available; estimates have been included in total.
[2] Data not available; estimate by chapter author included in total.
[3] Revised figure.
[4] American zone only.
[5] Bizonal area.
[6] Includes steatite as follows: 1946: 19,541; 1947: 20,835; 1948: 18,627; 1949: 20,880; 1950: 13,702; 1951: 22,628.
[7] Talc, pyrophyllite, pinite, and ground soapstone sold by producers. (No pinite sold by producers in 1949, 1950 or 1951.)

Canada.—According to official preliminary estimates [3] Canada produced in 1951 13,480 short tons of talc (value $164,550), 15,600 short tons of soapstone (value $162,900), and 107 tons (value $535) not differentiated as between talc and soapstone. Imports of talc and soapstone in 1951 were given as 9,283 tons (value $306,277), and exports of talc, 3,743 tons (value $48,857).

The Canadian talc and soapstone industry in 1950 was described as follows: [4]

Producers' shipments of talc and soapstone during 1950 amounted to 32,604 tons valued at $364,995 compared with 26,922 tons valued at $320,793 in 1949. Production in Ontario was mostly high-grade milled talc but output from workings in Quebec included crayons, blocks and ground soapstone. In British Columbia test shipments of talc and pyrophyllite were made and although the ground material had not been sold at the year-end, nominal values were assigned for statistical purposes.

The industry employed 58 persons and distributed $116,547 in wages and salaries during the year. Fuel cost $5,460 and 1,519,975 k. w. h. of electricity were purchased for $22,090.

Imports of talc and soapstone totalled 8,974 tons worth $288,020. Canadian exports of talc in 1950 amounted to 4,467 tons valued at $57,621.

[3] Canada, Department of Trade and Commerce, Dominion Bureau of Statistics, Preliminary Rept. on Mineral Production, 1951: Prepared in the Min., Met., and Chem. Sec., Industry and Merchandising Div., Dominion Bureau of Statistics, Ottawa, Canada, 1952, pp. 6, 7, and 36.
[4] Canada, Department of Trade and Commerce, Dominion Bureau of Statistics, The Talc and Soapstone Industry 1950: Industry and Merchandising Div., Min., Met., and Chem. Sec., Ottawa, Canada, 1951, 5 pp.

Consumption of ground talc and soapstone in Canada, 1947–49, by use and by Province, in short tons

	1947	1948	1949
USE			
Paints	7,352	6,041	5,378
Roofing	8,618	7,696	8,595
Pulp and paper	1,899	3,722	3,827
Rubber	3,075	3,125	3,002
Toilet and medicinal preparations	1,350	1,242	864
Electrical apparatus	330	658	815
Clay products	1,214	1,127	882
Soaps and cleaning preparations	524	310	215
Textiles	[1] 150	[1] 150	484
Insecticides and miscellaneous chemicals	2,388	2,461	4,674
Polishes	8	14	----
Prepared foundry facings	39	70	846
Iron foundries	[1] 106	[1] 106	110
Tanneries	----	[1] 50	50
Adhesives	[1] 6	4	----
Linoleum	6	6	5
Total	[2] 27,115	26,782	29,747
PROVINCE			
Nova Scotia	60	56	[3] 151
New Brunswick	509	292	381
Quebec	10,006	8,334	8,433
Ontario	14,208	15,911	18,511
Manitoba	1,503	1,493	1,729
Saskatchewan	81	113	60
Alberta	70	96	66
British Columbia	678	487	416
Total	27,115	26,782	29,747

[1] Partly estimated.
[2] Includes 50 tons unclassified by type of use.
[3] Includes Newfoundland.

Tin

By Abbott Renick and John B. Umhau

GENERAL SUMMARY

THE YEAR 1951 was an eventful one in the international tin trade, featured by soaring prices and the decline of the tin market. All new purchases of tin for the National Strategic Stockpile were suspended; private importation of tin was stopped, and the Reconstruction Finance Corporation was made the sole importer of tin; the Preparedness Subcommittee of the Senate Armed Services Committee published a comprehensive report on the tin situation; the National Production Authority placed tin under allocation control; and the RFC disputed with Bolivia what was considered to be a reasonable price for tin.

In the hope of arresting the unprecedented rising prices and reestablishing the normal market for tin, the United States Government invited major tin-producing countries to convene with its representatives in Washington. The resulting conferences, held March 14–28, concluded without reaching any agreement. Subsequently, a United States mission examined tin mines, smelters, and tin marketing in the Federation of Malaya and Singapore. The International Tin Study Group met again during 1951.

The Preparedness Subcommittee of the Senate Committee on Armed Services conducted a comprehensive investigation on tin, culminating in a report issued on March 5, 1951.[1] Among other measures the report recommended that tin purchasing be centralized in a single Government department and that stockpile purchasing be suspended until prices decreased to a reasonable level. The committee concluded that in case of war enough tin stocks were on hand to satisfy United States requirements, provided that stringent control and conservation measures were put into effect. A major recommendation of the subcommittee report called for an international conference of representatives of the tin producing and consuming countries to stimulate production, allocate tin supplies, and reduce the price. The committee recommended that the National Production Authority institute more stringent tin conservation and allocation measures. An offer of technical assistance to tin producers by the United States Government on a cooperative basis was also recommended.

On January 12, 1951, the RFC was requested to undertake the function of acquiring and disposing of tin-bearing materials (metals, ores, concentrates, etc.) in connection with the defense program. In accordance with the Defense Production Act of 1950 and Executive Orders 10161 and 10200, the Administrator of the General Services Administration, on March 5, 1951, delegated to the RFC the authority to purchase and make commitments to purchase tin metal, tin ores

[1] Preparedness Subcommittee of the Committee on Armed Services, United States Senate, Investigation of the Preparedness Program, Sixth Report, Tin 1951: 82d Cong., 1st sess., p. 48.

and concentrates, and tin contained in slags, flue dust, and drosses for Government use or for resale.

On March 7 the General Services Administration suspended all new purchases of tin for the National Strategic Stockpile, and announced that purchases by the Government for industrial uses would be held to a minimum.

NPA Order M–8, effective March 12, 1951, designated RFC, acting for and in behalf of General Services Administration, as the sole importer of pig tin. The same order placed all domestic users of pig tin, with limited exceptions, under allocation by NPA, beginning May 1, 1951.

World mine production of tin totaled 169,100 long tons in 1951, virtually unchanged from the 169,000 produced in 1950. World smelter production decreased 7,400 tons (4 percent), principally because of decreases of 4 percent in the output in both Malaya and the United States. World consumption decreased 8 percent.

The United States mine output of tin continued to be negligible, although Government assistance, afforded under the Defense Production Act of 1950, initiated the equipping of a tin mine in Alaska. A small production of tin resulted as a byproduct from the mining of molybdenite in Colorado.

Consumption of tin in 1951 in the United States, which was under Government control through the year, decreased 16 percent under 1950; consumption of primary tin decreased 20 percent and of secondary tin 6 percent. Domestic smelter output, nearly all from the Government-owned smelter at Texas City, Tex., decreased 1,266 long tons (4 percent) from 1950. Secondary tin production was 3 percent less than in 1950.

Metal imports decreased 66 percent, representing 48 percent of the total tin imported. Receipts of concentrates, in terms of metal, were 14 percent higher than in 1950. The increase was due chiefly to larger receipts from Indonesia and Thailand. Imports of tin in concentrate from Bolivia decreased 9 percent.

The total stocks of tin in the United States and in transit as of December 31, 1951, were 40,448 long tons, exclusive of the National Stockpile and metal afloat to the United States. As a reserve for civilian deficiency, the RFC on December 31, 1951, held 6,753 long tons of pig tin. On December 31, tin concentrates and other tin-bearing materials held by the RFC contained an estimated total tin content of 11,878 long tons. As of December 31, tin stocks held by industry and in transit to consuming plants were 21,817 long tons.

Tin prices in 1951 fluctuated violently. The price of tin in New York, which had risen from 76.4 cents per pound just before the outbreak of war in Korea to $1.51 at the beginning of 1951, reached $1.83 on January 25. On February 14 the Singapore price reached $1.93, equivalent to $1.97 in New York. As a result of suspension of all new purchases for the National Stockpile, together with the announcement that purchases by the Government for industrial uses would be held to a minimum, the price of tin fell to $1.34 per pound on March 9. A price of $1.03 was reached on August 1, 1951, and maintained to December 31, 1951. The annual average for 1951 was $1.28 per pound, the highest on record.

TABLE 1.—Salient statistics of tin in the United States, 1942–46 (average) and 1947–51

	1942–46 (average)	1947	1948	1949	1950	1951
Production—						
From domestic mines [1] ....long tons..	3.4	1.3	4.7	68.4	94.1	88.0
From domestic smelters [2] .....do....	30,503	33,300	36,703	35,834	33,118	31,852
From secondary sources .....do....	30,580	26,800	26,900	22,230	31,680	30,745
Imports for consumption:						
Metal .....do....	15,212	24,899	49,196	60,224	[3] 82,838	27,784
Ore (tin content) .....do....	31,577	29,410	37,492	38,311	25,960	29,618
Exports (domestic and foreign) .....do....	957	420	91	154	799	1,513
Monthly price of Straits tin at New York:						
Highest .....cents per pound..	70.00	94.00	103.00	103.00	163.50	184.000
Lowest .....do....	52.00	70.00	94.00	77.50	74.125	103.000
Average .....do....	52.516	77.94	99.25	99.316	95.557	128.308
World mine production .....long tons..	108,360	[3] 113,500	[3] 153,600	[3] 161,500	[3] 169,000	169,100

[1] Includes Alaska.
[2] Including tin content of ores used direct to make alloys.
[3] Revised figure.

GOVERNMENT REGULATIONS

Tin controls were tightened in 1951 to assure supplies for the rearmament program and to provide for equitable distribution of the remaining supply and encourage conservation. National Production Authority Order M–8, first issued in 1950, was further amended to limit monthly use and place tin supplies under allocation in 1951. Uses of tin not expressly set forth in schedules in M–8 were prohibited. During January 1951 consumption of pig tin was limited to 100 percent of the monthly average usage during the 6-month-base period ended June 30, 1950. During February and March industry was restricted to 80 percent of base-period use; during April, May, and June the rate was increased to 95 percent for tin platers and 90 percent for all other users. On March 12, 1951, the RFC was designated the sole importer of tin in the country to bring about more orderly arrangements for acquiring tin needed in the United States. Commencing May 1, 1951, pig tin was placed under allocation by prohibiting, subject to limited exceptions, any deliveries not covered by allocation authorizations to be issued monthly by the NPA. During the last half of 1951 all users were limited to 90 percent of base period use. Previous limitation rates allowed extra quantities for producing implements of war, but after July 1 all uses were made subject to the 90-percent limit. Limitations on pig-tin inventories were 120 day's supply for tin-plate manufacturers and 60 days for all other users.

The use of pig tin for making tin plate and terneplate was limited by M–8, which also permitted the use of tin for tin plate and terneplate in accordance with NPA Order M–24. M–24 controlled the uses of tin plate and terneplate (for cans M–25 and for closures M–26), the permitted materials in these uses, and the maximum permitted coatings of tin or terne metal. Effective July 1, 1951, tin plate and terneplate became subject to allotments under the Controlled Materials Plan (CMP). The use of tin in the manufacture of collapsible tubes was limited by Order M–27, the percentage varying with products to be packaged in the tubes.

DOMESTIC PRODUCTION

MINE OUTPUT

Domestic mine production of tin was again insignificant. Only 88 long tons of tin was produced in 1951 compared with 94 tons in 1950. Alaska again supplied virtually all the output. Mining in Alaska in 1951 was confined mainly to placer deposits of the Northern Tin Co., Inc., on Buck Creek and the United States Tin Corp. at Lost River in the Port Clarence district in the western part of Seward Peninsula. No lode tin was mined during 1951 from any Alaska deposits.

Small quantities of byproduct tin were produced in Colorado by the Climax Molybdenum Corp. and in North Carolina by the Foote Mineral Co.

Under the Defense Production Act of 1950, a financial assistance contract in the form of a 90-percent Government guaranty operating loan was negotiated with the United States Tin Corp. A mill building was erected and the installation of equipment was started at the old Lost River tin-tungsten lode mine in Alaska. The contract was one of the first of this type approved in the minerals field. On August 6, 1951, the Defense Minerals Administration released a list of approved minerals exploration projects which included two tin investigations, one by the Zenda Gold Mining Co., Seward Peninsula, Alaska, and the other by Keenan Properties, Lawrence County, S. Dak., with Government participation indicated at $54,000 and $90,000, respectively.

TABLE 2.—Mine production of tin (content) in the United States, 1942–46 (average) and 1947–51, by States, in long tons

Year	Alaska	South Dakota	Colorado	Other States	Total	
					Long tons	Value
1942–46 (average)	1.0	0.5	----	2.0	3.5	$4,060
1947	1.3	----	----	----	1.3	2,200
1948	[1] 4.7	(1)	----	----	4.7	10,380
1949	51.6	----	16.8	----	68.4	152,210
1950	79.5	----	14.6	----	94.1	201,446
1951	68.6	----	18.8	.6	88.0	252,920

[1] A very small quantity from South Dakota is included with Alaska.

SMELTER OUTPUT

Smelters in the United States produced 31,852 long tons of tin in 1951 compared with 33,118 tons in 1950. Production was virtually entirely that of the Government-owned smelter at Texas City. This smelter (Longhorn smelter) produced 30,934 long tons of pig tin—all 3-Star—(including 15 of secondary from drosses) in 1951 and 32,136 tons (including 44 of secondary from drosses) in 1950. Production of pig tin by the smelter in November and December 1951, was the lowest since August 1943. In addition, the production of Copan alloy (containing 84 percent tin) amounted to 700 long tons in 1951 and 940 tons in 1950.

The Longhorn smelter treated concentrates mainly from Bolivia, Indonesia, Thailand, and the Belgian Congo in 1951. The average grades of alluvial, Bolivian, and miscellaneous concentrates treated

during the 15 months ended June 30, 1951, and for the 6 months ended December 31, 1951, were as follows:

Average percent tin content

	15 months to June 30, 1951	*6 months ended Dec. 31, 1951*
Alluvial	73. 58	73. 17
Bolivian	34. 54	34. 13
Miscellaneous	56. 33	53. 48
Average	47. 09	48. 64

The average analysis of the concentrates used in 1942–49 was: [1a]

	Percent of concentrates	
	Bolivian	*Alluvial*
Sn	38. 0	73. 5
S	6. 0	-----
Pb	. 5	. 4
Sb	. 4	. 02
As	. 4	. 02
Bi	. 04	. 01
Cu	. 2	. 01
Zn	. 6	. 06
Fe	16. 0	3. 0
SiO_2	13. 0	2. 0

Of the total tin produced at the Longhorn smelter in 1951, 98 percent was 3-Star and 2 percent was Copan alloy. The smelter upgraded, remelted, or recast 1,528 tons in 1951. Of this 902 tons were recast into 3-Star from previously produced 3-Star (100 tons) and 2-Star (802 tons); and 626 tons of Copan to Copan. The Longhorn smelter continued to be operated on a cost-plus-fixed-fee arrangement by Tin Processing Corp. (a Delaware corporation and a subsidiary of N. V. Billiton Maatschappij). The contract with the firm was extended to June 30, 1952.

The Vulcan Detinning Co. recovered tin from low-grade concentrates in early 1951 but discontinued doing so during the summer, and the plant built for the purpose was placed in standby condition. In 1951, the RFC purchased 190 long tons of tin recovered in the United States by the Vulcan Detinning Co. from concentrates of foreign origin. Thereafter the Longhorn tin smelter became the only one operating in this country.

RFC assets of property, plant, and equipment under the tin program, but excluding stocks of tin metal, ores, and materials in process, were valued at $11,631,015 as of June 30, 1950, and had been increased to $12,439,928 by June 30, 1951. Direct operating costs before depreciation or byproduct credits totaled $5,872,288 in the calendar year 1951 ($5,667,028 in 1950). Operating cost per long ton of tin bullion produced from primary ores increased from $173 for the fiscal year ended June 30, 1951, to $220 in the last 6 months of 1951, because of curtailed production necessitated by the lack of ore. Although the total payroll was reduced from 914 on June 30 to 793 on December 31, 1951, overhead and maintenance costs could not be reduced, and the efficiency of operations in general suffered from the low rate of production. Tungsten-leaching operations and the production of

[1a] Hayward, Carle R., An Outline of Metallurgical Practice: 3d ed., D. Van Nostrand Co., Inc., Cambridge, Mass., January 1952, p. 324.

synthetic scheelite were suspended at the end of September, when all Bolivian ores containing enough tungsten to cause furnace trouble by hearth accretions had been treated.

TABLE 3.—Longhorn tin-smelter production, 1942–51, by months, in long tons

Month	1942	1943	1944	1945	1946	1947	1948	1949 [1]	1950 [2]	1951 [3]
January		2,611	2,153	3,114	3,812	3,024	3,172	3,257	2,627	3,211
February		2,334	2,419	3,162	3,823	2,815	2,800	3,254	2,362	3,096
March		1,491	2,513	3,310	3,881	2,877	2,602	3,104	2,729	3,123
April	525	1,055	2,611	3,407	3,891	2,816	2,906	2,851	2,484	3,058
May	1,246	1,032	2,402	3,451	3,904	3,112	3,310	3,007	2,852	3,059
June	1,663	1,498	2,439	3,502	3,856	2,712	3,651	3,006	2,204	2,655
July	1,924	1,184	2,618	3,548	3,853	2,517	3,509	2,910	2,256	2,406
August	1,655	1,347	2,553	2,912	3,672	2,237	3,509	3,005	2,396	2,505
September	2,026	2,029	2,501	3,323	3,323	2,356	2,859	2,910	2,805	2,155
October	2,014	2,089	2,651	3,558	3,125	3,026	2,300	2,964	3,209	2,055
November	2,300	2,020	2,852	3,628	3,119	2,759	2,907	2,994	3,207	1,806
December	2,343	2,037	2,907	3,676	3,209	3,041	3,153	2,791	3,005	1,805
Total	15,696	20,727	30,619	40,591	43,468	33,292	36,678	36,053	32,136	30,934

[1] Includes 238 tons of secondary from drosses.
[2] Includes 44 tons of secondary from drosses, but excludes tin content of ores (621 long tons) used direct to make alloys. Also exclusive of tin recovered from remelts.
[3] Includes 15 tons of secondary from drosses, but excludes tin content of ores (592 long tons) used direct to make alloys; also exclusive of tin recovered from remelts.

SECONDARY TIN

Recovery of secondary tin decreased 3 percent in 1951 compared with 1950. The value, however, was 30 percent greater than in 1950. Most of the tin recovered was contained in copper-, tin- and lead-base alloys. Only 3,300 long tons was recovered in the form of metallic tin, mostly by the detinning plants.

Tin recovered in copper-base alloys from scrap (accounting for 58 percent of the total recovered in all products in 1951) increased nearly 30 percent, while recoveries in white-metal alloys decreased 34 percent.

Detinning plants treated 481,443 long tons of tin plate clippings in 1951—the largest tonnage on record, exceeding the previous peak reached in 1950 by nearly 3 percent. In addition, old cans processed increased 32 percent to 22,131 long tons in 1951, compared with 16,818 tons in 1950; this was a small figure, however, compared with the record use of 175,870 tons in 1943. In total, 3,565 long tons of tin was recovered from this material. Tin recovered from tin-plate clippings in 1951 was 3,416 tons, 9 percent less than 1950, while that from old cans, 149 tons (mostly in the form of pig tin), increased 38 percent.

TABLE 4.—Secondary tin recovered in the United States, 1942–46 (average), and 1947–51, in long tons

Year	Tin recovered at detinning plants			Tin recovered from all sources			
	As metal	In chemicals	Total	As metal	In alloys and chemicals	Total	
						Long tons	Value
1942–46 (average)	3,516	288	3,804	3,920	26,660	30,580	$35,880,813
1947	2,720	360	3,080	2,900	23,900	26,800	46,848,175
1948	2,930	340	3,270	3,100	23,800	26,900	59,796,140
1949	2,850	410	3,260	3,170	19,060	22,230	49,461,354
1950	3,300	575	3,875	3,615	28,065	31,680	67,809,158
1951	3,150	415	3,565	3,300	27,445	30,745	88,363,153

CONSUMPTION

APPARENT CONSUMPTION

In 1951 the apparent consumption of primary tin, computed by adding domestic smelter production to net imports, amounted to only about half of that in 1950. As changes in consumer, dealer, and Government stocks are not taken into account, apparent consumption may vary greatly from actual consumption as measured in finished products. Table 5 gives the data for 1942–46 (annual average) and 1947–51. A comparable series for 1910–38 was published in Minerals Yearbook, 1939 (p. 680), and for 1939–48 in Minerals Yearbook, 1948 (p. 1212).

TABLE 5.—Apparent consumption of primary tin,[1] 1942–46 (average) and 1947–51, in long tons

Year	Long tons	Year	Long tons
1942–46 (average)	44,752	1949	95,904
1947	57,771	1950	115,156
1948	85,808	1951	58,123

[1] Includes some secondary metallic tin in imports whose quantity cannot be separately determined.

CONSUMPTION BY USES

Total domestic consumption of tin was 16 percent less in 1951 than in 1950. The use of primary tin decreased 20 percent and secondary 6 percent. The tin content of manufactured products was 88,169 long tons in 1951 (56,884 of primary and 31,285 of secondary) compared with 104,464 tons in 1950 (71,191 of primary and 33,273 of secondary). The tin plate and terneplate industry decreased its use of tin 14 percent, while the total quantity used by all other industries decreased 17 percent.

Five items—tin plate and terneplate, bronze and brass, solder, babbitt, and tinning—accounted for most of the total tin consumed in 1950 and 1951. Tin plate and terneplate took 35 percent (same in 1950), bronze and brass 25 percent (20 in 1950), solder 22 percent (26 percent in 1950), babbitt 7 percent, and tinning 3 percent. Uses of primary tin decreased in 1951 as follows: Tin plate 14 percent, solder and babbitt 29 percent, tinning 13 percent, collapsible tubes and foil 42 percent, pipe and tubing 65 percent, type metal 35 percent, and chemicals and oxide 57 percent. Bronze and brass was the only item that increased (16 percent) its use of primary tin, resuming its former wartime importance as the second largest user of tin. Tonnagewise, conservation was mainly effected in the use of primary tin for making solder (5,277 tons less), tin plate (4,858 tons less), collapsible tubes and foil (606 tons less), babbitt (1,008 tons less), miscellaneous alloys (699 tons less), and chemicals and tin oxide (495 tons less).

Tin mills operated at a lower rate in 1951 and produced 4 percent less tin plate than in the peak year 1950. In 1951 over half of the primary tin consumed was for making tin plate. About 61 percent of the tin used to make tin plate (excluding waste-waste, etc.) in 1951 was for hot-dipped and 39 percent for electrolytic. Hot-dipped tin plate production, however, accounted for only 35 percent and electrolytic 65 percent of the total output (excluding waste-waste, etc.) in 1951.

Electrolytic tin plate requires considerably less tin per unit of product than hot-dipped. Electrolytic lines established a new annual record in 1951 and produced 5 percent more tin plate than in 1950. Hot-dipped tin plate production declined 16 percent and was the smallest tonnage recorded since 1932. Terneplate production required 19 percent less tin in 1951 than in 1950. Short-terne output decreased 14 percent, whereas long ternes increased 3 percent.

Net industrial receipts of tin in 1951 were 81,139 long tons (30 percent less than in 1950), of which 60 percent consisted of primary pig tin. Receipts of primary tin decreased 40 percent and secondary or scrap 7 percent. Straits tin supplied 68 percent of primary receipts

TABLE 6.—Consumption of primary and secondary tin in the United States, 1942–46 (average) and 1947–51, in long tons

	1942–46 (average)	1947	1948	1949	1950	1951
Stocks on hand Jan. 1 [1]	39,838	27,100	25,743	27,070	24,621	31,856
Net receipts during year:						
Primary	48,053	59,882	62,119	47,782	79,992	48,298
Secondary	3,391	2,836	3,004	2,606	3,371	3,273
Terne	278	417	681	470	997	594
Scrap	28,056	26,598	29,840	22,193	30,839	28,974
Total receipts	79,778	89,733	95,644	73,051	115,199	81,139
Available	119,616	116,833	121,387	100,121	139,820	112,995
Stocks on hand Dec. 31 [1]	31,774	25,743	27,070	24,621	31,856	20,764
Total processed during year	87,842	91,090	94,317	75,500	107,964	92,231
Intercompany transactions in scrap	2,794	1,957	2,535	2,167	2,168	2,726
Total consumed in manufacturing	85,048	89,133	91,782	73,333	105,796	89,505
Plant losses	945	1,033	994	927	1,332	1,336
Tin content of manufactured products	84,103	88,100	90,788	72,406	104,464	88,169
Primary	54,394	59,166	59,863	47,163	71,191	56,884
Secondary	29,709	28,934	30,925	25,243	33,273	31,285

[1] Stocks shown exclude tin in transit or in other warehouses on Jan. 1, as follows: 1946, 1,600 tons; 1947, 1,000 tons; 1948, 940 tons; 1949, 328 tons; 1950, 61 tons; 1951, 1,355 tons, and 1952, 971 tons.

TABLE 7.—Consumption of tin in the United States, 1949–51, by finished product, in long tons of contained tin

Product	1949			1950			1951		
	Primary	Secondary	Total	Primary	Secondary	Total	Primary	Secondary	Total
Tin plate	29,617	-------	29,617	35,380	-------	35,380	30,522	-------	30,522
Terneplate	278	348	626	349	603	952	84	683	767
Solder	8,150	7,206	15,356	18,343	9,117	27,460	13,066	6,744	19,810
Babbitt	2,030	2,515	4,545	3,501	2,908	6,409	2,493	3,360	5,853
Bronze and brass	2,360	12,103	14,463	4,178	16,416	20,594	4,838	16,934	21,772
Collapsible tubes	672	43	715	[1] 1,438	[1] 228	[1] 1,666	[1] 832	[1] 208	[1] 1,040
Tinning	1,916	158	2,074	2,797	179	2,976	2,431	277	2,708
Foil	161	38	199	(1)	(1)	(1)	(1)	(1)	(1)
Pipe and tubing	193	38	231	383	57	440	133	94	227
Type metal	81	1,693	1,774	184	1,796	1,980	120	1,694	1,814
Bar tin	636	159	795	1,194	240	1,434	875	54	929
Miscellaneous alloys	245	145	390	[2] 1,543	164	1,707	[2] 844	183	1,027
White metal	146	107	253	693	524	1,217	134	146	280
Chemicals (other than oxide)	64	390	454	869	847	1,716	95	707	802
Tin oxide	270	237	507				279	119	398
Miscellaneous	344	63	407	339	194	533	138	82	220
Total	47,163	25,243	72,406	71,191	33,273	104,464	56,884	31,285	88,169

[1] Foil included with collapsible tubes.
[2] Includes 788 tons of tin in Copan produced in 1950, and 592 tons in 1951.

reported by plants in 1950 and only 25 percent in 1951, as virtually no tin was shipped from Malaya to the United States after March. The principal brand acquired in 1951 was Longhorn produced by the Texas City smelter, which has supplied industry almost half of its pig tin since 1942. Straits, the product of the large smelters in Malaya, was the principal brand used in the United States before the Second World War.

TABLE 8.—Tin content of tin plate and terneplate produced in the United States, 1935–51

Year	Total tin plate (all forms)			Tin plate (hot-dipped)			Tin plate (electrolytic)			Tin plate waste—waste, strips, cobbles, etc.		
	Gross weight (short tons)	Tin content (long tons)	Pounds of tin per short ton of plate	Gross weight (short tons)	Tin content (long tons)	Pounds of tin per short ton of plate	Gross weight (short tons)	Tin content (long tons)	Pounds of tin per short ton of plate	Gross weight (short tons)	Tin content (long tons)	Pounds of tin per short ton of plate
1935	1,926,896	27,290	31.7	1,926,896	27,290	31.7	----------	----------	------	----------	------	------
1936	2,349,402	33,750	32.2	2,349,402	33,750	32.2	----------	----------	------	----------	------	------
1937	2,819,635	39,221	31.2	2,724,278	37,921	31.2	----------	----------	------	95,357	1,300	30.5
1938	1,691,762	23,545	31.2	1,625,131	22,649	31.2	----------	----------	------	66,631	896	30.1
1939	2,644,704	36,640	31.0	2,546,216	35,322	31.1	----------	----------	------	98,488	1,318	30.0
1940	2,758,897	38,674	31.4	2,583,327	36,741	31.9	63,282	348	12.3	112,288	1,585	31.6
1941	3,388,139	44,854	29.7	3,188,713	42,860	30.1	87,836	457	11.7	111,590	1,537	30.9
1942	2,559,169	28,522	25.0	2,428,634	27,538	25.4	82,013	434	11.9	48,522	550	25.4
1943	2,077,102	21,726	23.4	1,684,807	19,386	25.8	327,713	1,787	12.2	64,582	553	19.2
1944	2,503,802	24,968	22.3	1,779,117	20,874	26.3	644,958	3,404	11.8	79,727	690	19.4
1945	2,656,335	26,080	22.0	1,709,412	20,762	27.2	859,636	4,598	12.0	87,287	720	18.5
1946	2,675,910	26,127	21.9	1,716,591	20,770	27.1	882,537	4,702	11.9	76,782	655	19.1
1947	3,731,348	30,980	18.6	1,872,152	22,159	26.5	1,734,535	7,981	10.3	124,661	840	15.1
1948	3,914,323	31,503	18.0	1,848,373	22,028	26.7	1,918,708	8,518	9.9	147,242	957	14.6
1949	3,863,801	29,617	17.2	1,648,001	19,613	26.7	2,030,567	8,814	9.7	185,233	1,190	14.4
1950	4,767,274	35,380	16.6	1,845,009	21,875	26.6	2,693,777	12,110	10.1	228,488	1,395	13.7
1951	4,591431	30,522	14.9	1,557,006	17,789	25.6	2,832,044	11,595	9.2	202,381	1,138	12.6
	Total terneplate			Short ternes			Long ternes			Terneplate waste—waste		
1935	218,586	1,064	10.9	104,596	644	13.8	113,990	420	8.3	----------	------	------
1936	265,585	1,312	11.1	140,319	872	13.9	125,266	440	7.9	----------	------	------
1937	292,478	1,397	10.7	162,724	924	12.7	129,754	473	8.2	----------	------	------
1938	207,888	1,007	10.9	129,139	739	12.8	78,749	268	7.6	----------	------	------
1939	286,876	1,454	11.4	181,959	1,009	12.4	104,917	445	9.5	----------	------	------
1940	317,108	1,513	10.7	167,321	933	12.5	149,787	580	8.7	----------	------	------
1941	568,957	2,046	8.1	267,675	1,157	9.7	292,301	852	6.5	8,981	37	9.2
1942	307,356	882	6.4	174,366	512	6.6	128,135	356	6.2	4,855	14	6.5
1943	225,327	434	4.3	118,033	225	4.3	105,334	203	4.3	1,960	6	6.9
1944	367,297	740	4.5	177,681	413	5.2	184,757	317	3.8	4,859	10	4.6
1945	371,447	741	4.5	193,586	447	5.2	170,442	281	3.7	7,419	13	3.9
1946	215,754	446	4.6	69,861	178	5.7	142,917	262	4.1	2,976	6	4.5
1947	240,299	501	4.7	92,683	221	5.3	142,818	270	4.2	4,798	10	4.7
1948	324,088	672	4.6	181,141	388	4.8	137,045	272	4.4	5,902	12	4.6
1949	239,641	626	5.9	81,682	177	4.9	150,143	435	6.5	7,816	14	4.0
1950	274,963	952	7.8	60,952	188	6.9	209,223	753	8.1	4,788	11	5.1
1951	273,244	767	6.3	52,614	201	8.6	216,069	555	5.8	4,561	11	5.1

STOCKS

Stocks of pig tin and tin in ore were 14 percent lower at the end of 1951 than at the beginning of the year. Tin in process, in scrap, and as secondary tin totaled about 10,720 tons (11,150 at beginning of year). Industrial stocks of primary tin were reduced 50 percent, with 56 percent of the total plant stock held by tin platers. Industrial plant stocks of pig tin at the end of 1951 were the lowest since the end of 1935. RFC stocks of tin metal were 18,618 tons comprising undelivered balances of industrial sales contracts, including 390 tons at beginning of the year compared with 6,753 at the year's

close; stocks of concentrates contained 15,068 tons of tin at the beginning of the year and 10,771 at the close; ores afloat or in foreign ports at the beginning of 1951 contained 5,606 tons and at the end of the year 1,107 tons.

TABLE 9.—Stocks of virgin pig tin in the United States, Dec. 31, 1946–51, in long tons [1]

	1946	1947	1948	1949	1950	1951
At consumers' plants	14,532	13,677	14,349	13,771	20,576	10,043
At other warehouses and in transit	1,000	940	328	61	1,355	971
Held by jobbers	124	157	100	292	384	82
Total consumers' stocks	15,656	14,774	14,777	14,124	22,315	11,096
Afloat to United States (estimated)	1,570	6,220	25	8,500	3,500	895
Total stocks [1]	17,226	20,994	14,802	22,624	25,815	11,991

[1] Excludes Government purchases delivered for stockpiling or at Texas City smelter. Also excludes tin in process and secondary pig tin.

PRICES

The average price of Straits tin in New York in 1951 was $1.28308 a pound, the highest on record. The peak monthly average was $1.8268 in February. At the beginning of the year the quotation stood at $1.50 a pound, having dropped 1 cent over the New Year holidays. However, unfavorable Korean news and the general feeling of uncertainty brought on a steady advance until January 25, when the highest price recorded in the regular New York market reached $1.84 a pound. On January 26, 1951, the Office of Price Stabilization issued a General Ceiling Price Regulation which established ceilings based upon prices that had been in effect from December 19, 1950, to January 25, 1951, inclusive.

On February 1, sales for spot and prompt delivery in the New York open market were reported at $1.825 a pound, establishing the market. Ceiling prices were maintained at $1.835 a pound under GCPR. On February 13 the price was advanced to $1.83 a pound. This price advance added confusion to the price structure on a world marketing basis. Following the GSA announcement on March 6 halting all tin purchases for the National Stockpile, New York prices dropped sharply.

The Sixth Report of the Preparedness Subcommittee of the Committee on Armed Services, United States Senate, Document 13, Tin 1951, dated February 12 and released March 5, 1951, criticized tin production and marketing policies. The committee recommended that the United States halt purchases of tin until prices returned to a lower level, that one Government agency become sole purchaser for account of American consumers, and that NPA impose much more stringent tin-conservation measures than were in effect.

On March 6 the General Services Administration announced that all new purchases of tin for the National Stockpile would be suspended immediately; purchase of tin by the Government for industrial use would be held to the barest minimum, and authority was redelegated to the RFC for the purchase and resale of tin. On March 12 the National Production Authority designated RFC as the sole importer of tin in the country. (On November 8 the Defense Production Administration announced that further stockpiling of tin was to

be discontinued at once and all tin purchased would be made available for industrial consumption, pursuant to allocations. The announcement said the step was taken because of the inability to obtain foreign tin at "a fair and reasonable price.")

From March 14 to 28 an International Tin Conference in Washington considered a long-term stabilization market program on pricing and distribution. Delegates from the United States, United Kingdom, British Colonial Territories, Belgium, the Netherlands, and Indonesia participated. The conference adjourned without reaching an agreement.

On March 12, when RFC became sole importer, the price was nominal at $1.34 a pound, the last open-market quotation. The RFC price on March 13 was $1.34. Thereafter, in line with its established policy of bringing about a more reasonable price, 12 changes were made, mostly below the going world price established in Singapore. By August 1 the RFC price had been established at $1.03 per pound, at which level it remained for the rest of 1951. (The RFC price was $1.03 from June 1, 1948 to September 28, 1949).

"Tin-metal, ore concentrates, powder, and scrap alloys" were excepted from Ceiling Price Regulation 31—Imports, which became effective May 9, 1951, because it was covered by a United States Government purchase program.

TABLE 10.—Monthly price of Straits tin for prompt delivery in New York, 1950–51, in cents per pound [1]

Month	1950			1951		
	High	Low	Average	High	Low	Average
January	77.50	74.25	75.917	[2] 184.00	150.00	171.716
February	74.50	74.125	74.354	183.00	181.50	182.681
March	77.75	74.375	75.745	[3] 181.75	134.00	145.464
April	77.625	74.25	76.447	150.50	142.00	145.827
May	78.50	76.50	77.500	142.00	139.00	139.955
June	78.75	76.375	77.699	136.00	106.00	118.048
July	97.50	79.25	89.881	106.00	106.00	106.00
August	107.75	97.50	102.054	103.00	103.00	103.00
September	104.00	95.50	101.287	103.00	103.00	103.00
October	126.00	104.00	113.351	103.00	103.00	103.00
November	[4] 163.50	127.50	137.675	103.00	103.00	103.00
December	155.00	136.00	144.775	103.00	103.00	103.00
Year	163.50	74.125	95.557	184.00	103.00	128.308

[1] Compiled from quotations published in the American Metal Market.
[2] Highest price recorded in regular market was $1.84 on Jan. 25, 1951, with a reaction to $1.83 at close of market on that day.
[3] RFC became sole procurer of tin in the United States on Mar. 12, 1951.
[4] 1 small lot reported sold in the forenoon of Nov. 8, at $1.6350 with reaction at the close to $1.55.

London and Singapore were the only free tin markets in 1951. The average London price for standard tin was £1,079.6 a long ton in 1951. The monthly average price fluctuated from the high of £1,470.3 in February to the low of £880.7 in August 1951, as it slowly followed the United States price downward. When the market year opened on January 2, 1951, this price was £1,130. By January 24 it had reached £1,235. The price-freezing order of January encouraged a sharp upward movement, and on February 14 tin changed hands at the record price of £1,615 per ton ($2.01875 per pound, equivalent New York price). The price thereafter gradually declined to £805 on August 2 (the lowest of the year) from which it recovered, despite lack of buying by the United States, to £1,030 in October. Monthly

prices averaged £966.2 (equivalent of $1.2078 per pound) during the last 4 months of 1951. At the close of 1951, the price was £905. English tin was under a voluntary embargo for export by members of the London Metal Exchange.

The Singapore market price for Straits ex works averaged £1,040.3 for 1951. The monthly average price reached the all-time peak of £1,451.6 in February. The quotation on February 14 was £1,547.5 ($1.93 a pound), the highest recorded. On March 13 (the day after RFC took over) the price was £1,116 (or the New York equivalent of $1.44 a pound). Between June 8 and August 1 Singapore prices were more or less the equivalent of RFC prices. The lowest monthly Singapore average was £830.3 ($1.0378 per pound U. S.) for July. The lowest price for the year was £790⅞ on August 7, following the Bank holiday observance, with sales at good volume. Average prices increased in September and October but settled down in November and December. On December 31, 1951, the price was £866.5.

FOREIGN TRADE [2]

Imports of tin concentrates and exports of tin plate were the principal items of foreign trade of the United States during the year. Pig tin, which had dominated the import field before World War II and since 1947, gave way both in quantity and value to tin concentrates. Of less importance has been foreign trade in tin-plate and terneplate scrap, circles, strips, waste-waste, miscellaneous tin and manufactures, and compounds. Imports of tin-plate scrap were 51,571 long tons in 1951 against 42,394 in 1950. In 1951 exports of tin-plate scrap were 810 long tons (562 in 1950), mostly to Mexico and Japan. Exports of tin cans were 33,171 long tons in 1951 compared with 28,946 tons in 1950.

Imports of metallic tin in 1951 were 66 percent less than in 1950, mainly because no Malayan tin was shipped to the United States after March. Of the total, 45 percent came from the Netherlands, 25 percent from Malaya, 23 percent from Belgium and the Belgian Congo, and the remainder from other sources. Receipts of ore, in terms of metal, were 14 percent greater than in 1950, principally due to substantial gain in imports from Indonesia. Bolivia was the main source of tin ore, accounting for 44 percent of the total, but furnished only 13,082 tons in 1951 (9 percent less than in 1950). Bolivia was the source of two-thirds of the tin in ores imported from 1941 to 1951, inclusive. Imports from Bolivia in 1951 were the smallest for any year since the tin smelter was put into operation at Texas City, Tex., in 1942.

Exports of metallic tin in 1951 were 1,513 long tons (the highest since 1943), with Canada as the destination of nearly 90 percent. Tin exports were under export license control.

The major tin-export item of the United States, as usual, was tin-plate (including terneplate), which increased 13 percent in 1951. Gains were made in the export markets of Latin America (most Argentina and Brazil), Australia-New Zealand, and Asia (mostly

[2] Figures on imports and exports compiled by M. B. Price and E. D. Page of the Bureau of Mines, from records of the U. S. Department of Commerce.

India). Exports to European countries decreased 6 percent. Shipments to Africa decreased about 3 percent despite the increase in tonnage to the Union of South Africa.

Exports of hot-dipped tin plate totaled 270,327 long tons, valued at $64,009,163 in 1951. Principal countries of destination were Australia (41,857 tons), Argentina (32,527 tons), Brazil (30,521 tons), Netherlands (28,989 tons) Union of South Africa (17,157 tons), and Italy (15,871 tons). Exports of electrolytic tin plate, totaling 209,762 long tons, valued at $45,781,174, were shipped to 60 countries, the leading ones being Brazil, Union of South Africa, Netherlands, Australia, and Argentina. Most of the terneplate exported went to Canada in 1951.

According to the American Iron and Steel Institute, producers in 1951 shipped for export 581,703 short tons (490,230 in 1950) of tin plate, of which 346,231 tons (392,651) was hot-dip and 235,472 (97,579) electrolytic.

TABLE 11.—Foreign trade of the United States in tin concentrates and tin, 1947–51

[U. S. Department of Commerce]

Year	Imports				Exports			
	Concentrates (tin content)		Bars, blocks, pigs, grain, or granulated		Ingots, pigs, bars, etc.			
					Domestic		Foreign	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
1947	29,410	$43,220,686	24,899	$42,684,651	415	$650,162	5	$9,887
1948	37,492	72,170,372	49,196	103,322,952	78	163,428	13	27,699
1949	38,311	78,175,836	60,224	133,707,223	76	176,795	78	145,370
1950	25,960	47,163,305	[1] 82,838	[1] 152,952,294	287	594,587	512	990,000
1951	29,618	82,434,443	27,784	73,285,021	264	762,662	1,249	3,978,852

[1] Revised figure.

TABLE 12.—Tin concentrates (tin content) imported for consumption in the United States, 1950–51, by countries

[U. S. Department of Commerce]

Country	1950		1951	
	Long tons	Value	Long tons	Value
Belgian Congo	1,526	$2,932,088	1,585	$4,613,270
Bolivia	14,419	25,912,116	13,082	35,374,838
Brazil			2	2,496
Burma	209	310,850		
China	63	110,336	1	5,307
Egypt			11	16,794
Indochina			14	22,988
Indonesia	6,925	12,905,101	11,684	33,136,082
Japan	147	183,933		
Malaya	26	51,201		
Mexico	118	227,405	106	270,597
Portugal	70	111,129	19	37,515
Thailand	2,457	4,419,146	3,114	8,954,256
Total	25,960	47,163,305	29,618	82,434,443

TABLE 13.—Tin [1] imported for consumption in the United States, 1950–51, by countries

[U. S. Department of Commerce]

Country	1950		1951	
	Long tons	Value	Long tons	Value
Belgian Congo	1,506	$2,600,907	915	$2,625,763
Belgium-Luxembourg	8,137	16,379,673	5,376	15,863,466
Bolivia	183	407,800	20	55,391
China	1,665	2,742,207	55	150,564
Germany	162	314,910	49	197,863
Japan	542	851,486		
Malaya	[2] 54,019	[2] 98,147,101	6,986	21,610,927
Mexico			[3]	449
Netherlands	[2] 7,667	[2] 13,871,823	12,506	26,952,576
Portugal	1	1,059		
Thailand	500	950,518	46	185,178
United Kingdom	[2] 8,456	[2] 16,684,810	1,831	5,642,844
Total	[2] 82,838	[2] 152,952,294	27,784	73,285,021

[1] Bars, blocks, pigs, grain, or granulated.
[2] Revised figure.
[3] Less than 0.5 ton.

TABLE 14.—Foreign trade of the United States in tin plate, taggers tin, and terneplate in various forms, 1947–51, in long tons

[U. S. Department of Commerce]

Year	Tin plate, taggers tin, and terneplate		Tin plate circles, strips, cobbles, etc. (exports)	Waste-waste tin plate (exports)	Terneplate clippings and scrap (exports)	Tin plate scrap	
	Imports	Exports				Imports	Exports
1947	585	553,748	5,340	21,209	9	30,797	54
1948	184	548,021	3,247	28,121	278	41,084	
1949	12,218	498,371	3,018	41,865	227	41,028	
1950	3,829	[1] 442,851	[1] 6,981	[1] 54,622	144	42,394	562
1951	398	498,808	12,995	55,955	144	51,571	810

[1] Revised figure.

TABLE 15.—Tin plate, and terneplate (including long ternes) exported from the United States, 1950–51, by country of destination

[U. S. Department of Commerce]

Destination	1950		1951	
	Long tons	Value	Long tons	Value
Algeria	2,013	$399,271	87	$19,394
Argentina	19,532	4,229,394	47,764	13,053,455
Australia	52,260	9,906,750	59,043	12,938,808
Austria	1,213	202,091	1,102	295,902
Belgium-Luxembourg	15,246	2,731,309	16,021	3,480,383
Brazil	44,359	8,414,306	66,166	15,632,756
British East Africa	1,613	262,385	931	201,111
Canada	7,070	1,680,421	7,493	1,218,577
Chile	1,302	246,823	1,578	403,294
China	1,343	249,792		
Colombia	6,090	1,140,256	4,901	1,458,016
Cuba	18,074	3,340,109	19,624	4,429,628
Denmark	17,344	3,175,829	14,980	3,132,776
Egypt	1,323	208,342	2,219	440,518
Finland	905	148,097	1,035	221,514
French Morocco	11,146	2,194,399	9,131	2,041,115
Greece	5,740	965,149	3,442	678,216
Hong Kong	[1] 2,194	[1] 262,931	17	3,253
India	4,027	673,253	11,937	2,541,445
Indonesia	[1] 3,432	[1] 697,933	3,683	888,879

For footnote, see end of table.

TABLE 15.—Tin plate, and terneplate (including long ternes) exported from the United States, 1950–51, by country of destination—Continued

Destination	1950		1951	
	Long tons	Value	Long tons	Value
Ireland	828	$142, 648	2, 441	$376, 443
Israel	2, 670	450, 322	2, 128	461, 323
Italy	26, 838	4, 896, 252	18, 973	4, 780. 455
Japan	365	74. 934	1, 446	370, 195
Lebanon	1, 782	310. 731	334	57, 090
Malaya	[1] 1, 819	[1] 249, 947	5, 417	1, 159. 224
Mexico	12, 920	2, 276. 674	20, 248	4, 176, 599
Netherlands	54, 110	10. 368, 561	47, 276	10, 501, 692
New Zealand	1, 140	203, 730	3, 586	763, 438
Norway	17, 562	3, 047, 558	13, 256	2, 694, 729
Pakistan	1, 475	234, 546	2, 007	442, 621
Peru	2, 842	562, 936	3, 688	826, 528
Philippines	11, 888	1, 959, 570	9, 963	2, 129, 018
Portugal	2, 088	400, 511	12, 715	3, 119. 373
Sweden	11, 283	2, 057, 282	15, 472	3, 238. 861
Switzerland	9, 515	1, 761, 626	7, 364	1, 627, 389
Taiwan	560	116, 303	1, 987	467, 979
Thailand	2, 954	429, 649	734	152, 410
Turkey	6, 927	1, 204, 687	3, 505	637, 425
Union of South Africa	35, 470	6, 312. 726	37, 826	8, 064, 919
Uruguay	7, 493	1, 413, 649	5. 714	1, 390, 567
Venezuela	1, 953	378, 598	3, 720	916, 270
Yugoslavia	3, 079	598, 676	2, 192	452, 982
Other countries	9, 034	1, 731, 000	5, 662	1, 346, 223
Total	[1] 442, 851	[1] 81, 741, 856	498, 808	113, 562, 793

[1] Revised figure.

TABLE 16.—Foreign trade of the United States in miscellaneous tin, tin manufactures, and tin compounds, 1947–51

[U. S. Department of Commerce]

Year	Miscellaneous tin and manufactures						Tin compounds	
	Imports			Exports				
	Tin foil, tin powder, flitters, metallics, tin and tin plate manufactures, n. s. p. f. (value)	Dross, skimmings, scrap, residues, and tin alloys, n. s. p. f.		Tin cans, finished or unfinished		Tin scrap and other tin bearing material except tin plate scrap (value)	Imports (pounds)	Exports (pounds)
		Pounds	Value	Long tons	Value			
1947	$162, 187	233, 932	$27. 334	26, 061	$8. 160, 356	$829, 386	30, 760	[1]
1948	119, 287	1, 679, 331	659, 450	36, 450	11, 208, 859	1, 681, 402	10, 917	[1]
1949	189, 564	1, 163, 875	424, 908	31, 087	10, 263, 790	2, 245, 217	980	41, 004
1950	215, 484	6, 293, 459	2, 146. 310	28, 946	10, 448, 917	869, 404	75, 825	122, 716
1951	365, 741	2, 566, 000	1, 897, 991	33, 171	14, 048, 409	2, 403, 354	102, 212	136, 179

[1] Not separately classified.

TECHNOLOGY

The Tin Research Institute [3] opened its new laboratories near London on May 31, 1951. Advantage was taken of the new laboratory extensions to begin investigations into the testing of alloys in the form of actual bearings and the casting of bronze in the form of long bars. Chief interest was centered on pilot-stage work on electro-

[3] Information concerning the institute's work and publications can be obtained in the United States from Tin Research Institute, Inc., 429 West 6th Ave., Columbus, Ohio.

deposited tin-alloy coatings. The institute released for publication several technical reports on varied subjects relating to tin and its industrial application. These releases included a paper summarizing the electrode position and corrosion resistance of a new tin-nickel alloy. The coating consists of 2 parts of tin and 1 part of nickel. It has a beautiful metallic luster with a faint rose-pink color, is hard, is as untarnishable as chromium, and can be deposited bright in one operation.

Rapid tinning of small aluminum and aluminum alloys was reported possible by use of an ultrasonic soldering bath. The ultrasonic transducer, which forms the basis of the soldering bath, makes use of the phenomenon known as magnetostriction, which is connected with the small dimensional changes that occur in ferromagnetic materials when they are placed in a magnetic field.[4]

A new tin-plate coating-thickness gage was put into operation. Adaptable to measuring tin-coating thicknesses for different kinds of cans, this new gage takes advantage of two instruments, the X-ray and the Geiger counter. It is capable of measuring thicknesses with a margin of error less than six ten-millionths of an inch. Completion of a new continuous annealing line at the Gary sheet and tin mill was announced. With 3,000 feet of sheet or strip in continuous process, this ingenious line is capable of giving a "universal temper" to about 136,000 net tons of material each year for can manufacturers.[5]

A high-temperature calorimeter designed for use up to 1,500° K. was described and the theory of operation presented. This calorimeter was used in 1951 to measure the heats of formation of sodium-tin alloys.[6]

"Improved Aluminum Bearings (Aluminum-Tin and Aluminum-Tin-Copper Alloys)" was the title of a paper. These alloys were reported to have a low coefficient of friction at high bearing loads and good resistance to seizing.[7]

The Reynolds Metals Co. developed a number of different types of packages which use aluminum to conserve tin and also the steel required when tin cans are used. In some of these packages, aluminum alone is used. In others, aluminum is combined with paper, wax, plastic, or fiber material to provide the kind of protection desired. Essentially the body of the can is made by winding a strip of aluminum foil into two or more layers, giving a total metal thickness sufficient for the structural requirements in the can wall.[8]

The first detinning plant ever built as a steel-company facility commenced regular operation at the Weirton Steel Co. division of the National Steel Corp. The plant was installed to conserve the company stock of tin and also to recover scrap from the tin mills which

[4] Chemical Age (London), vol. 65, No. 1669, July 7, 1951, p. 30.
[5] American Metal Market, Technological Advances in 1951: Jan. 5, 1952.
[6] Journal of Metals, vol. 4, No. 1, January 1952, pp. 33–38.
[7] Metal Progress, vol. 60, No. 4, October 1951, pp. 97–103.
[8] Steel, vol. 129, No. 19, Nov. 5, 1951, pp. 97–98.

formerly could not be used in open-hearth operations, because the coating is a contaminant. Annual capacity of the detinning plant is rated at 300,000 pounds of pig tin and 30,000 tons of bundled scrap. There is an additional recovery of tin through processing of sludge that accumulates in the plating cells of the company high-speed electrolytic lines.

Research by the Bureau of Mines on the refining of copper-tin byproduct alloy formed during operation of the United States Atomic Energy Commission Hanford plant at Richland, Wash., resulted in construction and operation of an electrolytic tin refinery by the Bureau of Mines at Albany, Oreg. A plant was designed to produce 1,000 pounds of pure tin per day at maximum capacity, and limited operations were begun on October 8, 1951.

Plant operations consisted of melting the crude alloy in a gas-fired crucible furnace and removing a high-uranium dross. The melted alloy was then cast into 300-pound anodes, which were placed in steel electrolytic cells containing an electrolyte composed of caustic soda, sulphur, and salt. Steel-cathode starting sheets were placed between the anodes to collect a pure metallic tin deposit. Periodically, the deposit was removed from the cathodes, remelted, and cast into 50-pound tin ingots.

WORLD REVIEW

INTERNATIONAL TIN STUDY GROUP

Representatives of eight major tin producing and consuming countries met in London in October 1946 and agreed that a study group should be established; in consequence, the International Tin Study Group was organized at a meeting in Brussels in April 1947. A brief report on the meetings held by the Study Group through 1951 has been published.[9] Regarding the 1951 meeting the following was given:

The sixth meeting of the Study Group was held in Rome in September 1951. The meeting discussed the problem of international cooperation, both long term and short term. The discussion also covered prices (including the question of non-discrimination in prices), restrictions on the consumption of tin and the future functions and work of the Study Group. Mine production for 1951 was estimated at 168,000 long tons against a commercial consumption of 147,000 tons.

Membership of the Study Group is confined to governments. The present membership is:

Australia, Belgium, Bolivia, British Colonial and Dependent Territories, Canada, China, France, India, Indonesia, Italy, Netherlands, Thailand, United Kingdom, United States of America.

The Management Committee of the Group supervises the work of the Secretariat and consists of:

Belgium, Bolivia, British Colonial and Dependent Territories, France, Indonesia, United Kingdom and United States of America.

(*See* Minerals Yearbook, 1950, pages 1220 and 1221, for reports on the first five meetings.)

[9] International Tin Study Group, Statistical Bulletin: Vol. 5, No. 1, January 1952, inside cover page.

WORLD MINE PRODUCTION

TABLE 17.—World mine production of tin (content of ore), 1941–45 (average) and 1946–51, by countries, in long tons

[Compiled by Berenice B. Mitchell]

Country	1941–45 (average)	1946	1947	1948	1949	1950	1951
North America:							
Canada	308	390	319	309	276	[1] 356	155
Mexico	299	262	[1] 171	182	358	[1] 440	366
United States	15	----	1	5	68	94	88
Total North America	622	652	[1] 491	496	702	[1] 890	609
South America:							
Argentina	990	600	522	273	268	[1] 267	242
Bolivia (exports)	40,644	37,619	33,266	37,336	34,115	31,213	33,132
Brazil	90	269	295	570	325	[1] 180	[2] 200
Peru [3]	66	31	51	64	[1] 51	[1] 38	86
Total South America	41,790	38,519	34,134	38,243	[1] 34,759	[1] 31,698	33,660
Europe:							
France	3	10	43	[1] 76	73	[1] 117	[2] 170
Germany, East	562	----	----	----	[2] 120	[2] 120	[2] 120
Italy	133	[1] 100	50	----	----	----	----
Portugal [4]	1,152	352	361	706	785	690	902
Spain	407	921	303	261	666	[2] 575	[2] 716
United Kingdom [5]	1,334	793	898	1,281	[1] 1,217	[1] [2] 1,230	[2] 1,210
Total Europe [6]	3,591	[1] 2,176	[1] 1,655	[1] 2,324	[1] 2,861	[1] 2,732	[2] 3,118
Africa:							
Belgian Congo [7]	16,765	[1] 14,095	[1] 14,369	13,539	13,760	[1] 13,464	13,669
French Cameroon	193	111	119	102	73	67	72
French Morocco	12	9	----	----	----	----	13
French West Africa	----	1	4	----	26	51	65
Mozambique	6	2	1	1	[1] 1	[1] 1	8
Nigeria	12,275	10,333	9,133	9,237	8,824	8,258	8,555
Northern Rhodesia	8	6	1	----	7	4	2
Southern Rhodesia	164	100	122	105	70	65	40
South-West Africa	138	177	146	111	123	100	76
Swaziland	96	37	[1] 22	20	32	37	32
Tanganyika (exports)	170	128	92	97	[1] 109	[1] 97	67
Uganda (exports)	275	[1] 202	154	190	128	[1] 192	118
Union of South Africa	500	487	483	457	471	[1] 643	746
Total Africa	30,602	[1] 25,688	[1] 24,646	23,859	[1] 23,624	[1] 22,979	23,463
Asia:							
Burma	1,480	342	1,792	1,147	1,781	[1] 1,520	1,624
China	[1] 6,282	[1] [2] 2,953	[1] 3,907	[1] 5,850	[1] [2] 3,937	[1] [2] 6,890	[2] 6,890
Indochina	675	----	----	30	40	62	92
Indonesia	17,326	6,419	15,915	30,562	28,965	[1] 32,102	30,986
Japan	1,122	57	[1] 106	118	190	326	426
Malaya	26,442	8,432	27,026	44,815	54,910	57,537	57,167
Thailand	6,914	1,056	1,401	4,240	[1] 7,815	10,364	9,502
Total Asia	60,241	[1] 19,259	[1] 50,147	[1] 86,762	[1] 97,638	[1] 108,801	106,687
Oceania: Australia	2,778	[1] 2,141	[1] 2,456	[1] 1,885	[1] 1,882	[1] 1,855	1,577
World total [6]	139,600	[1] 88,500	[1] 113,500	[1] 153,600	[1] 161,500	[1] 169,000	169.100

[1] Revised.
[2] Estimated by chapter authors or in a few instances from the Statistical Bulletin of the Internationa Tin Study Group, The Hague.
[3] Minor constituent of other base metal ores.
[4] Excluding mixed concentrates.
[5] Intake by smelters.
[6] Excluding production of U. S. S. R.
[7] Including Ruanda-Urundi.

WORLD SMELTER PRODUCTION

TABLE 18.—World smelter production of tin, 1941–45 (average) and 1946–51, by countries, in long tons

[Compiled by Berenice B. Mitchell]

Country	1941–45 (average)	1946	1947	1948	1949	1950	1951
Argentina	632	837	433	254	235	[1] 253	206
Australia	2,809	2,225	2,371	1,885	1,955	2,013	1,459
Belgian Congo	11,054	[1] 3,533	[1] 3,076	3,875	3,247	3,238	3,011
Belgium	----------	1,405	12,059	10,469	8,996	9,512	8,360
Bolivia (exports)	----------	----------	[1] 22	[1] 105	405	393	39
Brazil	80	178	220	185	157	[1] 118	[2] 180
Canada	308	390	319	308	276	356	155
China	[1] 6,282	[1 2] 2,953	3,907	[1] 5,850	[1 3] 3,937	[1 2] 6,890	[2] 6,890
Germany, West	717	----------	----------	26	[2] 120	[1 2] 375	[2 3] 600
Indochina	200	----------	----------	32	3	----------	----------
Indonesia	9,983	----------	----------	136	126	----------	----------
Italy	63	75	46	----------	----------	----------	----------
Japan	1,886	[1] 151	[1] 36	[1] 53	290	[1] 389	579
Malaya	35,355	11,523	29,318	49,707	62,737	68,747	65,914
Mexico	263	263	172	181	358	290	366
Netherlands	----------	945	8,981	16,402	19,247	21,027	20,977
Peru [4]	55	2	51	64	51	38	86
Portugal	1,542	[1] 187	373	282	218	[1] 209	[2] 240
Southern Rhodesia	57	80	121	127	75	80	63
Spain	386	1,440	704	483	803	[1] 1,597	945
Thailand	1,508	389	141	----------	----------	2	----------
Union of South Africa	745	858	601	554	595	[1] 718	829
United Kingdom	32,998	29,121	28,083	[5] 31,002	[5] 28,384	[1 2 5] 28,750	[2 5] 27,900
United States [6]	22,172	43,500	33,300	36.703	35,834	33,118	31,852
Total (estimate)	129,100	[1] 100,100	124,300	[1] 158,700	[1] 168,000	[1] 178,100	170,700

[1] Revised.
[2] Estimated by chapter authors or in a few instances from Statistical Bulletin of the International Tin Study Group, The Hague.
[3] Unofficial reports state production of 316 long tons in East Germany.
[4] Tin content of dross.
[5] Beginning January 1948, includes production from imported scrap and residues refined on toll.
[6] Includes tin content of ores used direct to make alloys.

WORLD CONSUMPTION

TABLE 19.—World consumption of tin, 1936–51, by countries, in long tons [1]

Country	1936	1937	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951
Argentina	1,365	1,097	1,117	1,509	1,499	1,719	1,086	570	659	633	1,172	1,309	1,912	434	1,200	1,200
Australia and New Zealand	2,212	2,519	2,444	2,449	2,996	3,679	3,030	2,762	2,479	2,613	2,167	2,946	2,704	2,536	2,382	2,972
Belgium-Luxembourg [3]	1,836	1,027	1,850	225	1,550	150	150	39	13	2,245	1,037	2,014	1,707	986	1,363	1,770
Brazil	849	922	682	1,260	901	1,589	653	370	468	544	1,021	1,080	1,488	1,104	1,542	1,200
Canada [3]	2,164	2,235	2,058	2,488	3,454	5,746	3,188	2,558	3,021	3,668	3,707	3,628	4,046	4,317	4,526	4,731
Czechoslovakia	1,685	1,732	1,561	253	365	3	------	------	------	------	139	1,505	1,610	1,030	1,000	1,800
Denmark	687	538	493	846	425	69	65	19	54	226	651	552	488	226	720	720
Finland	257	294	330	303	218	42	115	65	41	15	352	206	202	349	240	240
France	9,721	9,175	7,600	8,400	4,350	1,500	900	250	150	3,500	5,600	7,400	7,900	7,200	7,400	7,500
Germany	8,512	13,235	15,033	10,800	7,600	3,900	5,700	3,700	4,100	------	------	896	1,844	3,950	5,400	7,200
India	2,493	2,833	2,652	3,524	2,772	4,203	1,800	1,500	2,400	2,900	3,787	5,048	4,839	5,539	4,718	3,772
Italy	3,929	3,599	4,635	3,694	3,940	1,579	1,892	1,500	500	100	500	1,980	3,725	2,500	3,000	3,600
Japan [3]	6,370	10,000	10,000	10,000	10,000	7,860	7,860	7,860	7,860	7,860	1,729	1,632	1,729	1,800	2,700	2,700
Netherlands [3]	1,619	2,860	1,865	1,513	600	250	150	134	---------	3,004	1,454	3,203	3,331	3,277	3,029	1,970
Poland	1,322	1,271	1,819	1,164	300	200	100	------	------	[2]	[2]	1,138	2,117	1,767	1,200	1,500
Spain	661	977	1,200	854	1,066	788	114	406	577	801	1,436	500	500	474	540	660
Sweden	1,672	1,770	1,600	1,710	1,280	1,200	510	300	240	350	550	1,010	1,250	1,000	1,020	1,020
Switzerland	1,109	1,100	1,259	1,101	1,360	306	242	117	62	59	920	875	805	375	610	840
Turkey	433	583	627	266	790	515	163	94	403	885	199	350	742	638	1,093	720
United Kingdom [3]	21,860	25,971	18,290	27,279	29,225	30,000	23,478	17,631	18,435	16,396	26,598	27,384	25,241	20,823	23,254	23,892
U. S. S. R.	9,664	25,125	16,174	2,124	1,897	[2]	9,193	11,990	1,200	[2]	[2]	[2]	[2]	[2]	[2]	[2]
United States [3]	68,232	72,928	48,116	66,583	72,324	103,086	56,288	46,253	59,156	55,642	54,627	59,166	59,863	47,163	71,191	56,884
Others	7,848	7,709	7,095	6,155	6,988	5,716	4,516	2,882	3,082	3,559	4,768	7,178	6,957	8,512	7,872	8,109
World total	156,500	189,500	148,500	154,500	156,000	174,000	121,000	101,000	105,000	105,000	112,000	131,000	135,000	116,000	146,000	135,000

[1] Statistical Bulletins of the International Tin Study Group.
[2] Data not available; no estimate included in total.
[3] Reported real consumption; for all other countries figures represent apparent consumption.

REVIEW BY COUNTRIES

Australia.—Production of tin in concentrates as reported totaled 1,577 long tons in 1951, a 15-percent decrease from 1950. Domestic smelter production amounted to 1,459 tons, a 28-percent decrease. The Electrochemical Metal Refining Co. Pty., Ltd., of Sydney recovered 28 tons at its detinning plant during the year. In Queensland dredging results of the largest alluvial producer in the Herberton field, Tableland Tin Dredging N. L., were disappointing.

Belgian Congo.—The year 1951 was one of great activity in the Belgian Congo, with promise of production expansion in the future. Production of tin in concentrates was 13,669 long tons compared with 13,464 (revised) in 1950. Belgian Congo, including Ruanda-Urundi, contributed 58 percent of Africa's 1951 total tin production. Tin contained in exports of concentrates totaled 9,942 long tons, of which the United States received 1,630 long tons and Belgium 8,252 long tons. Exports of metal from Belgian Congo were 2,670 long tons, of which the United States received 640 long tons and Belgium 1,962 long tons. Stocks of tin metal increased from 13 tons at the beginning of 1951 to 44 at the end. Stocks of tin in concentrates increased from 673 tons at the beginning of 1951 to 1,099 tons at the end.

An outstanding development has been the disclosure by Géomines of a huge bed of cassiterite under its Manono cassiterite opencast in Northern Katanga. The borings made have shown the existence of such huge reserves that the company stopped the boreholes after they had reached a depth of 125 metres, and had continued to show cassiterite throughout. With the tonnage already revealed, Géomines has probably the biggest tin ore reserves in the world and is assured of supplies for several decades at least. Following on these discoveries, the company decided to enlarge its capital from Fcs. B. 200,000,000 to Fcs. B. 700,000,000, so as to be enabled to work this proposition adequately. The exploitation of these deposits will be carried out in a way not to upset the tin market.[10]

Bolivia.—Bolivia exported 6 percent more tin in concentrates in 1951 than in 1950. Total tin contained in exports of concentrates in 1951 was 33,132 long tons. Nearly 51 percent was consigned to the United States and approximately 49 percent to the United Kingdom, leaving about 100 tons for delivery to Chile and Argentina. There were no great changes in the relative export shares of the several mine groups. That of Patino Mines increased from 44 percent in 1950 to 45 percent in 1951. Hochschild decreased from 23 percent in 1950 to 20 percent in 1951. Aramayo increased from 7 percent in 1950 to 8 percent in 1951. Exports of metal from the Oruro smelter were 39 tons in 1951.

The 1950 Bolivian contract with the Reconstruction Finance Corporation expired December 31, 1950, but was extended for 2 months to February 28, 1951. During the following 3 months RFC procured Bolivian ores under an interim contract which expired May 31, 1951. No tin ores were bought from Bolivian sources from that date to August 31, 1951, although negotiations were continued.

In June 1951 the RFC, in conjunction with the State Department, sent a mission to Bolivia to investigate tin-production costs and their relationship to the Bolivian economy and the world tin market. This joint mission's findings and conclusions were to be utilized in the contract negotiations with the Bolivian Government.

The RFC announced on July 24, 1951, its willingness to pay a tin price of $1.12 per pound because of higher mining costs in Bolivia.

[10] Mining Journal (London), Annual Review Edition: May 1952, p. 121.

On September 5 the Bolivian Embassy in Washington and the RFC announced that a tin contract for 30 days had been agreed upon. The price was $1.12 per pound. This price, including smelting charges, was subject to revision. On September 19 it was announced that discussions between RFC and the Bolivian Government would begin September 24. Any price established for a long-term contract was to be retroactive to June 1, 1951, in regard to all tin delivered to the RFC under this new contract. Negotiations for a long-term contract with the Bolivian producers were held intermittently and their conversations with RFC officials entered a period of recess on October 11. At the end of the year a long-term contract was still to be negotiated.

Receipts of Bolivian ore at the Texas City smelter during the calendar year 1951 were:

	Ore		Tin	
	Long tons	Percent tin	Long tons	Percent total tin content
High-Grade	8,658	59.27	5,132	39.49
Medium-Grade	8,141	46.71	3,803	29.27
Low-Grade	19,435	20.89	4,060	31.24
Total	36,234	35.86	12,995	100.00

Brazil.—The Brazilian Department of Mineral Production (DNPM) has intensified investigation of the cassiterite deposits in the Rio das Mortes Basin, Minas Gerais. Local mining companies have operated, and new refining processes have been introduced by the Empresa Mineira de Estano, the largest producer. The Sao Joao del Rei deposits, discovered in 1942, contain cassiterite with a tin content of 66 to 73.2 percent. The two principal mines (Paiol and Rio Abaixo) have reserves of about 9,000 tons.

Burma.—Production of tin in concentrate was estimated at 1,624 long tons in 1951, a 7-percent decrease from 1950. Exports of tin in concentrate were about 1,477 long tons, of which 1,335 was shipped to Malaya for smelting. The Burmese political situation has been so disturbed since World War II that the 1951 tin output was only about one-fifth of the prewar level of 5,000 tons per year. To cite a typical example—the Tenasserim Peninsula coast area was formerly exploited for tin and tungsten ores by 8 or 10 small companies and numerous independent operators. These activities were suspended because of the continued unstable conditions. M. S. Han & Co. is mining tin and tungsten ores from its properties near the rail line just north of Thaton, about 35 miles north of Moulmein.

Conditions in the tin-mining district of lower Burma brought mining to a standstill. European staffs were, by Government order, confined to Tavoy town and not allowed to proceed to the mines for security reasons.

Indonesia.—In 1951, Indonesia was the third largest tin producer in the world. Production of tin in concentrates totaled 30,986 long tons, a 3-percent decrease from 1950. The Indonesian output of tin represented 18 percent of the world total. Tin production in Indonesia is confined to the islands of Banka, Billiton, and Singkep, which in 1951 supplied 63, 28, and 9 percent of the total, respectively.

Exports of tin in concentrates were 30,750 long tons, of which 21,110 was shipped to the Netherlands, 9,439 tons to the United States, and 201 tons to Malaya. The principal methods of mining alluvial tin deposits in Indonesia are dredging, gravel pumping, and hydraulicking. Over two-thirds of the production now comes from dredges and under one-third from gravel pumps and hydraulicking. The Chinese tributers treat on lease poorer or previously worked grounds unsuitable for larger scale European methods. In 1951, the tributers produced about 3 percent of the total production. Data on the number of producers, as of December 30, 1951, is set forth as follows:

Number of dredges operating	29
Gravel pumping and hydraulicking (number of mines operating)	65
Labor employed	22,526
Staff employed	1,090

Malaya.—During 1951 Malaya earned about 500 million United States dollars, of which rubber and tin accounted for about 90 percent.[11] Tin reached the all-time record of $783 (Malayan dollars) a picul (133⅓ pounds). The average for the year was $537—an increase of 44 percent over the 1950 average. The Commonwealth's greatest dollar earner was subjected throughout the year to terrorist activities on a widespread scale. By the end of 1951 an overall improvement in the general emergency could be discerned, and there were grounds for believing that this improvement was likely to be maintained.[12]

Mine production of tin in concentrate was 57,167 long tons in 1951 compared with 57,537 in 1950, 84,082 in the peak year 1940, and an annual average of 55,309 per year during the prewar period 1935–39.

Economically, one of the most serious aspects of the emergency is the interference with railway traffic which resulted from unstable political conditions. As a result of this situation, exploration has been almost completely arrested.

The number of dredges operating has increased steadily since 1947, although the average annual output per dredge has not recovered to the prewar level.

	1929	1933	1940	1948	1951
Number of dredges operating	105	23	104	63	83
Average annual output per dredge (tons of fine tin)	259	468	406	348	372

About 87 percent of the total Malayan production of tin in 1951 was obtained by dredging (52.6 percent) and gravel pumping (34.3 percent). The percentages from other methods of mining were hydraulicking, 3 percent, opencast mining 4 percent, underground mining 5 percent, dulang washing 1 percent.

In 1951 an analysis of dredge data shows that 67 dredges, for which both yardage and concentrate production are given, recovered 30,938.71 tons of concentrates (75 percent tin-content basis) from the washings of 143,305,351 cubic yards of gravel, or 0.36 pound of tin metal in concentrates per yard washed. The dredges for which yardage data were unavailable recovered 4,999.2 tons of concentrate.

[11] Mining Journal (London), Annual Review Edition: May 1952, p. 143.
[12] Malayan Tin Bureau, Tin News: November 1952, p. 6.

Thus, the average content figure is based on 86.1 percent of the concentrate recovered by dredging.

The smelting of tin ores in Malaya is carried on by two large companies—the Eastern Smelting Co., Ltd., with a smelter in Penang, and the Straits Trading Co., Ltd., with a smelter in Singapore. A negligible quantity of concentrates is smelted by a Chinese smelter for local consumption.

These plants decreased their output 4 percent and supplied 39 percent of the world smelter production in 1951. Concentrates treated were derived mostly from Malaya, with smaller tonnages from Thailand, Burma, Indonesia, and French Indochina. The tin content of concentrates available from Malaya was 57,167 long tons compared with 57,537 in 1950. Imports originating elsewhere contained 7,731 tons of tin against 9,912 in 1950. The plants shipped 64,956 tons of metal (about 56 percent from Penang and 44 percent from Singapore). Only 4 percent went to the United States in 1951. Stocks of tin metal increased from 1,991 at the beginning of 1951 to 2,852 at the end, while stocks of tin in concentrates decreased from 4,521 at the beginning to 4,488 at the end.

A United States mission for the study of problems in tin visited Malaya and Singapore on the invitation of the Government of Malaya, transmitted through and endorsed by the British Government.

The mission arrived at Singapore on November 6, 1951, and completed its study November 17. During that time it examined tin mines, smelters, and tin marketing in Malaya and in Singapore. The conclusions of the report are quoted as follows:

1. The emergency, as the guerrilla activities in Malaya are termed, was found to pervade every phase of Malayan life. Exploration for tin deposits and production expansion have been arrested. The casualty lists for Government forces and civilians, as well as for guerrillas, have reached into the thousands; the recorded dead exceeded five thousand before the end of September 1951.

In all considerations of future tin supply it must be recognized that Malaya, the world's largest producer, is a focal point in Communist aggression. Substantial success by these elements in Malaya could very easily engulf the country's tin producing neighbors with the result that well over one-half of the world's production might, in a surprisingly short time, become unavailable, except on Communist terms.

2. The Mission did not discover any evidence of curtailment of tin output by the mining or smelting industries. However, the emergency has arrested output expansion and interferes with efficient production. Until the emergency is brought under control, no substantial production expansion for tin can be expected.

3. Exploration has been almost completely arrested. The tin mining industry is rapidly depleting its reserves available under present technology and price levels. Perhaps most depressing of all aspects of the Malayan tin situation is the certainty of a declining output in the fairly near future, unless the problem of developing reserves to replace current depletion can be solved.

4. Proposals by the Mission as a group and as individuals that alternate methods of tin procurement be developed were countered by mining, smelter and Government representatives that the Singapore market be given a fair trial as an exclusive medium for procurement from Malaya before alternatives be discussed. Although the Mission pressed the point that the Singapore market might be unacceptable in Washington, the Malayan representatives maintained their position.

In the Mission's explorations of alternatives the following principles were put forward: That a term contract for a substantial quantity at a fixed price subject only to price index escalation be basic; that tin be delivered either as metal through a toll agreement with Malayan smelters or as concentrates; that any master contracts with large mine producers be available to any other producers no matter how small who might choose to subscribe; and concurrence of Governments involved would be acceptable if necessary.

Although the Malayan representatives admitted the feasibility of Mission suggestions, no willingness to permit the proposals to be conclusive developed.

5. The population of Malaya is approximately one-half native Malay, two-fifths Chinese and one-tenth Indian. This composition complicates political development * * *.

The present form of government in Malaya, the second to be established in the post-war period, is only three years old and apparently is still in a state of evolution. Tin output could be affected substantially by governmental change.

6. The development of the Federation of Malaya toward self-government has proceeded to such a degree that the wishes of local representation on the Council must be given serious consideration. Although the United Kingdom Government retains the authority to intervene in economic affairs, in practice any governmental arrangements involving tin probably would require the acquiescence of the Legislative Council of the Federation.

7. The steady post-war uptrend of the average wage scale indicates the gradual elimination of cheap common labor in the mining industry. It portends for the future an acceleration of mechanization with the resultant increase in capital investment and an increase in the proportion of skilled to unskilled labor at mines and smelters.

8. The mining technology appears to be thoroughly modern varying from United States placer practice only in response to difference in product, difference in nature of deposits, availability of very cheap labor, high power costs, availability of local materials and other such factors. The only technical possibility for substantially increased output seems to lie in the devising of a method for recovering very fine tin now being discharged in the slime tailings.[13]

Nigeria.—Production of tin in concentrate in Nigeria totaled 8,555 long tons in 1951, a 4-percent increase from 1950. In 1951 tin production was in the hands of 39 companies (mainly registered in the United Kingdom) and 76 individual owners (mainly Europeans in Nigeria). Only 6 of the companies had an output of over 300 tons; about 45 percent of the total output came from the Amalgamated Tin Mines of Nigeria, Ltd. The Nigerian industry is not highly mechanized (there is only one dredge in the territory), and about half its output still comes from small mines worked by tributers. The whole of the production is exported as concentrate to smelters in the United Kingdom. The grade in 1939 was 2.26 pounds of cassiterite per cubic yard, in 1948 only 1.01 pounds, and in 1950–51, 0.76 pound. It is hoped that additional reserves of good-grade tin lie in the deep deposits under the basalt layers on the Nigerian Plateau, and some companies have undertaken proof drillings and constructed prospect adits on these hard layers to reach the deposits at depths varying from 70 to 150 feet.

Reserves of cassiterite amounted to approximately 100,000 tons of proved and 33,000 tons of indicated mineral. Assuming a recovery of 70 percent metal after smelting, this would represent about 93,000 tons of tin. On the basis of the present annual output, say 10,000 tons, this would give a life of 9 years for the known Nigerian deposits (assuming no additional reserves were developed).[14]

Thailand.—Production of tin in concentrates in 1951 totaled 9,502 long tons, an 8-percent decrease compared with 1950. The number of dredges operated decreased from 31 in January to 28 in December. In 1951 production of tin in concentrate from dredges amounted to 5,525 long tons or 58 percent of total output; production from gravel pumps and hydraulicking amounted to 2,252 tons or 24 percent of total output. Production from other means and from dulang washing accounted for 899 tons or 9 percent, and 827 tons or 9 percent,

[13] Bureau of Mines Mineral Trade Notes, United States Tin Mission Report; Malay, 1951: Spec. Suppl. 39 (to vol. 35, No. 3), September 1952, pp. 1–3.
[14] International Tin Study Group, Statistical Yearbook: 1952, p. 63.

respectively, of total output. European mines accounted for 60 percent, Thailand mines for 38 percent, and Chinese mines for 2 percent of total production in 1951. Exports (reported as imports by receiving countries stated) of tin in concentrates were 8,809 long tons, of which 2,727 was shipped to the United States, 6,003 to Malaya, and 79 tons to the Netherlands.

An excellent description of the tin deposits and tin industry of Thailand was published in 1951, as a result of a joint investigation by the Royal Thai Department of Mines and the United States Geological Survey.[15]

United Kingdom.—Mine production totaled about 1,210 tons in 1951 compared with 1,230 tons in 1950. United Kingdom smelter production of tin was the third largest in the world in 1951. Output declined 3 percent compared with 1950. Year-end stocks of tin in concentrate were 1,923 tons (2,250 at beginning of year) and of metal 8,004 tons (11,504 at the beginning). Total stocks including tin metal and concentrates afloat and visible consumers' stocks were reported to be 13,300 tons at the end of 1951—a 15-percent decrease from 15,600 tons at the beginning of the year. Total virgin tin consumed was 23,892 tons, 3 percent above 1950. The following table provides data on the consumption of virgin tin in 1950 and 1951 by principal trades.[16]

	1950	*1951*
Tin plate	9,821	9,417
Tinning	1,373	1,475
Solder	2,798	3,277
Alloys:		
White metal	4,017	4,372
Bronze and gunmetal	2,504	2,825
Other	433	442
Wrought tin	1,260	948
Chemicals	908	971
Other uses	140	165
Total, all trades	23,254	23,892

[15] Brown, Glen F., Buravas, Saman, Charaljavanaphet, Jumchet, Jalichandra, Nitipat, Johnston, William D., Jr., Sresthaputra, Vija, and Taylor, George C., Jr.: Geologic Reconnaissance of the Mineral Deposits of Thailand; Geologic Investigations of Asia: Geol. Survey Bull. 984, 1951, pp. 1–183.
[16] Metal Bulletin (London), No. 3668, Feb. 15, 1952, p. 18.

Titanium

By Frank J. Cservenyak and Alfred Tumin

GENERAL SUMMARY

DOMESTIC production of titanium dioxide pigments, ilmenite, and titanium metal established new peak records in 1951. The production of titanium dioxide pigments continued to be the basis of the titanium industry; however, considerable progress was made in production of titanium metal. Consumption of rutile, mainly in welding-rod coatings and alloys, almost equaled the record established in 1943.

Considerable research was conducted by industry and the Government on production and utilization of titanium metal and its alloys. Although the production increased from about 75 short tons in 1950 to 495 tons in 1951, the price of titanium sponge remained unchanged at $5 per pound, and most of the production went into research and development of military items. This price necessarily limited widespread civilian use of titanium. Continued expansion of titanium metal production for civilian as well as military uses was expected if substantial reductions could be made in production and fabricating costs. Development of high-temperature titanium alloys and information on properties and uses of the metal and its alloys was also necessary for realization of the numerous potential applications.

Increased domestic production of ilmenite, supplemented by titanium slag imports from Canada, increased the United States readily available supply of materials for production of titanium dioxide pigments and future source materials for the production of titanium metal.

The supply of rutile was reported to be limited at the end of 1951. The increased demand for rutile was met in part by increased imports from Australia and significant reductions in producers' and consumers' stocks.

RESERVES

A preliminary unpublished report was prepared in 1951 on the titaniferous iron deposits of the Laramie Range, Wyo. Titaniferous iron deposits located 15 miles northeast of Laramie, Wyo., to a few miles beyond North Sybille Creek, Wyo., contain magnetite-ilmenite bodies and were reported to be large enough to be of commercial interest. Although deposits are known to occur at more than 30 places in this area, most of the exposures are small. These deposits have been divided into the following three grades: Grade 1, consisting of massive ilmenite with 0 to 35 percent by volume of silicates, mostly olivine and some spinel, containing 16 to 23 percent TiO_2; Grade 2,

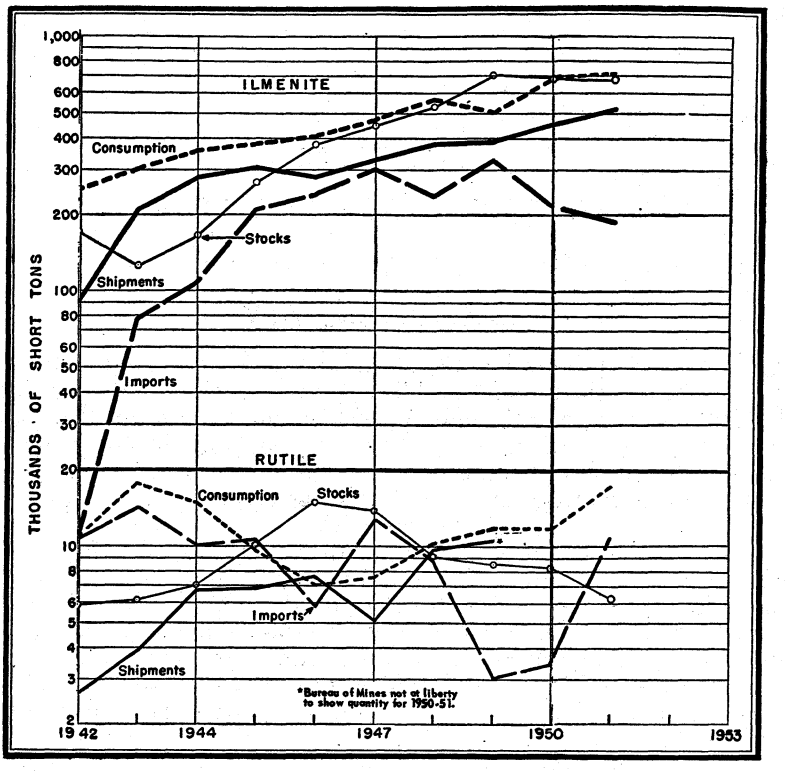

FIGURE 1.—Domestic shipments, imports, consumption, and stocks of ilmenite and rutile, 1942–51.

consisting of magnetite-ilmenite with 35 to 65 percent by volume of silicates, chiefly olivine and some spinel, plagioclase, and hypersthene, containing 10 to 16 percent TiO_2; Grade 3, consisting of magnetite-ilmenite with 65 to 85 percent by volume of silicates, largely plagioclase with olivine and hypersthene, containing 5 to 10 percent TiO_2. The principal tonnage is found in two blocks designated as the northern and southern areas. All of the ore estimated in the northern area occurs at an elevation of more than 6,900 feet and in the southern area at an elevation of more than 6,600 feet. There are approximately 9,150,000 short tons of indicated and inferred titaniferous magnetite ore in the main ore zone. Of this total, 8,650,000 tons is in the northern and southern blocks; the remaining 500,000 tons is in small lenses and masses. Deeper ore may be present in the structure occupied by the northern and southern ore bodies of Iron Mountain.[1]

Ilmenite was produced in 1951 as a byproduct from operations at Cascade, Idaho, concerned primarily with production of monazite and other materials. It was estimated that 3 deposits in the Long Valley area of Valley County, Idaho, total 150 to 200 million cubic yards of gravel containing 8 to 10 pounds of ilmenite per cubic yard.

[1] Newhouse, W. H., and Hagner, A. F., Preliminary Report on the Titaniferous Iron Deposit of the Laramie Range: U. S. Geol. Survey open file rept., 1951 (unpublished).

Reserves in Central Valley County deposits were estimated at 400 million cubic yards containing 15 to 30 pounds of ilmenite per cubic yard.

DOMESTIC PRODUCTION

CONCENTRATES

Production and shipments of ilmenite in 1951 were 535,835 and 510,840 short tons, respectively, an increase of 14 percent in production and 13 percent in shipments; both established new records for the fifth successive year. In the record-breaking years since 1947, ilmenite production increased 59 percent, while shipments increased 52 percent. Of the total ilmenite production New York continued to supply more than one-half, Florida about one-third, and North Carolina, Virginia, and Idaho the remainder.

Ilmenite in 1951 included a small quantity of mixed product containing altered ilmenite, leucoxene, and rutile. The mixed product was used in the manufacture of both titanium pigments and metal. Shipments of ilmenite ranged from 43 to 66 percent TiO_2 and rutile from 93 to 97 percent TiO_2.

TABLE 1.—Production and mine shipments of titanium concentrates from domestic ores in the United States, 1946–51, in short tons

Year	Ilmenite				Rutile			
	Production (gross weight)	Shipments			Production (gross weight)	Shipments		
		Gross weight	TiO_2 content	Value		Gross weight	TiO_2 content	Value
1946	282,447	282,708	130,624	$4,878,917	7,453	7,514	7,046	$996,989
1947	336,533	336,061	157,328	5,029,490	8,562	5,175	4,813	533,548
1948	383,745	381,508	177,447	5,793,973	7,380	9,907	9,226	647,334
1949	402,334	389,234	186,535	6,212,348	[1] 11,988	[1] 10,559	[1] 9,414	[1] 489,798
1950	[1] 468,320	[1] 452,370	[1] 230,826	[1] 5,606,584	[2]	[2]	[2]	[2]
1951	[1] 535,835	[1] 510,840	[1] 261,982	[1] 7,689,272	[2]	[2]	[2]	[2]

[1] Includes a mixed product containing altered ilmenite, leucoxene, and rutile.
[2] Figures withheld to avoid disclosure of individual company operations.

Florida.—The E. I. du Pont de Nemours & Co. property at Starke, Fla., produced ilmenite and a mixed product containing altered ilmenite, leucoxene, and rutile. Production at this property in 1951 increased about one-fourth over that in 1950.

The Rutile Mining Co. of Florida near Jacksonville and the Florida Ore Processing Co., near Melbourne, continued to produce rutile and ilmenite in 1951.

Idaho.—Ilmenite was produced by Baumhoff-Marshall, Inc., at Cascade, Idaho. Shipments in 1951 from this property were consumed for purposes that did not require a titanium content. The Idaho-Canadian Dredging Co. at Cascade, Idaho, began ilmenite operations at the end of 1951.

New York.—Production of ilmenite at Tahawus, Essex County, N. Y., by the National Lead Co. in 1951 exceeded the peak established in 1949.

North Carolina.—The Yadkin Mica & Ilmenite Co., subsidiary of the Glidden Co., produced ilmenite at Finley, Caldwell County, N. C. Production from this property in 1951 established a new record, slightly exceeding the previous peak in 1949.

Virginia.—Ilmenite was produced in 1951 at Piney River, Nelson County, Va., by the Calco Chemical Division of the American Cyanamid Co. Production at this property in 1951 was slightly higher than that in 1950.

METAL

Production of titanium sponge in 1951 was 495 short tons coming from plants operated by E. I. du Pont de Nemours at Newport, Del.; Titanium Metals Corp. of America at Sayreville, N. J., Niagara Falls, N. Y., and Henderson, Nev.; and leased facilities at the Bureau of Mines pilot plant, Boulder City, Nev.; and the Crane Co. at Chicago, Ill.

Du Pont began operating a commercial plant in May with a nominal capacity of 2 short tons of titanium sponge per day. The production rate originally estimated was reached in the latter part of 1951. Du Pont planned to reach an expected capacity of 2½ tons per day at this plant in 1952. At the request of the Government the General Services Administration was negotiating with du Pont for additional expansion in 1952.

Metal Hydrides, Inc., Beverly, Mass., produced 144,271 pounds of titanium powder in 1951 by reduction of titanium oxide with calcium hydride. This company supplied titanium as powder, titanium hydride, and titanium master alloys. The titanium powder is reported to be easily compressed into suitable forms and sintered either in vacuum or in a nonoxidizing atmosphere into solid blocks or finished products at as low as 900° to 1,000° C.

The Foote Mineral Co., Philadelphia, Pa., installed capacity for the production of extremely pure titanium by thermal decomposition of volatile titanium iodides. It offered, for research purposes, titanium crystal bar containing 99.9 percent Ti, approximately ½ inch in diameter by 19 inches in length (maximum).

New titanium organizations were formed in 1951. The National Research Corp., of Cambridge, Mass., and Monsanto Chemical Co. joined forces to develop an improved process for the production of titanium. Work already in process by National Research was expanded, and additional work was initiated by Monsanto's research department at Dayton, Ohio. P. R. Mallory & Co. and the Sharon Steel Corp. formed the Mallory-Sharon Titanium Corp. for the development, production, and marketing of titanium and titanium alloys. A new process for producing titanium metal was being investigated by Horizons Titanium Corp., a new firm formed by Horizons, Inc., of Princeton, N. J. backed by Ferro, Inc., of Cleveland, Ohio, and others. The process developed by Horizons, Inc., under the sponsorship of the Office of Naval Research, had advanced to the pilot-plant stage at the end of the year. The Kennecott Copper Corp., after having investigated several processes during the past several years, developed a process on a laboratory scale, which showed possibilities of yielding superior-quality metal, with certain production advantages over the present process. A pilot plant to evaluate the process on a scale of about 200

pounds per day was under construction at Battelle Memorial Institute in 1951 and was expected to begin operations around the middle of 1952.

The Titanium Metals Corp. of America, jointly owned by National Lead Co. and Allegheny Ludlum Steel Corp., signed a letter of intent in August 1951 for construction and operation of a plant to produce 3,600 tons of titanium per year for 5 years. An advance of $15 million was made to the Titanium Metals Corp. by the Government. This advance, plus interest at 4 percent per annum on the unpaid balance, was repayable either in dollars or in titanium metal. Titanium sponge acceptable to the Government was to have the following specifications: Titanium content, 99.3 percent minimum; total maximum impurities, 0.7 percent; iron, 0.25 percent maximum; nitrogen, 0.03 percent maximum; chlorides, to be established from operating and storage experience; and hardness after arc melting in an inert atmosphere, less than 250 Vickers or 61 Rockwell A. The site of the new operation is the former Basic Magnesium, Inc., plant at Henderson, Nev., built by the Government during World War II. Major components of this plant were leased from the State of Nevada. Power is to be allocated from Hoover and Davis Dams, up to a maximum of 151 million kw.-hr., by the Colorado River Commission from the quota allotted to the State of Nevada. The Henderson plant is the first fully integrated titanium plant with facilities for chloridation of titanium ore and recovery of magnesium and chlorine by electrolysis of magnesium chloride. The Henderson plant began initial operations in September 1951 and routine production in October.

The chief producers and suppliers of commercial grades of titanium-base alloys in various forms in 1951 were Rem-Cru Titanium Inc., Midland, Pa.; Titanium Metals Corp. of America, New York, N. Y.; and Mallory-Sharon Titanium Corp., Niles, Ohio.

CONSUMPTION AND USES

Consumption of ilmenite increased 5 percent in 1951, establishing a new record of 713,363 tons. Except in 1949, ilmenite consumption has increased steadily each year since 1942, when it was 257,535 tons. The manufacture of pigments, following the pattern of previous years, accounted for 99 percent of all ilmenite consumption. Ilmenite consumption in 1951, as in 1950, included a mixed product containing altered ilmenite, leucoxene, and rutile. The consumption of rutile in 1951 increased 47 percent over 1950 and almost equaled the record established in 1943. Increases were noted in new uses of rutile for titanium metal and fiber glass, which are reported under miscellaneous uses.

Titanium Pigments.—Production and shipments of titanium pigments in 1951 were 5 and 2 percent, respectively, above 1950 and established another new peak. Figures in this industry are supplied in confidence and consequently are not given here. However, the percentage distribution of titanium pigment shipments, by consuming industries, is shown in table 3.

Welding-Rod Coatings.—Production of titanium-coated welding rods was 287,065 short tons in 1951, an increase of 53 percent over the 188,000 tons in 1950; 154,000 tons was coated in 1949, 188,000 tons in 1948 and 481,000 tons in the record year 1943. Of the 1951 tonnage, 61 percent was coated with natural rutile, 15 percent with manufac-

tured titanium dioxide, 18 percent with both varieties, and 6 percent with ilmenite.

The General Electric Co. developed a process whereby titanium hydride is used to solder glass to metal and metal to ceramics and carbon, forming a strong bond. The areas soldered were painted with a thin layer of titanium hydride, and solder was placed upon both painted areas. The parts were placed together and heated to 900° F., under vacuum, to decompose the titanium hydride and cause the molten solder to adhere to both surfaces. The new technique was reported in use in aircraft ignition systems, and laboratory investigations suggested possible applications in the manufacture of transformers, capacitors, and electric motors.[2]

TABLE 2.—Consumption of ilmenite and rutile in the United States, 1942–48, total, and 1949–51, by products, in short tons

Product	Ilmenite		Rutile	
	Gross weight	Estimated TiO_2 content	Gross weight	Estimated TiO_2 content
1942	257,535	141,412	10,616	9,952
1943	302,822	142,868	17,634	16,451
1944	360,941	175,475	14,813	13,837
1945	381,178	187,580	9,791	9,144
1946	404,283	202,663	7,134	6,670
1947	479,524	250,859	7,692	7,083
1948	565,000	300,408	10,230	9,488
1949				
Pigments (manufactured titanium dioxide) [1]	505,432	265,854	(2)	(2)
Welding-rod coatings [1]	165	85	6,399	5,904
Alloys and carbide	4,969	2,037	660	619
Ceramics			143	136
Miscellaneous	42	24	[3] 4,686	[3] 4,204
Total	510,608	268,000	[3] 11,888	[3] 10,863
1950				
Pigments (manufactured titanium dioxide) [1 3]	671,335	347,747	(2)	(2)
Welding-rod coatings [1]	210	106	9,218	8,516
Alloys and carbide	7,666	3,803	1,454	1,366
Ceramics			195	185
Miscellaneous	33	19	854	802
Total	679,244	351,675	11,721	10,869
1951				
Pigments (manufactured titanium dioxide) [1 3]	703,068	367,937	(2)	(2)
Welding-rod coatings [1]	258	130	11,708	10,834
Alloys and carbide	10,024	4,962	2,939	2,752
Ceramics			265	248
Miscellaneous	13	8	[4] 2,315	[4] 2,184
Total	713,363	373,037	17,227	16,018

[1] "Pigments" include all manufactured titanium dioxide, consumption of which in welding-rod coatings was 1,082 tons in 1949, 1,439 tons in 1950, and 1,770 tons in 1951.
[2] Included in "Miscellaneous" to avoid disclosure of individual company operations.
[3] Includes a mixed product containing altered ilmenite, leucoxene, and rutile used to make pigments and metal.
[4] Includes metal and fiber glass.

[2] American Metal Market, G. E. Solders Metal to Glass, Carbon, and Ceramics with Titanium: Vol. 58, No. 69, Apr. 12, 1951, p. 1.

TABLE 3.—Distribution of titanium pigment shipments, 1935–45 (average) and 1946–51, by consuming industry, in percent of total

Industry	1935–45 (average)	1946	1947	1948	1949	1950	1951
Distribution by gross weight:							
Paints, varnishes, and lacquers	77.7	78.6	81.5	76.4	74.5	74.5	73.3
Floor coverings (linoleum and felt base)	2.5	2.5	3.7	4.5	4.6	4.2	4.4
Coated fabrics and textiles (oilcloth, shade cloth, artificial leather, etc.)	3.0	1.8	2.1	2.1	1.6	1.5	1.5
Rubber	2.5	2.0	2.6	2.5	3.1	3.0	2.5
Paper	6.8	6.1	5.5	5.4	6.6	6.2	5.9
Printing ink	1.0	.9	.9	.9	.9	.9	1.3
Other	6.5	8.1	3.7	8.2	8.7	9.7	11.1
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Distribution by titanium dioxide content:							
Paints, varnishes, and lacquers	68.8	71.9	74.3	69.9	67.5	66.9	64.9
Floor coverings (linoleum and felt base)	3.9	3.1	4.7	5.9	5.8	5.2	5.7
Coated fabrics and textiles (oilcloth, shade cloth, artificial leather, etc.)	3.7	2.3	2.6	2.7	2.1	2.0	2.1
Rubber	2.9	2.8	3.4	3.2	3.9	3.9	3.4
Paper	9.9	8.6	7.8	7.4	9.6	9.1	8.9
Printing ink	1.7	1.5	1.5	1.4	1.4	1.4	1.8
Other	9.1	9.8	5.7	9.5	9.7	11.5	13.2
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Titanium and its alloys offer special advantages for civilian use and military equipment because of their unusual combination of properties—lightness, strength, and resistance to corrosion. Tests were actively under way in 1951 on the use of titanium in civilian and military equipment.[3]

Reports and studies indicated that titanium metal would find use in the following fields:

1. Aircraft power plants: Its light weight and strength are needed here. Also, titanium can withstand the increasingly higher operating temperatures better than aluminum alloys.

2. Aircraft frames: As speeds increase, aircraft frames must be stronger and withstand higher temperatures. Titanium fits these requirements.

3. Pyrotechnics: Titanium powder burns in air with intense heat. This probably will be a small market.

4. Low-titanium alloys: A number of iron and nonferrous alloys include 0.1 to 3.5 percent titanium. The use of higher purity metal in these alloys enables producers to obtain cleaner and stronger alloys with greater regularity.

5. Marine equipment: Titanium is highly resistant to sea-water corrosion.

6. Chemical equipment: Titanium is generally resistant to corrosion, particularly by oxidizing, chlorine, and chloride reagents.

7. Ordnance: Unalloyed titanium is reported to be more resistant to projectiles than any armorplate now in existence.

[3] Mesick, B. S., The Metal of Tomorrow—Titanium: Ordnance, January–February 1951, pp. 351–354.

STOCKS

Inventories of ilmenite decreased slightly in 1951 and at the end of the year were equivalent (TiO_2 content basis) to about 11 months' requirements at the record rate of consumption in 1951. Rutile stocks dropped 24 percent in 1951 and at the end of 1951 were sufficient to sustain industry at the 1951 rate of use (TiO_2 content basis) for 4 months. Significant decreases in year-end stocks of rutile were reported by some welding-rod coatings, alloys, and carbide producers.

TABLE 4.—Stocks of titanium concentrates in the United States at end of year, 1950–51, in short tons

Stocks	1950 [1]				1951			
	Ilmenite		Rutile		Ilmenite		Rutile	
	Gross weight	Estimated TiO_2 content	Gross weight	Estimated TiO_2 content	Gross weight	Estimated TiO_2 content	Gross weight	Estimated TiO_2 content
Mine	32,848	15,216	3,780	3,516	57,843	26,349	50	47
Distributors [2]	169	101	1,799	1,713	692	415	577	547
Consumers	649,200	318,894	2,750	2,559	620,948	308,007	5,685	5,331
Total stocks	682,217	334,211	8,329	7,788	679,483	334,771	6,312	5,925

[1] Revised figures reflecting inventory corrections reported by industry.
[2] Includes ilmenite and rutile content of mixed zirconium-titanium concentrates.

PRICES

Ore.—Quotations, in E&MJ Metal and Mineral Markets for 1951, per long ton for ilmenite containing 56 to 59 percent TiO_2, f. o. b. Atlantic seaboard, according to grade and impurities, were $14–$16 at the beginning of 1951, $15–$17 in January, and $16–$18 in February, at which level they remained for the rest of 1951. Quotations were nominal. For rutile concentrates, guaranteed minimum 94 percent TiO_2 content, they were 3½–4½ cents per pound until November 29, 1951, when they increased to 5¼–6¼ cents per pound. Rutile was covered by General Ceiling Price Regulation, which established ceiling prices upon the basis of prices in effect during the base period December 19, 1950, to January 25, 1951. The year closed with a ceiling price for rutile concentrate averaging about 5 cents per pound, east coast ports.

Ferrotitanium.—Prices quoted in the magazine Steel at the beginning of 1951 were in effect until January 22, 1951, when all ferrotitanium prices increased. The increased quotations continued for the remainder of 1951. Ferrotitanium price quotations at the beginning of the year and on January 22, 1951, are shown in the following tabulation:

	Jan. 1, 1951	Jan. 22, 1951
Ferrotitanium, Low-Carbon, f. o. b. Niagara Falls, N. Y., freight allowed to St. Louis, spot add 5¢:		
(Ti, 20–25 percent; Al, 3.5 maximum; Si, 4 percent maximum; C, 0.10 percent maximum). Contract, 2″ x D, per pound of contained Ti:		
Ton lots	$1.40	$1.50
Less-than-ton lots	1.45	1.55
(Ti, 38–43 percent; Al, 8 percent maximum; Si, 4 percent maximum; C, 0.10 percent maximum). Contract, per pound:		
Ton lots	1.28	1.35
Less-than-ton lots	1.35	1.37
Ferrotitanium, High-Carbon: (Ti, 15–18 percent; C, 6–8 percent). Contract per net ton, f. o. b. Niagara Falls, N. Y., freight allowed to destination east of Mississippi River and north of Baltimore and St. Louis	167.00	177.00
Ferrotitanium, Medium-Carbon: (Ti, 17–21 percent; C, 3–4.5 percent). Contract per ton, f. o. b. Niagara Falls, N. Y., freight not exceeding St. Louis rate allowed	183.00	195.00

Metal.—Titanium powder, 96, 97, and 98.5 percent Ti, was quoted in the American Metal Market during 1951 at $5, $6, and $7 a pound, respectively, f. o. b. Beverly, Mass. Titanium sponge metal prices, as quoted by E. I. du Pont de Nemours & Co., Pigments Department, Wilmington, Del., remained the same as in 1950—$7.50 per pound in quantities of less than 100 pounds and $5 per pound in quantities of 100 pounds or more, all prices f. o. b. shipping point. Titanium metal prices for commercially pure and alloy grades, as quoted in Steel magazine and by the Titanium Metals Corp. of America, New York, N. Y., also remained the same during 1951: Base prices per pound in lots of 10,000 pounds and over in commercially pure and alloy grades f. o. b. mill: Hot and cold-rolled sheets, $15, Brackenridge, Pa.; hot-rolled sheared mill plate, $12, Brackenridge; cold-rolled strip, $15, West Leechburg, Pa.; rolled or cold-drawn round bar in small diameters and round wire, $10, Dunkirk, N. Y; forgings (rounds, disks, and round-cornered squares and rectangles), $6, Watervliet, N. Y.; hot-rolled bars (rounds, flats, and squares), $6, Watervliet. Extremely pure titanium produced by the iodide process was quoted by the Foote Mineral Co., Philadelphia, Pa., at $95 per pound in lots of 100 pounds and up and $125 per pound in lots of less than 100 pounds, f. o. b. Exton, Pa., with a minimum order of $10. This metal was available in crystalline bars approximately ½ inch in diameter by 19 inches in length (maximum).

Manufactured Titanium Dioxide.—Manufactured titanium dioxide (anatase), ceramic, chalk-resistant, and regular grade in bags, carlots, and delivered, were quoted by Oil, Paint and Drug Reporter throughout 1951 at 21–21½ cents per pound. Rutile, nonchalking, was quoted at 23–23½ cents during 1951.

FOREIGN TRADE [4]

Imports.—Receipts of ilmenite in 1951 were 189,078 short tons, 13 percent less than the 1950 total of 216,459 tons, 42 percent less than the record of 324,157 tons established in 1949, and the lowest since the 1944 total of 104,884 tons. Imports from India, the dominant source, dropped slightly. Canadian imports, consisting mostly of titanium slag, almost tripled in quantity. Norway, the second major source of ilmenite in 1950, did not supply any ilmenite to the United States in 1951. Rutile imports for 1951 were 11,023 short tons, over 3 times the 1950 total of 3,427 tons. The 1951 total was the largest since 1947, when 12,637 tons was imported. All imports of rutile were from Australia for the fourth successive year. Ilmenite and rutile remained free of tariff duties in 1951.

TABLE 5.—Titanium concentrates [1] imported for consumption in the United States, 1942–46 (average) and 1947–51, by countries, in short tons

[U. S. Department of Commerce]

Country of origin	1942–46 (average)	1947	1948	1949	1950	1951
ILMENITE						
Australia [2]	491	1,659	(3)		112	100
Brazil	3,462	1	8,708			1
Canada	22,159	7,122	4,519	540	1,357	[4] 3,776
Ceylon	930			2		
Egypt				721		
France					1	
India	94,101	262,503	184,309	289,739	187,834	185,145
Malaya			3,335			56
Norway	6,194	30,026	41,248	33,155	27,155	
Total as reported	127,337	301,311	242,119	324,157	216,459	189,078
Value of "as reported"	$738,827	$1,791,020	$1,758,848	$2,479,071	$1,198,545	$1,323,438
Australia: In "zirconium ore" [2]	2,635					
Grand total	129,972	301,311	242,119	324,157	216,459	189,078
RUTILE						
Australia [2]	2,691	7,460	8,771	3,085	3,427	11,023
Brazil	2,364					
French Cameroon	248	3				
India	190	113				
Norway			(3)			
Total as reported	5,494	7,576	8,771	3,085	3,427	11,023
Value of "as reported"	$406,358	$468,810	$588,713	$179,746	$149,733	$491,383
Australia: [2]						
In "zirconium ore"	4,775					
In "ilmenite"		5,061				
Grand total	10,269	12,637	8,771	3,085	3,427	11,023

[1] Classified as "ore" by the U. S. Department of Commerce.
[2] Most of the imports of titanium from Australia in 1940–47 were in mixed zircon-rutile-ilmenite concentrates, which were included as ilmenite, rutile, and zirconium ore in U. S. Department of Commerce figures. The quantities reported by the U. S. Department of Commerce have been adjusted to reflect percentage content of each item based on reports to the Bureau of Mines from importers.
[3] Less than 0.5 ton.
[4] Includes titanium slag containing approximately 70 percent TiO_2.

[4] Figures on imports and exports compiled by M. B. Price and E. D. Page, of the Bureau of Mines, from records of the U. S. Department of Commerce.

Exports.—Exports of titanium dioxide and pigments in 1951 established a new record of 39,242 short tons, an increase of 20 percent over the previous peak in 1950. Canada was the major recipient of titanium pigments from the United States in 1951, receiving 25,983 short tons. Other countries that received 1,000 short tons or more were as follows: Brazil, 1,724; Mexico, 1,576; Argentina, 1,223; Netherlands, 1,178; Cuba, 1,102 and France, 1,003. The remainder was distributed among 41 other countries. Exports of titanium concentrates increased from 600 tons in 1950 to 646 short tons in 1951. Canada received 592 tons of concentrates, and 4 other countries received small amounts. Exports of titanium ferroalloys in 1951 were 175 short tons, a slight increase over 1950. Canada received 164 short tons and 7 countries the remaining 11 tons. This increase in exports of ferroalloys was the first since 1944. Total titanium products exported in 1951 were valued at $13,444,911; tetrachloride and other compounds are no longer classified separately and are not included in this total.

TABLE 6.—Exports of titanium products from the United States, 1946–51, by classes

[U. S. Department of Commerce]

Year	Concentrates		Ferroalloys		Dioxide and pigments	
	Short tons	Value	Short tons	Value	Short tons	Value
1946	1,385	$200,866	550	$63,723	16,314	$3,092,607
1947	1,266	192,703	509	80,590	21,171	5,183,936
1948	1,454	187,225	480	82,874	26,824	7,126,956
1949	1,505	143,412	179	40,918	29,261	8,140,991
1950	600	57,753	171	42,741	32,660	8,799,758
1951	646	63,050	175	107,718	39,242	13,274,143

TECHNOLOGY

Smelting tests to remove iron from titaniferous iron ores by electric smelting, on a pilot plant scale, were carried out successfully by the Bureau of Mines laboratory at Boulder City, Nev. Approximately 15 tons of titanium slag running 65 to 70 percent TiO_2 was produced from titaniferous ores containing 30 to 45 percent TiO_2. The solubility of titanium slag in sulfuric acid indicated that it would be acceptable as a raw material for the production of titanium pigment. The iron content of the ore, which by chemical treatment would be converted to cheap ferrous sulfate, was obtained as a pig iron of better potential market and strategic value.[5]

The zirconium-titanium system was investigated by the Bureau of Mines laboratory at Albany, Oreg., over the entire range of compositions from 100 percent zirconium to 100 percent titanium, using both graphite-melted and arc-melted alloys. Maximum strengths were developed in 50-percent atomic composition in the hot-rolled, quenched, and annealed condition. Tensile strengths of the graphite-

[5] Stoddard, C. K., Cole, S. S., Eck, L. T., and Davis, C. S., Pilot Plant Smelting of Ilmenite in the Electric Furnace: Bureau of Mines Rept. of Investigations 4750, 1950, 15 pp.

melted alloys were 158,000 pounds per square inch. The resistance of these alloys to high temperatures was extremely poor.[6]

Experimental studies were conducted by the Bureau of Mines laboratory at Pittsburgh, Pa., to determine the explosive properties of titanium, zirconium, thorium, uranium, and their hydrides. Results of these tests disclosed that dust clouds of the powders in air constituted severe potential explosion hazards and indicated the advisability of processing and handling several of these powders in the dry state under helium or argon gas.[7]

As in 1950, commercial production of titanium metal in 1951 was based on modifications of the Kroll process, developed by the Bureau of Mines, involving reduction of titanium tetrachloride with magnesium. Considerable research and development work on titanium was carried out in 1951 under Government sponsorship or by private interests. A list of projects included under this research was drawn up by the Metallurgical Advisory Committee on Titanium.[8]

An article in Chemical Engineering reviewed titanium metal developments in 1951.[9] Considerable attention was given to the consolidation of sponge titanium to ingot, a problem involving the high melting point of titanium and the necessity of avoiding oxygen and other contaminants such as nitrogen, carbon, or iron. Several articles reported progress in melting titanium. An automatic continuous-casting arc furnace employing a nonconsumable electrode and a d. c. arc was operated successfully to melt commercially pure titanium sponge at a rate of 0.6 to 1.0 pound per minute with a power input of 64 to 100 kw.[10] Development of a tilting-type furnace using a graphite crucible, under vacuum or inert atmosphere, with high-frequency induction heating for melting titanium was reported.[11]

As titanium will be utilized mainly in the form of titanium base alloys, investigations were conducted in 1951 on alloying titanium metal with other metals.[12]

The fabrication of titanium requires different techniques than for other comparable hard metals. Considerable progress was reported during the year on machining and forming titanium and its alloys.[13]

A report at the end of the year described the use of spiral concentrators and electrostatic-magnetic separators at the Trail Ridge, Fla., titanium mineral concentrating plant to recover ilmenite, leucoxene, and zircon from beach sands near Starke, Fla. The Trail Ridge mine and plant are owned by E. I. du Pont de Nemours & Co. The plant was built by Humphreys Gold Corp. and was operated by that company for du Pont.[14]

[6] Hayes, E. T., Roberson, A. H., and Paasche, O. G., Zirconium-Titanium System: Constitution Diagram and Properties: Bureau of Mines Rept. of Investigations 4826, 1951, 11 pp.

[7] Hartman, I., Nagy, J., and Jacobson, M., Explosive Characteristics of Titanium, Zirconium, Thorium, Uranium, and their Hydrides: Bureau of Mines Rept. of Investigations 4835, 1951, 16 pp.

[8] Metallurgical Advisory Committee on Titanium, List of Known Titanium Research and Development Projects: Watertown Arsenal Inf. Bull. T3, Watertown, Mass., February 1952.

[9] O'Connor, Joseph A., Titanium—1951: Chem. Eng., October 1951, pp. 136–139.

[10] Radtke, S. F., Scriver, R. M., and Snyder, J. A., Arc Melting of Titanium Metal: Am. Inst. Min. and Met. Eng., Jour. Metals, vol. 3, No. 8, August 1951, pp. 620–624.

[11] Steel, Vacuum Melting Titanium and Zirconium: Vol. 128, No. 25, June 18, 1951, pp. 77–79.

[12] Metallurgical Advisory Committee on Titanium, Equilibrium Diagrams of Titanium Alloy Systems: Watertown Arsenal Inf. Bull. T4, Watertown, Mass., March 1952.

[13] Iron Age, New Air Force Machinability Research Report Issued: Vol. 168, No. 15, Oct. 11, 1951, pp. 110–114.

American Machinist, Working Titanium and Its Alloys: Vol. 95, No. 12, June 11, 1951, pp. 145–153.

Journal of Metals, Grinding Methods Evolved for Titanium: Vol. 3, No. 12, December 1951, pp. 1128–1129.

[14] Lenhart, Walter B., Spiral Concentrators for Gravity Separation of Minerals: Rock Products, vol. 54, No. 12, December 1951, pp. 92–95, 131.

A new series of titanium-base carbides containing nickel or cobalt auxiliary metal with small amounts of columbium and tantalum carbide was developed by Kennametal, Inc., Latrobe, Pa. The carbides known as Kentanium were developed for use in applications requiring strength and shock resistance under high-temperature operating conditions. Test information on Kentanium and on work done at Ohio State University on cermets of the same category was reported.[15]

WORLD REVIEW

World production of ilmenite and rutile in 1951 was estimated at 800,000 and 42,000 metric tons, respectively, and established new records. Ilmenite production increased slightly, while rutile production was about two-thirds above the 1950 output.

The United States continued to be the world's largest producer of ilmenite, accounting for nearly two-thirds of ilmenite produced in 1951. Australia continued to lead in the production of rutile.

Available data on world production of ilmenite and rutile in recent years, with revised figures, are shown in table 7.

TABLE 7.—World production of titanium concentrates (ilmenite and rutile) 1945–51, by countries, in metric tons

[Compiled by Pauline Roberts]

Country	1945	1946	1947	1948	1949	1950	1951
ILMENITE							
Australia [1]	[2] 8,494	[2] 6,716	[2] 10,475	[2] 11,756	[2] 10,839	[2] 12.417	([3])
Brazil	[4] 5,000			[4] 7,900	650		([3])
Canada	12,834	1,275	6,445	4,029	490	[2][5] 3,177	[5] 19,235
Egypt	46	146		1,601	635	260	317
India	174,848	187,993	265,143	233,098	[2] 313,126	216,076	143,174
Malaya			[4] 13,291	12,909	20,034	25,315	[4] 42,341
Norway	28,312	52,574	69,711	90,017	99,013	105,000	105,000
Portugal	301	633	243	155	680	47	34
Senegal	3,200	4,191	11,282	3,690	8,338	[2] 540	2,500
Spain	216	128	150	181	376	637	700
United States	279,880	256,230	305,296	348,126	364,989	424,851	486,099
Total ilmenite	[2] 513,000	[2] 509,886	[2] 682,036	[2] 713,500	[2] 819,170	[2] 788,000	[6] 800,000
RUTILE							
Australia [7]	9,901	8,283	13,406	[2] 15,348	[2] 14,206	[2] 18,379	33,718
Brazil	[4] 160	[4] 28	[4] 5			([8])	([3])
French Cameroon	1,440	1,260	755	576	403	25	([3])
French Equatorial Africa						6	([3])
India	620	262	160	129		([8])	([3])
Norway	76	63	51		16	([8])	([3])
Senegal							([3])
United States	6,513	6,761	7,767	6,695	10,875	([9])	([9])
Total rutile	18,710	16,657	22,144	[2] 22,748	[2] 25,500	[2] 25,320	[6] 42,000

[1] Estimated ilmenite content of all ilmenite-bearing concentrates.
[2] Revised figure.
[3] Data not available; estimate included in total.
[4] Exports.
[5] Includes titanium slag containing approximately 70 percent TiO_2. *See* Canada under World Review.
[6] Estimate.
[7] Estimated rutile content of all rutile-bearing concentrates.
[8] Figure withheld to avoid disclosure of U. S. production by difference. *See* footnote 9.
[9] Figure withheld to avoid disclosure of individual company operation.

[15] Koshuba, W. J., and Starrolakis, J. A., Cermets May Answer Jet Designers Prayers, Part II: Iron Age, vol. 167, No. 23, Dec. 6, 1951, pp. 154–158.

Australia.—Nine companies extracted rutile from beach sands in the Byron Bay area on the eastern Australia coast in 1951, 4 of which belonged to the Mineral Sands of Australia Association.[16] Zircon Rutile, Ltd., Byron Bay, New South Wales, announced that its rutile production in 1951 was more than double the quantity produced in 1950, when output was restricted. However, this rutile supply was insufficient to meet the demand, and many overseas orders had to be canceled.[17] Titanium & Zirconium Industries Pty., Ltd., found large low-grade deposits of rutile and ilmenite in the sand dunes of Stradbroke Island. At the end of 1951 this company was testing material obtained from suction dredging in swamp areas, sand dunes, and rich beach concentrates in its pilot plant on the island. Primary concentration was effected by Humphrey spirals. The annual capacity of the plant was 1,500 tons of rutile concentrates.[18]

The Bureau of Mineral Resources at Canberra announced that Australia has the largest known deposits of titanium in the world on the beaches and sand dunes for about 50 miles north and south of the New South Wales-Queensland border. The Zinc Corp. operated a trial plant on Stradbroke Island, Queensland, and expected to begin large-scale production.[19]

Strong American rutile buying for industrial purposes booked Australian producers for 1951 and 1952; however, future markets were uncertain because of generally increased costs of production and the possibility of increased sea freights.[20] Price of rutile in Australia during 1951 fluctuated around 4 cents a pound, on 95 to 97 percent TiO_2, c. i. f. Australia.[21]

Brazil.—The Companhia Quimica Industrial, CIL, South America, began constructing a titanium oxide plant at Engenheiro Trinidade, San Pablo, during 1951. This plant, the first of its kind in Central and South America, was expected to produce for domestic use 20 metric tons of titanium oxide and 50 tons of sulfuric acid per day.[22]

Rutile and ilmenite exports from Brazil to foreign countries totaled 15,426 tons and 20,167 tons, respectively, from 1937 to 1948.[23]

Canada.—Quebec Iron & Titanium Corp., subsidiary of Kennecott Copper Corp. and New Jersey Zinc Co., conducted mining operations on the world's largest ilmenite deposits at Allard Lake, Quebec. The ore in the 100-million long ton Main ore body and in the 12-million ton Cliff ore body averaged 32 percent TiO_2 and 36 percent Fe. Mining in 1951 was confined to the Main ore body, where 25-foot benches expose massive, solid ilmenite faces with very little waste interspersed. The Quebec Iron & Titanium Corp. mined and crushed 342,000 long tons of iron-titanium ore in 1951, during the mining and shipping season that began in April and ended in November. Of this amount, 332,000 tons was shipped from the mine to the smelter by the 550-mile waterway from Havre St. Pierre to Sorel. From initial production in October 1950 to the end of 1951 some 473,000 tons of ore was delivered from the mine to smelter stockpiles.

[16] Mining Engineering, vol. 4, No. 2, February 1952, p. 172.
[17] Chemical Engineering and Mining Review, vol. 44, No. 4, Jan. 10, 1952, p. 148.
[18] Chemical Engineering and Mining Review, vol. 43, No. 12, Sept. 10, 1951, p. 468.
[19] Chemistry and Industry, No. 51, Dec. 22, 1951, p. 1133.
[20] Queensland Government Mining Journal, vol. 52, No. 594, Apr. 20, 1951, p. 300.
[21] Metal Bulletin, No. 3631, Oct. 5, 1951, p. 18.
[22] Metal Bulletin, No. 3578, Mar. 23, 1951, p. 16.
[23] Pinto, Mario Da Silva, As Perspectivas Da Mineracao No Brasil: Republica Dos Estados Unidos do Brasil Boletim 86, 1950, p. 38.

Ilmenite ore was smelted to produce a titanium-rich slag running about 70 percent or more TiO_2 and an iron product at the Quebec Iron & Titanium Corp. Sorel plant. The electric furnaces at this plant were box-shaped, steel-framed, refractory-lined units containing 6 graphite electrodes in line; 224 and 390 volts of power supplied through Amplidyne controls constantly adjusted the elevation of the graphite electrodes to maintain proper temperature and arc voltage. The capacity of each furnace was 300 long tons of ore per day. This was blended with about 43 tons of coal fed on a continuous basis to produce 132 tons of titanium slag and 96 tons of refined iron per day. Titanium slag was tapped off periodically into a cast-steel slag pot and transferred by crane to a tilting mechanism for further refining. Molten iron was also tapped periodically at a 12-hour-cycle per furnace and transferred from the smelter by a 60-ton ladle and crane to the 60-ton electric arc-type refining furnaces.

From initial operation of the first furnace on an experimental basis in October 1950 to the end of 1951 a total of 46,676 long tons of ore was treated, which yielded 16,555 long tons of iron and 19,446 long tons of titanium slag. Titanium-slag production and shipments in 1951 totaled 17,438 and 7,176 long tons, respectively. Titanium slag was shipped in trial lots during 1951 to the pigment industry, of which the United States received 7,076 long tons and England the remaining 100 tons. No titanium slag was shipped in 1950.

Expenditures in the Q. I. T. project to January 1, 1952, totaled some $34.4 million, including $4.8 million for exploration, development, mine property, and construction at the mine at Allard Lake; $7.7 million for the 27-mile railroad from the mine to Harve St. Pierre Terminal; and $18.6 million for construction and experimental operations at the smelter at Sorel.[24]

A surface showing of ilmenite was staked in the St. Adele-St. Agathe district about 50 miles northeast of Montreal. Widths of up to 250 feet were noted, and the assays of two samples taken from the find showed 21 and 12 percent TiO_2, respectively, with iron contents of 48 and 23 percent.[25]

Another recent discovery of titanium-bearing ore was reported in 1951 at Ivry, Canada, north of Montreal. The Ivry deposit contains approximately 1 million long tons of titanium-bearing ore.[26]

Ceylon.—The Government of Ceylon planned a beach mineral plant in 1951 for refining beach mineral sands. Extensive deposits of ilmenite, rutile, and zircon were found at Pulmodai on the northeast coast of Ceylon. The chief product of the plant will be ilmenite, with appreciable amounts of rutile and zircon as byproducts.[27]

India.—A new metallurgical laboratory was completed during 1951 in Jamshedpur upon 26 acres of land donated by Tata Industries, Ltd. Financial assistance for the construction of this laboratory was given by the Indian Government, Sir Ratan Tata Trust, Sardar Bahadur Sir Indra Singh, and others. The working functions of the laboratory include fundamental and applied metallurgical research on titanium ores, minerals, and refractories. Statistical studies,

[24] Knoerr, Alvin W., World's Major Titanium Mine and Smelter Swing into Full-Scale Production: Eng. and Min. Jour., vol. 153, No. 3, March 1952, pp. 72–79.
[25] Northern Miner, vol. 37, No. 13, Sec. 1, June 21, 1951, p. 9.
[26] Foreign Commerce Weekly, vol. 45, No. 4, Oct. 22, 1951, p. 20.
[27] Mining Journal, Ann. Rev. No., May 1951, p. 119.

chemical analysis, physics, the treatment of ores and alloys, metal structure, processing, electrodeposition, and corrosion are a few of the subjects the laboratory intends to cover.[28]

The Government of India fixed an annual overall quota for rutile exports in 1951. The issue of rutile licenses was considered by the Deputy Chief Controller of Exports, Custom House, Madras, India, on receipt of applications supported by a no-objection certificate from the Travancore-Cochin Government, a certificate from the Director of Geology to the effect that the consignment of rutile exported was free from monazite, and a treasury chalan in proof of payment of the appropriate application fees.[29]

Extensive deposits of high-quality ilmenite sands containing up to 50 percent titanium dioxide were found in Ratnagiri district, Bombay. Exploitation of the ore was to begin in the coastal village of Malgund, about 300 miles south of Bombay, at the rate of about 1,500 long tons per year, production to increase up to 5,000 tons. India produced 143,174 metric tons of ilmenite in 1951, most of which was mined in the southwest coastal State of Travancore.[30]

Japan.—The Osaka Special Steel Co. produced charcoal pig iron and titanium slag containing 50 percent TiO_2 by processing iron sands in an electric furnace. A laboratory method for producing metallic titanium from slag was announced by this company in 1951, with the following basic operations: (1) Reduction of iron sand in an electric furnace producing charcoal pig iron and titanium-bearing slag; (2) chlorination of slag, producing titanium tetrachloride; (3) purification of the titanium tetrachloride; (4) reduction of the titanium tetrachloride with magnesium and vacuum distillation to produce metallic titanium.[31]

The estimated ore reserves in the beach sands of Japan totaled about 10 million long tons, averaging 30 to 35 percent Fe and 5 to 10 percent TiO_2. These sands were concentrated in a Mitsubishi wet magnetic separator equipped with a permanent magnet. The concentrates ran about 55 percent Fe, 12 percent TiO_2, and 0.2 to 0.3 percent V_2O_5.[32]

The Nittetsu Mining Co. treated beach sands and obtained about 1,200 tons of concentrates monthly. At another location on the coast of Japan the Misawa Steel Co. produced about 3,000 tons of black sand per month, averaging 35 percent iron and 8 percent titanium oxide. The Kawaaki Steel Co. also recovered black sands. All work of excavating the black sands was done by hand and portable log washers.[33]

Norway.—The only producer of ilmenite in Norway in 1951 was the Sokndal mine on the southwestern coast between Egersund and Flekkefjord. The ore, which contained 17 percent TiO_2 and 20 percent Fe, was concentrated by magnetic separation to an ilmenite concentrate that contained 44 percent TiO_2 and 36 percent Fe and a magnetic

[28] Chemical Age, Progress in India: Vol. 64, No. 1652, Mar. 10, 1951, p. 390.
[29] Rossow, Robert J., Procedure for Export of Rutile From Travancore-Cochin State: Consular Rept., Am. Embassy, Madras, India, Reference 907, Despatch 75, July 21, 1951 (unpublished).
[30] Metal Industry (London), India: Vol. 79, No. 12, Sept. 21, 1951, p. 247.
[31] Engineering and Mining Journal, Japanese Plan to Produce Titanium: Vol. 152, No. 11, November 1951, p. 104.
[32] Mineral Trade Notes, Beach Sands: Vol. 33, No. 3, August 1951, pp. 13–14.
[33] Skillings' Mining Review, Black Sands on Japan's Coast Contain Iron and Titanium: Vol. 60, No. 39, Jan. 5, 1952, p. 5.

concentrate that contained 66 percent Fe and 3 percent TiO_2. The annual capacity of the plant was reported in 1951 to be 100,000 long tons of ilmenite concentrate and 20,000 tons of magnetite concentrate. The deposit covers 75,000 square meters. Reserves to a depth of 100 meters below the present main level in the mine were calculated at 30 million tons of ore averaging 17 percent TiO_2.[34]

Union of South Africa.—A survey report by the Titanium Corp. of South Africa, Ltd., on the Umgababa area of Natal stated that there were 2,000,000 long tons of ilmenite ore containing 48 to 52 percent TiO_2, 200,000 tons of zircon, and 100,000 tons of rutile containing 94 to 97 percent TiO_1 in the claim area. This corporation intended to mine and export these minerals and also erect a pilot plant for the manufacture of titanium dioxide pigments. The Umgababa area reportedly presented no technical difficulties in transportation or electrical facilities, as railroads, highways, sealanes, and power lines are nearby.[35]

Deposits of ilmenite sand were reported at Natal, Swakopmund, and Bushveld Complex and smaller deposits containing 9 to 25 percent TiO_2 in the Tugela Valley below the Middle Duft in Zuzuland. An analysis of the Natal Coast sands indicated that ilmenite makes up 70 to 85 percent of the heavy minerals present, which ranged from 5 to 90 percent. The reserves of these ilmenite coastal sands were very large; however, some large areas were unworkable owing to town-land restrictions and high cost of land associated with seaside resorts. Random sampling of Swakopmund ilmenite sands along the West Coast indicated that heavy minerals ranged from 4 to 87 percent of the sand. Possible utilization of South African titanium resources, location and nature of titanium deposits, methods of processing titanium ore, metallurgical developments, and 60 references on titanium were reported in 1951.[36]

United Kingdom.—The Imperial Chemical Industries, Ltd., in 1951 led all British titanium metal producers so far as being able to offer titanium metal commercially. Work on titanium sponge was done at Widnes, whereas ingot and wrought forms were produced at Witton. Annual output was reported to be about 11 long tons, the bulk of which was absorbed by aircraft engine manufacturers. The price of titanium sponge was quoted in 1951 as about 50/d. ($7.00) per pound, ingot at £5 ($14.00) per pound, and products around £6 ($16.80) and upward.[37]

The British Titan Products, Ltd., manufacturer of titanium oxide pigments, maintains plants at Billingham County, Durham, and at Grimsby. The Billingham plant, originally planned for production of 2,000 tons of anatase-type titanium oxide per year, increased its annual production in 1951 to 16,000 tons per year. The Grimsby plant, completed in January 1949, received permission in April 1950 to double its production capacity of rutile-type titanium oxide from 12,000 to 24,000 tons per year. It was anticipated that at the end of

[34] Bureau of Mines, Mineral Trade Notes: Vol. 33, No. 2, August 1951, p. 24.
[35] Seddicum, Paul C., Opportunity for Private Investment. Mining of Titanium: Consular Rept., Am. Embassy, Durban, South Africa, Despatch 126, Jan. 16, 1952 (unpublished).
[36] Frankel, J. J., Schady, A. M., and Du Plessis, D. J., Titanium—A Critical Review, With Special Reference to the Utilization of South African Resources: Jour. Chem., Met. and Min. Soc., South Africa, vol. 52, No. 3, September 1951, pp. 39–57.
[37] Metal Bulletin, Metal at British Industries Fair: No. 3693, May 16, 1952, p. 22.

1952 total anatase- and rutile-type titanium oxide production by this company would be about 40,000 tons per year. This expansion to the existing Grimsby plant was expected to be completed by the middle of 1952 at a cost of more than £1,500,000 ($4,200,000). The cost will include a 140-ton-per-day acid plant operating on pyrites, and it will incorporate the first flash roaster unit in the country.[38]

Prices of titanium pigments increased in February 1951 for the first time in 2 years, principally because of increased manufacturing and raw-material costs. In July 1951 the new basic price of rutile-type titanium oxide was £133 ($372.40) per ton, and the anatase type £115 ($322.00) per ton.[39]

Changes in United Kingdom tariff laws were made in September 1951 as a consequence of the tariff concessions agreed upon by the United Kingdom during the conference at Torquay, allowing the titanium dioxide rate of duty to drop to 15 percent from the previous rate of 20 percent. This rate was chargeable on and after September 1, 1951.[40]

Western Germany.—Titangesellschaft, m. b. H. reported the construction of an additional production unit to its titanium dioxide plant at Leverkusen, West Germany. War damage that destroyed 80 percent of the prewar capacity at this plant was repaired in the latter part of 1949; however, 1951 output of titanium dioxide pigment was not sufficient to meet domestic demand. Therefore, titanium dioxide was not available for export in 1951.[41]

[38] Chemistry and Industry, British Titan Products, Ltd.: No. 38, Sept. 22, 1951, pp. 788–790.
[39] Chemical Age, vol. 64, No. 1667, June 23, 1951, p. 964.
[40] Chemical Age, vol. 65, No. 1670, July 14, 1951, p. 55.
[41] Chemical and Engineering News, German Titanium Plant To Be Doubled: Vol. 29, No. 12, Mar. 19, 1951, p. 1136.

Tungsten

By Robert W. Geehan and Charles Katlin

GENERAL SUMMARY

DURING 1951 production of tungsten concentrates reached the highest level since 1944, and consumption exceeded all years since 1945. The first half of 1951 was a critical period, with consumption exceeding production and imports; however, during the latter half of the year the import rate increased materially, and drawdown of inventories as a means to cover excess consumption was no longer necessary. The Government instituted drastic restrictions on the use of tungsten, provided a long-term program designed to stimulate domestic production, and began to purchase foreign concentrates for resale to industry. The price of tungsten concentrates increased. In April the domestic ceiling price was set at $65 per short-ton unit,[1] but foreign prices reached levels well above this point.

TABLE 1.—Salient statistics of tungsten concentrates in the United States,[1] 1947–51, in pounds of contained tungsten

Year	Production	Shipments from mines	Imports for consumption	Consumption	Industry stocks at end of year		
					Producers	Consumers and dealers	Total
1947	3,026,470	2,944,622	6,018,005	7,812,000	368,316	3,343,392	3,711,708
1948	4,033,389	3,838,287	7,548,101	8,853,000	563,418	5,284,901	5,848,319
1949	2,896,084	2,631,506	6,274,102	4,958,000	827,045	4,229,444	5,056,489
1950	3,965,040	4,587,687	16,147,313	6,597,000	216,468	5,121,206	5,337,674
1951	5,913,750	5,972,551	6,376,513	11,410,000	234,282	4,037,502	4,271,784

[1] Includes Alaska.

Domestic production increased 49 percent over 1950. California was again the leading tungsten-producing State, followed by Nevada and North Carolina. The Pine Creek mine of United States Vanadium Co. retained first place among United States producers of tungsten.

General imports and imports for consumption were both less in 1951 than in 1950. Noteworthy were the decrease in shipments (general imports) from Korea from 2,345,000 pounds (metal content) in 1950 to 905,000 pounds in 1951 and the increase in shipments from Spain and Portugal from 136,000 pounds (metal content) in 1950 to 1,816,000 pounds. General imports were well below average during the first half of 1951; and in February amounted to only 228,000 pounds (metal content) as contrasted with the average monthly receipt of 628,000 pounds for the year.

[1] A short-ton unit equals 20 pounds of tungsten trioxide (WO_3) and contains 15.862 pounds of tungsten (W). A short ton of 60-percent WO_3 contains 951.72 pounds of tungsten

Consumption of concentrates (60-percent WO_3 basis) in the United States was 11,989 short tons in 1951, compared with 6,932 tons in 1950. The trend toward increased use of tungsten carbide and other products produced from tungsten metal powder continued in 1951.

Industry stocks of tungsten concentrates (60-percent WO_3 basis) were 4,488 short tons on December 31, 1951, compared with 5,608 tons at the end of 1950.

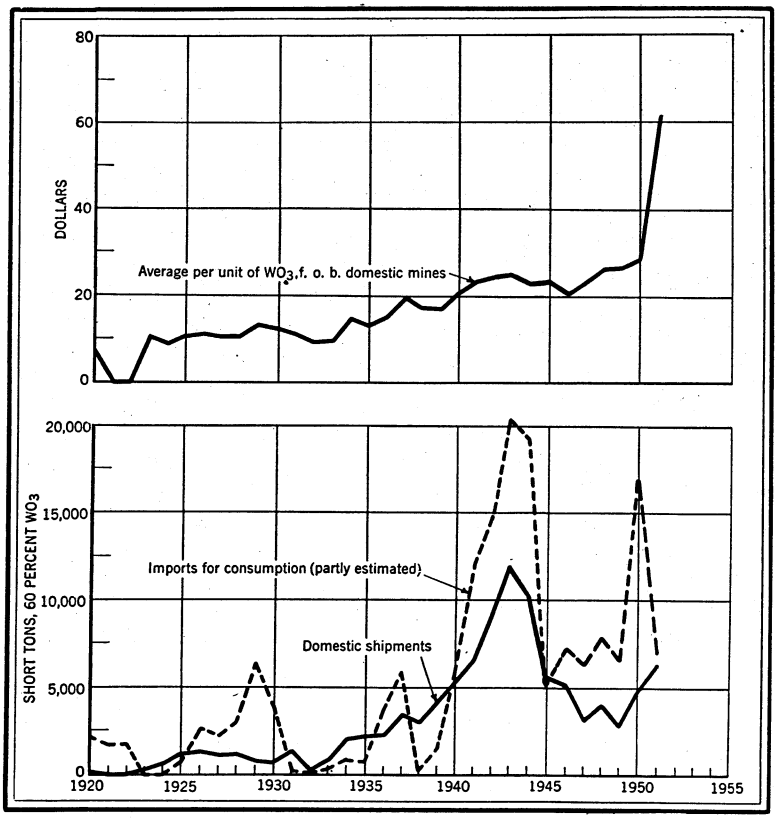

FIGURE 1.—Domestic shipments, imports, and average price of tungsten ores and concentrates, 1920–51.

GOVERNMENT REGULATIONS

To stimulate domestic production, General Services Administration announced a domestic tungsten program to be carried out in accordance with a policy determination made by Defense Minerals Administration and Defense Production Administration. The original program announced May 10, 1951, provided for the purchase of standard-grade tungsten concentrates by the Government at $63 per short-ton unit for 5 years or until 1,468,750 units were purchased. On June 20, 1951, it was amended to provide for termination of the

program when 3,000,000 short-ton units had been delivered or on July 1, 1956, whichever occurred first. The program contained a penalty schedule which outlined deductions from the base price of $63 for offgrade concentrates. On December 27, 1951, the schedule was modified to provide a higher allowance for molybdenum without penalty.

Defense Minerals Administration issued Orders MO–4 and MO–6 regarding the allocation of tungsten concentrates. The National Production Authority issued Orders M–30, M–80, and M–81 covering allocation and use of tungsten products. The Office of Price Stabilization announced several orders affecting tungsten; among these are GCPR–SR 42, CPR–19, CPR–33, and GOR–9. At the end of 1951 the following ceiling prices were in effect:

Tungsten concentrates, $65 per short-ton unit.
Ferrotungsten, $5 per pound of contained tungsten (in lots of 10,000 pounds or more).
Carbon-reduced tungsten metal powder, $6 per pound.
Hydrogen-reduced tungsten powder, $7.75 per pound.
Tungstic acid, $4.30 per pound (in 1,000-pound lots).
Tungstic oxide, $4.65 per pound (in 1,000-pound lots).
Ammonium paratungstate, $4.15 per pound (in 1,000-pound lots).
Sodium tungstate crystals, $3.15 per pound (in 250-pound lots).
Anhydrous sodium tungstate, $3.55 per pound (in 255-pound lots).

The International Materials Conference was established early in 1951 to cope with international problems relating to scarce materials. A Tungsten-Molybdenum Committee was formed. This committee announced agreements regarding tungsten that had been approved by the member Governments. During the third quarter all member producing and consuming nations, except Brazil, agreed that producing nations would not demand a price higher than $65 per short-ton unit and that importing nations would pay at least $55 f. o. b. port of shipment. There was no similar agreement during the fourth quarter. For the third and fourth quarters, international quotas were announced; the United States was allotted 44.8 and 47.8 percent, respectively, of the estimated free world production.

DOMESTIC PRODUCTION

The tungsten ore mined and milled in the United States, in general, contains 0.3 to 2.5 percent WO_3 and is usually beneficiated to a concentrate containing 60 percent or more WO_3. The leading tungsten producers in the Western States depend on ore containing tungsten only as scheelite (calcium tungstate). Hübnerite (manganese tungstate) is the chief tungsten mineral in ores produced in North Carolina and is also important in Idaho and Colorado deposits. Wolframite (iron-manganese tungstate) and ferberite (iron tungstate) contributed only minor quantities of the tungsten ore mined in 1951. Some concentrates are treated by chemical processes to remove impurities; still others are dissolved and reprecipitated as synthetic scheelite. Most of the concentrates are then shipped to plants for conversion to ferrotungsten or tungsten powder. However, some high-purity scheelite concentrates are sent to steel plants, where they are charged directly to the steel bath.

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During 1951 many producers expanded the capacity of mines and surface plants, and output of concentrates (60 percent WO_3 basis) increased to 6,214 tons in 1951 compared with 4,166 tons in 1950.

TABLE 2.—Tungsten concentrates produced and shipped in the United States, 1950–51, by States [1]

State	Produced				Shipped from mines			
	1950		1951		1950		1951	
	Short tons (60 percent WO_3 basis)	Units	Short tons (60 percent WO_3 basis)	Units	Short tons (60 percent WO_3 basis)	Units	Short tons (60 percent WO_3 basis)	Units
Alaska			1	60	13	787	10	606
Arizona	1	24	15	919	1	24	11	655
California	1,686	101,200	2,495	149,694	2,025	121,492	3,007	180,402
Colorado	197	11,805	326	19,565	196	11,802	336	20,188
Idaho	185	11,095	401	24,044	222	13,346	377	22,636
Missouri	(2)	18			(1)	18		
Montana							1	44
Nevada	1,009	60,558	1,922	115,307	1,123	67,363	1,482	88,916
North Carolina	1,088	65,271	1,035	62,078	1,240	74,393	1,041	62,463
Oregon			1	43			1	43
Utah			(2)	21			(2)	9
Washington			18	1,094			9	570
Total	4,166	249,971	6,214	372,825	4,820	289,225	6,275	376,532

[1] Production is credited to the State where ore was mined. Shipments are credited to the State where final concentrates were produced.
[2] Less than 0.5 ton.

TABLE 3.—Tungsten concentrates shipped from mines in the United States,[1] 1947–51

Year	Quantity		Reported value f. o. b. mills [2]		
	60 percent WO_3 basis (short tons)	Tungsten content (pounds)	Total	Average per unit of WO_3	Average per pound of tungsten
1947	3,094	2,944,622	$4,349,851	$23.43	$1.48
1948	4,033	3,838,287	6,355,386	26.27	1.66
1949	2,765	2,631,506	4,377,066	26.38	1.66
1950	4,820	4,587,687	8,170,924	28.25	1.78
1951	6,275	5,972,551	22,976,028	61.02	3.85

[1] Includes Alaska.
[2] Values apply to finished concentrates.

Production in 1951 was obtained from many widely scattered operations in 9 States and Alaska, but 3 States—California, Nevada, and North Carolina—supplied 88 percent of the total; and 8 operators—Bradley Mining Co., Climax Molybdenum Co., Getchell Mine, Inc., Nevada-Massachusetts Co., Nevada Scheelite, Inc., Surcease Mining Co., Tungsten Mining Corp., and United States Vanadium Co.—produced 87 percent of the United States total. California was again the premier tungsten-producing State, and Nevada the second largest.

Alaska.—Rocky Mountain Mining Co. (near Nome), Russell R. Schaefer (Crooked Creek), and United States Tin Co. (Lost River) produced small quantities of tungsten concentrates.

Arizona.—There was a marked increase in activity at tungsten deposits in Arizona during 1951; reports indicate 18 operators as contrasted with only 2 in 1950.

George W. Campbell & Sons produced 2 tons of concentrates from the Blue Eagle claims in Yuma County. L. G. Fernstrom & Co. reported the construction of a 25-ton mill and production of 1.5 tons of concentrates from Las Guijas mine in Pima County. An output of 2 tons of concentrates came from the J. F. Moore mine in Mohave County. Nikas Mining Co. mined 600 tons of ore from the Morning Star mine; much of this was shipped to a custom mill. K. Short reported production from the Boriana deposit in Mohave County.

TABLE 4.—Tungsten concentrates shipped from mines in the United States, 1946–51, shipments for maximum year, and total shipments, 1900–51, by States, in short tons of 60 percent WO_3[1]

State	Maximum shipments		Shipments by years							Total shipments, 1900–51	
	Year	Quantity	1946	1947	1948	1949	1950	1951 Quantity	1951 Percent of total	Quantity	Percent of total
Alaska	1916	47	19	13			13	10	0.16	200	0.15
Arizona	1936	489	20	13	23	[2]	1	11	.17	3,925	2.87
California	1943	3,871	1,262	394	1,767	952	2,025	3,007	47.92	42,436	30.99
Colorado	1917	2,707	213	68	208	222	196	336	5.35	25,588	18.68
Connecticut	1916	3								11	.01
Idaho	1943	4,648	641	61	86	66	222	377	6.01	15,959	11.65
Missouri	1940	13			4	2	[2]			37	.03
Montana	1946	84	84	4	28	9		1	.02	546	.40
Nevada	1942	3,052	2,617	2,002	949	740	1,123	1,482	23.62	40,048	29.24
New Mexico	1915	45								103	.08
North Carolina	1950	1,240	307	538	965	770	1,240	1,041	16.59	5,219	3.81
Oregon	1949	3				3		1	.02	4	[3]
South Dakota	1917	270	1							1,296	.95
Texas	1946	1	1							1	[3]
Utah	1917	33	27	1	3	1		[2]	[3]	239	.17
Washington	1938	303	1					9	.14	1,335	.97
Total	1943	11,945	5,193	3,094	4,033	2,765	4,820	6,275	100.00	136,947	100.00

[1] Shipments are credited to the State where final concentrates were produced.
[2] Less than 0.5 ton.
[3] Less than 0.01 percent.

California.—With a 48-percent increase in output, California again was the major tungsten-producing State. Production in 1951 was 2,208 short tons of concentrates averaging 68 percent WO_3, compared with 1,468 tons averaging 69 percent WO_3 in 1950. Shipment of concentrates totaled 2,590 short tons averaging 70 percent WO_3, compared with 1,751 tons averaging 69 percent WO_3 in 1950. Concentrates produced at Pine Creek from ores and low-grade concentrates produced in other States are not included in the California production but are included in shipments. Of the 119 tungsten producers in the State, 5 (Black Rock Mining Corp., Fresno Mining Corp., Mineral Materials Co., Surcease Mining Co., and United States Vanadium Co.) supplied 92 percent of the total production. Other important

producers were Don Burgner, Consolidated Tungsten Mine, Garnet Dike Mine, Hanging Valley Tungsten Co., Huntley Industrial Minerals, Inc., R. D. Morris, Sherman Peak Mining Co., and Tulare County Tungsten Mines.

The United States Vanadium Co. Pine Creek mine and concentrator near Bishop again was the leading producer of tungsten concentrates in the United States in 1951 and also treated a large quantity of ore and concentrates produced by other firms. Total production of concentrates was 74 percent higher than in 1950, while the output of the Pine Creek mine increased 25 percent. Mine development during 1951 included driving 2,700 feet of raises and 2,300 feet of drifts and crosscuts. The company completed a separate crushing, conveying, and sampling plant, with a capacity of 1,000 tons in 8 hours, to treat custom ores.[2]

Black Rock Mining Corp. resumed operations at the Black Rock mine near Bishop from which it mined 42,287 short tons of tungsten ore which was shipped to the United States Vanadium Co. concentrator nearby.

Surcease Mining Co. produced 194 short tons of concentrates at its plant near Atolia, a 14-percent increase over its 1950 total. The Star Bright mine, operated by Mineral Materials Co., produced 105 tons of concentrates, a 134-percent increase over the 1950 output.

Fresno Mining Co. increased production of concentrates during 1951 at the Strawberry mine near Fresno to 90 short tons. A new flotation unit was installed to treat tailings, and new ore bodies were being developed in the No. 4 mine. The Garnet Dike mine, also near Fresno, increased its output of tungsten concentrates by 80 percent over the 1950 quantity. The Alpine mine in Alpine County, idle in 1950, mined and treated 2,225 tons of ore during 1951 under the operation of R. D. Morris. The Shamrock mine in Inyo County was a new producer.

Consolidated Tungsten mine, a division of Kennametal, Inc., operated the Harrel Hill mine in Tulare County. The Hanging Valley Tungsten Co. reported production of 12 tons of concentrates in a 2-month operative period at the Hanging Valley mine near Bishop in 1951; during 1950 this mine was idle. Development at this deposit in 1951 included driving a new 120-foot adit.

Huntley Industrial Minerals, Inc., extracted 10 tons of concentrates from ore and tailings at the Huntley mines near Bishop; the mine was not worked during 1950. Production more than double the 1950 output was achieved by the Sherman Peak Mining Co. from the Sherman Peak and Hill Top mines. Tulare County Tungsten Mines production from the Big Jim mine in 1951 was 16 tons of concentrates; the mine was core drilled during 1951. A 50-ton mill was installed by the Good Hope Mining Co. at the Pioneer mines and Good Hope claim in Tulare County, Calif.

Colorado.—Tungsten concentrates produced and shipped in 1951 totaled 317 short tons averaging 62 percent WO_3, and 322 tons averaging 63 percent WO_3, respectively; 1950 production and shipments were 176 tons averaging 67 percent. There were 41 producers of tungsten in Colorado in 1951, but only 5 produced over 6 tons of concentrates.

[2] McKinley, H. L., Holmes, T. W., and Sausa, L. E., How U. S. V.'s Pine Creek Mine Will Increase Tungsten Output: Eng. and Min. Jour., vol. 152, No. 5, May 1951, pp. 76–83.

The byproduct plant of the Climax Molybdenum Co. at Climax, Lake County, designed to recover valuable minerals occurring in minute amounts in the molybdenite ore treated contributed the major portion of Colorado's production of tungsten concentrates in 1951. The following data have been abstracted from the firm's Annual Report for the year 1951:

During the year 1951 the company produced approximately 259,000 pounds of tungsten contained in the form of concentrate. This compared with 162,000 pounds during 1950. Research to improve recoveries of tungsten has been moderately successful and will be continued. The combination of greater capacity and improved recoveries should result in substantially increased production during 1952.

There was also a byproduct recovery of pyrite, tin concentrate, monazite, and topaz.

Hetzer Mines, Inc., recovered 24 short tons of concentrates from ferberite ores shipped to its mill near Nederland by lessees of Hetzer Mines properties and others. Johnson Bros. & Prime, operating the Hoosier mine near Nederland, produced 15 tons of concentrates in 1951 and completed 250 feet of drifting during the year on the 225-foot level. Vanadium Corp. of America leased the Hetzer mill in November 1951 and produced some concentrates there during the last 2 months of the year. Cobb and Weldon produced tungsten concentrates from various properties leased from Hetzer Mines, Inc.

Idaho.—In 1951 the Bradley Mining Co. produced 216 tons of hübnerite concentrate from the Ima mine, Lemhi County; this presented an increase of 99 percent over 1950. Considerable scheelite was obtained from its Yellow Pine mine, Valley County, as a byproduct in antimony-gold ore operations and from the Ima mine as a coproduct of the hübnerite.

The McRae Tungsten Corp. drove 150 feet of drift at the Snowbird mine. Small quantities of concentrate were produced by M. W. Hickman & A. W. Kelsey, of Riggins, and by Walter Schmitroth, of Smelterville.

Montana.—The only reported production was the mining of 300 tons of ferberite ore by the Alps Mining & Milling Co. from the Harvey Creek Argo Group mine in Granite County. A small quantity of concentrates was shipped by H. & H. Mines from the Henderson Creek mine in Granite County.

Nevada.—With a 90-percent increase over 1950 in its output of tungsten concentrates, Nevada moved up to the second-place position as a tungsten-producing State in 1951. Shipments totaled 1,271 short tons of tungsten concentrates averaging 70 percent WO_3 compared with 883 tons averaging 76 percent WO_3 the previous year. (Much low-grade concentrate was beneficiated at plants in other States before final shipment.) There were 32 tungsten producers in 1951, but 5 (Gabbs Exploration Co., Getchell Mine, Inc., Lindsay Mining Co., Nevada-Massachusetts Co., and Nevada Scheelite) supplied 95 percent of the total production of tungsten concentrates.

The Nevada-Massachusetts Co. retained first place among Nevada tungsten producers. The company recovered 627 tons of concentrates from its Mill City operations; mining was carried on steadily

at the Stank, Humboldt, and Sutton No. 2 underground mines, as well as in open pits. Improvements were made in the crushing plant, and alterations were being effected in the milling plant to increase capacity and efficiency.

Getchell Mine, Inc., idle in 1950, derived the second largest tungsten production in the State during 1951 from 121,000 short tons of ore taken from the Getchell mine near Winnemucca. Toward the end of the year an increasingly efficient flotation operation raised the general grade of the concentrate considerably. The Getchell mill treated 18,800 tons of custom ore. Lindsay Mining Co., operating the Gunmetal mine in Mineral County, produced 61 tons of concentrates and custom-milled a small additional quantity; the mine was idle in 1950.

Gabbs Exploration Co. had a considerable production of tungsten concentrates from the mine of the same name in Nye County. The Nevada Scheelite mine in Mineral County became a division of Kennametal, Inc.; the mine yield of concentrates in 1951 increased 39 percent over the previous year's output. During the year the shaft was sunk an additional 100 feet to the 400-foot level, and drifts were driven from there. A production of 34 tons was obtained from El Capitan mine in Nye County, operated by Gordon Smith. The Stormy Day mine, operated by John B. Mayfield, produced 6 tons of concentrates; developments included a 200-foot exploration tunnel and a 60-foot winze.

Other notable producers of tungsten concentrates were Boundy and Claghorn, of Cherry Creek; Cherry Creek Mining Co. operating the Cherry Creek mine in White Pine County; Minerva Scheelite Mining Co., of Ely; Nevada Tungsten Corp. operating the Silver Dyke mine in Mineral County; and Fred Vollmer.

A considerable quantity of tungsten ore was mined by the Valley View Mining Co. from the mine of the same name near Winnemucca. Nevada Mining Co. operating the Mountain King claim near Red House, Black Rock Mining Co. operating the Lincoln mine in Lincoln County, and Gale G. Peer operating the Conquest mine near Austin also produced sizable quantities of tungsten ore.

North Carolina.—In 1951 the Tungsten Mining Corp., sole tungsten operator in the State, produced 1,145 short tons of tungsten concentrate averaging 54 percent WO_3 from the Hamme mine in Vance County, compared with 1,086 tons averaging about 60 percent WO_3 in 1950. Shipments by the company totaled 1,135 tons averaging 55 percent WO_3 in 1951 as compared with 1,200 tons averaging 62 percent WO_3 in 1950. This firm produces a high-grade hübnerite concentrate along with some low-grade sheelite concentrate that is shipped to another firm for upgrading. During 1951 work included 16,019 feet of drilling and 9,023 feet of development. The Central shaft was deepened 258 feet to the 827-foot level, and the Sneed shaft was sunk from the 500-foot level to 785 feet. The milling plant capacity was being increased to 600 tons.

Utah.—The Beaver Tungsten Mines, Inc., sank 100 feet of shaft at its mine near Beaver. The Desert Tungsten Co. mined a small amount of ore from the Desert mine, Juab County. Small quantities of concentrates were shipped by Star Dust Mines, Inc., of Salt Lake City and D. G. Brush of Delta. Cecil R. Woodman produced a small

amount of tungsten concentrates from the Yellow Hammer mine, Tooele County.

Washington.—Germania Consolidated Mines, Inc., reported the production of 12 tons of concentrates, chiefly wolframite, from the Germania Consolidated mine in Stevens County near Fruitland. A small quantity of scheelite concentrate was produced by the Kelly Camp Tungsten Co. from the mine of the same name in Ferry County; new equipment included a ball mill and magnetic separator. Some concentrates were shipped by the Pacific Mining Co. of Spokane. The Tungsten Mining & Milling Co. produced a small amount of concentrates from the Germania mine in Stevens County near Wellpinit.

CONSUMPTION AND USES

Consumption of tungsten concentrates (60-percent WO_3 basis) in the United States was 11,989 short tons in 1951, compared with 6,932 tons in 1950. Of the total consumed in 1951, 2,310 tons (19 percent) was converted into ferrotungsten, the form in which much of the tungsten is introduced into steel. However, high-purity tungsten concentrates are charged directly to the steel bath; 1,300 tons (11 percent) was so used in 1951. Tungsten-metal powder and other tungsten products, chiefly the former, utilized 8,379 tons or 70 percent of the total concentrates consumed in 1951.

Changes in the use pattern of tungsten during the period 1942–51 are indicated in table 5. The increased use for "Metal powder and other" reflects growth in the tungsten carbide industry. Tungsten powder is the raw material from which nearly all tungsten carbide is produced.

TABLE 5.—Consumption of tungsten concentrates in the United States, 1942–51, by uses, in short tons of 60 percent WO_3

Year	Ferrotungsten		Direct to steel		Metal powder and other		Total
	Quantity	Percent of total	Quantity	Percent of total	Quantity	Percent of total	
1942	12,400	68	3,100	17	2,750	15	18,250
1943	12,300	61	2,900	14	5,100	25	20,300
1944	11,800	59	2,600	13	5,700	28	20,100
1945	7,400	50	2,000	13	5,500	37	14,900
1946	2,400	35	1,900	28	2,500	37	6,800
1947	3,800	46	1,400	17	3,000	37	8,200
1948	4,100	44	1,850	20	3,350	36	9,300
1949	2,472	47	838	16	1,900	37	5,210
1950	1,165	17	1,966	28	3,801	55	6,932
1951	2,310	19	1,300	11	8,379	70	11,989

PRICES

Late in January the General Ceiling Price Regulation was announced; this led to several sets of ceiling prices, depending on the dates of previous shipments. On April 6 a uniform ceiling price of $65 per short-ton unit was established; this was modified on May 1 by an announcement that tungsten concentrates of foreign origin were freed of price control when sold to any agency of the United States Government. Quotations listed in E&MJ Metal and Mineral Markets were $56.50 per short-ton unit at the start of the year and

$65 after February 1 for domestic concentrates, f. o. b. North Carolina. No quotations were published for western concentrates until April 6; after that date all domestic concentrates were listed at $65. Similar quotations for foreign concentrates (London prices) ranged from $50 at the start of the year to $78.75 on March 15, fluctuated in the range $65–$73 to July 19, held steady at $67 until December 20, and closed the year at $64.50 (all prices per short-ton unit, without duty). After the duty of $7.93 per short-ton unit is added to the foreign quotations, it is evident that no foreign tungsten could be imported at or below the ceiling price of $65 per short-ton unit after the April 6 date, when this ceiling price was announced. This situation prevented imports for consumption by private firms and led to sales to industry, at the ceiling price, of material imported by the Government.

As reported to the Bureau of Mines, the average price for domestic concentrates shipped was $61.02 a short-ton unit in 1951.

FOREIGN TRADE [3]

Domestic production is inadequate for requirements, and the United States imports both tungsten concentrates and products, chiefly the former. In 1951, the movement of tungsten concentrates from foreign sources to the United States was disrupted by factors discussed in the previous section. During the first 4 months of 1951 general imports averaged only 410,433 pounds, tungsten content, per month, and in February they were only 227,988 pounds; the average for 1950 was 695,166 pounds. Action by the Government, which included purchases of foreign tungsten concentrates for resale to industry and participation in the International Materials Conference, coupled with increased world production, reversed this trend, and average monthly general imports for the last 8 months of 1951 were 736,539 pounds.

In 1951 Portugal replaced Korea as the main source of imports of tungsten in ores and concentrates and contributed 1,280,000 pounds (general imports), as compared with 131,000 pounds in 1950; Korea dropped from first place to fourth and contributed 905,000 pounds in 1951, compared with 2,345,000 pounds in 1950. China, the most important source in many prior years, contributed only 34,000 pounds; this contrasts with 4,960,000 pounds in 1949.

Imports for consumption of tungsten metal, chiefly from United Kingdom, were 85,086 pounds (210,972 pounds in 1950). Imports for consumption of ferrotungsten, chiefly from Japan, were 2,018,035 pounds (gross weight) containing 1,574,187 pounds of tungsten (1,379,979 pounds tungsten content in 1950). Imports of tungstic acid, chiefly from Japan, contained 2,810 pounds of tungsten. Imports of ferrochromium tungsten contained 114 pounds of tungsten.

In 1951, there were reexports of 16 tons (gross weight) of tungsten ore and concentrate and no exports, compared with 328 and 7 tons, respectively, in 1950. Exports of ferrotungsten were 283,701 pounds (gross weight) in 1951 (332,705 pounds in 1950). Exports of tungsten metal, stellite, wire, shapes, and alloys other than ferrotungsten were 248,054 pounds (gross weight) in 1951 (151,968 pounds in 1950).

[3] Figures on imports and exports compiled by M. B. Price and E. D. Page, of the Bureau of Mines, from records of the U. S. Department of Commerce.

TABLE 6.—Tungsten ores and concentrates imported into the United States, 1950–51, by countries

[U. S. Department of Commerce]

Country	General imports [1]		Imports for consumption [2]		
	Gross weight (pounds)	Tungsten content (pounds)	Gross weight (pounds)	Tungsten content (pounds)	Value
1950					
Argentina	536, 122	302, 966	30, 697	15, 973	$20, 085
Australia	999, 398	517, 018	816, 010	467, 787	429, 708
Belgian Congo	722, 587	405, 895	431, 481	236, 501	188, 590
Belgium-Luxembourg	2, 000	1, 231	2, 000	1, 231	1, 475
Bolivia	3, 034, 464	1, 305, 669	3, 222, 711	1, 784, 092	1, 795, 518
Brazil	1, 336, 776	753, 807	1, 435, 021	810, 149	930, 753
Burma	168, 310	81, 882	217, 766	120, 925	115, 216
Canada	2, 000	507	41, 199	10, 012	16, 480
China	796, 162	394, 441	13, 457, 528	7, 439, 167	6, 854, 002
Hong Kong	24, 300	2, 673			
Japan	770, 416	453, 862	950, 516	541, 672	563, 704
Korea	4, 708, 793	2, 344, 505	4, 667, 571	2, 481, 707	2, 257, 907
Mexico	154, 808	80, 721	377, 655	218, 112	208, 897
Mozambique	5, 488	2, 988			
Netherlands	15, 646	10, 799	95, 752	56, 668	51, 061
New Zealand	44, 068	22, 718	42, 269	22. 718	28, 272
Peru	1, 014, 126	559, 127	1, 007, 747	559, 077	457, 513
Portugal	253, 158	130, 880	281, 118	147, 983	256, 931
Spain	9, 211	4, 956	234, 880	155, 418	146, 054
Switzerland	220	176			
Thailand	1, 725, 683	952, 376	1, 879, 163	1, 043, 973	954, 281
Union of South Africa	22, 692	12, 801	61, 249	34, 148	32, 953
Total	16, 346, 428	8, 341, 998	29, 252, 333	16, 147, 313	15, 309, 400
1951					
Argentina	22	17	507, 086	295, 423	598, 538
Australia	1, 688, 160	884, 295	1, 563, 897	846, 631	2, 443, 617
Belgian Congo	188, 448	105, 047	55, 382	30, 746	72, 462
Bolivia	2, 287, 352	948, 169	1, 404, 312	692, 588	2, 010, 237
Brazil	1, 884, 736	1, 071, 396	1, 079, 661	618, 899	1, 156, 380
British East Africa	35, 663	19, 096	35, 663	19, 096	46, 339
Burma	488, 950	248, 538	576, 921	289, 296	275, 255
Chile	982	533	982	533	2, 151
China	58, 006	33, 522	35, 967	18, 175	43, 435
Japan	113, 380	65, 108	283, 467	155, 692	295, 512
Korea	1, 721, 923	904, 810	1, 323, 974	705, 131	2, 450, 548
Mexico	520, 663	231, 897	345, 943	152, 017	526, 148
New Zealand	2, 548	1, 313			
Peru	788, 725	431, 198	634, 537	345, 894	647, 539
Portugal	2, 424, 060	1, 279, 872	1, 897, 109	997, 570	3, 552, 367
Spain	1, 004, 690	536, 117	877, 813	468, 653	1, 948, 732
Thailand	1, 427, 230	772, 470	1, 367, 873	739, 519	1, 360, 567
Union of South Africa	1, 000	650	1, 000	650	1, 900
Total	14, 636, 538	7, 534, 048	11, 991, 587	6, 376, 513	17, 431, 727

[1] Includes ores and concentrates imported for immediate consumption plus material entering country under bond.

[2] Includes ores and concentrates withdrawn from bond during year (irrespective of time of importation) plus imports during year for immediate consumption. This includes imports which entered duty free for the United States Government.

WORLD REVIEW

Continued large demand and attendant high prices accounted for a 28-percent rise in world production over 1950. At the end of 1951 several large deposits were being prepared for production. High export duties and rigid Government regulations regarding foreign exchange continued to retard production. However, late in 1951 satisfactory arrangements to counteract these restrictions were being worked out.

Algeria.—Underground development was reported to have blocked out 52,000 metric tons of ore with an average grade of 1.4 percent WO_3 at Beneleta near Bone in northeastern Algeria. A mill was being erected at the deposit.[4]

Argentina.—Argentina, which had a large production during World War II, had a very small output in 1951 and shipped only 17 pounds of contained tungsten to the United States. Negotiations under way during the year were expected to lead to a resumption of large-scale production.

Australia.—King Island Sheelite, Ltd., mined and milled 163,710 long tons of ore averaging 0.55 percent WO_3 during the year ended October 31, 1951. Production of concentrates totaled 973.06 tons with an average grade of 61.6 percent WO_3 and included 8,000 units from the Vanner retreatment plant. This new retreatment plant was completed in May 1951 and produced concentrates assaying 48.8 percent WO_3. The water shortage of the previous year was avoided by the completion of a 45-million-gallon water storage dam in time to retain the winter rainfall. The firm estimated ore reserves at the end of October 1951 to be 2,465,736 tons.

It was reported that a company was formed to acquire and exploit the Pioneer mine near Hatches Creek, Northern Territory, and that Tungsten Consolidated, Ltd., acquired an option on the reputedly rich deposit at Rye Park near Frogmore, New South Wales.[5]

Bolivia.—A new schedule of compulsory foreign exchange regulations applicable to tungsten exports was established in July.[6] It was expected that loans and long-term purchase agreements which were completed or being negotiated between the United States and major Bolivian producers would lead to development of tungsten mines and to the expansion of milling facilities.

Of the 1,631 metric tons of tungsten concentrates exported from Bolivia in 1951, 1,447 tons was shipped to the United States and the remainder to the United Kingdom. Most of these concentrates were of the wolframite type.

Burma.—Despite the hampering activities of insurgents and Karen revolutionists, Burma produced more tungsten concentrate in 1951 than in any year since 1948.

Canada.—Canadian Exploration, Ltd., the subsidiary of Placer Development, Ltd., resumed operations at the Government-owned Emerald Tungsten mine at Salmo, British Columbia. A 250-ton mill was installed for the Government and operations were begun in November of 1951. A deposit outside the Government-owned area was explored, and the mill was to be expanded to provide capacity for treating ore from this area.[7]

China.—Soviet Russia was reported to have sent 260 technicians to develop tungsten mines in China.[8]

Finland.—In 1951, 6 tons of tungsten concentrates was obtained as a byproduct from 13,363 metric tons of ore produced at the Ylojarvi copper mine.

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[4] Bureau of Mines, Mineral Trade Notes: Vol. 32, No. 4, April 1951, p. 26.
[5] Bureau of Mines, Mineral Trade Notes: Vol. 33, No. 5, November 1951, p. 20.
[6] Bureau of Mines, Mineral Trade Notes: Vol. 33, No. 6, December 1951, p. 23.
[7] Bureau of Mines, Mineral Trade Notes: Vol. 33, No. 1, July 1951, p. 21.
[8] New York Times, July 21, 1951.

France.—The tungsten mines in France were described.[9]

Hong Kong.—Output of the Needle Hill mine, the only licensed tungsten mine operating in the colony during 1951, was 19 tons of tungsten concentrate. Shipments during 1951 were 15 tons to the United Kingdom and 4 tons to the United States.

India.—Wolframite mining was reported to have been resumed at the mines at Digana, Jodhpur State, Rajasthan, after 5 years of inactivity.[10]

Korea.—In spite of the fighting in Korea, a relatively small output of tungsten was maintained during 1951. Flotation tests on ore from the San Dong mine, from which most of this production was obtained, were described.[11]

Mexico.—The Mesa Larga tungsten mine in Chihuahua was worked as a placer and vein deposit. Production from June 1950 to June 1951 was reported to total 350 to 400 metric tons of concentrates.[12]

Portugal.—Agreements were signed by three Portuguese companies (Minas de Cerva, S. A. R. L., Sociedade das Minas do Gerez, Lda., and Miniera Gouveense, Lda.), with ECA, which was to provide the necessary equipment to expand production.[13]

The export duty on tungsten concentrates was increased in June 1951 to 40 escudos (about $1.40) per kilo (2.2 pounds) from the previous level of 1½ escudos per kilo. Production of tungsten in Portugal during 1951 nearly doubled that of 1950.

Southern Rhodesia.—Equipment was installed to recover scheelite from the gold ore milled at the Sunace mine of Falcon Mines, Ltd.[14]

A fourfold increase in production over that of 1950 was obtained in Southern Rhodesia in 1951.

Spain.—Production of concentrates increased from 850 metric tons in 1950 to 2,300 in 1951. Much of the increase was the output of "Aventureros," men who mine by hand methods wherever ore is available. The Carmen mine in La Coruna Province was an important producer. New exchange rates were established for the export of tungsten.[15]

Thailand.—A contract was signed by the United States Government and the Mae Lama Co. calling for the delivery of 2,000 long tons of concentrates during the 3-year period 1952–54.[16]

United Kingdom.—Small-scale mining of tungsten ore was resumed in Devonshire.[17]

Uganda.—Mining and milling equipment was replacing primitive hand methods in Uganda during 1951.[18]

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[9] Sevin, R., Le Wolfram en France: Echo des mines et de la métallurgie, No. 10, October 1951, pp. 543–546, and No. 11, November 1951, pp. 607–609.
[10] Mining World, vol. 13, No. 8, July 1951, p. 54.
[11] Mitchell, Will, Jr., Sollenberger, C. L., and Kirkland, T. G., Flotation Tests on Korean Scheelite Ore: Min. Eng., vol. 190, No. 1, January 1951, p. 60.
[12] Bureau of Mines, Mineral Trade Notes: Vol. 33, No. 6, December 1951, p. 23.
[13] Bureau of Mines, Mineral Trade Notes: Vol. 33, No. 6, December 1951, pp. 23–24.
[14] Mining Magazine, vol. 84, No. 3, March 1951, p. 134.
[15] Bureau of Mines, Mineral Trade Notes: Vol. 32, No. 5, May 1951, pp. 33–34.
[16] Bureau of Mines, Mineral Trade Notes: Vol. 33, No. 1, July 1951, p. 21.
[17] Mining Journal, vol. 236, No. 6038, May 11, 1951, p. 452.
[18] Bureau of Mines, Mineral Trade Notes: Vol. 32, No. 6, June 1951, pp. 25–26.

TABLE 7.—World production of tungsten ores, 1946–51, by countries, in metric tons of concentrates containing 60 percent WO_3

[Compiled by Pauline Roberts and Berenice B. Mitchell]

Country	1946	1947	1948	1949	1950	1951
North America:						
Canada	----	375	791	191	[1] 215	15
Mexico	75	77	133	65	67	325
United States (shipments)	4,711	2,807	3,659	2,508	[1] 4,373	5,693
Total North America	4,786	3,259	4,583	2,764	[1] 4,655	6,033
South America:						
Argentina	457	33	33	[2] 30	[2] 20	[2] 30
Bolivia (exports)	2,120	2,635	2,485	2,543	2,461	2,718
Brazil (exports)	1,623	1,329	1,144	575	[1] 759	[2] 1,000
Peru	510	579	353	455	[1] 516	770
Total South America	4,710	4,576	4,015	[2] 3,600	[2] 3,760	[2] 4,500
Europe:						
Finland	----	----	4	49	20	8
France	286	408	567	700	[1] 442	765
Italy	13	10	4	1	2	6
Portugal	630	3,149	2,944	2,700	2,500	4,680
Spain	431	461	876	888	[1] 850	2,300
Sweden	490	322	317	468	362	[2] 500
U. S. S. R. (estimate)	1,500	[1] 3,500	[1] 5,000	[1] 6,000	[1] 7,500	7,500
United Kingdom	108	89	[1] 46	[1] 81	[1] 74	54
Total Europe (estimate)	3,500	[1] 7,900	[1] 9,800	[1] 10,900	[1] 11,800	[2] 15,800
Asia:						
Burma	----	1,045	1,824	740	[1 2] 750	1,647
China	2,691	6,900	12,200	[1 2] 9,000	[1 2] 12,000	[2] 15,800
India	3	----	----	----	2	----
Japan	[3] 59	19	9	20	64	86
Korea:						
Korea, Republic of	1,180	1,227	1,245	1,448	[2] 2,000	[2] 900
North Korea		975	1,000	1,000	[2] 1,000	[2] 1,200
Malaya, Federation of	10	50	87	69	27	54
Thailand (Siam)	[1] 300	[1] 700	[1] 800	[1] 1,100	[1] 1,200	1,200
Total Asia	[1] 4,243	[1] 10,916	[1] 17,165	[1 2] 13,400	[2] 17,000	[2] 20,900
Africa:						
Belgian Congo	397	670	236	276	164	285
Egypt	----	----	15	----	----	7
French Morocco	----	----	[1] 1	----	[1] 12	30
Nigeria	5	4	4	5	5	23
Southern Rhodesia	53	26	80	26	64	231
South-West Africa	----	10	12	6	4	[2] 5
Tanganyika (exports)	----	----	[1] 1	42	15	15
Uganda	102	139	126	183	217	220
Union of South Africa	144	91	151	416	96	160
Total Africa	701	940	[1] 626	954	[1] 577	[2] 975
Oceania:						
Australia	1,041	1,132	1,234	[1] 1,371	[1] 1,235	1,864
New Zealand	30	24	28	28	24	[2] 35
Total Oceania	1,071	1,156	1,262	[1] 1,399	[1] 1,259	[2] 1,900
Grand total (estimate)	[1] 19,000	[1] 28,700	[1] 37,500	[1] 33,000	[1] 39,000	50,100

[1] Revised figure.
[2] Estimate.
[3] Preliminary data for the fiscal year ended March 31 of year following that stated.

Uranium, Radium, and Thorium

By H. D. Keiser

GENERAL SUMMARY

EXPANSION of the Nation's atomic energy program proceeded in 1951 at an accelerated pace marked by intensive activity in all phases of the program; plans for further expansion were formulated beyond that authorized by the Congress under the $2,032 million appropriated for the fiscal year ended June 30, 1951. Atomic weapons were produced at the rate authorized by the President for the year 1951, and significant advances were made in weapons research and development.

New construction announced by the Atomic Energy Commission in 1951 included a $54 million feed materials plant at Fernald, Ohio, and a $45 million production plant near Denver, Colo. Construction was in progress throughout the year on the $1,250 million Savannah River Project (the so-called hydrogen or superbomb project) in Aiken and Barnwell Counties, S. C., and on the $500 million gaseous diffusion plant at the Kentucky Ordnance Works near Paducah, Ky.

Production of the fissionable isotope uranium–235 and plutonium in 1951 were at a new record rate and at lowered unit costs despite higher labor and material costs. Output of domestic uranium ore reached a record-breaking level as the result of a well-stimulated raw materials program. Two new ore-processing mills, to treat the increasing quantities of ore, were placed in operation during 1951—one at Salt Lake City, Utah, and the other at Grand Junction, Colo. Deliveries of uranium ore from the Belgian Congo and Canada continued at scheduled rates, and plants were under construction in the Union of South Africa for recovering uranium to be sold to the United States and the United Kingdom. Shipments of radioisotopes by the AEC in 1951 were 26 percent larger in number than in 1950.

MINE AND MILL PRODUCTION

Increased productive activity in 1951 resulted in the United States maintaining its position as second among the free nations in the mining and processing of uranium ores.[1] The record-breaking domestic production was attributable to an expanded exploratory drilling program, higher prices for uranium ores (*see* section on Prices), a bonus for initial ore production, the opening of new producing areas, and increased processing capacity.[2] Over $250,000 was paid in 1951 to ore producers by the AEC under the new bonus program,[3] and about

[1] Atomic Energy Commission, Tenth Semiannual Report (Major Activities in the Atomic Energy Programs): July 1951, p. 8.
[2] Atomic Energy Commission, Eleventh Semiannual Report (Some Applications of Atomic Energy in Plant Science): January 1952, p. 6.
[3] Atomic Energy Commission, Quarter Million Paid Out in Bonuses in 1951, Press Release: Jan. 30, 1952, 3 pp.

the same amount was involved under the seven uranium-exploration contracts executed by the Defense Minerals Administration during 1951.

Virtually all the uranium ore mined in 1951 came from the Colorado Plateau, where exploratory drilling by the AEC and the Geological Survey reached a combined rate of nearly 750,000 feet a year, almost double that for 1950. Two new ore-processing plants were placed in operation during 1951—one by Vitro Chemical Co. at Salt Lake City, Utah, and the other by Climax Uranium Co. at Grand Junction, Colo. A detailed description was published of the plant operated by the Galigher Co. (for the AEC) at Monticello, Utah.[4] Toward the close of 1951 negotiations were concluded with the Anaconda Copper Mining Co. for constructing an ore-buying station and a processing plant in the Grants, N. Mex., district.

A significant area of activity in 1951 was the Marysvale, Utah, district, where five mines in the central area produced substantial quantities of ore. In the Grants, N. Mex., district intensive exploration was continued by the Atchison, Topeka & Santa Fe Railway Co. on its holdings, and important reserves of carnotite were delineated in the Todilto limestone. The Anaconda Copper Mining Co. entered the Grants, N. Mex., district early in 1951 and pursued an extensive exploration program; the company was designated by the Laguna Indian Tribal Council to carry out a detailed exploration program on the tribal lands east of Grants. Copper-uranium ore was mined during 1951 in the White Canyon area of southeastern Utah.

Carnotite deposits were discovered in 1951 near Edgemont, S. Dak., in the Lakota member of the Dakota sandstone formation; the discovery indicated carnotite deposition over a broad area in the Dakotas, Wyoming, and Montana.[5] Details of the AEC exploration program were presented in the course of several addresses made by representatives of the Commission.[6]

The survey of domestic thorium resources by the Bureau of Mines, under AEC sponsorship, was continued in 1951 and involved investigation of the monazite content of placer deposits in Idaho, Montana, Wyoming, North Carolina, and South Carolina. In examination of several of the southeastern deposits the Geological Survey collaborated with the Bureau.

Consideration was given in 1951 to low concentrations of uranium in carbonaceous and bituminous shales, particularly the Chattanooga formation reportedly found in vast tonnages over thousands of square miles of Tennessee and Kentucky and containing about 0.008 percent U_3O_8.[7] The view was expressed, however, that recovery of uranium from shales was not commercially feasible at present.[8]

[4] Butler, John A., Utah's New Uranium Mill: Eng. and Min. Jour., vol. 152, No. 3, March 1951, pp. 56–62.
[5] Staff of Raw Materials Operations Office, Atomic Energy Commission, The Atom: Min. World, vol. 14, No. 5, Apr. 15, 1952, pp. 42–43.
[6] Johnson, Jesse C., The Search for Uranium: Address before Am. Inst. Min. and Met. Eng., Mexico City, D. F., Mexico, Oct. 31, 1951.
Merritt, Phillip L., Uranium and the Petroleum Industry: Address before Am. Assoc. Petrol. Geol., St. Louis, Mo., April 26, 1951; Uranium Exploration in the United States: Address before the Am. Inst. Min. and Met. Eng., Mexico City, D. F., Mexico, Oct. 31, 1951; Review of the Current Uranium Exploration Program: Address presented at Information Meetings on Raw Materials Research, University of Arkansas, Fayettville, Ark., Nov. 28, 1951.
[7] Mining Engineering, Uranium—Swords or Plowshares: Vol. 3, No. 9, September 1951, pp. 762–766.
[8] Glennan, T. Keith, Address before Iowa Radio News Association Seminar, Iowa State College, Ames, Iowa: Sept. 28, 1951.

Exploration by airborne methods, employing principally the scintillation counter, increased in 1951. About 10,000 miles of airborne radioactivity traverse was flown in 1951 by the Geological Survey,[9] and a magnetometer survey in the Marysvale, Utah, area aided in the exploration for pitchblende.[10]

Development of a process whereby uranium in phosphates can be extracted economically in the production of triple superphosphate was disclosed by the AEC in February 1951;[11] in April 1951 International Minerals & Chemical Corp. announced that it would build a new $10 million phosphate chemical plant at Mulberry, Fla., incorporating a uranium-recovery unit;[12] and in November 1951 construction by Blockson Chemical Co., Joliet, Ill., of the first full-scale plant for recovering uranium from wet-process phosphoric acid was announced. Other companies actively interested in recovering uranium from phosphate were said to include Allied Chemical & Dye Corp., Tennessee Corp., Mathieson Chemical Corp., Armour Fertilizer Works, and Virginia-Carolina Chemical Corp.[13]

REFINERY AND REACTOR PRODUCTION

Uranium.—Output of the fissionable isotope uranium–235 continued to increase in 1951, and unit costs continued to decrease. The unit-cost reductions were made in spite of increasing labor and material costs and resulted from the continuing improvement in production processes and the expanded volume of operations.[14] New construction announced by the AEC in 1951 included a feed-materials plant to be built at an estimated cost of $54 million on a 1,200-acre site at Fernald, Ohio, 19 miles northwest of Cincinnati;[15] a production plant of an undisclosed type to be erected on a 2,500-acre tract near Denver, Colo., to cost about $45 million, and to be known as the Rocky Flats Plant;[16] and another production plant on 4,000 acres at the Pantex Ordnance Works, 17 miles southeast of Amarillo, Tex.[17] Construction proceeded throughout 1951 on the Savannah River Project in Aiken and Barnwell Counties, S. C., reestimated to cost more than $1,250 million, and on the $500 million gaseous diffusion plant at the Kentucky Ordnance Works, near Paducah, Ky. The K–31 addition to the gaseous diffusion plant at Oak Ridge was completed during 1951.[18]

Plutonium.—Production of plutonium in 1951 was also at a new record rate and at new low unit costs. The cost of production was reported to be half of what it was in 1946 and 1947.[19]

[9] Scharon, LeRoy, Geophysics: Min. Eng., vol. 4, No. 2, February 1952, p. 160.
[10] Rove, Olaf N., Mining Geology: Min. Eng., vol. 4, No. 2, February 1952, p. 141.
[11] Atomic Energy Commission, Process Developed for Extracting Uranium from Phosphates, Press Release: Feb. 21, 1951, 1 p.
[12] Atomic Energy Newsletter, vol. 5, No. 4, Apr. 10, 1951, p. 1.
[13] Wimpfen, Sheldon P., Uranium from Phosphate Rock: Address before Nat. Fertilizer Assoc., Atlanta, Ga., Nov. 14, 1951.
[14] Work cited in footnote 2, p. 10.
[15] Work cited in footnote 12.
[16] Nucleonics, vol. 8, No. 5, May 1951, p. 85.
[17] Atomic Energy Newsletter, vol. 4, No. 12, Jan. 30, 1951.
[18] Work cited in footnote 2, p. 10.
[19] Engineering and Mining Journal, vol. 152, No. 12, December 1951, p. 141.

TABLE 1.—Radioisotopes shipped by the U. S. Atomic Energy Commission, 1946–51, by kinds, in number of shipments

Radioisotope	1946 [1]	1947	1948	1949	1950	1951	Total
Iodine-131	68	495	978	1,537	2,353	3,183	8,614
Phosphorus-32	48	537	901	1,420	1,736	2,112	6,754
Carbon-14	47	108	124	192	259	342	1,072
Sodium-24	1	80	119	229	286	176	891
Sulfur-35	12	39	41	108	125	168	493
Gold-198 and gold-199	17	52	29	36	164	268	566
Cobalt-60	4	32	30	64	137	190	457
Potassium-42	6	31	24	75	123	132	391
Calcium-45	5	42	33	68	89	111	348
Iron-55 and iron-59	5	41	33	54	68	67	268
Strontium-89 and strontium-90	3	9	18	19	46	62	157
Other	30	186	314	568	848	1,014	2,960
Total	246	1,652	2,644	4,370	6,234	7,825	22,971

[1] Shipped by Manhattan District, Corps of Engineers, U. S. Army Service Forces.

Isotopes.—Midyear 1951 marked the close of the first 5 years' distribution of reactor-produced radioisotopes by the AEC, during which period over 18,900 shipments were made to over 600 institutions in the United States and about 1,100 shipments to approximately 250 institutions in 31 countries abroad.[20] Thousand-curie sources of gamma radiation made of cobalt–60 or tantalum–182 were made available by the AEC in 1951.[21] In August 1951 Bendix Aviation Corp. and Tracerlab, Inc., arranged with the AEC to conduct studies on the problems of chemical processing of radioisotopes and to determine the desirability of designing, constructing, and operating a nuclear reactor for the production of isotopes.[22] Opportunities for private industry in the production of isotopes were outlined, and the ultimate objective of the AEC was said to be "to work itself out of the isotope business."[23]

Radium.—Production of radium in the United States during 1951 was relatively small and principally salvaged from consumers' wastes. Radium and its derivatives were produced by the Canadian Radium & Uranium Corp., New York, N. Y.

Thorium.—The principal domestic producers of thorium compounds (chiefly nitrate and oxide) in 1951 were Lindsay Light & Chemical Co., West Chicago, Ill.; Maywood Chemical Works, Maywood, N. J.; and Rare Earths, Inc., Paterson, N. J. Commercial production of thorium metal in the United States was relatively small; principal producers were Westinghouse Electric Corp. (Lamp Division), Bloomfield, N. J., and Metal Hydrides, Inc., Beverly, Mass. Thorium-production statistics are not available under the regulations of the Atomic Energy Act of 1946.

CONSUMPTION AND USES

Weapons.—Atomic weapons were produced at the rate authorized by the President for the year 1951, and significant advances were made in weapons research and development.[24] Three separate series of

[20] U. S. Atomic Energy Commission, Isotopes—a Five-Year Summary of United States Distribution: August 1951, 451 pp.
[21] U. S. Atomic Energy Commission, Washington, D. C., Press Release: Jul. 29, 1951, 2 pp.
[22] Work cited in footnote 2, p. 33.
[23] Glennan, T. Keith, New Horizons for Industry in the Isotopes Field: Address before "Radioisotopes in Industry" conference, Case Institute of Technology, Cleveland, Ohio, Apr. 5, 1951.
[24] Work cited in footnote 2, p. 19.

tests were held in connection with weapons development—1 at Eniwetok in the central Pacific and 2 at the Nevada testing grounds near Las Vegas. Knowledge gained in the 1951 tests was incorporated in stockpile weapons.[25] The first of the three series of tests, referred to as limited-scale weapons tests, took place in Nevada during January and February and were the first conducted in continental United states since the original atomic bomb was fired at Alamogordo, N. Mex., in July 1945. In April and May the second series of tests, described as a full-scale test program, was conducted jointly by the AEC and the Department of Defense at Eniwetok. The program was said to have included detonations of sufficient energy yield to confirm estimates as to the effects of weapons several times more powerful than the Hiroshima and Nagasaki weapons.[26] The third series of tests, announced as experimental nuclear detonations, was conducted in Nevada during October and November. Major objectives of the tests were to provide data for weapons development purposes and means for studying various physical effects, such as blast, radiation, and heat. The Department of the Army used the tests for a combat-troop training exercise.[27] The scientific director of the AEC tests was reported to have stated that America's atomic knowledge had virtually doubled in 1951 and that the advance in atomic weapons in the year was almost equal to all the previous developments which followed the first nuclear detonation in 1945.[28]

Industrial Power.—Economic and technical studies of nuclear energy as a possible source of industrial power were continued in 1951;[29] the official view on the subject was expressed by the chairman of the AEC as follows:[30]

> When most of us think of the peaceful promise of atomic energy, I believe we think of power—cheap power to do man's work and to bring light into the dark corners of the world. This, of course, is one of our objectives. I would like to be able to tell you today that we have reached a turning point in the road to this objective similar to the one we have reached in the field of weapons, but I cannot. We are still some years away from having the answers to the questions that will have to be answered before we can estimate with any degree of assurance how far we shall be able to advance toward the goal of cheap atomic power, or which is the best road or roads for us to follow. We are now entering a very critical phase of our work in nuclear reactor development which should give us at least some of these answers.
>
> I say we are entering a critical phase in our progress toward power because of the experimental reactors that are now being built and the studies which are now

[25] Director of Defense Mobilization, The Battle for Production: 4th Quart. Rept. to the President, Jan. 1, 1952, p. 9.
[26] Work cited in footnote 1, pp. 1 and 3.
Bulletin of the Atomic Scientists, vol. 7, No. 8, August 1951, pp. 239–240.
[27] Work cited in footnote 2, p. 20.
[28] Bulletin of the Atomic Scientists, vol. 7, No. 12, December 1951, p. 381.
[29] Atomic Energy Commission, Advisory Committee of Electric Power Industry Submits Report to Atomic Energy Commission: Press release, June 22, 1951, 16 pp.
Compton, Arthur H., Atomic Energy: Address before Am. Inst. Min. and Met. Eng., St. Louis, Mo., Feb. 19, 1951.
Dean, Gordon, Atomic Energy and the Industrial Mobilization Program: Address before Am. Ordnance Assoc., New York, N. Y., Dec. 5, 1951.
Glennan, T. Keith, Industry and the Atom: Address before Am. Soc. Mech. Eng., Atlantic City, N. J., Nov. 29, 1951.
Hafstad, Lawrence R., The Future of Atomic Energy: Address before 2d Academic Conference, Northwestern University, Evanston, Ill., March 2, 1951; Reactors: Sci. American, vol. 184, No. 4, April 1951, pp. 43–50; The Atomic Energy Commission Reactor Program: Address at Oak Ridge Summer Symposium Oak Ridge, Tenn., Sept. 5, 1951.
Sporn, Philip, Development of Atomic Energy—How Can Industry Best Participate: Nucleonics, vol. 8, No. 2, February 1951, pp. 9–12, 104.
Suits, C. G., Power from the Atom—an Appraisal: Nucleonics, vol. 18, No. 2 February 1951, pp. 3–9.
[30] Dean, Gordon, The Responsibilities of Atomic World Leadership: Address presented at University of Southern California, Los Angeles, Calif., Oct. 5, 1951.

being made. In these machines and in the results of these studies will be the answers to many of the problems that today confront us.

When these answers begin to come in, we will have a much better basis than we do now for plotting our course into the future and for making intelligent estimates as to just how far we can go. As you know, there have been many guesses made, some very pessimistic and some spectacularly hopeful. For myself, I would like to reserve final judgment until we have answers to more questions than we do now. I do know this: We are going to have atomic energy power plants, but just how many we will have and what contribution they will make to our economy hinges largely on the factor of cost. To make atomic power worthwhile, we must get the cost of these plants down to where they can compete with coal, gas, oil, and hydroelectric plants. When this will be, and in how many areas it will be true, is something about which today we can only guess. But we *are* going to have atomic power, and we are going to have it first for military use, where developmental costs can be charged to the national security. Later, when we know more, and have gotten this developmental phase out of the way, we can make a better estimate about how far we can go. We are now in that critical period when the answers to our questions are beginning to come in.

In December 1951 the AEC experimental breeder reactor at the Commission's reactor-testing station near Arco, Idaho (*see* Uranium, Radium, and Thorium chapter, Minerals Yearbook, 1950) was brought up to criticality and electrical power generated at a rate exceeding 100 kilowatts. Construction of the materials testing reactor and the land-based prototype submarine thermal reactor at the reactor-testing station and of the submarine intermediate reactor at the Knolls (Schenectady, N. Y.) atomic power laboratory were continued throughout 1951. At Oak Ridge the homogeneous-reactor experiment was brought nearer to completion. Design and development facilities leading toward aircraft propulsion by nuclear energy were established at Lockland, Ohio, under new contractual direction.[31]

Privately financed studies of reactor technology by four industrial groups progressed in 1951, and reports were submitted to the Commission by two of the groups, which reports were under consideration by the Commission. One objective of the studies was to give industry an opportunity to invest private funds in reactors and to build and operate them with profit in proportion to efficiency and improvements. In September 1951 the School of Reactor Technology, operated by the Oak Ridge National Laboratory, graduated its first regular class of 43 engineers. Immediately after graduation of the first class, a second class of 67 students began the 12-month course, which was largely classified.[32]

Isotopes.—The AEC made 7,825 shipments of radioisotopes in 1951, an increase of 26 percent over the 6,234 shipments made in 1950. About half of the radioisotope shipments in 1951 were for use in the field of medical therapy. Industrial applications of radioisotopes, particularly the use of cobalt–60, increased substantially and were discussed in the scientific and technical press.[33] Results were

[31] Work cited in footnote 2, pp. 20–24.

[32] Work cited in footnote 2, pp. 24–25.

[33] Black, W. A., Noncontacting Thickness Gages for Flat Rolled-Steel Products: Iron and Steel Eng., vol. 28, No. 8, August 1951, pp. 132–134.

Eastwood, W. S., Gamma Radiography in the United Kingdom: Nucleonics, vol. 9, No. 1, July 1951, pp. 50–59.

Guest, G. H., Radioisotopes; Industrial Applications: Pitman Publishing Corp., Toronto, 1951, 185 pp.

Schwinn, W. L., The Economics and Practical Application of Cobalt-60 in the Radiographic Inspection of Steel Weldments: Symposium on the Role of Nondestructive Testing in the Economics of Production, Am. Soc. Test. Materials, Spec. Tech. Pub. 112, 1951, pp. 112–135.

Simard, G. L., Burke, M., and Salley, D. J., Radiotracer Studies on the Interaction of Dithiophosphate With Galena; the Depressant Action of Phosphate: Min. Eng., vol. 190, No. 1, January 1951, pp. 39-44.

West, R., A Low-Energy Gamma-Ray Source for Radiography and Thickness Measurement: Nucleonics, vol. 9, No. 3 September 1951, pp. 76–77.

published in 1951 of a technical and economic survey of present and possible future uses of fission products.[34]

Radium.—The overall use of radium continued to decline in 1951 owing to rapid growth in application of radioisotopes, especially cobalt-60, in both medical therapy and radiography. Consumption of radium as an energy source in luminous paints was at about the level prevailing in 1950. (*See* Uranium, Radium, and Thorium chapter, Minerals Yearbook, 1950, for shipments of primary radium refined in the United States, 1941–48, inclusive; data for subsequent years are not available.)

TABLE 2.—Radioisotopes shipped by the U. S. Atomic Energy Commission, 1946–51, by uses, in number of shipments

Use	1946 [1]	1947	1948	1949	1950	1951	Total
Medical therapy	88	716	1,142	2,037	3,037	3,911	10,931
Animal physiology	78	508	777	1,028	1,230	1,314	4,935
Physics	17	134	202	315	448	325	1,441
Chemistry	27	138	225	228	274	231	1,123
Plant physiology	16	62	116	241	319	216	970
Industrial research	14	51	85	[2] 176	[2] 270	[2] 379	975
Bacteriology	4	33	53	83	87	130	390
Metallurgy	2	10	11	(2)	(2)	(2)	23
Other			33	262	[3] 569	[3] 1,319	2,183
Total	246	1,652	2,644	4,370	6,234	7,825	22,971

[1] Shipped by Manhattan District, Corps of Engineers, U. S. Army Service Forces.
[2] Metallurgical use included with "Industrial research."
[3] Specific field of utilization unknown (issuance of general authorizations permits approved applicant to use radioisotopes at a specified location for any research and development activity, and permits him to obtain from any supplier any available form and quantity of any radioisotope distributed on authorization or approval of the U. S. Atomic Energy Commission).

PRICES

Uranium Ore.—On February 28, 1951, the AEC announced a new bonus for domestic uranium-ore production and a price increase for Colorado Plateau ores, with the objective of further stimulating the mining of uranium in the United States. The bonus plan, effective March 1, 1951, through February 28, 1954, provided for the following: [35]

1. For new mining properties, bonus payments will be made on each pound of uranium oxide in acceptable ore delivered to qualified mills or Commission ore-buying stations up to and including the first 10,000 pounds.
2. For mining properties that have produced less than 10,000 pounds of uranium oxide during the period April 9, 1948, to March 1, 1951, bonus payments will be made on the difference between what the mining property has delivered between April 9, 1948, and March 1, 1951, and 10,000 pounds.
3. Bonus payments per pound of uranium oxide in acceptable ores produced from qualified mining properties will range from $1.50 for those ores assaying 0.10 percent uranium oxide to $3.50 for ores assaying 0.20 percent or more. Thus, the maximum bonus that may be obtained for production from new mines will range from $15,000 to $35,000, depending on the grade of ore delivered.

The following mills were listed by the AEC as "qualified" uranium mills:
United States Vanadium Co., Uravan, Colo.
United States Vanadium Co., Rifle, Colo.
Climax Uranium Co., Grand Junction, Colo.
Vanadium Corporation of America, Durango, Colo.

[34] Stanford Research Institute, Industrial Uses of Radioactive Fission Products, A Report to the United States Atomic Energy Commission: Stanford, Calif., 1951, 102 pp.
[35] U. S. Atomic Energy Commission, Bonus for Initial Production of Uranium Ores from Domestic Mines. Effective March 1, 1951, through February 28, 1954: Domestic Uranium Program, Circ. 6, June 27, 1951, 2 pp.

Vanadium Corporation of America, Naturita, Colo.
Vanadium Corporation of America, Hite, Utah.
Vitro Chemical Co., 600 West 33d St. South, Salt Lake City, Utah.

Commission ore-buying stations (operated by the American Smelting & Refining Co., on behalf of the AEC) were located at Monticello and Marysvale, Utah.

Since April 1948, the AEC had offered a $10,000 bonus—through December 31, 1951, not collected—for discovery of a new deposit and production therefrom of the first 20 short tons of domestic uranium ore or mechanical concentrate assaying 20 percent or more uranium oxide. The new bonus was in addition to and did not supersede this old one. According to the AEC, the new bonus differed from the old one as follows:

1. Whereas the old bonus applied only to ores or mechanical concentrates assaying 20 percent or more uranium oxide (very high grade), the new bonus provided for payments for ores containing as low as 0.10 percent uranium oxide, and for maximum payments for ores assaying as low as 0.20 percent.
2. Whereas the old bonus was paid only after 20 short tons of ore was delivered to a qualified mill or ore-buying station, the new bonus would be paid on each pound of uranium oxide sold in acceptable ores up to and including the first 10,000 pounds.
3. Whereas the old bonus did not apply to carnotite-roscoelite ores of the Colorado Plateau, the new bonus would apply.

The new schedule of guaranteed minimum prices for carnotite-roscoelite ores of the Colorado Plateau,[36] effective March 1, 1951, through March 31, 1958, increased the base price paid for uranium ores containing as little as 0.10 percent uranium oxide from 50 cents per pound to $1.50 per pound, and for ores containing 0.20 percent uranium oxide or more from $2 per pound to $3.50. In addition, the premium paid on ores containing more than 4 pounds of uranium oxide to the ton was increased from 25 cents to 75 cents per pound (*see* Minerals Yearbook, 1949, p. 1254). The new price schedule follows:

U_3O_8 percent:	*Price per pound U_3O_8*	U_3O_8 percent:	*Price per pound U_3O_8*
Less than 0.10	No payment	0.15	$2.50
0.10	$1.50	.16	2.70
.11	1.70	.17	2.90
.12	1.90	.18	3.10
.13	2.10	.19	3.30
.14	2.30	.20 and more	3.50

The new schedule provided for the same development and haulage allowances that were in effect previously, also for the same payment for contained V_2O_5, the same additional premium for U_3O_8 in excess of 10 pounds U_3O_8 per short ton, and for the same limits on contained lime ($CaCO_3$). High-lime carnotite-roscoelite ore continued salable throughout 1951 at the Monticello, Utah, plant of AEC under special contracts, and the previously guaranteed minimum price for ores other than the carnotite-roscoelite type was unchanged in 1951. (*See* Minerals Yearbook, 1949, pp. 1254–1255.)

On March 29, 1951, the AEC announced that it would accept at its Monticello and Marysvale, Utah, ore-purchase depots copper-bearing uranium ores that met the specifications of Domestic Uranium Pro-

[36] U. S. Atomic Energy Commission, Guaranteed Minimum Price for Uranium-Bearing Carnotite-Type or Roscoelite-Type Ores of the Colorado Plateau. Effective March 1, 1951, through March 31, 1958. Domestic Uranium Program, Circ. 5, Revised Feb. 26, 1951, 2 pp.

gram Circular 5, revised,[37] with reference to U_3O_8 content, lime content, physical characteristics, and impurities. Purchases were made under contractual arrangements with individual producers.

Prices established in 1950 for low-grade development ore from Marysvale, Utah, area continued in effect throughout 1951. (*See* Minerals Yearbook, 1950, p. 1265.)

TABLE 3.—Consumption of uranium and thorium compounds for nonenergy purposes in the United States, 1947–51, in pounds of contained U_3O_8 and ThO_2

[U. S. Atomic Energy Commission]

Industry	1947	1948	1949	1950	1951
URANIUM (U_3O_8 EQUIVALENT)					
Chemical (including catalytic)	2,400	1,993	2,426	2,835	2,016
Ceramic (including glass)	825	385	270	938	875
Photographic		225			
Electrical	150	200	103	33	88
Total U_3O_8	3,375	2,803	2,799	3,806	2,979
THORIUM (ThO_2 EQUIVALENT)					
Gas-mantle manufacture	26,658	36,697	44,621	48,471	31,132
Refractories and polishing compounds	3,110	1,634	1,847	1,889	3,382
Chemical and medical	1,176	1,767	596	2,097	6,246
Electrical	1,283	427	237	314	1,457
Total ThO_2	32,227	40,525	47,301	52,771	42,217

Uranium.—High-purity uranium metal was available throughout 1951 to AEC licensees at about $50 a pound. The metal, in the form of pencil-size rods about 4 inches long, was produced by Mallinckrodt Chemical Co., St. Louis, Mo., and distributed to all the major chemical companies, from which the metal was available to the licensees in its original rod form, as rolled sheets, and as foil.

Radium.—Radium was quoted throughout 1951 at $20 to $25 per milligram; one source, however, offered radium element throughout the year at $16.00 to $21.50 per milligram, depending on quantity.

Isotopes.—Isotopes were available in 1951 through the Isotopes Division of the AEC in a somewhat wider range than in 1950, with prices generally unchanged. Isotopes available included those produced at the Oak Ridge National Laboratory, Argonne National Laboratory, and Brookhaven National Laboratory, of the AEC; at Chalk River, Ontario, Canada; and at Amersham and Harwell, England.[38] All isotopes used to study, diagnose, or treat cancer and allied diseases were made available by the Isotopes Division free of production costs. In September 1951 the AEC made arrangements with Stanford Research Institute of Stanford, Calif., to study the cost and pricing structure of the isotope distribution program.[39]

Thorium.—Thorium metal was quoted in 1951 by 1 producer, f. o. b. producer's plant, per gram in lots of less than 200 grams per item, in the form of powder, 45 cents, unsintered bars, 50 cents, sintered bars, 65 cents, sheet—0.005 inch and over, 75 cents, and sheet—0.002 to

[37] Work cited in footnote 36.
[38] U. S. Atomic Energy Commission (Isotopes Division, Oak Ridge, Tenn.), Isotopes: Catalog and Price List 4, March 1951, 75 pp.
[39] Work cited in footnote 2, p. 33.

0.0049 inch, 85 cents; and in lots of 200 grams or more per item, at 35, 40, 50, 60, and 70 cents per gram, respectively.

Average prices in 1951 for thorium nitrate and oxide were reported by a large producer in 100-pound lots, f. o. b. producer's plant, as follows: Thorium nitrate, mantle grade—domestic price $2.20, export $3.35 per pound; thorium oxide, 97 percent ThO_2—domestic price $5.40 per pound; thorium oxide, photographic-lens grade, 99 percent ThO_2—domestic price $11.45 per pound.

FOREIGN TRADE [40]

Deliveries of uranium concentrates to the AEC from the Belgian Congo and Canada continued at scheduled rates during 1951. Cumulative exports of radioisotopes reported by the AEC as of November 30, 1951, reached 1,213 shipments distributed among 33 different nations.[41] Data are not disclosed on imports and exports of uranium and thorium ores, concentrates, metal, alloys, and compounds.

In July 1951 the AEC enlarged its radioisotope export program to include all radioactive materials sold in the United States except hydrogen-3 (tritium) and for the first time made radioisotopes produced in the United States available to foreign users for industrial research and applications. The action increased the number of different radioactive isotopes available for export from 26 to 99.[42]

TABLE 4.—Radium salts imported for consumption in the United States, 1947–51

[U. S. Department of Commerce]

Year	Radium salts			Radioactive substitutes (value)
	Milligrams	Value		
		Total	Average per gram	
1947	76,681	$1,504,814	$19,600	----------
1948	77,018	1,385,337	17,900	$6,273
1949	98,032	1,719,656	17,500	370
1950	80,969	1,235,511	15,300	6,106
1951	89,805	1,225,564	13,600	5,399

WORLD REVIEW

In the deliberations by the United Nations on disarmament during 1951, proposals of the United States were adopted by the Committee of Twelve, consisting of representatives of the 11 Security Council members and Canada (*see* Uranium, Radium, and Thorium chapter, Minerals Yearbook, 1950), as the basis of a report to the next Assembly. The Sixth General Assembly opened in Paris on November 6, 1951, with a 10-day general debate on the state of the world. A tripartite proposal by France, the United Kingdom, and the United States was

[40] Figures on imports and exports (unless otherwise indicated) compiled by M. B. Price and E. D. Page, of the Bureau of Mines, from records of the U. S. Department of Commerce.
[41] Work cited in footnote 2, p. 151.
[42] U. S. Atomic Energy Commission, Washington, D. C., Press Release: July 15, 1951, 4 pp.

adopted on December 19 by the First Committee and presented to the General Assembly in the form of a resolution which, at the year end, was still under consideration; the resolution read, in part, as follows: [43]

> The General Assembly * * * directs the Disarmament Commission to prepare proposals to be embodied in a draft treaty (or treaties) for the regulation, limitation, and balanced reduction of all armed forces and all armaments, for the elimination of all major weapons adaptable to mass destruction, and for effective international control of atomic energy, the prohibition of atomic weapons and the use of atomic energy for peaceful purposes only.

Under an amendment to the Atomic Energy Act, approved by President Truman on October 30, 1951, wider exchange of nonweapon data was permitted with nations that do not threaten the security of the United States; the amendment read, in part, as follows: [44]

> Section 10 (a) is hereby amended by inserting the following subsection 10 (a) (3) after subsection 10 (a) (2):
> "(3) Nothing contained in this section shall prohibit the Commission, when in its unanimous judgment the common defense and security would be substantially promoted and would not be endangered, subject to the limitations hereinafter set out, from entering into specific arrangements involving the communication to another nation of restricted data on refining, purification, and subsequent treatment of source materials; reactor development; production of fissionable materials; and research and development relating to the foregoing * * * ."

The third American-British-Canadian conference on radiation-detection instruments was held at the Atomic Energy Research Establishment, Harwell, England, beginning April 30, 1951. The conference lasted 2 weeks, with the first week devoted to technical discussions on the design and application of radiation-detection instruments and the second week to visits to the facilities of British instrument manufacturers.[45]

WESTERN HEMISPHERE

Canada.—On January 2, 1951, approval by the Canadian Government was announced for construction of another reactor at Chalk River, Ontario, Canada's nuclear energy research center. Experience gained in operation of the two other reactors at Chalk River was to be used in designing the new reactor, which was to cost about C$30 million and employ heavy water as a moderator.[46]

Virtually all the uranium ore produced in Canada in 1951 came from the mine of the Crown company, Eldorado Mining & Refining (1944), Ltd., at Port Radium, on Great Bear Lake, N. W. T. Owing to a fire on November 9 which destroyed the crushing plant and mill at the property, ore production for the year was 13 percent less than in 1950. Development footage and exploratory diamond drilling totaled 13,101 feet and 54,715 feet, respectively, compared with 13,388 and 26,148 feet in 1950. Year-end estimates indicated that ore reserves were being maintained.[47]

Outstanding in the search during 1951 for new sources of uranium in Canada was the increased activity that prevailed in the Goldfields

[43] Sterenberg, Elizabeth, United Nations Disarmament News: Bull. Atom. Sci., vol. 8, No. 4, April 1952, pp. 116–118, 126.
[44] Amendment to the Atomic Energy Act of 1946, Public Law 235, 82d Congress, Chapter 633, 1st sess., approved Oct. 30, 1951.
[45] Atomic Energy Newsletter, vol. 5, No. 6, May 8, 1951, p. 1.
[46] Atomic Energy Control Board, Ottawa, Canada, Press Release: Jan. 2, 1951, 4 pp.
[47] Eldorado Mining & Refining (1944), Ltd., Annual Report for the Year Ending Dec. 31, 1951: P. 3.

district of Saskatchewan, on the north shore of Lake Athabaska. Eldorado Mining & Refining (1944), Ltd., the principal company operating in the area, advanced substantially development of its properties along the north shore of Beaverlodge Lake. Development on its Ace and Eagle claims included deepening of the Ace shaft from 599 to 1,143 feet, 7,150 feet of drifting and cross-cutting, and 34,803 feet of exploratory diamond drilling. The underground program on the Eagle property was discontinued in June and equipment moved to the Fay zone, about 4,000 feet southwest of the Ace shaft, where sinking of a 5-compartment production shaft had reached a depth of 72 feet at the year end. A large surface construction program was to be undertaken in 1952, including erection of a concentrator; production operations were scheduled to begin early in 1953.[48] Extensive exploration and development operations by private interests in 1951 were also underway in the Goldfields district and in the Black Lake-Charlebois Lake region, about 140 miles east of Goldfields. In Ontario activity centered mainly in the Sault Ste. Marie and Wilberforce regions and in British Columbia in the Hazelton district and at Birch Island, about 80 miles north of Kamloops. Exploration continued in the Great Bear Lake, Hottah Lake, and Marian River regions of Northwest Territories.[49] Geologic and economic features of Canadian uranium deposits were discussed in the technical press.[50]

On March 6, 1951, announcement was made that producers of Canadian uranium would receive henceforth a development allowance of C$1.25 per pound of contained U_3O_8 during the first three years of production. At the same time the period of a guaranteed market price was extended by 2 years from April 1, 1958, to April 1, 1960. The announcement, in effect, raised Canadian prices for uranium to a level comparable with that established on March 1, 1951, in the United States by the AEC.[51]

A commercial beam therapy unit employing cobalt-60 produced at Chalk River, Ontario, was installed in the Victoria Hospital, at London, Ontario. The unit was the first of its kind produced in the world. Selling price of the unit was C$48,000; a therapy unit employing radium with an equivalent dosage would cost approximately C$45,000,000.[52]

Chile.—The Chilean Government announced in 1951 that pitchblende had been found in the tailings at old copper mines near Carrizal, north of Vallenar, in Atacama Province, and near Tambillos, south of La Serena, in Coquimbo Province.[53]

Mexico.—Discoveries of uranium deposits in Mexico were reported during 1951 at El Guichi, near Eldorado, Culiacán district, Sinaloa;[54]

[48] Work cited in footnote 47, pp. 5-8.
[49] Lang, A. H., Continued Uranium Search Begins to Bring Results: Northern Miner, vol. 36, No. 36, Nov. 27, 1951, pp. 101 and 111.
[50] Bichan, W. James, Uranium in Western Canada: Western Miner, vol. 24, No. 10, October 1951, pp. 52, 54, 56, 58, 60, 62, 64, 66.
Buffam, B. S. W., and Gillanders, E. B., The Exploration and Development of Canadian Uranium Deposits: Canadian Min. and Met. Bull., vol. 44, No. 474, October 1951, pp. 678-681.
Lang, A. H., Canadian Deposits of Uranium and Thorium: Geol. Survey of Canada, Paper 51-10, Ottawa, 1951, 157 pp.
[51] W. J. Bennett (president, Eldorado Mining & Refining (1944), Ltd.), addressing the annual convention of the Prospectors and Developers Association and the 4th annual meeting of the Geol. Assoc. of Canada, Toronto, Ontario, Mar. 6, 1951.
[52] Work cited in footnote 47, p. 9.
[53] Engineering and Mining Journal, vol. 152, No. 12, December 1951, p. 152.
[54] Mining World, vol. 13, No. 6, May 1951, p. 55.

near Susucato, Zitacuaro district, Michoacan; and in the mountains near the city of Oaxaca, Oaxaca.[55]

EUROPE

Germany.—Significant deposits of uranium ore were found in North Bavaria during 1951, according to reports. The deposits are situated in a zone about 100 kilometers long that extends southeast from Amberg toward the Czechoslovak border.[56] Uranium deposits were discovered in old mine workings near Wittichen, in the Klosterbach Valley, where silver- and cobalt-bearing ore was formerly mined.[57]

Italy.—Exploration was begun in 1951 under Government auspices of the uranium occurrences found in the Province of Trento, in the Fersina River Valley. Autunite and torbernite occurrences were discovered in the Province of Cuneo near Lurisia and in the Pesio Valley.[58] Italo-French interests applied to the Italian Government for a concession for exploiting uranium occurrences found in the St. Vincent area of the Aosta Valley.[59] The Sardinian Regional Government announced plans to take over development of the uranium deposits discovered in the Decimomannu region.[60]

Norway.—After 3 years of planning and building, the Norway-Netherlands reactor at Kjeller, near Oslo, Norway, went into operation on July 30, 1951, and the following afternoon the reactor produced its first radioactive isotope.[61] Heavy water is used as the moderator in the reactor, which has a rating of 100 kilowatts. Norway provided the heavy water, and the Netherlands furnished the uranium. The reactor will be utilized for the production of isotopes, neutron research, research on metals and materials, and the peaceful applications of atomic energy.[62] An article describing the constructional details of the reactor was published.[63]

Sweden.—A large deposit containing uranium was discovered at Guliksberg, near Anund Lake, in Swedish Lapland. Preliminary surveys indicated an ore body 1,900 feet long and 1,000 feet wide.[64] Proposed construction of a reactor near the research station of the Academy of Sciences in Stockholm, was announced.[65]

U. S. S. R.—The second and third atomic explosions by the Soviet Union were announced by the White House on October 3 and October 22, 1951, respectively; detection of the first atomic explosion had been revealed by President Truman on September 23, 1949.[66] Torbernite deposits were reported to have been discovered in 1951 near Lake Ochrida, in Albania, by members of a Russian Mission. The uranium ore was to be exploited under supervision of engineers from the Russian Mining Office, at Budapest, Hungary.[67] Important resources of uranium ore were said to have been found in the Rhodope mountains

[55] Engineering and Mining Journal, vol. 152, No. 10, October 1951, p. 150.
[56] Mining Journal (London), vol. 236, No. 6027, Feb. 23, 1951, p. 186.
[57] Metal Bulletin (London), No. 3617, Aug. 17, 1951, p. 20.
[58] Mining World, vol, 13, No. 4, April 1951, p. 49.
[59] Mining World, vol. 13, No. 3, March 1951, p. 43.
[60] Mining World, vol. 13, No. 9, August 1951, p. 56.
[61] Chemical Age, vol. 65, No. 1674, Aug. 11, 1951, p. 199.
[62] Work cited in footnote 45, p. 1.
[63] Dahl, Odd, and Randers, Gunnar, Heavy-Water Reactor at Kjeller, Norway: Nucleonics, vol. 9, No. 5, November 1951, pp. 5–17.
[64] Work cited in footnote 58, p. 46.
[65] Nucleonics, vol. 8, No. 4, April 1951, p. 86.
[66] Atomic Energy Newsletter, vol. 6, No. 4, Oct. 9, 1951, p. 1; vol. 6, No. 6, Nov. 6, 1951, p. 2.
[67] Work cited in footnote 62, pp. 44 and 46.

of Bulgaria, and the formation of a State-controlled mining company to exploit the deposits was announced by the Bulgarian Government.[68] A new uranium mine was reportedly opened in 1951 at Hermanovw Seisy, near Jachymov, in Czechoslovakia,[69] and uranium ore discovered near Pribram on the site of an old silver mine.[70] Late in 1951 Lt. Col. Fedya Astrachov, head of Russia's uranium-mining project in East Germany, and a Stalin prize winner, fled to freedom in the West.[71]

United Kingdom.—During 1951 two reactors, both producing plutonium, were placed in operation at Sellafield, Cumberland, England.[72] Drawings and estimates of a prototype atomic power unit for large merchant ships and warships were reportedly being prepared by an engineering firm under contract to the British Government.[73] In November 1951 the Ministry of Supply offered increased prices for uranium ores and concentrates to prospectors in the Colonies and Dependent Territories, bringing the prices in line with those offered by the United States and Canada. The Ministry also announced that it was willing to discuss purchase terms for thorium-bearing minerals.[74]

AFRICA

Morocco.—Moroccan government sources reported in 1951 the discovery of uranium minerals at Bouazzer and Azegour in the South Atlas Mountains. The occurrence at Bouazzer was said to be complex and difficult to exploit, whereas that at Azegour was described as a pitchblende occurrence.[75]

Mozambique.—Under an agreement reportedly concluded between the French Government and a Portugese mining group, over 100 tons of uranium ore was shipped about the beginning of 1951 to France from the Tete district.[76]

Union of South Africa.—In 1951 2 more gold-mining companies operating on the Witwatersrand joined the list of prospective producers of uranium, bringing the total of such companies to 6 (*see* Uranium, Radium, and Thorium chapter, Minerals Yearbook, 1950). The 2 additional companies were the Stilfontein Gold Mining Co., Ltd., and West Driefontein Gold Mining Co., Ltd.; production of uranium by the 2 companies was expected to begin in 1953.[77] The AEC announced that the construction of plants in South Africa to recover uranium from gold-ore residues was proceeding on schedule;[78] initial production of uranium was expected in the second half of 1952 by West Rand Consolidated Mines, Ltd.[79] In a discussion of the gold-uraninite mineralization of the Witwatersrand deposits evidence

[68] Work cited in footnote 58, p. 44.
[69] Mining World, vol. 13, No. 11, October 1951, p. 65.
[70] Mining Journal (London), vol. 236, No. 6026, Feb. 16, 1951, p. 163.
[71] U. S. Department of State Bulletin, Behind the Iron Curtain, a Year-End Review: Vol. 26, No. 656, Jan. 21, 1952, pp. 84–85.
[72] Nucleonics, vol. 8, No. 3, March 1951, p. 88; vol. 9, No. 5, November 1951, p. 70.
[73] Nucleonics, vol. 8, No. 2, February 1951, p. 90.
[74] Metal Bulletin (London), No. 3644, Nov. 20, 1951, p. 19.
[75] Atomic Energy Newsletter, vol. 6, No. 4, Oct. 9, 1951, p. 5.
[76] Mining World, vol. 13, No. 1, January 1951, p. 55.
[77] Nucleonics, vol. 8, No. 6, June 1951, p. 48.
[78] Work cited in footnote 2, p. 6.
[79] Mining Journal (London), vol. 236, No. 6021, Jan. 12, 1951, p. 29.

was presented in a paper published in 1951 that tended to support the hypothesis that the deposits are of hydrothermal origin.[80]

ASIA AND AUSTRALIA

Australia.—The uranium occurrence at Rum Jungle, near Darwin, Northern Territory, and that at Radium Hill, near Olary, South Australia, were the scenes of much activity in 1951. Mining of ore was begun at Rum Jungle; two shafts were sunk, and a water supply was brought to the field. The discoverer of the deposit was paid a reward of $2,240 on the basis that 25 tons of uranium oxide would be produced. Further payment of $4,480 will be made for each additional 25 tons until total payments reach $56,250, the maximum payment for any uranium discovery in Australia.[81]

Under an arrangement with the Commonwealth Government, the Government of South Australia agreed to undertake the mining of uranium at Radium Hill. Exploratory work was performed by the South Australian Mines Department concurrently with investigation of the Mount Painter area in the Flinders Ranges. Geophysical surveys were reported to have been favorable for an extensive occurrence. A large area was, in consequence, reserved from operations under the Mining Act, indicating that the area would be investigated solely by the Mines Department.[82]

The first discovery of uranium in Victoria was made at Sunnyside, a gold-mining center in the mountains of East Gippsland. Active exploration of the area was planned.[83] An area of about 100 square miles surrounding the uranium occurrence along the banks of the Ferguson River near Katherine, 200 miles south of Darwin, was declared a Crown reserve by the Northern Territory Mines Branch. Geophysicists of the Commonwealth Bureau of Mineral Resources were planning to examine the area.[84]

China.—According to a press report originating in New Delhi, India, said to be based on statements by refugees from Sinkiang Province in northwest China, Russia has constructed an atomic plant in the Ili district, near the Soviet border. Prof. Bruno Pontecorvo, a nuclear scientist who defected to the U. S. S. R. in 1950 (*see* Uranium, Radium and Thorium chapter, Minerals Yearbook, 1950), was alleged to be working at the plant.[85] Other press reports from Taipei, Formosa, were to the effect that arrangements had been made to mine uranium ore near Ining, in the vicinity of the Ili district, and that a range for testing atomic bombs had been established along the northern fringe of the Takla Makan, a desert 275 miles southwest of Tihwa, the capital of Sinkiang.[86]

India.—Discovery of two uranium-bearing belts in Eastern and Central India was announced by the Minister of Natural Resources

[80] Davidson, C. F., and Bowie, S. H. U., On Thucolite and Related Hydrocarbon-Uraninite Complexes, With a Note on the Origin of Witwatersrand Gold Ores: Geol. Survey of Great Britain Bull. 3, London, 1951, pp. 1–19.
[81] Work cited in footnote 54, p. 42.
[82] Mining Journal (London): Vol. 236, No. 6034, Apr. 13, 1951, p. 337.
Mining Magazine (London): Vol. 85, No. 5, November 1951, p. 297.
[83] Mining Magazine (London), vol. 84, No. 5, May 1951, p. 297.
[84] Mining Record, vol. 62, No. 43, Oct. 25, 1951, p. 7.
[85] New York Times, vol. 100, No. 34,168, Aug. 12, 1951, p. 3.
[86] New York Times, vol. 100, No. 34,055, Apr. 21, 1951, p. 5; vol. 101, No. 34,231, Oct. 14, 1951, p. 35.

and Scientific Research.[87] The Directorate of Mines, Rajasthan Government, stated that uranium had been found in the Aravalli Hills, about 20 miles from Udaipur.[88] India's first nuclear reactor, to be used for research purposes and the production of radioisotopes, was to be built within 2 years, with France cooperating in its construction.[89] A search for uranium deposits in the Gilgit region and the Hindukush Ranges in Baluchistan, Pakistan, was reported.[90]

[87] Engineering and Mining Journal, vol. 152, No. 6, June 1951, p. 144.
[88] Work cited in footnote 60, p. 43.
[89] Iron Age: Vol. 168, No. 18, Nov. 1, 1951, p. 82.
[90] Mining Journal (London), vol. 236, No. 6023, Jan. 26, 1951, p. 78.

Vanadium

By Hubert W. Davis

GENERAL SUMMARY

THE CENTER of vanadium-ore mining in the United States is the Colorado-Utah region, where it is produced chiefly as a byproduct of uranium. For security reasons, publication of figures on production and consumption of vanadium ore in the United States has been suspended since 1947 at the request of the Atomic Energy Commission. Small outputs are made in Arizona, Nevada, and New Mexico. Some vanadium is recovered as a byproduct of phosphate rock mined in Idaho. Vanadium is also recovered as a byproduct of chrome ore at Glens Falls, N. Y., and as a byproduct of petroleum residues at Wood-Ridge, N. J.

Imports of vanadium concentrates in 1951 were 33 percent less than in 1950, but receipts of ferrovanadium declined only 5 percent. Exports of ferrovanadium in 1951 were 48 percent more than in 1950.

On March 8, 1951, the quotation on vanadium ore was advanced to 31 cents a pound of contained vanadium; the former price was 27½ cents.

TABLE 1.—Vanadium in ores and concentrates produced in the United States, 1938–47 [1]

Year	Pounds	Year	Pounds
1938	1,613,155	1943	5,586,492
1939	1,984,068	1944	3,527,054
1940	2,162,916	1945	2,963,913
1941	2,513,051	1946	1,272,148
1942	4,439,130	1947	2,117,962

[1] Data for 1940–47 are receipts at mills and Government purchasing depots.

USES

About 90 percent of the vanadium used is consumed as ferrovanadium in the manufacture of tool steels, engineering steels, high-strength structural steels, nonaging rimming steels, and special wear-resistant cast irons. Some ferrovanadium is used in welding-electrode

coatings and as a deoxidizer, and some metal is utilized in magnets. Some vanadium oxide is also used in the production of tool steel. The largest uses of vanadium oxide and ammonium metavanadate are as catalysts, in glass and ceramic glazes, for driers in paints and inks, and for laboratory research. Ductile vanadium, 99.8 to 99.9 percent pure, was made available in 1950.[1]

According to Steel:[2]

> Vanadium is one of the most recent of the rare metals to become industrially available. Pure vanadium metal has been rare, even though alloys of vanadium have been produced in quantity for many years. It has been considered a rare metal primarily because it is difficult to produce in the metallic state without the addition of alloying elements.
>
> Vanadium is eighth in order of natural abundance of those metals useful for structural purposes. In this respect it ranks ahead of nickel and copper.
>
> Pure, ductile vanadium metal can now be obtained in massive form for remelting, as well as in ingots, bars, sheet, and foil. The metal is lighter than iron, has good structural properties, and resists pitting and corrosion by salt spray and sea water. It can be rolled at ordinary temperatures; cold reductions up to 85 percent have been made without annealing. Pure vanadium machines well and is easily welded with regular shielded-arc methods.

PRICES

For many years vanadium ore has been quoted at 27½ cents a pound of contained V_2O_5, but on March 8, 1951, it was advanced to 31 cents. This quotation, however, disregards the grade of the ore or the presence or absence of objectionable impurities—matters important to the refiners, inasmuch as impurities vitally affect recovery. Throughout 1951 vanadium pentoxide (technical grade) was quoted at $1.06 to $1.28 a pound of V_2O_5 and ferrovanadium at $3 to $3.20 a pound of contained vanadium (depending upon grade of the alloy).

FOREIGN TRADE[3]

Imports of vanadium concentrates (all from Peru) were 982,878 pounds (contained vanadium) in 1951, a decrease of 33 percent from 1950. There were no imports of vanadium-bearing flue dust in 1951. Imports of ferrovanadium were 123,050 pounds (gross weight) valued at $100,261 in 1951 compared with 130,022 pounds valued at $91,193 in 1950. The 1951 imports comprised 70,810 pounds from Japan, 19,800 pounds from France, 18,910 pounds from United Kingdom, and 13,530 pounds from Germany. Vanadium ore and concentrates enter the United States free of duty. However, the rate of duty on ferrovanadium is 12½ percent ad valorem and on vanadic oxide, anhydride, salts, and compounds and mixtures of vanadium, 40 percent ad valorem.

[1] Iron Age, Pure Vanadium Now in Limited Production: Vol. 166, No. 14, Oct. 5, 1950, pp. 95-96.
[2] Steel, Pure Vanadium—a Promising Engineering Material: Vol. 129, No. 27, Dec. 31, 1951, pp. 52-55.
[3] Figures on imports and exports compiled by M. B. Price and E. D. Page, of the Bureau of Mines, from records of the U. S. Department of Commerce.

TABLE 2.—Vanadium ore or concentrates and vanadium-bearing flue dust imported for consumption in the United States, 1942–51

[U. S. Department of Commerce]

Year	Vanadium ore or concentrates			Vanadium-bearing flue dust		
	Pounds		Value	Pounds		Value
	Gross weight	Vanadium content		Gross weight	Vanadium content	
1942	36,492,268	2,422,376	$1,274,483	624,423	154,028	$29,545
1943	22,117,131	2,052,620	1,080,150	748,749	64,393	53,553
1944	4,247,490	1,284,603	633,719	191,901	40,171	28,059
1945	8,776,328	1,550,479	725,362	133,795	26,293	19,378
1946	2,784,349	791,057	390,077	97,750	20,931	13,480
1947	3,274,548	983,869	448,076	143,124	71,819	15,483
1948	4,034,509	1,051,675	534,374			
1949	2,028,980	551,337	272,124			
1950	5,110,403	1,457,010	708,806	9,575	804	2,475
1951	3,893,900	982,878	526,941			

Exports of vanadium ore and concentrates totaled 2,817 pounds (contained vanadium) valued at $6,581 in 1951 compared with 963 pounds valued at $2,615 in 1950. The 1951 exports comprised 2,386 pounds to Canada and 431 pounds to France. Exports of ferrovanadium totaled 122,344 pounds (gross weight) valued at $190,346 in 1951 compared with 82,449 pounds valued at $183,307 in 1950. The 1951 exports comprised 118,931 pounds to Canada and 3,413 pounds to Austria. Exports of vanadium metal, alloys, and scrap were 1,712 pounds valued at $6,481 in 1951 compared with 4,106 pounds valued at $2,688 in 1950. The 1951 exports comprised 1,710 pounds to Canada and 2 pounds to United Kingdom.

WORLD REVIEW

World production of vanadium ores is limited almost entirely to four countries—Northern Rhodesia, Peru, South-West Africa, and the United States. From 1941 through 1947 output from these sources ranged from 1,400 to 4,400 metric tons, with the United States the leading producer.

Vanadium has also been recovered commercially from phosphate rock, iron ore, chrome ore, magnetite beach sands, caustic soda solution employed in the Bayer process of refining bauxite, naphtha soot collected from the smokestacks of ships and industrial plants, and vanadiferous ashes derived from asphaltites.

Because complete information on the quantity of vanadium recovered as byproducts of iron ore and other raw materials is lacking, it is not possible to determine world production of vanadium from all sources. Consequently, table 3 reflects only the production of vanadium in ores and concentrates for the countries listed, plus the quantity recovered in the United States as a byproduct of phosphate rock.

Argentina.—Vanadium occurs in small deposits widely scattered in the Provinces of Córdoba and San Luis. A small quantity of ore is mined for the production of 3 to 6 metric tons of vanadium pentoxide annually.

TABLE 3.—World production of vanadium in ores and concentrates, 1942–51, in metric tons

[Compiled by Berenice B. Mitchell]

Country	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951
Argentina	------	------	4	3	6	7	(1)	(1)	(1)	(1)
Northern Rhodesia	388	426	254	219	68	56	173	153	------	87
Peru	1,010	847	514	688	322	435	511	456	436	[2] 400
South-West Africa	453	577	385	420	430	282	187	163	295	[2] 300
United States (shipments) [3]	2,014	2,534	1,600	1,344	577	961	(4)	(4)	(4)	(4)
Total [5]	3,865	4,384	2,757	2,674	1,403	1,741	(4)	(4)	(4)	(4)

[1] Figure not available.
[2] Estimate.
[3] Includes vanadium recovered as a byproduct of phosphate-rock mining.
[4] United States figures for 1948–51 withheld at request of Atomic Energy Commission.
[5] Total represents data only for countries shown in table and excludes vanadium in ores produced in French Morocco, Spain, and U. S. S. R., for which figures are not available; the total also excludes quantities of vanadium recovered as byproducts from other ores and raw materials.

Northern Rhodesia.—The Rhodesia Broken Hill Development Co., Ltd., is the only producer of vanadium in Northern Rhodesia. Output of vanadium oxide was 167 long tons averaging 91.32 percent V_2O_5 in 1951. There was no production in 1950, although shipments were made from stock. Feed to the vanadium leach plant in 1951 was derived from various sources and totaled 10,120 short tons averaging 2.82 percent V_2O_5. Recovery of vanadium was 60.3 percent, which was considered satisfactory in view of the low grade of the material treated. According to the company:

> It is becoming increasingly difficult to maintain a continuous supply of vanadium bearing material with a grade suitable for leaching, because of the gradual exhaustion of accumulated surface dumps. Much experimental work has been carried out in an effort to produce a leach grade concentrate from the low grade mixed fines tailings and recent flotation tests have been encouraging.

Peru.—The famous Mina Ragra mine of the Vanadium Corp. of America in the Andes near Ricran, Department of Junin, has been an important source of vanadium since 1907, when production was begun. Output in Peru was about 700 metric tons of V_2O_5 in 1951 compared with 779 tons of V_2O_5 in 1950.

South-West Africa.—The Abenab West lead-vanadium mine of the South West Africa Co., Ltd., was the only producer of vanadium in South-West Africa in 1951. Output of concentrates (V_2O_5 content) was about 600 short tons in 1951 compared with 580 tons in 1950. Exports of concentrates were 3,151 short tons averaging about 12.6 percent V_2O_5 in 1951, all of which went to Europe.

Zinc [1]

By O. M. Bishop and Esther B. Miller

GENERAL SUMMARY

THE DEMAND engendered by the National Defense Program prompted the domestic zinc industry to smelt the greatest quantity of slab zinc and mine the largest tonnage of recoverable zinc since the war year 1943. Smelter output, 2 percent above the 1950 level, totaled 930,000 short tons (67 percent from domestic ores, 28 percent from foreign ores, and 5 percent from secondary material). Domestic mine production of recoverable zinc was 681,000 tons or 9 percent above the 623,000 tons of 1950. Montana, with 86,000 tons, led all the States in mine production of zinc, followed in order by Idaho, New Jersey, Colorado, Oklahoma, Arizona, amd New Mexico. Imports of zinc in ores and concentrates increased 9 percent to 303,000

TABLE 1.—Salient statistics of the zinc industry in the United States, 1942–46 (average) and 1947–51

	1942–46 (average)	1947	1948	1949	1950	1951
Production of primary slab zinc:						
By sources:						
From domestic ores.....short tons..	544,990	510,058	537,966	591,454	588,291	621,826
From foreign ores.....do....	294,271	292,437	249,798	223,328	255,176	259,807
Total.....do....	839,261	802,495	787,764	814,782	843,467	881,633
By methods:						
Electrolytic.....percent of total..	35	37	40	40	41	38
Distilled.....do....	65	63	60	60	59	62
Production of redistilled secondary slab zinc.....short tons..	48,841	59,542	62,320	55,041	66,970	48,657
Stocks on hand at primary smelters Dec. 31.....short tons..	182,905	67,046	19,179	90,710	[1] 7,948	21,344
Price:						
Prime Western at St. Louis:						
Average for period...cents per pound..	8.35	10.50	13.58	12.15	13.88	17.99
Highest quotation.....do....	10.50	10.50	17.50	17.50	17.50	19.50
Lowest quotation.....do....	8.25	10.50	10.50	9.00	10.00	17.50
Yearly average at London.....do....	5.36	12.58	14.38	14.41	14.89	21.46
Mine production of recoverable zinc [2] short tons..	684,011	637,608	629,977	593,203	623,375	681,189
Tri-State district (Joplin) percent of total..	26	17	14	13	13	13
Western States.....do....	45	54	58	60	59	58
Other.....do....	29	29	28	27	28	29
World smelter production of zinc short tons..	1,754,000	[1]1,763,000	[1]1,882,000	[2]2,008,000	[2]2,167,000	2,309,000

[1] Revised figure. [2] Includes Alaska.

[1] This chapter deals primarily with the smelter branch of the industry. Fuller details of zinc mining are given in the various State chapters of this volume. As some zinc ore is used directly in the manufacture of zinc pigments, *see also* the chapter on Lead and Zinc Pigments and Zinc Salts.

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short tons, but imports of slab zinc declined 44 percent to 88,000 short tons. Consumption of slab zinc, curtailed by the restrictive orders of the National Production Authority, declined 3 percent to 934,000 tons in 1951, a consumption exceeded only by the alltime peak year 1950. Although inventories of slab zinc at producers' plants increased by 13,000 tons, they remained at a relatively low level. Consumers' stocks declined by 14,000 tons to 50,000 short tons, the equivalent of requirements for 19 days. Zinc prices were controlled by the Office of Price Stabilization throughout 1951. The price for Prime Western grade at East St. Louis was 17.50 cents per pound for most sellers until October 2, 1951, when an increase of 2 cents per pound was authorized and made.

GOVERNMENT REGULATIONS

In 1950 the Korean War caused a prompt acceleration of the Nation's defense program, which necessitated introducing Government controls in the latter part of the year. Regulatory measures instituted in 1950 are described in the Zinc chapter of Minerals Yearbook, 1950.

Among the 1950 measures was National Production Authority Order M–15, effective December 1, 1950, which limited civilian consumers of zinc and zinc-metal products to an average quarterly consumption rate not to exceed 80 percent of their quarterly average as established in the 6-month period ended June 30, 1950. The same order specified that inventories should not exceed a 45-day supply or a "practicable minimum working inventory," whichever was less. On June 15, 1951, Order M–15 was amended to limit quarterly consumption of Special High-Grade zinc to 70 percent of that used in the base period, and allowable inventories of zinc and zinc metal products were restricted to 30 days or the "practicable minimum working inventory," whichever was less. On July 5 NPA issued a new Order M–9, which placed slab zinc under allocation effective August 1. Under this order no dealer or consumer could accept delivery of 20 short tons or more of slab zinc during any calendar month without an allocation authorization.

DOMESTIC PRODUCTION

Statistics on zinc production are compiled both on a mine and on a smelter basis. The mine-output data, based upon the zinc content of ores and concentrates produced (adjusted to account for average smelting losses), form an accurate measure of domestic zinc output from year to year. Smelter production of slab zinc from domestic ores represents a more accurate figure of actual zinc recovery but usually differs from the mine figure owing to a time lag between mine or mill shipments and smelter production. Over a period of years, these variations tend to balance within the limits of statistical error.

MINE PRODUCTION

Zinc mining in the United States is centered largely in six areas—the Tri-State area of southeastern Kansas, southwestern Missouri, and northeastern Oklahoma; Tennessee-Virginia; Sussex County,

N. J.; St. Lawrence County, N. Y.; northern Illinois-Wisconsin; and the Western States (principally Montana, Idaho, Colorado, Arizona, New Mexico, Utah, Washington, Nevada, and California, in descending order of production in 1951).

TABLE 2.—Mine production of recoverable zinc in the United States, 1942–46 (average) and 1947–51, by States, in short tons

State	1942–46 (average)	1947	1948	1949	1950	1951
Western States and Alaska:						
Alaska		25	22	2	6	1
Arizona	30,234	54,644	54,478	70,658	60,480	52,999
California	5,545	5,415	5,325	7,209	7,551	9,602
Colorado	37,637	38,745	45,164	47,703	45,776	55,714
Idaho	84,061	83,069	86,267	76,555	87,890	78,121
Montana	32,524	45,679	59,095	54,195	67,678	85,551
Nevada	17,730	16,970	20,288	20,443	21,606	17,443
New Mexico	46,622	44,103	41,502	29,346	29,263	45,419
Oregon		1		6	21	3
South Dakota	43	19	29			
Texas	9	22				24
Utah	38,671	43,673	41,490	40,670	31,678	34,317
Washington	12,305	13,800	12,638	10,740	14,807	18,189
Total	305,381	346,165	366,298	357,527	366,756	397,383
West Central States:						
Arkansas	137	18	31	1	8	50
Kansas	54,524	41,497	35,577	29,433	27,176	28,904
Missouri	29,568	17,074	6,463	5,911	8,189	11,476
Oklahoma	98,179	51,062	43,821	44,033	46,739	53,450
Total	182,408	109,651	85,892	79,378	82,112	93,880
States east of the Mississippi River:						
Illinois	7,922	10,073	12,980	18,157	26,982	21,776
Kentucky	435	508	639	935	731	3,457
New Jersey	82,608	76,871	76,332	50,984	55,029	62,917
New York	36,968	34,116	34,566	37,973	38,321	40,051
Tennessee	37,001	31,212	29,524	29,788	35,326	38,639
Virginia	17,448	16,788	15,882	13,166	12,396	7,332
Wisconsin	13,840	12,224	7,864	5,295	5,722	15,754
Total	196,222	181,792	177,787	156,298	174,507	189,926
Grand total	684,011	637,608	629,977	593,203	623,375	681,189

Mine production of recoverable zinc (including that recovered as zinc pigments and salts directly from ore) increased to 681,000 tons in 1951 or 9 percent above the 1950 total. This high output was achieved despite a 2-week shutdown of mines, mills, and smelters caused by a strike in the Western States in late August and early September. The combined Western States provided 58 percent (59 percent in 1950) of

TABLE 3.—Mine production of recoverable zinc in the United States,[1] 1950–51, by months, in short tons

Month	1950	1951	Month	1950	1951
January	43,808	60,086	August	56,487	54,545
February	46,327	54,512	September	54,858	50,382
March	51,999	60,795	October	55,937	60,613
April	49,319	56,277	November	55,432	57,483
May	52,166	59,114	December	57,493	57,041
June	50,874	56,872			
July	48,675	53,469	Total	623,375	681,189

[1] Includes Alaska.

the total output, the States east of the Mississippi River 28 percent (28), and the West Central States—Arkansas, Kansas, Oklahoma, and Missouri—14 percent (13).

Montana was the leading zinc-producing State, the output being the greatest since 1920. The production was chiefly from the Butte Hill area, the East Helena slag dump, and the Mike Horse and Jack Waite properties.

Idaho, which has held first place in tons of zinc mined since 1943, yielded that position to Montana in 1951. About 96 percent of the State total came from the Coeur d'Alene region and most of the remainder from the Warm Springs district.

Colorado exceeded its 1950 production by 22 percent. Mines in Eagle County produced 52 percent of the State zinc in 1951, San Miguel 17 percent, Lake 15 percent, and other counties 15 percent.

Arizona zinc output declined 12 percent in 1951 owing to a decrease in output of zinc-lead ores from the Copper Queen mine at Bisbee.

New Mexico output of zinc, the highest since 1944, was 55 percent above the 1950 production despite the strike throughout the year at the Hanover mine of New Jersey Zinc Co.

Zinc output in Utah in 1951 was 8 percent higher than in 1950. The United States and Lark property continued to be the largest producer.

Zinc production in Washington was at an alltime high in 1951. The Grandview, Pend Oreille, Deep Creek, and Holden mines supplied 98 percent of the State production.

Zinc output in Nevada declined 19 percent as production from the Pioche district dropped from 19,650 tons to 14,350. Oxidized ores from operating mines and the former Metals Reserve Company Clark County stockpile were shipped to the Tooele, Utah, slag-fuming plant.

California mine output of zinc increased 27 percent over 1950. The Darwin and Shoshone groups and the Afterthought and Penn mines supplied virtually the entire output. The Carbonate King mine produced some oxidized zinc ore, which was treated at a slag-fuming plant.

Zinc production in the Tri-State district increased 14 percent in 1951, largely in response to the substantial rise in lead and zinc concentrate prices.

Zinc production from mines in the States east of the Mississippi River in 1951 was 9 percent higher than in 1950. The principal produc-

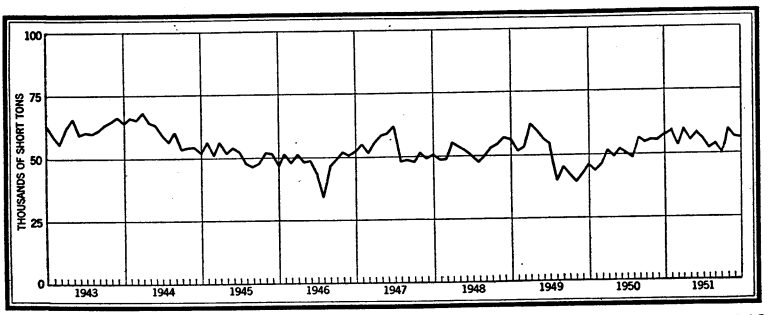

FIGURE 1.—Mine production of recoverable zinc in the United States, 1943–51, by months.

TABLE 4.—Twenty-five leading zinc-producing mines in the United States in 1951, in order of output

Rank	Mine	District	State	Operator	Type of ore
1	Butte Mines	Summit Valley (Butte)	Montana	Anaconda Copper Mining Co	Zinc-lead.
2	Franklin and Sterling Hill	New Jersey	New Jersey	New Jersey Zinc Co	Zinc.
3	Balmat	St. Lawrence County	New York	St. Joseph Lead Co	Zinc-lead.
4	Eagle	Red Cliff	Colorado	Empire Zinc Division, New Jersey Zinc Co	Zinc.
5	Star	Hunter	Idaho	Sullivan Mining Co	Zinc-lead.
6	United States and Lark	West Mountain (Bingham)	Utah	U. S. Smelting, Refining & Mining Co	Do.
7	Mascot No. 2	Eastern Tennessee	Tennessee	American Zinc Co. of Tennessee	Zinc.
8	Ground Hog group	Central	New Mexico	American Smelting & Refining Co	Do.
9	Oswaldo	Central	do	Kennecott Copper Corp	Do.
10	Edwards	St. Lawrence County	New York	St. Joseph Lead Co	Do.
11	Davis-Bible group	Eastern Tennessee	Tennessee	Universal Exploration Co	Do.
12	Pioche	Pioche	Nevada	Combined Metals Reduction Co	Zinc-lead.
13	United Verde	Verde (Jerome)	Arizona	Phelps Dodge Corp	Zinc-copper.
14	Iron King	Big Bug	do	Shattuck Denn Mining Corp	Zinc-lead.
15	Bunker Hill and Sullivan	Yreka	Idaho	Bunker Hill & Sullivan Mining & Concentrating Co	Do.
16	Bautsch	Northern Illinois	Illinois	Tri-State Zinc, Inc	Zinc.
17	Calumet	Wisconsin	Wisconsin	Calumet & Hecla Consolidated Copper Co	Zinc-lead.
18	Bayard group	Central	New Mexico	U. S. Smelting, Refining & Mining Co	Zinc.
19	Resurrection group	California (Leadville)	Colorado	Resurrection Mining Co	Zinc-lead.
20	Page	Yreka	Idaho	Federal Mining & Smelting Co	Do.
21	Austinville	Austinville	Virginia	New Jersey Zinc Co	Do.
22	Grasselli	Eastern Tennessee	Tennessee	American Zinc Co. of Tennessee	Zinc.
23	Kearney group	Central	New Mexico	New Mexico Consolidated Mining Co	Do.
24	Grandview	Metaline	Washington	American Zinc Lead Smelting Co	Zinc-lead.
25	Morning	Hunter	Idaho	Federal Mining & Smelting Co	Do.

TABLE 5.—Mine production of recoverable zinc in the United States, in short tons, by districts that produced 1,000 tons or more during any year, 1942–46 (average) and 1947–51

District	State	1942–46 (average)	1947	1948	1949	1950	1951
Tri-State (Joplin region)	Kansas, southwestern Missouri, Oklahoma.	181,406	109,338	84,839	78,628	80,558	91,553
Summit Valley (Butte)	Montana	12,107	40,712	52,625	47,982	63,511	80,500
Coeur d'Alene	Idaho	77,727	79,251	83,801	74,370	86,103	74,989
New Jersey	New Jersey	82,608	76,871	76,332	50,984	55,029	62,917
Central	New Mexico	41,552	38,155	35,140	26,376	26,897	41,884
St. Lawrence County	New York	36,968	34,116	34,566	37,973	38,321	40,051
Eastern Tennessee [1]	Tennessee	37,001	31,212	29,524	29,788	35,326	38,639
Upper Mississippi Valley	Northern Illinois, Iowa,[2] Wisconsin.	16,314	17,077	14,061	17,846	26,793	31,403
Red Cliff	Colorado	20,894	17,375	16,355	17,450	19,956	29,200
West Mountain (Bingham)	Utah	17,491	20,446	22,077	22,311	16,120	18,286
Pioche	Nevada	14,254	14,362	18,612	18,651	19,655	14,350
Metaline	Washington	9,525	9,754	5,985	6,496	11,032	12,753
Park City region	Utah	10,076	10,956	10,320	8,359	7,425	10,209
Verde (Jerome)	Arizona			459	4,350	7,800	10,155
Big Bug	do	3,922	4,991	5,832	8,798	10,416	9,688
Kentucky-Southern Illinois	Kentucky, Southern Illinois.	5,883	5,728	7,422	6,541	6,642	9,584
Upper San Miguel	Colorado	1,170	2,067	3,486	6,004	8,881	9,228
California (Leadville)	do	6,051	4,809	5,726	6,455	7,392	8,144
Austinville	Virginia	16,819	16,788	15,882	13,166	[1] 12,396	[1] 7,332
Pioneer (Superior)	Arizona	2,821				2,595	6,240
Pima (Sierritas, Papago, Twin Buttes).	do	2,841	4,727	5,758	7,177	5,802	5,414
Coso	California	535	603	4,497	4,062	5,237	4,720
Warren (Bisbee)	Arizona	10,198	32,546	27,669	35,393	20,707	4,511
Harshaw	do	2,614	2,006	2,875	2,947	4,193	4,076
Old Hat (Oracle)	do	2,907	3,427	3,796	5,195	4,603	3,583
Northport	Washington	1,247	2,788	3,271	1,412	1,304	3,496
Tintic	Utah	2,825	3,969	3,680	6,082	5,985	3,410
Cochise	Arizona	901	3,143	2,875	1,760	1,025	3,243
Pioneer (Rico)	Colorado	3,666	3,433	3,180	1,354	1,365	2,527
Eureka (Bagdad)	Arizona	214	257	2,321	2,304	1,478	2,504
Smelter (Lewis and Clark Counties).	Montana	1,431	748	3,417	1,463	2,358	2,428
Magdalena	New Mexico	3,893	5,013	4,856	2,263	1,677	2,276
Chelan Lake [3]	Washington	1,431	1,000	3,289	[3] 2,724	[3] 2,430	[3] 1,879
Warm Springs	Idaho	3,992	2,791	1,545	1,635	1,236	1,860
Rush Valley and Smelter (Tooele County).	Utah	7,363	5,642	3,552	2,188	1,219	1,608
Aravaipa	Arizona	165	20	1,098	783	921	1,404
Heddleston	Montana	1,428	1,482	1,437	2,026	892	1,395
Yellow Pine (Goodsprings)	Nevada	522	725	434	447	643	1,332
Animas	Colorado	763	1,310	748	1,029	961	1,183
Sneffels	do	415	[4]	815	1,053	810	1,094
Tomichi	do	340	1,684	1,983	1,456	963	1,011
Campo Seco	California	1,229	2,350		363	326	884
Breckenridge	Colorado	476	1,279	171	362	427	366
Ophir	Utah	149	987	786	1,004	374	341
Flat Creek	California	1,080	1,707				305
Pinos Altos	New Mexico	319	724	1,056	243	144	213
Ten Mile	Colorado	1,546	4,587	10,338	9,716	2,925	16
Cow Creek [5]	California	36		[4]	[4]	[4]	[4]
Smelter (Cascade County)	Montana				1,278		

[1] Includes very small quantity produced elsewhere in State.
[2] No production in Iowa since 1917.
[3] Includes Peshastin Creek and Wenatchee River districts.
[4] Quantity withheld to avoid disclosure of individual company operations.
[5] This district is not listed in order of 1951 output.

ing mines were the Franklin and Sterling Hill mines, New Jersey; the Balmat mine, New York; the Mascot No. 2 mine, Tennessee; the Edwards mine, New York; the Davis-Bible group, Tennessee; the Bautsch mine, Illinois; the Calumet mine, Wisconsin; the Austinville mine, Virginia; and the Grasselli mine, Tennessee. These nine mines or mine groups furnished 82 percent of the zinc mined east of the Mississippi River.

The 25 leading zinc-producing mines in the United States in 1951, listed in table 4, yielded 60 percent of the total domestic zinc output; the 3 leading mines produced 25 percent and the 6 leading mines 35 percent.

Detailed information on the production of mines and mining districts in the United States may be found in the chapters of this volume dealing with the mine production of gold, silver, copper, lead, and zinc in the various States.

SMELTER PRODUCTION

During 1951, 18 primary zinc-reduction plants were in operation; 9 operated with horizontal retorts exclusively, 4 with vertical retorts exclusively (1 electrothermic), and 5 with electrolytic methods.

Horizontal-Retort Plants.—The total number of retorts reported at horizontal-retort primary plants in 1951 was 54,624, the same as in 1950. Of the total retorts reported, 52,484 were in use at the close of 1951, again the same as in 1950.

Vertical-Retort Plants.—Four vertical-retort continuous distilling plants operated during 1951. The total number of vertical retorts increased from 88 on December 31, 1950, to 89 at the end of 1951. At the close of 1951, 84 vertical retorts were in operation.

Electrolytic Plants.—Five electrolytic zinc-reduction plants were in operation during 1951. There was a total of 3,370 cells at the plants on December 31, 1951, of which 3,340 (99 percent) were in operation. The number of cells at the end of 1950 was 3,360, of which 3,322 (99 percent) were operating.

Smelting Capacity.—Irrespective of additions or subtractions of smelter recovery units, statistics on domestic smelting capacity vary from year to year, owing to changes in metallurgical practices among the various plants. According to reports to the Bureau of Mines, the zinc-reduction plants in the United States on December 31, 1951, had a stated annual capacity of 1,082,610 tons of slab zinc under normal operating conditions, allowing for necessary shutdowns for repairs. This figure, which compares with a 1,044,000-ton reported capacity at the end of 1950, indicates that 1951 output was 86 percent of capacity. Horizontal- and vertical-retort plants operated at 86 percent of a stated 650,900-ton capacity (86 percent of a 619,000-ton capacity in 1950), electrolytic plants at 90 percent of a 375,000-ton capacity (93 percent of 369,000-ton capacity in 1950), and secondary smelters at 57 percent of a 56,710-ton capacity (69 percent of a 56,000-ton capacity in 1950).

Waelz Kilns and Slag-Fuming Plants.—During 1951 there was no change in the companies operating Waelz kilns or slag-fuming plants (see Minerals Yearbook, 1950, p. 1288, for a list of such companies).

The four slag-fuming plants in 1951 treated 606,116 tons of hot and

cold slag, which yielded 108,140 tons of oxide fume containing 74,672 tons of recoverable zinc. Corresponding figures for the four operating plants in 1950 were 652,172, 102,826, and 63,522 tons, respectively.

Expansion of slag-fuming facilities planned, as of the end of 1951, included capacity for 7,200 tons of recoverable zinc at the Herculaneum, Mo., smelter of the St. Joseph Lead Co., and 10,000 tons of recoverable zinc at the Selby, Calif., smelter of the American Smelting & Refining Co.

Active Zinc-Reduction Plants.—In July 1951 the New Jersey Zinc Co. began full-scale continuous operation of the first Sterling furnace [2] at its Palmerton, Pa., smelter. The patented process is a new method of smelting zinc ores using an electric arc to generate heat for the reduction. When an iron-bearing zinc ore, such as that from the Sterling Hill, N. J., mine is being smelted, 95 percent of the zinc is recovered in the condensers, and the iron is tapped from the furnace as pig iron. The process is equally well adapted to marmatitic zinc ores when roasted. Overall power consumption approximates 3,000 kw.-hr. per short ton of slab zinc produced.

In West Virginia the Matthiessen & Hegler Zinc Co. took over operation of the plant at Meadowbrook formerly operated by E. I. Du Pont de Nemours & Co. Otherwise, there was no change during the year with respect to zinc-reduction plants operating in the United States. (*See* Minerals Yearbook, 1950, pp. 1289 and 1290, for a list of such plants.)

SLAB ZINC

The output of primary slab zinc in 1951 was 5 percent above 1950 production and the highest since 1943. Output from domestic concentrates increased 6 percent and that from foreign concentrates 2 percent.

Production of redistilled slab zinc decreased 27 percent from the record output established in 1950. Of the 48,657 tons of redistilled secondary slab zinc produced in 1951, 16,251 tons (33 percent) was produced at primary smelters and 32,406 tons (67 percent) at secondary plants.

The output of remelted secondary slab zinc is not included with that of redistilled metal. In 1951 the quantity of slab zinc recovered by remelting purchased scrap was 4,454 tons (7,243 tons in 1950). Zinc rolling mills and other substantial consumers of slab zinc recover large quantities of zinc from scrap generated in their own plants, but metal so recovered is excluded from Bureau of Mines canvasses.

In addition to redistilled and remelted unalloyed secondary zinc, a large quantity of secondary zinc is recovered each year in the form of alloys, zinc dust, zinc pigments, and zinc salts. Additional information on secondary zinc is given in the Secondary Metals—Nonferrous chapter of this volume.

Strikes caused some production losses but did not impair output as seriously as in some years. The strike of mine, mill, and smelter workers in the Western States from August 23 to September 6 curtailed output in that area. Several other strikes of short duration at zinc-reduction plants curtailed production of slab zinc slightly.

[2] Handwerk, E. C., Mahler, G. T., and Fetterolf, L. D., The Sterling Process: Jour. Metals, vol. 4, No. 6, June 1952, pp. 581–586.

TABLE 6.—Primary and redistilled secondary slab zinc produced in the United States, 1942–46 (average) and 1947–51, in short tons

Year	Primary			Redistilled secondary	Total (excludes zinc recovered by remelting)
	From domestic ores	From foreign ores	Total		
1942–46 (average)	544,990	[1] 294,271	839,261	48,841	888,102
1947	510,058	292,437	802,495	59,542	862,037
1948	537,966	249,798	787,764	62,320	850,084
1949	591,454	223,328	814,782	55,041	869,823
1950	588,291	[1] 255,176	843,467	66,970	910,437
1951	621,826	259,807	881,633	48,657	930,290

[1] Includes a small tonnage of foreign slab zinc further refined into high-grade metal in the United States.

Of the 1951 output of primary zinc, 62 percent was distilled and 38 percent produced electrolytically.

Production of Special High Grade, Brass Special, and Prime Western slab zinc increased 4, 29, and 1 percent, respectively, in 1951. Production of the Selected grade was over three times that of 1950. Output of Regular High Grade and Intermediate declined 9 and 4 percent, respectively. Of the total 1951 output (comparable 1950 figures in parentheses) 41 percent (41) was Prime Western, 30 percent (30) Special High Grade, 19 percent (21) Regular High Grade, 7 percent (5) Brass Special, 2 percent (2) Intermediate, and 1 percent (less than 1) Selected.

TABLE 7.—Distilled and electrolytic zinc, primary and secondary, produced in the United States, 1942–46 (average) and 1947–51, in short tons

CLASSIFIED ACCORDING TO METHOD OF REDUCTION

Year	Electrolytic primary	Distilled	Redistilled secondary [1]		Total
			At primary smelters	At secondary smelters	
1942–46 (average)	290,299	548,962	21,930	26,911	888,102
1947	295,520	506,975	22,093	37,449	862,037
1948	312,477	475,287	28,070	34,250	850,084
1949	326,152	488,630	22,782	32,259	869,823
1950	342,085	501,382	28,411	38,559	910,437
1951	336,087	545,546	16,251	32,406	930,290

CLASSIFIED ACCORDING TO GRADE

Year	Grade A		Grade B (Intermediate)	Grades C and D		Grade E (Prime Western)	Total
	Special High Grade (99.99% Zn)	Regular High Grade (Ordinary)		Brass Special	Selected		
1942–46 (average)	246,445	235,569	55,511	74,738	20,541	255,298	888,102
1947	239,274	190,429	36,812	61,104	12,844	321,574	862,037
1948	248,346	196,482	38,892	45,946	4,723	315,695	850,084
1949	230,576	206,651	21,513	56,388	2,565	352,130	869,823
1950	271,678	192,075	21,571	46,730	4,021	374,362	910,437
1951	281,571	175,499	20,734	60,511	13,494	378,481	930,290

[1] For total production of secondary zinc, *see* chapter on Secondary Metals—Nonferrous.

Montana continued to be the largest producer of primary slab zinc in 1951; Pennsylvania and Oklahoma were in second and third places, respectively. Of the States for which production statistics may be shown separately, Illinois, Idaho, and Arkansas occupied the next three positions. As usual, in Montana and Idaho slab zinc was produced by electrolytic methods only. In Illinois and Texas both electrolytic and distilled zinc metal were recovered, whereas in all other States zinc was produced by distillation exclusively.

TABLE 8.—Primary slab zinc produced in the United States, by States where smelted, 1942–46 (average) and 1947–51, in short tons

Year	Arkansas	Idaho	Illinois	Montana	Oklahoma	Pennsylvania	Texas and West Virginia [1]	Total	
								Short tons	Value
1942–46 (average)	31,363	37,110	156,280	204,275	98,414	207,051	104,768	839,261	$144,183,426
1947	17,158	41,801	113,192	197,453	128,398	193,524	110,969	802,495	171,894,429
1948	15,586	42,064	93,229	207,717	137,844	171,276	120,048	787,764	209,860,330
1949	17,116	41,854	86,823	216,578	157,650	156,920	137,841	814,782	202,391,849
1950	20,688	53,922	108,301	216,104	145,117	162,539	136,796	843,467	240,050,708
1951	21,776	54,468	108,544	208,482	161,247	189,177	137,939	881,633	321,619,718

[1] Includes Missouri, 1943–44 and 1947–51.

BYPRODUCT SULFURIC ACID

Sulfuric acid made from sulfur dioxide gases produced in roasting zinc blende (sphalerite) is an important byproduct of zinc smelting. To utilize a larger proportion of their acid-producing capacity, some plants also consume large quantities of native sulfur. Combined production of sulfuric acid from both these sources (*see* table 9) increased 5 percent in 1951.

TABLE 9.—Sulfuric acid (basis, 100 percent) made at zinc-blende roasting plants in the United States, 1947–51

Year	Made from zinc-blende [1]		Made from native sulfur		Total [1]		
	Short tons	Value [2]	Short tons	Value [2]	Short tons	Value [2]	
						Total	Average per ton
1947	598,703	$8,001,205	266,104	$3,556,281	864,807	$11,557,486	$10.38
1948	529,478	7,478,271	233,099	3,292,261	762,577	10,770,532	10.97
1949	476,932	7,276,481	130,592	1,992,423	607,524	9,268,904	11.85
1950	609,571	8,829,236	243,743	3,530,464	853,314	12,359,700	11.25
1951	635,948	10,218,400	261,106	4,195,451	897,054	14,413,851	12.48

[1] Includes acid from foreign blende.
[2] At average of sales of 60° B. acid.

ZINC DUST

Production of zinc dust in 1951 totaled 31,695 tons, a 10-percent increase over 1950 output. Zinc powder and blue powder are not included in Bureau of Mines production totals; the zinc dust included is restricted to commercial grades that comply with close specifications as to percentage of unoxidized metal, evenness of grading, and fineness

of particles. The zinc content of the dust produced in 1951 ranged from 95.00 to 99.70 percent and averaged 97.71 percent. Shipments of zinc dust, which totaled 31,054 tons—590 tons of which went to foreign countries—were slightly below production. Producers' stocks of zinc dust rose from 424 tons (revised) at the beginning of the year to 726 tons at the end.

The average price of zinc dust shipped to domestic consumers in 1951 was 21.2 cents a pound compared with 16.6 cents in 1950. The raw materials used to manufacture zinc dust are reviewed in the Secondary Metals—Nonferrous chapter of this volume. Most of the production is from zinc scrap (principally galvanizers' dross), but some is recovered from zinc ore, slab zinc, and as a byproduct of zinc refining.

TABLE 10.—Zinc dust [1] produced in the United States, 1942–46 (average) and 1947–51

Year	Short tons	Value		Year	Short tons	Value	
		Total	Average per pound			Total	Average per pound
1942–46 (average)	25,951	$5,346,423	$0.103	1949	22,776	$6,195,072	$0.136
1947	30,602	7,589,296	.124	1950	28,922	9,602,104	.166
1948	32,217	10,051,704	.156	1951	31,695	13,438,680	.212

[1] All produced by distillation.

ZINC PIGMENTS AND SALTS

The principal zinc pigments are zinc oxide and lithopone, and the principal salts are the chloride and sulfate. These products are manufactured from various zinc-bearing materials, including ore, metal, scrap, and residues. Details of the production of zinc pigments and salts are given in the Lead and Zinc Pigments and Zinc Salts chapter of this volume.

CONSUMPTION AND USES

According to reports from approximately 700 plants, 933,971 tons of slab zinc was put into process in 1951, 3 percent less than the record quantity of 1950. Receipts at consumers' plants in 1951 were 919,617 tons.

Galvanizing continued to be the largest field of zinc use in 1951, accounting for 43 percent of the total consumption of slab zinc; the quantity so consumed during the year was 9 percent less than the record high used in 1950. The use of slab zinc for zinc-base alloys (largely die castings), the second largest application of the metal, was the highest on record, exceeding the previous peak established in 1950 by 2 percent. Consumption of slab zinc for the manufacture of brass products increased 3 percent over 1950 to the highest point since 1946 but was well below the average of the World War II period. The low level of slab zinc consumption in brass in the postwar period is attributed to the abnormal flow of brass scrap to the mills.

TABLE 11.—Consumption of slab zinc in the United States, 1947–51, by industries, in short tons [1]

Industry and product	1947	1948	1949	1950	1951
Galvanizing: [2]					
Sheet and strip	115,147	120,360	146,923	188,406	144,329
Wire and wire rope	49,726	49,906	39,231	47,317	51,792
Tubes and pipe	77,238	81,874	78,030	91,877	79,221
Fittings	10,467	14,037	11,487	15,948	21,186
Other	108,749	104,792	75,209	98,138	103,751
Total galvanizing	361,327	370,969	350,880	441,686	400,279
Brass products:					
Sheet, strip, and plate	50,212	51,813	43,157	68,737	67,815
Rod and wire	34,653	32,076	23,651	43,413	46,056
Tube	15,488	15,890	12,816	17,385	15,927
Castings and billets	3,155	4,228	2,620	4,170	7,098
Copper-base ingots	7,299	3,546	2,701	4,081	5,743
Other copper-base products	1,540	1,587	589	1,587	653
Total brass products	112,347	109,140	85,534	139,373	143,292
Zinc-base alloy:					
Die castings	210,214	230,995	199,665	285,022	282,812
Alloy dies and rod	3,802	3,171	2,024	2,929	11,135
Slush and sand castings	453	462	492	1,576	2,487
Total zinc-base alloy	214,469	234,628	202,181	289,527	296,434
Rolled zinc	70,680	76,672	55,200	68,444	64,085
Zinc oxide	18,376	15,657	10,292	18,187	18,223
Other uses:					
Wet batteries	1,462	1,368	1,359	1,527	1,749
Desilverizing lead	2,687	2,654	2,448	2,947	2,186
Light-metal alloys	607	1,125	1,060	1,356	3,132
Other [3]	4,405	5,522	2,887	4,087	4,591
Total other uses	9,161	10,669	7,754	9,917	11,658
Total consumption [4]	786,360	817,735	711,841	967,134	933,971

[1] Excludes some small consumers.
[2] Includes zinc used in electrogalvanizing and electroplating, but excludes sherardizing.
[3] Includes zinc used in making zinc dust, bronze powder, alloys, chemicals, castings, and miscellaneous uses not elsewhere mentioned.
[4] Includes 3,577 tons of remelt zinc in 1947, 3,141 tons in 1948, 2,394 tons in 1949, 3,035 tons in 1950, and 4,505 tons in 1951.

The quantity of slab zinc consumed for rolled products in 1951 decreased 6 percent from the 1950 figure. In addition to slab zinc, the rolling mills remelt and reroll the metallic scrap produced from their fabricating operations. The scrap so treated in 1951 amounted to 11,627 tons compared with 13,841 tons in 1950. Purchased zinc scrap, in the form of zinc clippings, old zinc scrap, and engravers' plates, totaling 3,799 tons, was melted and rolled in 1951 (4,516 tons in 1950). Production of rolled zinc from both slab zinc and purchased scrap was 66,088 tons, a decrease of 6 percent from the 1950 total. Inventories of rolled zinc were 2,006 tons on December 31, 1951, compared with 1,411 tons (revised figure) on the same date in 1950. In addition to the actual shipments of 52,557 tons of rolled zinc in 1951, the rolling mills processed 24,563 tons of rolled zinc (including that which was remelted and rerolled) in manufacturing 13,473 tons of semifabricated and finished products.

TABLE 12.—Rolled zinc produced and quantity available for consumption in the United States, 1950–51

	1950			1951		
	Short tons	Value		Short tons	Value	
		Total	Average per pound		Total	Average per pound
Production:						
Sheet zinc not over 0.1 inch thick	18,436	$8,805,695	$0.239	17,535	$10,536,341	$0.300
Boiler plate and sheets over 0.1 inch thick	926	377,778	.204	2,211	1,112,648	.252
Strip and ribbon zinc [1]	49,167	18,335,444	.186	44,713	21,057,114	.236
Foil, rod, and wire	1,546	849,581	.275	1,629	1,014,227	.311
Total rolled zinc	70,075	28,368,498	.202	66,088	33,720,330	.255
Imports	211	92,862	.220	149	84,406	.283
Exports	3,290	1,496,158	.227	4,868	3,126,189	.321
Available for consumption	67,652			60,774		
Value of slab zinc (all grades)			.142			.182
Value added by rolling			.060			.073

[1] Figures represent net production. In addition 13,841 tons of strip and ribbon zinc in 1950 and 11,627 tons in 1951 were rerolled from scrap originating in fabricating plants operated in connection with zinc rolling mills.

Table 13 shows the six commercial grades of refined slab zinc and purchased remelt spelter consumed by the various industries in 1951. Of the 933,971 tons of domestic and foreign zinc consumed, 41 percent was Prime Western, 38 percent Special High Grade, and 14 percent Regular High Grade, compared with 44, 34, and 14 percent, respectively, in 1950. All grades of zinc were used for galvanizing. Prime Western was the principal grade used in the hot-dip process, the higher grades being used chiefly for electrogalvanizing. Rigid specifications in brass manufacture necessitate the use of high-purity metal, 76 percent of the total used in this industry in 1951 being of the 2 highest grades.

TABLE 13.—Consumption of slab zinc in the United States in 1951, by grade and industry, in short tons

Industry	Special High Grade	Regular High Grade	Intermediate	Brass Special	Selected	Prime Western	Remelt	Total
Galvanizers	14,491	19,683	10,615	12,033	269	340,699	2,489	400,279
Brass products	29,988	78,513	2,730	11,823	3,518	15,788	932	143,292
Zinc-base alloy	293,406	1,533	116	50		316	1,013	296,434
Rolled zinc	10,465	26,451	7,790	17,137	165	2,077		64,085
Zinc oxide	251	303		19		17,650		18,223
Other	3,931	1,672	580	771	5	4,628	71	11,658
Total	352,532	128,155	21,831	41,833	3,957	381,158	4,505	933,971

CONSUMPTION OF SLAB ZINC BY GEOGRAPHIC AREAS [3]

The geography of slab zinc consumption is available in detail only since 1940. During the 12-year period through 1951, substantial shifts occurred, largely as a result of conversion to war production in 1940–41 and reconversion to peacetime consumption in 1945–46. The distribution of slab-zinc consumption by geographic divisions and States, both total and for individual uses, is shown in tables 14 to 20.

Consumption of Slab Zinc for All Uses.—During the period 1940–51 Illinois ranked first among the 42 zinc-consuming States and the District of Columbia, with an annual average of 139,376 tons. Since 1945 Ohio has been in second place. Connecticut, the second largest consuming State during the World War II period owing to the large quantities of zinc consumed in the brass plants of the State, has since dropped to fourth place. Pennsylvania has held either second or third place since 1940. The greatest concentration of slab-zinc consumption is in the region comprising Illinois, Indiana, Michigan, Ohio, and Wisconsin. This area, which has consistently ranked first in zinc consumption since 1940, uses nearly half the total quantity of slab zinc consumed annually in the United States. The region of least consumption is the Mountain States, including Arizona, Colorado, Idaho, Nevada, New Mexico, and Utah, which have consumed less than 0.3 percent of the total.

Consumption of Slab Zinc for Galvanizing.—The iron and steel industry, the largest consumer of slab zinc, uses it for galvanizing or rustproofing sheets, wire, tube and pipes, building and pole-line hardware, railway-signal equipment, chains, bolts, screws, and a multitude of other items. The principal iron- and steel-producing States are thus also the principal consumers of zinc for galvanizing. From 1940 through 1943 Pennsylvania ranked first among the 34 States that consumed zinc for this purpose. In 1944 Ohio displaced Pennsylvania and retained the top position in the succeeding years through 1951. The greatest concentration of zinc consumption for galvanizing is in the region comprising Illinois, Indiana, Ohio, and Pennsylvania, which consumed 62 percent of the average annual domestic total for this use in 1940–45. In 1946 total zinc used for galvanzing in these States rose to 65 percent but declined to 63 percent in 1947 and 1948, 61 percent in 1949, 59 percent in 1950, and 58 percent in 1951.

[3] This section is based partly on a detailed study by Ransome, Alfred L., Consumption of Slab Zinc in the United States by Industries, Grades, and Geographic Divisions, 1940–45: Bureau of Mines Inf. Circ. 7450, 1948, 30 pp.

TABLE 14.—Consumption of slab zinc in the United States, 1944–48 (average) and 1949–51, by geographic division and State [1]

Geographic division and State	1944–48 (average)		1949		1950		1951	
	Short tons	Rank	Short tons	Rank	Short tons	Rank	Short tons	Rank
I. New England:								
Connecticut	85,019	4	40,948	5	70,115	4	69,926	4
Massachusetts	12,752	15	7,454	16	9,507	16	9,745	15
Maine	497	27	67	31	97	31	95	35
New Hampshire	136	32	(2)	34	(2)	36	(2)	37
Rhode Island	206	31	(2)	30	(2)	28	(2)	28
Total	98,610	3	48,650	4	80,014	3	80,348	3
II. Middle Atlantic:								
New Jersey	20,967	11	19,084	12	23,231	12	21,517	12
New York	45,544	6	39,619	6	55,070	7	57,809	6
Pennsylvania	122,463	3	105,308	3	139,400	3	137,056	3
Total	188,974	2	164,011	2	217,701	2	216,382	2
III. South Atlantic:								
Delaware							(2)	31
District of Columbia	77	36	21	32	(2)	34	(2)	36
Florida	88	35					(2)	33
Georgia	2,078	19	1,703	20	2,164	21	1,689	23
Maryland	24,355	9	26,525	9	36,649	10	28,878	9
South Carolina	112	33			(2)	32		
Virginia	521	26	267	27	207	30	273	32
West Virginia	23,150	10	25,694	11	29,736	11	25,616	10
Total	50,381	4	54,210	3	68,825	4	57,032	4
IV. East North Central:								
Illinois	146,538	1	131,619	1	183,957	1	167,937	1
Indiana	65,806	5	52,837	4	67,449	5	58,191	5
Michigan	44,032	7	32,265	7	57,017	6	55,864	7
Ohio	124,957	2	123,903	2	152,008	2	158,685	2
Wisconsin	20,062	12	9,152	15	13,752	14	13,951	14
Total	401,395	1	349,776	1	474,183	1	454,628	1
V. East South Central:								
Alabama	18,531	13	26,383	10	37,061	9	25,502	11
Kentucky	7,364	16	9,781	14	(2)	15	(2)	16
Tennessee	1,191	23	860	25	(2)	23	(2)	25
Total	27,086	5	37,024	5	48,808	5	35,206	6
VI. West North Central:								
Iowa	6,798	17	4,600	17	4,680	17	4,480	18
Kansas	89	34	19	33	(2)	33	(2)	30
Minnesota	3,073	18	2,970	18	4,250	18	3,798	19
Missouri	15,688	14	13,166	13	16,500	13	19,472	13
Nebraska	1,236	22	1,587	21	(2)	22	(2)	24
Total	26,884	6	22,342	7	27,122	7	29,517	7
VII. West South Central:								
Arkansas							(2)	39
Louisiana	252	29	(2)	29	722	26	(2)	27
Oklahoma	765	25	(2)	24	1,261	24	(2)	22
Texas	2,044	20	1,836	19	3,289	19	4,959	17
Total	3,061	8	3,014	8	5,272	8	7,885	8
VIII. Mountain:								
Arizona	19	39					(2)	34
Colorado	1,523	21	(2)	22	2,474	20	(2)	21
Idaho	215	30	(2)	26	(2)	27	(2)	29
Nevada	29	38						
Utah	38	37	(2)	35	(2)	35	(2)	38
Total	1,824	9	1,851	9	3,160	9	3,038	9
IX. Pacific:								
California	24,830	8	27,305	8	37,525	8	41,898	8
Oregon	493	28	245	28	244	29	1,051	26
Washington	1,172	24	1,019	23	1,245	25	2,481	20
Total	26,495	7	28,569	6	39,014	6	45,430	5
Grand total [1]	824,710	------	709,447	------	964,099	------	929,466	------

[1] Excludes remelt zinc and some small consumers of slab zinc.
[2] Nominal quantity consumed included with subtotal for division, as less than 3 companies reported.

TABLE 15.—Consumption of slab zinc for galvanizing in the United States, 1944–48 (average) and 1949–51, by States [1]

State	Geographic division	1944–48 (average)		1949		1950		1951	
		Short tons	Rank	Short tons	Rank	Short tons	Rank	Short tons	Rank
Alabama	V	18,442	7	25,918	5	36,520	4	24,827	6
California	IX	14,138	8	13,493	8	21,208	8	23,756	8
Colorado	VIII	1,475	20	(2)	20	(2)	19	(2)	19
Connecticut	I	3,579	15	1,843	16	3,003	17	3,241	17
Florida	III	87	32					(2)	28
Georgia	III	2,072	18	(2)	18	(2)	20	(2)	22
Illinois	IV	38,218	3	43,430	3	55,276	3	46,510	3
Indiana	IV	25,539	4	25,113	6	35,375	6	31,570	4
Iowa	VI	124	30	(2)	30	89	30	294	27
Kentucky	V	7,334	9	(2)	9	(2)	9	7,945	9
Louisiana	VII	246	27	(2)	26	722	24	(2)	24
Maine	I	468	25	(2)	29	(2)	29	(2)	31
Maryland	III	19,612	6	26,196	4	36,136	5	28,486	5
Massachusetts	I	6,615	10	4,188	12	5,460	11	5,530	13
Michigan	IV	4,259	13	2,598	15	4,446	13	6,481	12
Minnesota	VI	3,069	16	(2)	14	4,250	14	(2)	16
Missouri	VI	4,041	14	3,472	13	4,087	15	6,720	10
Nebraska	VI	235	28	(2)	27	(2)	27	(2)	26
New Hampshire	I	73	33						
New Jersey	II	5,647	12	4,608	10	4,546	12	5,519	14
New York	II	5,810	11	4,382	11	6,031	10	6,619	11
Ohio	IV	78,358	1	78,663	1	88,629	1	79,149	1
Oklahoma	VII	752	23	(2)	21	1,261	21	(2)	20
Oregon	IX	486	24	(2)	25	229	26	238	29
Pennsylvania	II	69,286	2	67,230	2	79,344	2	73,559	2
Rhode Island	I	198	29	(2)	28	(2)	25	(2)	25
South Carolina	III	96	31			(2)	31		
Tennessee	V	937	22	(2)	23	(2)	22	941	23
Texas	VII	1,491	19	(2)	19	3,251	16	4,431	15
Utah	VIII	33	34	(2)	24				
Virginia	III	413	26			185	28	(2)	30
Washington	IX	1,028	21	(2)	22	1,041	23	(2)	21
West Virginia	III	21,159	5	(2)	7	29,187	7	24,701	7
Wisconsin	IV	2,745	17	1,806	17	2,505	18	3,155	18
Total		338,065		[3] 348,983		[3] 439,368		[3] 397,790	

[1] Excludes remelt zinc. Includes zinc used in electrogalvanizing and electroplating, but excludes sherardizing.
[2] Quantity withheld to avoid disclosure of individual company operations.
[3] Includes States not individually shown (footnote reference 2).

Consumption of Slab Zinc for Brass Products.—From 1940 through 1951 Connecticut has ranked first among the States consuming slab zinc for brass products; but, owing to the wartime demand for brass and the construction of new plant facilities, there has been some change in the rank of the other leading States. In 1940 Michigan was in second place, followed by New York, Illinois, Ohio, and Pennsylvania, whereas in 1951 Illinois ranked second, with Michigan in third place, followed by Ohio, New York, and Wisconsin.

TABLE 16.—Consumption of slab zinc for brass products in the United States, 1944–48 (average) and 1949–51, by States [1]

State	Geographic division	1944–48 (average)		1949		1950		1951	
		Short tons	Rank	Short tons	Rank	Short tons	Rank	Short tons	Rank
Alabama	V	88	15	(2)	13	488	13	(2)	12
California	IX	1,500	12	643	11	1,311	11	1,927	11
Colorado	VIII	41	20	(2)	15	(2)	14	(2)	17
Connecticut	I	75,644	1	34,615	1	59,837	1	60,055	1
Delaware	III							(2)	15
District of Columbia	III	77	16	(2)	16	(2)	16	(2)	18
Florida	III	1	32						
Georgia	III	6	26	(2)	23	(2)	21	(2)	26
Illinois	IV	24,661	2	12,297	2	15,978	2	16,460	2
Indiana	IV	7,220	9	2,222	9	3,183	9	4,232	9
Iowa	VI	2	30					(2)	28
Kansas	VI	47	18	(2)	20	(2)	19	(2)	23
Kentucky	V	25	21	(2)	24			(2)	16
Maine	I	5	27	(2)	26	(2)	24	(2)	29
Maryland	III	4,684	10	329	12	513	12	(2)	13
Massachusetts	I	4,468	11	2,100	10	2,785	10	2,973	10
Michigan	IV	19,763	3	8,542	3	15,084	3	14,649	3
Minnesota	VI	3	29						
Missouri	VI	233	13	(2)	14	(2)	15	43	19
Nebraska	VI	4	28	(2)	25				
New Hampshire	I	54	17	(2)	17	(2)	22	(2)	21
New Jersey	II	7,946	8	3,481	8	4,077	8	5,666	8
New York	II	14,917	5	6,805	4	9,627	5	9,390	5
Ohio	IV	15,557	4	5,712	5	11,016	4	10,831	4
Oregon	IX	7	25	(2)	21	(2)	18	(2)	25
Pennsylvania	II	9,559	7	3,485	7	7,155	7	6,483	7
Rhode Island	I	9	24	(2)	22	(2)	23	(2)	24
South Carolina	III	16	22						
Tennessee	V							(2)	20
Texas	VII	14	23	(2)	18	(2)	17	(2)	22
Utah	VIII	2	31			(2)	25	(2)	30
Virginia	III	44	19	(2)	19	8	20	(2)	27
Washington	IX	94	14						
West Virginia	III							(2)	14
Wisconsin	IV	14,831	6	4,441	6	7,449	6	7,461	6
Total [1]		201,522		[3] 85,189		[3] 138,739		[3] 142,360	

[1] Excludes remelt zinc.
[2] Quantity withheld to avoid disclosure of individual company operations.
[3] Includes States not individually shown (footnote reference 2).

Consumption of Slab Zinc for Zinc-Base Alloys.—The automobile industry is the largest user of zinc-base alloys, principally for die-cast parts and assemblies, such as fuel pumps, carburetors, radiator grilles, windshield-wiper motors, and a wide variety of both interior and exterior hardware. Thus the region embracing Illinois, Indiana, Michigan, Ohio, and Wisconsin, in which the automobile industry is centered, is the area of greatest concentration of slab-zinc consumption for zinc-base alloys. Over 64 percent of the zinc for die casting and other zinc-base alloy uses in 1951 was consumed in this region.

TABLE 17.—Consumption of slab zinc for zinc-base alloys in the United States, 1944–48 (average) and 1949–51, by States [1]

State	Geographic division	1944–48 (average)		1949		1950		1951	
		Short tons	Rank	Short tons	Rank	Short tons	Rank	Short tons	Rank
Alabama	V					(2)	12		
California	IX	8,700	8	12,901	7	14,717	7	15,693	6
Colorado	VIII							(2)	16
Connecticut	I	4,166	10	3,466	10	5,535	10	5,044	10
Florida	III	1	19						
Illinois	IV	42,170	1	48,772	1	75,739	1	72,740	1
Indiana	IV	11,283	6	13,082	6	16,677	6	11,740	8
Kansas	VI	29	14					312	14
Kentucky	V							(2)	15
Maryland	III	58	13						
Massachusetts	I	17	15			(2)	14	(2)	17
Michigan	IV	19,762	4	(2)	4	37,302	3	34,333	4
Missouri	VI	11,184	7	(2)	9	11,944	9	12,254	7
New Jersey	II	5,426	9	9,324	8	12,694	8	8,448	9
New York	II	20,660	3	23,220	3	33,356	4	35,825	3
Ohio	IV	30,415	2	39,292	2	52,051	2	68,321	2
Oklahoma	VII	13	16						
Oregon	IX							(2)	12
Pennsylvania	II	18,411	5	18,601	5	25,600	5	25,774	5
Texas	VII	445	12	(2)	12	(2)	13	(2)	13
Virginia	III	5	18	(2)	13	(2)	15	(2)	18
Washington	IX	8	17						
Wisconsin	IV	2,486	11	(2)	11	(2)	11	3,335	11
Total [1]		175,239		[3] 202,163		[3] 289,511		[3] 295,421	

[1] Excludes remelt zinc.
[2] Quantity withheld to avoid disclosure of individual company operations.
[3] Includes States not individually shown (footnote reference 2).

Consumption of Slab Zinc for Rolled Zinc.—During the period 1940–51, although the quantity of slab zinc consumed for rolled zinc changed widely, the geographic pattern of consumption and rank of the consuming States varied little. Illinois and Indiana ranked first and second, respectively, except in 1951, when Pennsylvania moved into second place and Indiana dropped to third.

TABLE 18.—Consumption of slab zinc for rolled zinc in the United States, 1944–48 (average) and 1949–51, by States

State	Geographic division	1944–48 (average)		1949		1950		1951	
		Short tons	Rank	Short tons	Rank	Short tons	Rank	Short tons	Rank
Connecticut	I	1,410	8	(1)	7	(1)	6	(1)	6
Illinois	IV	39,503	1	26,538	1	35,134	1	31,471	1
Indiana	IV	20,554	2	(1)	2	(1)	2	(1)	3
Iowa	VI	6,672	4	(1)	4	(1)	5	(1)	5
Massachusetts	I	1,626	7	(1)	6	(1)	7	(1)	7
New York	II	3,783	5	(1)	3	(1)	4	(1)	4
Pennsylvania	II	7,244	3	(1)	5	(1)	3	(1)	2
West Virginia	III	1,965	6	(1)	8	(2)	8	(1)	8
Total		82,757		55,200		68,444		64,085	

[1] Quantity withheld to avoid disclosure of individual company operations.

Consumption of Slab Zinc for Zinc Oxide.—Because of the small number of companies consuming slab zinc in the manufacture of zinc oxide and because individual company figures may not be disclosed, it is not possible to show specific quantities consumed in each

State. Table 19, however, gives the relative rank of each State and the totals for each year.

TABLE 19.—Consumption of slab zinc for zinc oxide in the United States, 1944–48 (average) and 1949–51, by States

State	Geographic division	1944–48 (average)		1949		1950		1951	
		Short tons	Rank	Short tons	Rank	Short tons	Rank	Short tons	Rank
Illinois	IV	1,907	2	(1)	2	(1)	2	(1)	3
Indiana	IV	1,010	3	(1)	3	(1)	3	(1)	2
Pennsylvania	II	15,115	1	(1)	1	(1)	1	(1)	1
Total		18,032		10,219		18,187		18,223	

[1] Quantity withheld to avoid disclosure of individual company operations.

Consumption of Slab Zinc for Other Uses.—The distribution by States of the quantity of zinc consumed for such purposes as slush castings, wet batteries, desilverizing lead, light-metal alloys (other than zinc-base alloys), zinc dust, sundry chemicals, and bronze powder is shown in table 20.

TABLE 20.—Consumption of slab zinc for other uses in the United States, 1944–48 (average) and 1949–51, by States [1]

State	Geographic division	1944–48 (average)		1949		1950		1951	
		Short tons	Rank	Short tons	Rank	Short tons	Rank	Short tons	Rank
Alabama	V			(2)	12			(2)	27
Arizona	VIII	19	21					(2)	17
Arkansas	VII							(2)	26
California	IX	491	5	268	7	289	10	522	5
Colorado	VIII	7	24						
Connecticut	I	220	10	(2)	10	297	9	(2)	13
Idaho	VIII	215	11	(2)	5	(2)	4	(2)	9
Illinois	IV	79	14	(2)	14	(2)	12	(2)	6
Indiana	IV	201	12	46	15	(2)	14	276	14
Iowa	VI			(2)	16	(2)	15	(2)	16
Kansas	VI	13	22	(2)	18	(2)	16	(2)	21
Kentucky	V	6	25						
Louisiana	VII	6	26					(2)	25
Maine	I	24	20						
Maryland	III							(2)	20
Massachusetts	I	26	18	(2)	17	11	17	9	23
Michigan	IV	247	8	(2)	13	(2)	13	401	11
Minnesota	VI	1	28	(2)	21			(2)	28
Missouri	VI	230	9	332	6	412	6	455	7
Nebraska	VI	997	3	(2)	3	(2)	3	(2)	3
Nevada	VIII	29	17						
New Hampshire	I	10	23						
New Jersey	II	1,948	2	1,671	2	1,914	2	1,884	2
New York	II	375	6	468	4	516	5	(2)	4
Ohio	IV	627	4	236	8	312	8	384	12
Oklahoma	VII							(2)	22
Pennsylvania	II	2,846	1	(2)	1	2,809	1	3,240	1
Tennessee	V	254	7	(2)	11	(2)	7	(2)	10
Texas	VII	93	13					(2)	19
Utah	VIII	3	27	(2)	19	(2)	18	(2)	24
Virginia	III	59	15	(2)	20	(2)	19	(2)	18
Washington	IX	43	16	(2)	9	(2)	11	(2)	8
West Virginia	III	26	19					(2)	15
Wisconsin	IV					(2)	20		
Total [1]		9,095		[3] 7,693		[3] 9,850		[3] 11,587	

[1] Excludes remelt zinc.
[2] Quantity withheld to avoid disclosure of individual company operations.
[3] Includes States not individually shown (footnote reference 2).

STOCKS

Producers' Stocks.—Inventories of slab zinc at producers' plants were more than doubled during 1951 but were still relatively low, inasmuch as ending stocks in 1950 had been the lowest since 1925.

TABLE 21.—Stocks of zinc at zinc-reduction plants in the United States at end of year, 1947–51, in short tons

	1947	1948	1949	1950	1951
At primary reduction plants	67,046	19,179	90,710	[1] 7,948	21,344
At secondary distilling plants	1,601	1,669	3,511	[1] 936	637
Total	68,647	20,848	94,221	8,884	21,981

[1] Revised figure.

Consumers' Stocks.—On December 31, 1951, consumers' stocks of slab zinc were 50,071 tons compared with 64,206 tons at the beginning of the year. At the average monthly rate of consumption in 1951, consumers' stocks on hand on December 31 were approximately 19 days' requirements.

TABLE 22.—Consumers' stocks of slab zinc at plants at the beginning and end of 1951, by industries, in short tons

Date	Galvanizers	Brass mills [1]	Die casters [2]	Zinc rolling mills	Oxide plants	Others	Total
Dec. 31:							
1950	[3] 36,296	[3] 8,466	[3] 14,644	3,190	[3] 383	[3] 1,227	[3] [4] 64,206
1951	20,110	14,717	10,137	3,538	320	1,249	[4] 50,071

[1] Includes brass mills, brass ingot makers, and brass products.
[2] Includes producers of zinc-base die castings, zinc-alloy dies, and zinc-alloy rods.
[3] Revised figure.
[4] Stocks on Dec. 31, 1950, and 1951, exclude 629 (revised figure) and 410 tons, respectively, of remelt spelter.

PRICES

The price of zinc was controlled by the Office of Price Stabilization during 1951. Ceiling prices were established for zinc on January 26, 1951, at the highest price (for each seller) at which sales were made between December 19, 1950, and January 25, 1951. Thus a number of ceiling prices were maintained. The bulk of zinc sales, however, were based on the 17.50-cent-per-pound quotation for Prime Western-grade slab zinc at East St. Louis. The 17.50-cent price remained in effect until October 2, 1951, when the Office of Price Stabilization permitted a rise of 2 cents per pound. No further change in price occurred in 1951.

The official London price of £151 per long ton of zinc (equivalent to 18.88 cents per pound computed on the 280.00-cent per £ base), established by the British Ministry of Supply on October 4, 1950, was in effect until April 1, 1951, when the Ministry increased the price to £160 (20.00 cents). The price was raised by £30 on July 14 to £190 (23.75 cents), at which level it remained for the remainder of the year. (During the latter half of 1951 sterling exchange rates varied between 278.63 and 280.00 cents per £, hence dollar-equivalent prices varied slightly from the £190 or 23.75-cent level).

TABLE 23.—Price of zinc concentrates and zinc, 1947–51

	1947	1948	1949	1950	1951
Joplin 60-percent zinc concentrates: [1]					
Price per short ton—dollars	66.20	86.37	72.28	87.39	120.00
Average price common zinc at—					
St. Louis (spot) [1]—cents per pound	10.50	13.58	12.15	13.88	17.99
New York [1]—do	11.01	14.21	12.86	14.60	18.75
London [2]—do	12.58	14.38	14.41	14.89	21.46
Price indexes (1925–29 average=100):					
Zinc (New York)	155	200	181	205	264
Lead (New York)	196	241	206	178	234
Copper (New York)	143	150	131	[4] 145	165
Nonferrous metals [3]	142	159	146	[4] 152	183
All commodities [3]	155	168	158	164	184

[1] Metal Statistics, 1952.
[2] E&MJ Metal and Mineral Markets English quotations converted into American money on basis of average rates of exchange recorded by Federal Reserve Board.
[3] Based upon price indexes of U. S. Department of Labor.
[4] Revised figure.

TABLE 24.—Average monthly quoted prices of 60-percent zinc concentrates at Joplin, and of common zinc (prompt delivery or spot) St. Louis and London 1950–51 [1]

Month	1950			1951		
	60-percent zinc concentrates in the Joplin region (dollars per ton)	Metallic zinc (cents per pound)		60-percent zinc concentrates in the Joplin region (dollars per ton)	Metallic zinc (cents per pound)	
		St. Louis	London [2]		St. Louis	London [2]
January	56.20	9.81	10.87	115.00	17.50	18.88
February	55.00	9.75	10.68	115.00	17.50	18.88
March	55.59	9.94	10.85	115.00	17.50	18.88
April	61.88	10.70	11.59	115.00	17.50	20.00
May	74.13	11.99	12.89	115.00	17.50	20.00
June	94.66	14.77	15.49	115.00	17.50	20.00
July	99.00	15.00	15.94	115.00	17.50	22.18
August	99.00	15.00	15.94	115.00	17.50	23.74
September	115.00	17.10	17.86	115.00	17.50	23.74
October	115.00	17.50	18.84	134.23	19.42	23.74
November	115.00	17.50	18.88	135.00	19.50	23.75
December	115.00	17.50	18.88	135.00	19.50	23.71
Average for year	[3] 87.39	13.88	14.89	[3] 120.00	17.99	21.46

[1] Joplin: Metal Statistics, 1952, p. 597. St. Louis: Metal Statistics, 1952, p. 593. London: E&MJ Metal and Mineral Markets.
[2] Conversion of English quotations into American money based on average rates of exchange recorded by Federal Reserve Board.
[3] Represents average price realized on total shipments for year.

TABLE 25.—Average price received by producers of zinc, 1947–51, by grades, in cents per pound [1]

Grade	1947	1948	1949	1950	1951
Grade A:					
Special High Grade	11.10	13.72	12.76	14.30	18.79
Regular High Grade	10.76	13.40	12.29	14.16	18.48
Grade B: Intermediate	11.19	13.49	12.94	14.69	18.57
Grades C and D:					
Brass Special	10.67	13.33	12.75	14.47	18.20
Selected	10.26	13.05	12.87	17.37	18.00
Grade E: Prime Western	10.39	12.93	12.18	14.11	17.92
All grades	10.71	13.32	12.42	14.23	18.24
Prime Western; spot quotation at St. Louis [2]	10.50	13.58	12.15	13.88	17.99

[1] Does not include overquota premium payments made by Office of Metals Reserve in 1947.
[2] Metal Statistics, 1952, p. 593.

FOREIGN TRADE [4]

Imports.—Total imports (general imports) of zinc in ores and concentrates in 1951 increased 9 percent over 1950. Of the 303,038 tons imported, 47 percent came from Mexico, 32 percent from Canada, and 10 percent from Peru. The remaining 11 percent was largely from Bolivia, Guatemala, Argentina, Spain, Australia, the Union of South Africa, Yugoslavia, and Chile.

Slab-zinc imports declined to 87,983 tons or 44 percent less than the quantity imported in 1950. Canada supplied nearly 97 percent of the total. The remaning 3 percent came principally from Norway, Mexico, Belgium-Luxembourg, French Morocco, and the Netherlands.

TABLE 26.—Zinc imported into the United States, in ores, blocks, pigs, or slabs, 1949–51, by countries, in short tons [1]

[U. S. Department of Commerce]

Country	1949	1950	1951
Ores (zinc content):			
Argentina		8	5,546
Australia	4,956	[2] 2,366	2,825
Bolivia	3,526	[2] 3,810	7,849
Canada	61,314	[2] 77,525	97,134
Chile		[2] 40	1,088
Guatemala		473	6,539
Mexico	144,101	[2] 155,283	143,648
Peru	14,901	[2] 16,946	29,136
Spain	4,880	17,738	4,392
Union of South Africa	6,568	3,794	2,655
Yugoslavia			1,473
Other countries	933	590	753
Total ores	241,179	[2] 278,573	303,038
Blocks, pigs, or slabs:			
Belgium-Luxembourg	1,933	3,617	612
Canada	109,708	108,937	85,006
French Morocco			440
Germany		1,637	
Italy		2,679	
Mexico	14,191	26,293	760
Netherlands		2,005	254
Norway	960	7,939	882
Peru		1,205	
Poland-Danzig		358	
United Kingdom		555	
Yugoslavia		485	
Other countries	133	264	29
Total blocks, pigs, or slabs	126,925	155,974	87,983

[1] Data are general imports which comprise zinc imported for immediate consumption plus material entering country under bond.
[2] Revised figure.

[4] Figures on imports and exports compiled by M. B. Price and E. D. Page, of the Bureau of Mines, from records of the U. S. Department of Commerce.

TABLE 27.—Zinc imported for consumption in the United States, 1947–51, by classes [1]

[U. S. Department of Commerce]

Year	Ores (zinc content)		Blocks, pigs, slabs		Sheets		Old, dross and skimmings [2]		Zinc dust		Total value [3]
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	
1947	194,822	$12,165,163	72,063	$14,822,407	1	$457	5,105	$439,511	-------	-------	$27,427,538
1948	133,814	11,737,624	92,495	24,911,454	120	32,871	10,273	1,181,495	41	$5,370	37,868,814
1949	109,535	11,748,199	125,564	29,340,620	32	8,144	3,732	558,702	17	4,397	41,660,062
1950	[4] 237,564	[4] 24,313,625	[4] 155,332	[4] 38,759,435	211	92,862	[4] 2,862	[4] 688,176	472	80,564	[4] 63,934,662
1951	198,373	27,043,611	87,983	31,088,382	149	84,406	6,603	284,030	154	74,362	58,574,791

[1] Excludes imports for manufacture in bond and export, which are classified as "imports for consumption" by the U. S. Department of Commerce.
[2] Includes dross and skimmings as follows: 1947—4,391 tons, $353,415; 1948—8,637 tons, $873,099; 1949—2,668 tons, $335,283; 1950—1,229 tons, $186,748; 1951—6,547 tons, $242,998.
[3] In addition, manufactures of zinc were imported as follows: 1947—$4,429; 1948—$16,056; 1949—$2,583; 1950—$142,369; 1951—$51,700.
[4] Revised figure.

Exports.—The value of zinc ores, concentrates, and metal exported amounted to $22,018,441 in 1951 compared with $7,414,904 in 1950. In addition to the items shown in tables 28 and 29, considerable zinc is exported each year in brass, pigments, chemicals, and galvanized iron and steel. Export data on zinc pigments and chemicals are given in the Lead and Zinc Pigments and Zinc Salts chapter of this volume.

Exports of slab zinc in 1951 totaled 36,510 tons, almost 3 times as much as the quantity exported in 1950. The United Kingdom, India, and Brazil were the chief importers, receiving 55, 13, and 11 percent, respectively, of the total. Table 29 contains details of exports of zinc slab and sheet.

TABLE 28.—Zinc ore and manufactures of zinc exported from the United States, 1947–51

[U. S. Department of Commerce]

Year	Zinc ore, concentrates, and dross (zinc content)		Slabs, pigs, or blocks		Sheets, plates, strips, or other forms, n. e. s.		Zinc scrap (zinc content)		Zinc dust	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1947	1,404	$215,123	106,669	$22,817,004	10,898	$4,234,306	(1)	(1)	1,646	$448,407
1948	3,547	422,314	65,537	15,852,819	7,344	3,290,410	(1)	(1)	891	299,494
1949	[2] 2,925	[2] 477,718	58,709	18,699,597	7,456	3,496,169	1,570	$224,291	690	261,484
1950	[2] 1,140	[2] 264,907	12,917	3,967,055	4,810	2,322,150	6,212	674,235	506	186,557
1951	[2] 3,090	[2] 792,800	36,510	15,592,994	6,579	4,360,689	4,613	8[illegible],302	723	400,656

[1] Not separately classified before Jan. 1, 1949; formerly included with "Other forms, n. e. s."
[2] Effective Jan. 1, 1949, "dross" included with "scrap."

TABLE 29.—Slab and sheet zinc exported from the United States, 1948–51, by destination, in short tons

[U. S. Department of Commerce]

Destination	Slabs, pigs, and blocks				Sheets, plates, strips, or other forms, n. e. s.			
	1948	1949	1950	1951	1948	1949	1950	1951
Country:								
Argentina	741				478			100
Austria	213	1,172		466	1	9		
Belgium-Luxembourg	5,132	1,081	67		17	19	21	3
Brazil	1,279	2,286	830	3,967	106	85	74	310
Canada	504	10	24	1,702	3,584	2,958	2,778	2,668
Chile	980	425	190	466	152	90	18	70
China	44	30			106	12	12	
Colombia	3	40	3		134	214	322	369
Cuba	303	116	274	199	103	71	131	176
Denmark		2,794	641	80				
Finland		112				3		
France	2,205	4,840		933	6	(1)	(1)	367
Germany	3,473	4,293		215		49		26
India	11,550	12,608	4,588	4,728	544	1,685	417	807
Indonesia	1	2			242	50	9	9
Israel	58	19	105	3		54	70	97
Italy	112	319	224					
Japan			374	816				45
Malaya					137	375		
Mexico	61	131	349	211	568	776	575	859
Netherlands	280	4,028			74	230	1	1
Pakistan				220	4	58	3	10
Philippines	2	3	4	5	42	63	54	140
Portugal					243			
Sweden					8	25	10	4
Switzerland	1,273	1,432	112	823	38	99	11	20
Turkey	6				22	2	4	4
Union of South Africa				1	80	76	37	69
United Kingdom	37,269	22,811	4,941	20,024	109	40	98	25
Yugoslavia				1,244			(1)	
Other countries	48	157	191	407	546	413	165	400
Total	65,537	58,709	12,917	36,510	7,344	7,456	4,810	6,579
Continent:								
North America	872	267	652	2,117	4,374	3,858	3,544	3,765
South America	3,034	2,760	1,026	4,440	1,032	505	481	1,098
Europe	49,969	42,994	6,035	23,789	577	515	154	485
Asia	11,662	12,687	5,204	5,814	1,266	2,465	591	1,151
Africa		1		5	94	104	40	70
Oceania				345	1	9		10

1 Less than 0.5 ton.

Tariff.—Following agreements at the Geneva Trade Conference of 1947 import duties of ¾ cent per pound on zinc-bearing ores and concentrates (zinc content) and ⅞ cent per pound on zinc in blocks, pigs, slabs, and dust were established, effective January 1948. These duties remain in effect until June 6, 1951, when the tariff was reduced to 7/10 cents per pound on ore and 7/10 cent per pound on zinc metal.

WORLD PRODUCTION

World mine and smelter production of zinc in recent years, insofar as data are available, are shown in tables 30 and 31.

TABLE 30.—World mine production of zinc (content of ore), 1946–51, by countries, in metric tons [1]

[Compiled by Pauline Roberts]

Country [2]	1946	1947	1948	1949	1950	1951
Algeria	3,858	6,639	6,391	6,501	[3] 7,177	9,466
Argentina	14,724	16,230	12,189	10,921	12,699	15,475
Australia	174,669	185,183	193,526	184,919	[3] 205,632	197,843
Austria	608	1,805	3,154	2,694	2,970	3,355
Belgian Congo	36,258	41,088	46,584	55,420	[3] 74,805	88,704
Bolivia (exports)	19,188	14,612	21,124	17,629	19,570	30,535
Canada	213,469	188,569	212,429	261,506	[3] 284,153	309,450
Newfoundland	49,433	40,115	39,253			
Finland [4]	1,900	2,200	2,500	2,500	[3] 2,100	2,400
France	4,846	5,822	5,395	11,159	12,419	13,283
French Equatorial Africa				44	621	518
French Morocco	1,693	1,838	1,671	[3] 2,750	12,521	19,450
Germany: West Germany	22,212	22,308	28,920	57,816	69,298	72,935
Greece	345	1,259	1,400	1,695	3,184	6,300
Guatemala	(5)	(5)	(5)	(5)	332	6,457
Italy	29,200	57,794	[3] 73,292	[3] 74,562	[3] 87,026	100,733
Japan	[3] 21,324	[3] 27,216	[3] 33,132	[3] 44,268	52,032	64,416
Korea, Republic of		800	221		(5)	(5)
Mexico	139,535	195,814	179,029	178,402	223,530	180,064
Nigeria		6	363	72		
Northern Rhodesia [6]	17,466	21,479	22,526	23,217	23,080	22,953
Norway	4,311	5,637	6,320	[3] 6,603	[3] 5,702	5,500
Peru	59,736	58,181	58,842	72,037	[3] 87,879	105,900
Poland [6]	56,614	71,756	87,089	85,300	86,200	86,200
South-West Africa [7]		5,385	10,600	12,700	[3] 11,300	14,817
Spain [4]	38,000	41,000	47,000	50,000	[3] 64,000	74,000
Sweden	37,821	35,925	35,485	35,158	[3] 37,121	38,000
Tunisia	1,554	2,703	2,382	3,315	2,932	3,548
U. S. S. R. [4 6]	90,000	106,000	110,000	110,000	128,700	148,000
United Kingdom					37	
United States [8]	521,477	578,425	571,503	538,142	565,513	609,195
Yugoslavia	[3] 21,681	[3] 32,087	[3] 38,789	[3] 44,017	[3] 38,092	39,420
Total (estimate)	[3] 1,583,000	[3] 1,769,000	[3] 1,853,000	[3] 1,895,000	[3] 2,123,000	2,271,000

[1] Data derived in part from the Yearbook of the American Bureau of Metal Statistics, the United Nations Statistical Yearbook, and the Statistical Summary of the Mineral Industry (Imperial Institute, London).
[2] In addition to the countries listed, Czechoslovakia, East Germany, North Korea, Rumania, and Turkey also produce zinc, but production data are not available; estimates by senior author of chapter included in total.
[3] Revised figure.
[4] Estimate.
[5] Data not yet available; estimate by senior author of chapter included in total.
[6] Smelter production.
[7] Zinc content of lead-copper ore sorted from dumps, plus jig concentrates derived from the same source.
[8] Recoverable.

TABLE 31.—World smelter production of zinc, 1946–51, by countries, in metric tons [1]

[Compiled by Pauline Roberts]

Country [2]	1946	1947	1948	1949	1950	1951
Argentina	1,814	2,631	1,602	[3] 2,651	[4] 7,530	[4] 8,600
Australia	77,541	70,535	82,617	82,255	[3] 84,995	78,246
Belgium [5]	[3] 79,313	133,011	153,928	176,565	177,326	200,886
Canada	168,448	[3] 161,718	178,329	186,920	[3] 185,398	198,290
China	----------	320	330	[4] 180	[4] 180	[4] 180
Czechoslovakia	(6)	1,964	(6)	(6)	(6)	(6)
France	31,014	[3] 42,979	56,067	60,597	71,531	74,600
Germany: West Germany	[5 7] 14,855	[5 7] 20,723	[5 7] 41,352	86,916	[3] 122,796	140,640
Italy	15,706	22,849	26,397	[3] 26,602	38,119	47,227
Japan	11,253	14,849	21,200	[3] 32,232	49,008	56,340
Mexico	41,982	56,749	48,323	53,496	53,492	58,750
Netherlands	2,011	9,532	13,588	15,614	19,752	22,605
Northern Rhodesia	17,466	21,479	22,526	23,217	23,080	22,953
Norway	30,210	34,580	42,000	[3] 41,090	[3] 43,173	40,233
Peru	936	1,013	1,464	1,261	1,262	870
Poland	56,614	71,756	87,089	85,300	86,200	86,200
Rumania	(6)	2,300	(6)	(6)	3,000	(6)
Spain	17,568	[r] 19,825	21,203	19,551	21,264	21,345
U. S. S. R. [4]	90,000	106,000	110,000	110,000	128,700	148,000
United Kingdom	66,569	69,392	73,138	65,124	71,418	70,851
United States	660,665	728,007	714,644	739,154	765,176	799,800
Yugoslavia	3,171	6,374	6,442	8,791	10,844	13,223
Total (estimate)	[3] 1,392,000	[3] 1,599,000	[3] 1,707,000	[3] 1,822,000	[3] 1,966,000	2,095,000

[1] Data derived in part from the Yearbook of the American Bureau of Metal Statistics, the United Nations Monthly Bulletin and the Statistical Yearbook, and the Statistical Summary of the Minerals Industry (Imperial Institute, London).

[2] In addition to the countries listed, East Germany produces zinc, but production data are not available; estimates by senior author of chapter included in total.

[3] Revised figure.

[4] Estimated.

[5] Includes production from reclaimed scrap.

[6] Data not available; estimate by senior author of chapter included in total.

[7] American and British zones only.

Zirconium

By A. J. Kauffman, Jr.

GENERAL SUMMARY

ZIRCONIUM has come recently to the attention of metallurgists and engineers as a structural metal having tremendous potentialities. Because it is highly resistant to heat and corrosion, zirconium is a promising structural material for nuclear reactors and may play an important part in harnessing atomic power. It is also of great interest to engineers seeking a metal that can withstand the high temperatures in the combustion chambers of jet engines and superrockets.

DOMESTIC PRODUCTION

Mine Production.—Domestic output of zircon continued to increase during 1951, surpassing the record production of 1950 by more than 50 percent. Principal producers were again the Rutile Mining Co. of Florida, South Jacksonville, Fla., and Humphreys Gold Corp., Starke, Fla. The Florida Ore Processing Co., Melbourne, Fla., improved its facilities and was expected to increase production. Humphreys Gold Corp. at Starke, Fla., again accounted for the increased domestic production. This company operates the titanium-mineral concentrator of E. I. duPont de Nemours & Co. on a contract basis; the zircon is obtained by treating the concentrator rejects.

Accumulation of zircon-rich concentrator rejects at Boise, Idaho, continued as a consequence of the monazite recovery operation there.

Refinery Production.—The principal producers of zirconium refractories, compounds, metal, and alloys are listed below:

Producer and plant location:	*Products*
F. W. Berk & Co., Woodbridge, N. J.	Zirconium compounds.
De Rewal International Rare Metals Co., Philadelphia 5, Pa.	Low-hafnium zirconium oxide and metal powder; zirconium compounds.
Electro Metallurgical Co., Division of Union Carbide & Carbon Corp., New York 17, N. Y.	Zirconium alloys.
Foote Mineral Co., Philadelphia, Pa.	Zirconium metal, compounds, and ground zircon.
Kawecki Chemical Co., Boyertown, Pa.	Potassium fluozirconate.
The Massillon Refractories Co., Massillon, Ohio.	Zircon crucibles, brick, and special shapes.
Metal Hydrides Inc., Beverly, Mass.	Zirconium metal powder, zirconium hydride, and various alloys.
Norton Co., Worcester, Mass.	Fused stabilized zirconia refractories.

Rohm & Haas Co., Philadelphia 5, Pa	Zirconium tanning agent.
Stauffer Chemical Co., New York 17, N. Y.	Zirconium tetrachloride.
Chas. Taylor & Sons (subsidiary of National Lead Co.), Cincinnati, Ohio.	Special zirconia refractories.
Titanium Alloy Manufacturing Division of National Lead Co., Niagara Falls, N. Y.	Zirconium metal sponge and briquets, alloys, compounds, ground zircon, and stabilized zirconia refractories.
Westinghouse Electric Corp., Pittsburgh, Pa.	Zirconium metal, experimentally.
Bureau of Mines, Albany, Oreg	Zirconium metal.

CONSUMPTION AND USES

Annual domestic requirements for zirconium minerals are estimated to be 20,000 to 30,000 tons. According to information furnished by the principal zircon dealers, the distribution, by use, for 1951 was as follows: Porcelain enamel, 7 percent; pottery, 7 percent; electrical and chemical porcelain, 3 percent; refractories, 45 percent; glass, 1 percent; metals and alloys, 7 percent; foundry facings, 19 percent; miscellaneous, 11 percent.

Zircon is used as an acid-type refractory because its resistance to abrasion is coupled with a striking resistance to attack by certain molten metals, acidic chemicals, slags, and glasses. Zircon refractories are used mainly in aluminum-melting furnaces because they are not wetted by aluminum metal, dross, or slag. Zircon is used as a foundry and molding sand primarily because the mineral is not wetted by molten iron; as a consequence, zircon grains will not adhere to the outer surface of castings. Zirconia (chemically prepared zirconium dioxide), when stabilized with magnesia or lime is an important refractory.[1] Baddeleyite, naturally occurring zirconium dioxide, is used in the manufacture of refractories, whiteware bodies, and glass furnace linings.

Zirconium chemicals are increasingly important.

Ductile zirconium metal is becoming available in ever-increasing amounts;[2] the bulk of the metal produced, however, is used by Government agencies. Zirconium is useful in the construction of nuclear reactors. Its desirable properties are corrosion resistance, ductility strength, and low rate of neutron absorption.[3] The resistance to corrosion by acids and alkalies suggests important uses in the chemical industry for applications such as a material for tank linings, pipes, valves, and immersion heaters. Its high tensile strength and resistance to attack and discoloration by iodine, mercury salts, and high-temperature sterilization make it well suited for surgical instruments, suture wire, bone screws, and cranial plates.

Magnesium-cerium-zirconium alloys have a combination of good casting qualities and good mechanical properties at ordinary and

[1] Canadian Metals, New Refractory: Vol. 14, No. 2, February 1951, p. 6.
Kolb, Jack, New Zirconia Refractory Withstands 4600° F: Iron Age, vol. 167, No. 3. Jan. 18 1951, p. 79.
Chemical and Engineering News, Norton Announces Commercial Production of Stabilized Zirconia: Vol. 27, No. 7, Feb. 12, 1951, p. 559.
Trombe, F. and Foex, M., (Ceramics Composed of Zirconia and Lanthanum Oxide): Compt. rend., vol. 223, 1951, pp. 254–256.
[2] Materials and Methods, Zirconium: Vol. 34, No. 6, December 1951, pp. 94–96.
[3] Chemical Age, Zirconium Prospects: Vol. 64, No. 1652, Mar. 10, 1951, p. 369.
Miller, G. L., Commercial Uses of Zirconium Developing: Iron Age, vol. 167, No. 20, May 1951, pp. 83–87.
Brumbaugh, R. J., Corrosion Resistance of Zirconium: Ind. Eng. Chem., vol. 43, December 1951, pp. 2878–2880.

elevated temperatures, which make them attractive for some important lightweight stressed components of engines for which magnesium-base materials have been unsuitable in the past. Studies have been made of other alloys also.

STOCKS

Inventories of zircon concentrates (65 percent ZrO_2), including some baddeleyite held by industry, totaled about 7,515 short tons at the close of 1951, compared with 8,100 short tons for the 1950 year end. Mixed zircon-rutile stocks were reduced to 723 short tons (about 629 tons zircon), compared with 2,400 short tons (about 1,500 tons zircon) at the end of 1950.

PRICES

E&MJ Metal and Mineral Markets quoted zircon concentrates (65 percent ZrO_2), c. i. f. Atlantic ports, at \$50–\$55 per ton at the beginning of 1951; \$60–\$70, April 26; \$70–\$72, November 8; \$47–\$52, December 13; and \$47–\$50, December 20.

Quotations for zirconium-metal powder (ductile metal cannot be made directly from this material) of \$7–\$8 per pound, depending upon quantity, remained unchanged during 1951. Ductile zirconium metal made by the iodide-reduction process and fabricated forms from that stock produced by the Foote Mineral Co. were quoted as follows: Zirconium crystal bar at \$90 per pound in quantities less than 100 pounds; zirconium wire, 0.070- to 0.003-inch diameter, \$327 to \$793 per kilogram; zirconium swaged rod, 7/16- to 5/64-inch diameter, \$200 to \$210 per kilogram; and zirconium sheet, 0.015- to 0.002-inch thick, \$289 to \$450 per kilogram. In November 1951, Titanium Alloy Manufacturing Division, National Lead Co., producers of ductile zirconium by the magnesium-reduction process, quoted the following prices for the ductile metal and forms fabricated from that stock: Zirconium-metal sponge and briquets, \$10 per pound; hot-rolled plate and bars at a base price of \$27 per pound; hot-rolled strip, \$28 per pound; cold-rolled strip, \$35 per pound; and cold-drawn wire, \$32.50–\$42.50 per pound, depending upon size. Zirconium tetrachloride, the starting material for the production of ductile zirconium, was quoted at \$0.34 per pound, f. o. b. Niagara Falls, N. Y., in lots of 1 ton to a carload.

According to Iron Age, zirconium-ferrosilicon alloys, 12–15 percent (39–43 percent Si) and 35–40 percent (47–52 percent Si), were \$0.07 and \$0.21, respectively, per pound of alloy, f. o. b. plant, carlots, in January 1951 and remained unchanged throughout the year.

The Oil, Paint and Drug Reporter quoted zirconium compounds, per pound, in carlots, as follows: In January acetate was quoted at \$0.21¼; carbonate at \$0.31½; hydride, \$7; nitrate at \$1.75; and oxide, \$1.50. Acetate increased to \$0.26½ in March and continued at that level throughout the year; the price of carbonate remained unchanged; hydride increased to \$12 during the latter part of October and then held steady; nitrate increased to \$2.10 in March and to \$4.50 in October, and thereafter was unchanged; oxide held at \$1.50 throughout the year.

FOREIGN TRADE [4]

Imports of zirconium ore into the United States during 1951 came from Australia and Brazil.

Exports of zircon concentrates in 1951, principally to Canada, totaled 370 short tons valued at $36,548. Zirconium metal and alloy exports increased to 83,461 pounds, valued at $49,675. Canada and France were the major recipients.

TABLE 1.—Zirconium ore (concentrates) imported for consumption in the United States, 1947–51, by countries, in short tons [1]

[U. S. Department of Commerce]

Year	Australia [2]	Brazil	Canada	India	Total	
					Short tons	Value
1947	21,894	4,619	2	4,181	30,696	$891,161
1948	14,320	3,553	2	279	18,154	571,161
1949	18,839	1,994	----	----	20,833	636,529
1950	15,988	697	141	----	16,826	431,107
1951	25,208	2,084	----	----	27,292	664,428

[1] Concentrates from Australia are zircon or mixed zircon-rutile-ilmenite, and those from Brazil are baddeleyite or zircon. All other imports are zircon.

[2] Imports of zircon, rutile, and ilmenite from Australia until early 1948 were largely in the form of mixed concentrates. These mixed concentrates are classified by the U. S. Department of Commerce arbitrarily as "zirconium ore," "rutile," or "ilmenite." Total zircon content of the "zirconium ore" (as shown in this table) and of the "rutile" and "ilmenite" concentrates (*see* Titanium chapter) are estimated as follows: 1947, 22,727 tons; 1948, 13,873 tons; 1949, 14,623 tons; 1950, 15,098 tons; and 1951, 24,577 tons.

TECHNOLOGY

The important role ductile zirconium is playing in the nuclear-reactor development program was indicated in the Atomic Energy Commission press release dated March 6, 1951, which announced plans to encourage wider industrial participation in the manufacture of high-purity zirconium metal.

A brief account of the development of ductile zirconium follows:

In 1925 the Netherlands investigators, A. E. Van Arkel and J. H. deBoer, produced the pure metal while working at the University of Leyden.[5] The deBoer process was modified by the Philips Lamp Co., Eindhoven, Netherlands, and put into commercial operation. The Foote Mineral Co., Philadelphia, Pa., further modified the process and for many years was the only producer of ductile zirconium metal in this country. The Foote company has been instrumental in engineering the production of iodide-process zirconium from 4-inch-diameter glass bulbs to 24-inch metal deposition tubes.[6]

The major producer of ductile zirconium is the Northwest Electrodevelopment Laboratory, Bureau of Mines, Albany, Oreg. Dr. William J. Kroll and his coworkers at Albany developed the magnesium-reduction method, a multistep batch process for the production of ductile zirconium. The Bureau of Mines was encouraged in this

[4] Figures on imports and exports compiled by M. B. Price and E. D. Page, of the Bureau of Mines, from records of the U. S. Department of Commerce.

[5] Shelton, S. M., Zirconium: Sci. Am., June 1951, pp. 19–21.

[6] Chemical Engineering, Tetraiodide Process Yields Ductile Zirconium for the Atomic Energy Commission: Vol. 58, No. 3, March 1951, pp. 183–184; No. 5, May 1951, pp. 234–235.
Litton, F. B., High-Purity Zirconium: Metal Progress, vol. 60, No. 6, December 1951, pp. 83–86.

work by the Bureau of Ships, Navy Department, and by the Atomic Energy Commission because of their long-range interests in ductile zirconium.

The steps involved in the magnesium-reduction method are: (1) Reaction of zircon and carbon to form zirconium carbide, more recently by the treatment of purified zirconium oxide and carbon in a graphite resistor furnace; (2) chlorination of the carbide to form crude zirconium tetrachloride; (3) purification of the crude chloride; (4) reduction of the purified chloride by molten magnesium to form zirconium sponge; and (5) melting of the sponge to form ingots of ductile zirconium metal. Each batch produces about 150 pounds of metal sponge from 420 pounds of raw chloride; 100 pounds of magnesium metal is used for the reduction. Expansion of plant facilities was underway in 1951 to increase production to at least 10,000 pounds of zirconium sponge per month.[7]

Titanium Alloy Manufacturing Division, National Lead Co., Niagara Falls, N. Y., produced ductile zirconium in 1951 using the Kroll magnesium-reduction method.

Westinghouse Electric Corp. investigated a process for reducing zirconium dioxide with calcium metal.

Much of the ductile zirconium metal produced before 1951 contained varying amounts of hafnium, which occurs in nature associated with zirconium minerals; zircon, the most abundant source of the metal, contains about 2.5 percent hafnium. Hafnium and zirconium resemble each other in chemical behavior more than any other two elements. Due to this similarity, the first problem in preparing pure zirconium is to remove hafnium.[8] Hafnium metal is ductile, is resistant to corrosion, and has a high melting point. These properties suggest possible uses in the electronics industry for filament and cathode surfaces. The oxide and salts exhibit catalytic properties; the oxide and carbide are highly refractory and may find use in superrefractories for jet engines, nuclear reactors, and other high-temperature devices.

WORLD REVIEW

Australia.—For many years Australia has been the world's principal producer of zircon concentrates. Zircon-Rutile, Ltd., largest Australian zircon producer, reported an improved market for its products in 1950, a condition that apparently continued through 1951, as witnessed by the greatly increased exports to the United States.[9] Australian zircon producers, however, were reported also to be concerned about future outlets for their material because of the increased output of the Florida operations.[10]

Brazil.—Baddeleyite (zirconium dioxide) is found in large concentrations in the Pecos de Caldas area of the States of São Paulo and Minas Gerais, Brazil. Deposits of zircon are known in the States of Baía, Espírito Santo, and Rio de Janeiro.

[7] Stephens, W. W., and McClain, J. H., Ductile Zirconium: Chem. Eng., vol. 58, No. 3, 1951, pp. 116-117.

[8] Litton, F. B., Preparation and Some Properties of Hafnium Metal: Jour. Electrochem. Soc., vol. 98, No. 12, December 1951, pp. 488-494.
Adenstedt, H. K., Physical, Thermal, and Electrical Properties of Hafnium and High Purity Zirconium: Trans. Am. Soc. Metals, vol. 44, April 1951, pp. 949-973.

[9] Industrial and Mining Standard, vol. 105, No. 2685, Oct. 5, 1950, p. 17.

[10] Mining Journal (Queensland Government), Zircon—Disposal of Australian Output: Vol. 52, No. 591, January 1951, p. 32.

Egypt.—Zircon is found in black sands of the Mediterranean coast around the mouths of the Rosetta and Damietta branches of the Nile. Production for 1942 and 1944 was 39 and 12 metric tons, respectively.

Germany (Eastern Zone).—The Geological Institute of the University of Rostock indicated that zirconium and titanium minerals would soon be recovered commercially from beach sands along the Baltic Sea coastline of Mecklenburg.[11]

Senegal (French West Africa).—Zircon-rich black sands occur near Rufisque. Production of zircon concentrates in 1949 amounted to 245 metric tons. Assistance was reported sought from the Economic Cooperation Administration in obtaining equipment to mine the deposits.[12]

Union of South Africa.—Attention has been given in recent years to the beach sands of Natal, notably in the vicinity of Durban. Heavy mineral concentrates from the sands reportedly contain 8 percent zircon.[13]

United Kingdom.—Annual zircon requirements of the United Kingdom were estimated at 5,000 to 7,000 tons per year.[14] According to reports, a plant for making a range of zirconium products was under construction by Goodlass Wall & Lead Industries, Ltd., at Newcastle-upon-Tyne; operations were expected to begin in 1951.

[11] Mining World, vol. 12, No. 5, May 1950, p. 54.
[12] Mining World, vol. 12, No. 4, April 1950, p. 49.
[13] South African Mining and Engineering Jour., vol. 61, No. 2991, June 10, 1950, p. 505.
[14] Work cited in footnote 10.

Minor Metals

By E. J. Carlson, A. J. Kauffman, Jr., H. D. Keiser, and Stanley Needleman[1]

CESIUM AND RUBIDIUM[2]

CESIUM and rubidium usually occur together in nature. Cesium is obtained chiefly from pollucite, a cesium-aluminum-sodium silicate mineral that contains 30 to 36 percent Cs_2O and about 3 percent Rb_2O. Pollucite occurs in pegmatites found in Maine, the Black Hills of South Dakota, South-West Africa, and the Union of South Africa. Rubidium is extracted commercially from the lithium-mica mineral, lepidolite. Some varieties of beryl that are particularly white contain as much as several percent of cesium and rubidium; these elements could be extracted economically from such beryl if the demand for them were sufficient.

Production.—Cesium and rubidium metals and compounds were produced in 1951 by DeRewal International Rare Metals Co., Philadelphia, Pa.; Maywood Chemical Works, Maywood, N. J. (Cs metal, Cs and Rb compounds); Fairmount Chemical Co., Newark N. J. (Cs and Rb metals and compounds); General Electric Co., Scotia, N. Y. (Cs metal); A. D. Mackay, Inc., New York, N. Y. (Cs and Rb metals and compounds); and Foote Mineral Co., Philadelphia, Pa. (Cs compounds). Harshaw Chemical Co., Cleveland, Ohio, produced synthetic optical crystals of cesium iodide for use in scintillator counters and optical devices.

Uses.—Cesium and rubidium are used principally in photoelectric cells as the active agents in the emission of electrons. Cesium is used in vapor lamps adapted for infrared signalling uses by the military. Cesium and rubidium are used as catalysts in the polymerization of certain resin materials to yield a durable protective coating. It was reported in 1951 that cesium–137, a gamma-emitting fission product with a half life of 33 years, might rival cobalt–60 in radiation therapy. Rb–87 is a naturally occurring radioactive isotope of rubidium that emits beta radiation.

Prices.—Chemically pure cesium and rubidium metal, double-distilled, in sealed glass ampoules, were quoted in 1951 at $4–$5 and $4.50–$5.50 per gram, respectively, depending on quantity.

[1] Unless otherwise indicated, figures on imports and exports compiled by M. B. Price and E. D. Page, of the Bureau of Mines, from records of the U. S. Department of Commerce. Beryllium and zirconium, included in the 1950 Minor Metals chapter, are reviewed in separate chapters in this volume.

[2] Prepared by Stanley Needleman.

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Technology.—A method was developed of extracting cesium from ore and mixtures of metals.[3] Methods for accurate quantitative analysis of rubidium in lepidolite by spectrochemical procedures were described, using potassium as an internal standard.[4]

World Review.—An output of about 100 tons of pollucite was reported in South-West Africa during 1946–51; 19 tons of this cesium ore (26–30 percent Cs_2O) and 11,090 tons of lepidolite (1.5 percent Rb_2O) were produced in 1951 from pegmatite deposits 18 miles south of Karabib. Several tons of pollucite was recovered as a byproduct of beryl mining in the Union of South Africa.

COLUMBIUM (NIOBIUM) AND TANTALUM[5]

To insure a dependable supply of columbium and tantalum, emphasis has been placed on the development of low-grade domestic deposits. As a result of the extensive monazite exploration program of the Bureau of Mines, under contract to the Atomic Energy Commission, substantial tonnages of columbite-tantalite have been found as constituents of black sands. Preliminary investigations by the Bureau of Mines, Federal Geological Survey, and Arkansas Geological Survey have disclosed appreciable quantities of columbium associated with the titanium minerals and bauxite in Pulaski and Saline Counties, Ark. Further mining and metallurgical research will be necessary before these metals can be assured in the quantities required by industry for the defense effort.

On March 19, 1951, the National Production Authority placed columbium and tantalum under defense allocation by an amendment to Order M–3. Columbium-bearing steels had been reserved for defense needs under Order M–3; subsequent amendments thereto limited the proportion of columbium that could be used in stainless steel. In December 1951 the National Production Authority issued Order M–80 permitting the use of columbium and tantalum in the manufacture of Class A and/or Class B products required by the Department of Defense or Atomic Energy programs. Certification by the Aircraft Production Resources Agency was required for columbium and tantalum alloys used in the aircraft program. Columbium-coated welding rod was classified as a columbium-bearing steel.

Mine Production.—Domestic mine shipments of columbite-tantalite concentrates during 1951 totaled 925 pounds. Principal producers were Beryllium Mining Co., Inc. (New Anniversary claims), Ohio City, Colo., and George C. Bland (Beecher Lode), Hill City, S. Dak. Small lots of columbite-tantalite concentrates produced during the year may have remained unsold.

Domestic Refiners.—Ferrocolumbium and ferrocolumbium-tantalum alloys were produced by the Electro Metallurgical Division, Union Carbide & Carbon Co., Niagara Falls, N. Y. Miscellaneous tantalum and columbium products were manufactured by Fansteel Metallurgical Corp., North Chicago, Ill. Kennametal, Inc., Latrobe, Pa., marketed "Kentanium," a carbide containing columbium and tantalum.

[3] British Nonferrous Metals Research Assoc., Bull. 270, December 1951, p. 470.
[4] Ahrens, L. H., and Gorfinkle, L. G., Quantitative Spectrochemical Analysis of Rubidium in Lepidolite: Am. Jour. Sci., vol. 249, June 1951, pp. 451–456.
[5] Prepared by Stanley Needleman.

TABLE 1.—Columbium and tantalum concentrates shipped from mines in the United States, 1941–51

Year	Columbium concentrates		Tantalum concentrates	
	Pounds	Value	Pounds	Value
1941			250	$219
1942			200	175
1943	5,771	$1,465	[1] 9,411	27,621
1944	3,208	917	[1] 7,204	23,317
1945	1,149	287	[1] 5,500	13,366
1946			[1] 3,475	8,793
1947			[1] 3,259	8,677
1948	100	[2]	500	[2]
1949	[3]	[3]	[4] 1,020	1,785
1950	[3]	[3]	[4] 1,000	2,150
1951	[3]	[3]	[4] 925	1,528

[1] Principally microlite.
[2] Bureau of Mines not at liberty to publish.
[3] Columbite and tantalite production not differentiated and given under tantalum concentrates.
[4] Tantalite-columbite.

Uses.—High-temperature alloys, important to jet engines and gas turbines, compete with heat- and corrosion-resistant stainless steels for the world's limited supply of columbium, an alloying agent that has acquired strategic importance in the last decade. Columbium is an important additive to the supertemperature alloys; when used in concentrations of 1 to 5 percent, it maintains strength at high temperatures and provides good resistance to creep. The principal use of columbium in steels is as a carbide stabilizer; it decreases susceptibility to intergranular corrosion, improves weldability, and increases creep and impact strength. Columbium is becoming increasingly important as a constituent of ferrous and nonferrous alloys being developed for parts exposed to high temperatures generated in jet engines and gas turbines. Chromium-nickel-columbium steel has strength properties adequate for applications such as rotor forgings, blades, and tubes used in gas turbines.[6] A report was published in 1951 reviewing the effects of small additions of columbium to certain high-temperature jet engine alloys,[7] and the titanium-columbium system was studied.[8] Kentanium, the new columbium-tantalum carbide, is used in the aircraft industry.

Tantalum, a readily formative and highly corrosion-resistant metal, is used principally in the pure form. Considerable quantities are used in the chemical industries for heat exchangers, condensers, absorption towers, and other devices subject to corrosive attack. The metal is a structural material suitable for use with hydrogen peroxide under a wide range of conditions as far as peroxide stability and resistance to corrosion are concerned. Research continued on tantalum for use in capacitors. Tantalum metal is used in surgery for cranial plates and sutures and in electronics as a structural component in many types of vacuum tubes. The carbide of tantalum is used for cutting tools, dies, and other wear-resisting parts. Tantalum oxide is an important component of silica-free optical glass.

[6] Iron and Coal Trades Review, Gas-Turbine Steels and Alloys: March 1951, pp. 485–490.
[7] Sullivan, J. D., Metals for the High-Speed Age: Eng. and Min. Jour., vol. 152, No. 9, September 1951, pp. 82–84.
[8] Hansen, M., Kamen, E. L., Kessler, H. D., and McPherson, D. J., Systems Titanium Molybdenum and Titanium-Columbium: Jour. Metals, vol. 3, No. 10, October 1951, pp. 881–888.

Tantalum can be substituted for columbium in the high-temperature alloys on a point for point basis, providing equal strength and creep resistance. The corrosion resistance of tantalum-molybdenum alloys was the subject of an important investigation.[9] Improved ductility and reduction in tendency to air-harden are imparted to chromium stainless steels by additions of columbium and tantalum.

Patents issued during 1951 included a method for making a tantalum anode for gas-filled tubes [10] and a method for drawing filled tantalum tubes.[11]

Prices.—Metal Bulletin (London) quotations on columbite, 50–55 percent combined pentoxides (Cb_2O_5 plus Ta_2O_5), per unit, c. i. f. Atlantic ports, opened the year at 250s.–260s. and on January 19 was stabilized at 256s., with no further changes during 1951. E&MJ Metal and Mineral Markets quotations for tantalum ore, 55–60 percent Ta_2O_5, were unchanged during the year at $2–$2.50 per pound. Columbium-metal powder held steady at $62.75 per pound, and tantalum-metal powder was offered at $33.50. Prices of columbium metal have remained unchanged since 1948, being quoted at $280 per kilogram for rod and $250 for sheet. Similarly, tantalum rod was quoted at $160.60 and sheet at $143. Ferrocolumbium and ferro-columbium-tantalum were quoted throughout 1951 at $4.90 and $2.75 per pound of contained columbium, respectively.

Foreign Trade.—During 1951 imports of columbite ore into the United States declined about 10 percent compared with 1950, although receipts from Nigeria increased slightly. The bulk of the United States supply continued to be low-grade columbite concentrates. Tantalite imports decreased during the year.

Other imports, all from the United Kingdom, included: Columbium alloys, principally ferrocolumbium, 63,622 pounds, valued at $175,778; columbium metal, 6,178 pounds, valued at $18,806; and tantalum metal, 5,750 pounds, valued at $8,646.

TABLE 2.—Columbium and tantalum ores (columbite and tantalite concentrates) imported for consumption in the United States, 1949–51, by countries, in pounds

[U. S. Department of Commerce]

Country	Columbium ore			Tantalum ore		
	1949	1950	1951	1949	1950	1951
Australia						1,467
Belgian Congo	198,585	400,868	177,273	38,086	211,433	210,402
Belgium-Luxembourg [1]					85,683	20,876
Brazil	8,568	10,981	6,377	63,478	13,378	
Japan [1]		31,835			10,691	
Mozambique	1,200		17,082			
Netherlands [1]				29,500		
Nigeria	1,349,126	1,280,930	1,324,841	4,480	7,543	5,700
Portugal		2,103				
Union of South Africa				1,120		
Total: Pounds	1,557,479	1,726,717	1,525,573	136,664	328,728	238,445
Value	$561,945	$752,926	$1,348,561	$237,292	$244,205	$190,383

[1] Presumably country of transshipment rather than original source.

[9] Schumb, W. C., Radtke, S. F., and Bever, M. B., Corrosion Resistance of Tantalum-Molybdenum Alloys: Ind. Eng. Chem., vol. 42, No. 5, May 1950, pp. 826–829.

[10] Smith, E. K. (assigned to Electrons, Inc.), Tantalum Anode for Gas-Filled Tubes: U. S. Patent 2,538,053, Jan. 16, 1951.

[11] Seabury, D. S. (assigned to Western Union Telegraph Co.), Method for Drawing Filled Tantalum Tubes: U. S. Patent 2,549,249, Apr. 17, 1951.

The United States exported 41 pounds of tantalum ore, valued at $2,221, to the United Kingdom. No columbium ore was exported. Exports of columbium metal and alloys, principally to the United Kingdom, totaled 42 pounds, valued at $2,646; exports of tantalum metal and alloys totaled 1,676 pounds, valued at $74,814; principal recipients were United Kingdom, Sweden, France, Germany, and Italy.

WORLD REVIEW

Angola.—Large deposits of columbite-tantalite have been discovered in the Lobito area of Angola.

Argentina.—Tantalite occurs at Salta, near the Bolivian border, and in the San Louis Province. The deposits at Salta are the more important.

Belgian Congo.—Legislative Ordinance 33/99, dated March 12, 1951, removed columbite-tantalite minerals from the schedule of export taxes; this was done in an effort to stimulate operations of marginal deposits.

Geomines, at Manono, continued to be the principal columbite-tantalite producer in the country. Expansion of production was expected as a result of financial assistance supplied by the Foreign Expansion Division, Defense Materials Procurement Agency, formerly Economic Cooperation Administration.

Columbite-tantalite reserves in Congo and Ruanda-Urundi have been estimated at about 22,500 metric tons. The Somuki mine at Mouye, Ruanda-Urundi, resumed production, and the Buranga mine at Minetain, increased its output. Extensive prospecting in Ruanda-Urundi took place in certain areas of Mugendo, Gisitwe, Corem, and Runyankezi.

Canada.—Interest was shown in a deposit containing a small concentration of tantalite at Ross Lake, northeast of Yellowknife, Northwest Territory. Tantalum Refining & Mining Corp. of America, Ltd., conducted beneficiation studies which suggested further investigation.

French Cameroons.—The possibility of recovering columbite-tantalite as a byproduct of tin mining at Mayo Darle was investigated. Occurrences of columbite-tantalite have been found at Betare-Oya, on a tributary of the Lom River; on a tributary of the Mba River; and near the town of Dschang on the British Cameroons frontier.

French Equatorial Africa.—Several promising deposits were investigated in the Mayombe region of Moyen Congo. This area had a record of past production.

Malaya.—About 15 tons of columbite-tantalite concentrates was produced between 1945–51 as a byproduct of gold mining at Mayoko, in Moyen Congo. Malayan output of columbite for 1951 was about 25 tons; the concentrate was obtained as a byproduct of tin mining in the State of Kedah. Alluvial deposits of columbite-tantalite were investigated at Bakri near Muar on the west coast of the State of Johore and at Semiling in the northern part of the State of Kedah.

Mozambique.—About 92,550 kilograms of samarskite (an iron-calcium columbate-tantalate containing uranium and rare-earth elements) was produced in the Tete district of Mozambique. Shipments were made to France and the United Kingdom.

TABLE 3.—World production of columbite concentrates, 1935–51, in pounds [1]

[Compiled by Stanley Needleman and Berenice B. Mitchell]

Year	Argentina [1] [2]	Belgian Congo [1]	Brazil [3]	French Equatorial Africa [7]	India	Mozambique [1]	Nigeria	Uganda	Union of South Africa	United States (mine shipments)	World total (estimate)
1935	(4)	141, 120	(4)	----------	(4)	(4)	759, 360	(4)	[5] 19, 572	(6)	950, 000
1936	(4)	125, 685	(4)	----------	2, 262	(4)	1, 086, 400	(4)	[5] 13, 612	(6)	1, 300, 000
1937	(4)	207, 270	23, 770	----------	1, 254	(4)	1, 606, 080	(4)	[5] 1, 604	(6)	1, 850, 000
1938	----------	337, 365	28, 477	----------	(4)	(4)	1, 187, 200	(7)	[5] 1, 302	(6)	1, 600, 000
1939	----------	361, 620	76, 769	----------	(4)	(4)	965, 440	(7)	[5] 954	(6)	1, 450, 000
1940	----------	590, 940	33, 662	----------	(4)	(4)	887, 040	(7)	[5] 186	(6)	1, 550, 000
1941	4, 400	458, 640	7, 981	----------	(4)	17, 637	945, 770	----------	----------	----------	1, 450, 000
1942	6, 600	280, 035	1, 074	----------	(4)	11, 574	1, 937, 600	----------	----------	----------	2, 250, 000
1943	1, 800	332, 955	37, 500	----------	[8] 21, 600	11, 023	1, 796, 480	(7)	----------	5, 771	2, 250, 000
1944	200	648, 270	116, 871	----------	[8] 1, 470	9, 965	4, 603, 536	[3] 12, 320	----------	3, 208	5, 450, 000
1945	1, 000	436, 590	----------	10, 584	----------	3, 314	3, 519, 040	[9] 13, 194	----------	1, 149	4, 050, 000
1946	(4)	370, 440	15, 435	2, 200	----------	440	3, 472, 000	[9] 4, 883	----------	----------	3, 900, 000
1947	(4)	[10] 348, 390	----------	----------	(4)	----------	2, 880, 640	[9] 2, 800	----------	----------	3, 300, 000
1948	(4)	[10] 319, 725	10, 494	3, 461	(4)	----------	2, 455, 040	[9] 2, 285	----------	100	2, 950, 000
1949	[3] 1, 080	[10] 255, 780	33, 942	12, 984	(4)	550	1, 989, 120	[3] [5] 5, 571	----------	(6)	2, 500, 000
1950	(4)	[10] 297, 675	26, 709	3, 655	(4)	7, 700	1, 935, 360	[3] [5] 11, 413	----------	(6)	2, 450, 000
1951	(4)	[10] 209, 437	11, 000	----------	(4)	[11] 11, 133	2, 419, 200	[3] [5] 45, 560	----------	(6)	2, 850, 000

[1] This table and table 4 include a number of revisions of figures published in previous minor metals chapters. Concentrates produced in Argentina, Belgian Congo, French Equatorial Africa, and Mozambique are frequently termed "columbite-tantalite," this designation being applied because, in general, their composition (Cb_2O_5 Ta_2O_5) lies in an intermediate range, neither Cb_2O_5 nor Ta_2O_5 being strongly predominant. In tabulating production of columbite and tantalite, all output designated "columbite-tantalite" has arbitrarily been placed in this table. Concentrates imported into the United States are designated specifically as either columbite or tantalite, this classification sometimes being arbitrary; therefore discrepancies between figures in the columbite and tantalite production tables and United States import tables for these minerals should be viewed accordingly. In addition to countries shown, Bolivia reportedly exported 1,034 pounds in 1945, 6,834 pounds in 1946, and 1,043 pounds in 1951; production of columbite in Madagascar has been reported in 1945, 22 pounds and in 1951, 8,598 pounds; production in Malaya during the Japanese occupation was estimated at about 10,000 pounds; in 1950, 17,920 pounds; and in 1951, 56,000 pounds; Portugal exported columbite-tantalite concentrates in 1950, 3,009 pounds and in 1951, 4,526 pounds.

[2] Estimated average Cb_2O_5 content of concentrates.

[3] Exports.

[4] Data not available.

[5] Columbite-tantalite concentrates.

[6] Columbite and tantalite production in the United States not always differentiated; *see* table 4, on tantalite.

[7] Tin-columbite-tantalite concentrates, columbite-tantalite content unspecified, produced as follows: 1938, 20,066 pounds; 1939, 8,014 pounds; 1940, 1,546 pounds; 1943, 15,700 pounds; 1947, 329 pounds; 1948, 210 pounds.

[8] United States imports.

[9] Contained in 17,687 pounds mixed concentrates in 1945; in 7,706 pounds in 1946; in 3,651 pounds in 1947; in 3,203 pounds in 1948.

[10] In addition, tin-columbite-tantalite concentrates were produced as follows: 1947, 597,555 pounds, columbite-tantalite content unspecified; 1948, 1,148,050 pounds; 1949, 1,944,810 pounds; 1950, 2,431,674 pounds; 1951, 2,597,019 pounds (columbite-tantalite content averaging about 10 percent for 1948–51).

[11] In addition to figure shown, 204,036 pounds of samarskite was produced.

TABLE 4.—World production of tantalite concentrates, in 1935–51, in pounds [1]

[Compiled by Stanley Needleman and Berenice B. Mitchell]

Year	Australia	Brazil [2]	Nigeria	Southern Rhodesia	South-west Africa	Uganda	Union of South Africa	United States (mine shipments) [3]	World total (estimate)
1935	33, 981	(3)	----------	2, 000	13, 448	(4)	(5)	7, 681	66, 500
1936	33, 555	(3)	----------	(3)	[6] 6, 720	[2] 41, 431	(5)	----------	96, 500
1937	40, 320	(3)	----------	(3)	[6] 6, 384	[2] 61, 949	(5)	16, 307	137, 000
1938	44, 979	56, 165	----------	15, 900	[6] 4, 861	(5)	(5)	36, 189	168, 000
1939	18, 547	53, 508	----------	10, 260	4, 166	(5)	(5)	340	94, 500
1940	14, 157	59, 781	----------	15, 680	[6] 22	(5)	(5)	----------	98, 500
1941	----------	200, 619	----------	35, 840	[6] 228	----------	(5)	250	255, 000
1942	1, 904	249, 120	----------	29, 120	[6] 40	----------	(5)	200	295, 000
1943	27, 418	399, 033	4, 500	13, 820	[6] 2	(4)	(5)	[7] 9, 411	485, 000
1944	24, 192	443, 125	27, 082	12, 640	(5)	[8] 9, 518	6, 312	[7] 7, 204	575, 000
1945	1, 053	66, 138	29, 792	14, 740	----------	[8] 3, 636	776	[7] 5, 500	127, 000
1946	806	98, 035	2, 890	16, 900	----------	(5)	[9] 4, 000	[7] 3, 475	132, 000
1947	1. 411	71, 650	8, 310	27, 300	493	(5)	----------	[7] 3, 259	118, 000
1948	12, 023	9, 202	8, 243	16, 120	17	(5)	----------	500	51, 500
1949	3, 502	91, 237	4, 980	10, 840	5, 364	(5)	(3)	[10] 1, 020	123, 000
1950	16, 536	18, 700	2, 240	1, 700	12, 570	(5)	[9] 4, 000	[10] 1, 000	62, 500
1951	5, 129	8, 818	6, 720	----------	3, 974	(5)	[9] 6, 000	[10] 925	37, 500

[1] *See* table 3, footnote 1. United States imports show 98 pounds tantalite received from Anglo-Egyptian Sudan in 1944; 700 pounds from Canada in 1944; and 1,805 pounds and 2,442 pounds from India in 1943 and 1944, respectively.
[2] Exports.
[3] Prior to 1941, concentrates were designated as "tantalite-columbite", however, in composition, Ta_2O_5 was strongly predominant over Cb_2O_5, therefore, these concentrates have been tabulated in this table rather than table 3, on columbite. From 1941 to 1948, inclusive, tantalite and columbite are differentiated.
[4] Data not available.
[5] *See also* table 3, on columbite.
[6] In addition, tin-tantalite-columbite concentrates, unspecified tantalite-columbite content, produced as follows: 1936, 1,165 pounds; 1937, 1,322 pounds; 1938, 1,366 pounds; 1940, 1,456 pounds; 1941, 370 pounds; 1942, 161 pounds; 1943, 560 pounds; 1944, 2,000 pounds.
[7] Principally microlite.
[8] Includes bismutotantalite as follows: 1944, 6,720 pounds; 1945, 670 pounds. Footnotes 2 and 5, above, also apply.
[9] Sales and exports.
[10] Tantalite-columbite.

Nigeria.—Production of columbite was adversely affected by lack of rain and curtailment of electric power supplies. The Government of Nigeria has increased the scales of royalties on both columbite and tin. It has been asserted that these scales are not justified by existing working costs and that this situation has made the lower grade ore uneconomical.[12]

Reserves of columbite in Nigeria, as of March 31, 1951, were estimated at about 10,000 long tons, of which about 7,000 tons was proved.[13]

South-West Africa.—This country reported a production of 3,794 pounds of columbite-tantalite during 1951, principally from the Karabib-Usakos area.

Uganda.—Columbite production came from the Ankole-Kigezi area; largest producer was the African Base Metals Concern, with workings in the Kakanena-Kavu, Savami, and Ankole districts. The known columbite-tantalite area extends from Dwata to Kabira, in northwest Kashara County, and south to Kamezi on the Ruanda border.[14] Columbite has been reported in northern Kinkizi.[15] A

[12] Mining World, vol. 161, No. 4197, September 1951, p. 147.
[13] Annual Report of the Mines Dept. (Nigeria) for a period Jan. 1, 1950, to March 1951, Kaduna, 1951, p. 12.
[14] Geological Survey Dept. of Uganda, Records: 1950, p. 31.
[15] Survey, Land and Mines Dept., Uganda Protectorate, Annual Report, 1950 Entebbe, 1951, p. 35.

sample of pyrochlore from Sukulu Hill, Tororo, Uganda, was submitted by the Geological Survey of Uganda to the United States Bureau of Mines for beneficiation tests. Flotation tests were not successful, although not enough tests were made to be conclusive.

GALLIUM [16]

Gallium is unique among metals in that it remains liquid through a temperature range of 3,515° F.—from a melting point of 85.5° F. to a boiling point of 3,601° F. Unfortunately, it is extremely corrosive and consequently difficult to handle, particularly at higher temperatures. Although gallium is as abundant as lead in the crust of the earth, the price that it commands is over twice that of gold. Few significant commercial concentrations of the metal have been found. The richest known gallium-bearing mineral, germanite, contains up to 1.85 percent of the metal. The ores of tin, zinc, and aluminum contain varying small amounts of gallium. Some Bolivian tin ores run as high as 0.05 percent gallium, and aluminum ores have been found to contain 0.002 to 0.008 percent gallium. Flue dust from certain coals of east-central England have assayed up to 0.17 percent gallium.

Production.—Gallium metal was produced in 1951 by the Aluminum Ore Co., East St. Louis, Ill.; and the Anaconda Copper Mining Co., Great Falls, Mont.

Consumption and Uses.—Demand for gallium in 1951 was negligible. No new applications were developed. The principal use of the metal, as in recent years, was as a component in the construction of direct-reading fused quartz thermometers. Minor amounts of gallium were used in optical mirror backings, dental alloys, gallium-vapor lamps, and as an excitant in phosphors for fluorescent lighting and luminous paints. Research studies were conducted on gallium and alloys of the metal with tin, aluminum, and zinc for potential use as a liquid-metal heat-transfer medium in nuclear energy apparatus.[17]

Prices.—Quotations on gallium metal, 99.9 percent pure, in 1951 continued the same as in 1950, with the metal offered at $4.50 per gram in lots of less than 100 grams; $3.50, for 100 to 999 grams; and $3.00, for 1,000 to 2,499 grams.

GERMANIUM [18]

Through development of improved germanium diodes and transistors, further and substantial progress was achieved in 1951 toward the imminent revolution in electronics, which has, according to the prognosticators, far-reaching implications.

Production.—Germanium production, principally in the form of the dioxide, increased about 80 percent in 1951 compared with 1950 and reached an all-time high. The Eagle-Picher Co., Joplin, Mo., maintained its position as the leading domestic producer of germanium and its compounds. A relatively small but significant output of germanium dioxide was reported by the American Steel & Wire Co.

[16] Prepared by E. J. Carlson.
[17] Evans, R. M. and Jaffee, R. I., Low-Melting Gallium Alloys: U. S. Atomic Energy Commission, Nuclear Science Abs., vol. 5, No. 17, Sept. 15, 1951, p. 701.
[18] Prepared by H. D. Keiser.

(subsidiary of the U. S. Steel Corp.), Donora, Pa., the only other producer. American Zinc, Lead & Smelting Co. announced that a new unit for the recovery of germanium was under construction at its Fairmont City, Ill., plant and would be placed in operation during 1952.[19] Toward the close of 1951 the Eagle-Picher Co. filed a tax-amortization application with Defense Materials Procurement Agency in connection with its plans to increase the capacity of its germanium-production facilities at Joplin, Mo. Action on the application had not been completed at the year end.

Consumption and Uses.—Apparent consumption of germanium and its compounds in 1951, based on producers' shipments and imports, increased slightly more than 100 percent compared with 1950 and was almost identical in quantity with domestic production in 1951. As in the last several years, virtually all the germanium consumed was used in the metal form by the electronics industry for the production of diodes and transistors. (*See* Germanium review in the Minor Metals chapter, Minerals Yearbook 1950.) About 6,000,000 diodes were said to have been made in 1951 and were extensively used in television receivers.[20] Principal manufacturers of diodes and transistors in 1951 included General Electric Co., Syracuse, N. Y.; Philco Corp., Philadelphia, Pa.; Raytheon Manufacturing Co., Newton, Mass.; Sylvania Electric Products, Inc., Woburn, Mass.; and Western Electric Co., Allentown, Pa. Numerous companies, most of them already in the general electronics field, were reportedly preparing to produce diodes and transistors in 1952.

Transistors are of two types, the contact type and the junction type. The contact type was developed first, and a large part of the improved performance of the transistor results from development of the junction type. A germanium crystal touched by two closely spaced fine wires comprised the contact transistor, whereas in the junction transistor this point-contact arrangement has been replaced by a large-area contact. A thin layer of electrically positive (electron-deficient) germanium is sandwiched between two electrically negative (electron-rich) germanium ends. Transistor action takes place over the entire area of contact (junction) between the two types of germanium. The junction transistor therefore operates more efficiently and consumes far less power than the contact transistor.[21]

Stocks and Prices.—Producers' 1951 year-end stocks of germanium were larger than at the close of 1950 but were relatively low owing to the strong demand for the metal that prevailed during 1951. Germanium was quoted by E&MJ Metal and Mineral Markets at $180 per pound throughout 1951.

Foreign Trade.—Imports of germanium in 1951 comprised 319 pounds of germanium dioxide, valued at $66,121, from Germany and the United Kingdom.[22] Data on United States exports of germanium are not available.

Technology.—An investigation of the physical metallurgy of germanium was begun in the latter part of 1951 by the Bureau of Mines at its Mississippi Valley Experiment Station, Rolla, Mo.

[19] American Zinc, Lead & Smelting Co., St. Louis, Mo., Annual Report: 1951, p. 16.
[20] Kaar, I. J., Electronics Division, General Electric Co., Syracuse, N. Y., Address before New York Society of Security Analysts: New York, N. Y., June 2, 1952.
[21] Ridenour, Louis N., A Revolution in Electronics: Sci. Am., vol. 185, No. 2., August 1951, pp. 13–17.
[22] Source: U. S. Tariff Commission

The investigation involved the design and construction of special furnaces for reducing germanium oxide and for remelting and casting the metal and development of new instruments for measuring the various electrical properties of germanium.

A metallurgical process was described for recovering germanium from flue dusts produced in burning British coals. Recovery in the regulus of more than 90 percent of the germanium in the dust was achieved, followed by extraction of 90 to 95 percent of the metal in the regulus.[23] Direct reduction of germanium tetrachloride with zinc vapor to produce germanium metal of electronic grade was discussed. The purity and electronic properties of the germanium equaled or exceeded those of germanium prepared by the standard hydrolysis and hydrogen reduction of germanium dioxide.[24]

In an investigation of junction transistors, the effects of diffusion of electrons through a thin p-type layer of germanium was studied in specimens consisting of two n-type regions with the p-type region interposed.[25] Research investigations were conducted on various physical and electrical characteristics of germanium semiconductors.[26] The electrical resistivity of aluminum alloys containing germanium was found to increase linearly with the atomic percentage of the solute atoms.[27]

INDIUM[28]

Indium is a silver-white metal with a bluish tinge and is ductile, malleable, softer than lead, crystalline, and diamagnetic. The metal is widely distributed in the crust of the earth but generally found only as traces with the ores of zinc, lead, tin, tungsten, and iron. Commercial production of indium has been principally from zinc-smelter residues, which have been found to contain up to 1.0 percent of the metal.

Production.—The indium content of metal and compounds produced domestically in 1951 exceeded by about 10 percent the previous all-time high production of 1950. Principal producers of indium were the American Smelting & Refining Co., Denver, Colo., and Perth Amboy, N. J.; the Anaconda Copper Mining Co., Great Falls, Mont.; and the Cerro de Pasco Copper Corp., Brooklyn, N. Y.

Uses.—The chief use of indium has been as a plating for engine bearings, especially where high bearing loads, elevated operating temperatures, and severe conditions of lubricant corrosion are encountered. A small percentage of indium added to silver-lead solders materially improves the coverage, spreadability, and bonding strength of such solders.

World Review.—Indium production in Peru was reported to be 80,853 grams, which was appreciably less than the 1950 production of 514,000 grams. Canada, which produced 154,000 grams in 1950, had an estimated production of 30,000 grams of indium for 1951.

[23] Powell, A. R., Lever, F. M., and Walpole, R. E., The Extraction and Refining of Germanium and Gallium: Jour. App. Chem., vol. 1, part 12, December 1951, pp. 541-551.
[24] Medcalf, William E., Direct Reduction of Germanium Tetrachloride: Eagle-Picher Co., Joplin Mo., Quart. Rept. 2, Aug. 1-Nov. 1, 1951, 31 pp.
[25] Shockley, W., Sparks, M., and Teal, G. K., p-n Junction Transistors: Phys. Rev., vol. 83, No. 1, July 1, 1951, pp. 151-162.
[26] Purdue Research Foundation, Lafayette, Ind., Semiconductor Research: Quart. Rept. 1, July 1-Sept. 30, 1951, 35 pp.
[27] Robinson, A. T., and Dorn, J. E., Effect of Alloying Elements on the Electrical Resistivity of Aluminum Alloys: Jour. Metals, vol. 3, No. 6, June 1951, pp. 457-460.
[28] Prepared by E. J. Carlson.

TABLE 5.—Producers' shipments of indium, 1942–51 [1]

Year	Troy ounces	Price per troy ounce [2]	Year	Troy ounces	Price per troy ounce [2]
1942	[3] 21,000	$30–$15	1947	13,908	$2.25
1943	59,568	15–10	1948	12,202	2.25
1944	82,427	10–7.50	1949	54,784	2.25
1945	57,434	7.50–2.25	1950	125,777	2.25
1946	9,667	2.25	1951	153,191	2.25

[1] Includes metal content of compounds.
[2] Nominal published prices, electrolytic grade, 99.9 percent.
[3] Estimated.

RARE-EARTH MINERALS AND METALS [29]

Nature has been relatively generous in distributing rare-earth elements throughout the world and has endowed this country with two commercial sources—monazite, a rare-earth phosphate containing thorium, and bastnaesite, a rare-earth fluocarbonate. The known properties of the individual members of the rare-earth group are characteristically similar; ordinarily the elements occur together in the same minerals and are difficult to separate. The group as a whole is as abundant in the earth's crust as cobalt, boron, zinc, or lead.

Interest in domestic deposits of monazite and bastnaesite continued to increase during 1951. The Bureau of Mines, under contract to the Atomic Energy Commission, continued to examine stream gravels in Idaho, Montana, Wyoming, North Carolina, and South Carolina as part of a program to evaluate the monazite deposits of the United States; the Geological Survey collaborated with the Bureau in examining several southeastern deposits. The bastnaesite deposit near Mountain Pass, San Bernardino County, Calif., was mapped by the Geological Survey. An examination, incidental to the mapping, showed that the deposit covers an area roughly 6 miles long and 2 miles wide, southeast of the Birthday claims originally discovered in 1949. The bastnaesite occurs in veins and bodies of barite-carbonate rock associated with shonkinite and syenite.

Reserves of rare-earth minerals, especially those in Idaho and California, point to the possibility of this country becoming self-sufficient, with respect to these source materials, within the not too distant future.

Production.—Domestic monazite production for 1951 was twice the output for 1950. Operations in the monazite-rich gravels of Idaho accounted for the increase. Significant production also came from Florida. The producing companies were Baumhoff-Marshall Co., Boise, Idaho; Warren Dredging Corp., Boise, Idaho; Humphreys Gold Corp., Jacksonville, Fla.; and Climax Molybdenum Co., Leadville, Colo.

Monazite-production statistics are classified because the mineral comes under the regulations of the Atomic Energy Act of 1946, being a source of thorium, a fissionable material. No bastnaesite production was reported during the year.

[29] Prepared by A. J. Kauffman, Jr.

Consumption and Uses.—Principal monazite processors are Lindsay Light & Chemical Co., West Chicago, Ill.; Rare Earths, Inc., Paterson, N. J.; and Maywood Chemical Works, Maywood, N. J. Producers of mischmetal and ferrocerium include: Cerium Metals Corp., New York, N. Y.; General Cerium Corp., Edgewater, N. J.; New Process Metals Corp., Newark, N. J.; and Kent Metal & Chemical Co., Edgewater, N. J.

Large quantities of rare-earth fluorides and oxides are used as cores for high-luminosity carbon electrodes. Ordinary carbon arc lamps, although of high intensity, dissipate much of this intensity in the infra-red region of the spectrum. Addition of the rare-earth compounds results in a brilliant white light because of the intense emission in the visible region. High-speed photography has been made possible by the use of these high-luminosity electrodes. The pyrophoric property of ferrocerium, an alloy of iron and the rare-earth metals, makes the material desirable for striking flints used in mechanical lighters. This property has made possible tracer bullets and luminescent shells.

Mischmetal, the mixture of all of the rare-earth elements in metallic form, contains 45 to 55 percent cerium. An aluminum alloy with 11 percent mischmetal has stress-rupture properties superior to present commercial alloys in the range of 700° to 800° F.[30] The creep resistance of extruded magnesium is improved in the range of 400° to 600° F. Additions of rare-earth metals improve the hot-workability of austenitic chromium-nickel and other high-alloyed steels.[31]

Prices.—During 1951 quotations for mischmetal and ferrocerium remained unchanged at $4.50 and $8.00 per pound, respectively. High-purity cerium metal was offered at $18.00 per pound.

Foreign Trade.—Receipts of mischmetal and ferrocerium alloys for 1951 totaled 699 pounds valued at $4,543. Germany was the principal source. Imports of rare-earth chlorides from Brazil amounted to 822,125 pounds, valued at $281,681. (*See* the Minor Metals chapter, Minerals Yearbook, 1950, p. 1325, for statistics covering imports of mischmetal and ferrocerium, 1924–50; cerium and other rare-earth compounds, 1922–50; and exports of mischmetal and ferrocerium, 1942–50.)

WORLD REVIEW

India.—Except for a small tonnage shipped to England, India has had a complete embargo on monazite exports since 1947. The Indian Government has interest in controlling the exports of monazite because of the thorium content. According to a report published in 1951, Indian Rare Earths, Ltd., was being set up at Alwaye, in Travancore, by the Government of India and Travancore to operate a plant to process 1,500 tons of monazite annually. Societe de Produits Chimiques des Terres Rares, of France, was making the plant installation and contributing technical assistance until Indian personnel could be trained.[32]

[30] Loring, B. M., Baer, W. H., and Ackerlind, C. G., A Mischmetal Aluminum Alloy for Elevated Temperature Service: Naval Research Laboratory Rept. 3871, November 1951, Unclassified.
Leontis, T. E., Effect of Rare-Earth Metals on Properties of Extruded Aluminum: Jour. Metals, vol. 3, No. 11, November 1951, pp. 987–993.

[31] Post, C. G., Schoffstal, D. G., and Beaver, H. O., Hot-workability of Stainless Steel Improved by Adding Cerium and Lanthanum: Jour. Metals, vol. 3, No. 11, November 1951, pp. 973–979.

[32] Mining World, vol. 13, No. 7, June 1951, pp. 44 and 48.

Brazil.—Brazil, like other governments, has placed tight restrictions on the export of monazite. Deposits of monazite in the vicinity of Victoria, State of Espirito Santo, were being worked by the Monazita e Ilmenita do Brasil and Foote Minerios Industrializados. The latter company lost an attempt to block by injunction the Government ruling that prohibits export of the mineral to the United States.[33] A new plant for treating monazite has been erected at Guarapari, Espirito Santo.[34]

RHENIUM [35]

Rhenium, first discovered in Germany in 1925, has been one of the neglected elements, but recent research at the University of Tennessee suggests that it may have important specialized uses. It is a heavy, silver-white metal with a melting point of 3,440° C. abs. This metal alloys readily with tungsten, nickel, cobalt, tantalum, platinum, rhodium, iridium, gold, and iron. Rhenium is widely distributed in the crust of the earth but is not found in any commercial concentrations. Molybdenite has proved to be the richest mineral source of the element. The rhenium content of domestic molybdenites was reported to run as high as 0.05 percent, although specimens of this mineral from Norway have assayed up to 0.30 percent. Flue dust from roasting molybdenum concentrates is the principal commercial source of the metal.

Production and Prices.—Rhenium and potassium perrhenate have been produced by the Chemistry Department of the University of Tennessee since 1942. Only a few pounds of the metal has been produced yearly. The price varied with the quantity purchased. In pound lots the price was reported to be $900.00 per pound.

Uses.—The high melting point gives rhenium value in high-temperature alloys, which offer excellent corrosion-resistant properties. The metal has a longer life than tungsten when operated at any given temperature. Thermocouples of platinum-rhenium and platinum, of platinum-rhenium and rhodium, or iridium-rhenium and iridium have high electromotive forces and can be used at temperatures up to 1,900° C.

SELENIUM AND TELLURIUM [36]

Selenium and tellurium are closely associated mineralogically and have many properties in common. Moreover, they are both derived from the same principal industrial source—blister copper. Economically, however, the two metals differed markedly in 1951. Selenium was a strategic metal in limited supply, the year-end stocks of which were at the lowest level since 1935. Tellurium, on the other hand, was abundant, and at the close of the year overall stocks, including the metal content of producers' stocks of compounds and unprocessed anode slimes, exceeded a 5-year supply of the metal on the basis of apparent consumption in 1951.

Production.—Domestic output of elemental selenium in 1951 was 457,004 pounds compared with 511,325 pounds in 1950—a decline of

[33] Engineering and Mining Journal, vol. 152, No. 7, July 1951, p. 208.
[34] Mining World, vol. 13, No. 11, October 1951, p. 59.
[35] Prepared by E. J. Carlson.
[36] Prepared by H. D. Keiser

about 11 percent, attributable largely to (1) reduced production of high-selenium copper at one mine, (2) the accumulation of selenium-containing anode slime during the year at one copper refinery, and (3) a decrease of about 4 percent in the production of electrolytic copper in the United States. Domestic production of elemental tellurium in 1951 totaled 160,933 pounds compared with 59,713 pounds in 1950.

TABLE 6.—Salient statistics of elemental selenium and tellurium in the United States, 1942–46 (average) and 1947–51, in pounds

Year	Selenium					Tellurium		
	Production	Producers' shipments	Producers' stocks at end of year	Imports [1]		Production	Producers' shipments	Producers' stocks at end of year
				Pounds	Value			
1942–46 (average)	475,408	454,394	388,637	191,172	$328,351	86,769	61,046	156,101
1947	512,648	489,415	280,368	529,175	893,171	45,248	71,300	122,717
1948	561,156	570,718	270,806	267,118	489,762	48,806	78,788	92,735
1949	468,502	317,960	334,067	171,581	317,145	109,021	64,278	135,605
1950	511,325	723,128	124,201	363,312	767,952	59,713	98,070	97,249
1951	457,004	455,608	85,947	246,552	1,017,863	160,933	144,972	113,210

[1] Includes selenium salts.

Producers of selenium and tellurium and their compounds in 1951 were the American Smelting & Refining Co., Baltimore, Md.; International Smelting & Refining Co., Perth Amboy, N. J.; and United States Metals Refining Co., Carteret, N. J. The United States Smelting, Refining & Mining Co. produced tellurium and tellurium compounds at its East Chicago, Ind., lead refinery. Kennecott Copper Corp. proceeded with the installation of facilities at its Garfield, Utah, copper refinery for the recovery of selenium and tellurium, with initial recovery operations scheduled for September 1952.

Consumption and Uses.—Apparent consumption (producers' domestic shipments plus imports) of elemental selenium and elemental tellurium in 1951 was 702,130 and 144,972 pounds, respectively, representing a 35-percent decline for selenium and a 48-percent increase for tellurium, compared with the respective apparent consumption in 1950. In the instance of selenium, the lower apparent consumption in 1951 reflected reduced production and a decline in imports rather than any decrease in demand. On the contrary, the metal was in such short supply that on December 10, 1951, the National Production Authority issued Order M–91 placing both imported and domestically produced selenium under complete allocation. NPA announced that the action was necessary if essential defense requirements for selenium were to be met.

The principal uses of selenium in 1951 were (1) in manufacturing rectifiers used to convert alternating current to direct current in television and radio sets and to perform the same function as power tubes; (2) in producing special grades of stainless steel to improve machinability and in casting stainless steel to provide gas control and thereby assure soundness of castings; (3) as a decolorizer in the glass industry; and (4) for diversified chemical purposes, including its use (a) in the production of pigments and enamels, (b) as a rubber accelerator, and

(c) as a catalyst in the synthesis of organic chemical and drug products. High-purity-grade (99.99 plus percent) and DDQ-grade (99.95 percent) selenium are used for manufacturing rectifiers. In the glass and pigment industries, commercial-grade (99.5 percent) selenium is used. Selenium dioxide is employed as a catalyst in the preparation of chemicals and drugs. Ferroselenium is used in producing stainless steel.

Tellurium was used principally (1) in manufacturing alloys, such as tellurium lead, tellurium copper, and various tellurium bronzes, and (2) in the rubber industry as a secondary vulcanizing agent. Minor uses were as an additive and core wash to induce chill in the manufacture of iron castings, and as a coloring agent in the production of art glass and ceramics. A tellurium copper with a machinability approaching that of free-cutting brass and with an electrical conductivity of 90 percent of that of pure copper was produced. A tellurium bronze also became available that had high strength, hardenability, ease of machining, and corrosion resistance. Tellurium imparts hardness, toughness, and increased corrosion resistance to lead. In rubber, tellurium provides resistance to heat and aging.

Stocks.—Producers' stocks of elemental selenium decreased 31 percent in 1951, whereas those of elemental tellurium increased 16 percent. The stocks of selenium at the end of 1951 represented less than a 2-month supply, based on apparent consumption for the year.

Prices.—Selenium, black, powdered, 99.5 percent pure, was quoted at $3.00–$3.50 per pound throughout 1951. The quotation for tellurium continued unchanged at $1.75 per pound, as in the preceding 12 years.

Foreign Trade.—Imports of selenium and its salts in 1951 totaled 246,552 pounds, valued at $1,017,863, a decrease of 32 percent in quantity but an increase of 33 percent in value, compared with 1950. Canada was the source of 200,622 pounds (81 percent) of 1951 imports, valued at $756,744. Japan furnished 20,793 pounds, valued at $145,165, and 19,815 pounds, valued at $97,719, was received from Sweden. Germany, Mexico, and Belgium supplied most of the remainder. Tellurium imports were virtually nil, amounting to 25 pounds of tellurium in compounds received from Canada. Data on exports of selenium and tellurium are not available.

World Review.—Canadian production of selenium increased 45 percent in 1951 in response to strong demand for defense purposes. The total selenium output was 382,603 pounds valued at C$1,239,633, compared with 261,973 pounds valued at C$633,975 in 1950. Tellurium production decreased from 10,075 pounds valued at C$19,143 in 1950, to 8,913 pounds valued at C$16,400 in 1951.[37]

About three-fourths of the total selenium production in Canada in 1951 was recovered by Canadian Copper Refiners, Ltd., at its Montreal East, Quebec, refinery from copper anodes produced from the copper-gold ores of Noranda Mines, Ltd., Noranda, Quebec, and from blister copper derived from the copper-zinc ores of Hudson Bay Mining & Smelting Co., Ltd., Flin Flon, Manitoba. About one-fourth of the total production was recovered at the Copper Cliff, Ontario, refinery of the International Nickel Co. of Canada, Ltd., from the Sudbury

[37] Dominion Bureau of Statistics, Ottawa, Ontario, Canada.

copper-nickel ores. Selenium and its compounds were also produced by the International Nickel Co. of Canada, Ltd., at its Clydach refinery, near Swansea, Wales, United Kingdom.

THALLIUM [38]

Thallium is recovered commercially from flue dust and residues accumulated in certain plants and smelters that produce lead, zinc, copper, cadmium, sulfuric acid, and white arsenic.

Production.—The Globe cadmium refinery of the American Smelting & Refining Co., at Denver, Colo., was the sole producer of thallium metal in the United States. Domestic output of thallium metal and sulfate totaled about a few thousand pounds during 1951.

Consumption and Uses.—Producers' shipments of thallium metal and sulfate in 1951 indicated that thallium was consumed at the same rate as in the previous year. The use of thallium compounds for rodent and insect control declined whereas use of thallium in scintillator counter crystals and as a phosphor activator increased.

Thallium-bromide-iodide synthetic optical crystals were used as prisms and windows for use in infrared spectroscopy and infrared achromatic lenses, and as lens components for microscope objectives for use in infrared optical instruments.

Prices.—Trade journals quoted thallium metal and sulfate in 1951 at $12.50 and $10.50 per pound, respectively, in 10-pound lots.

Technology.—Thallium was reported to be more effective than lead in improving gasoline performance, according to the findings incorporated in United States Patent 2,562,885.[39]

The Salt Lake Experiment Station of the Bureau of Mines, at Salt Lake City, Utah, investigated methods for recovering thallium from certain products of American Smelting & Refining Co. smelters.

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[38] Prepared by Stanley Needleman.
[39] Petroleum Processing, Processing Patents: Vol. 6, No. 12, December 1951, p. 1407.

Minor Nonmetals

By J. C. Arundale, H. P. Chandler, W. F. Dietrich, B. L. Gunsallus, O. S. North and R. D. Thomson [1]

GREENSAND [2]

THE FOLLOWING firms reported production of greensand during 1951: The Permutit Co., 330 West 42d St., New York, N. Y.; Zeolite Chemical Co., Medford, N. J.; and Inversand Co., Clayton, N. J. All production was from open-pit operations in Burlington and Gloucester Counties, N. J., and all shipments were for water softening and purification.

Prices of refined greensand ranged from about $54–$122 per short ton, f. o. b. shipping point.

TABLE 1.—Greensand marl sold or used by producers in the United States, 1946–51

Year	Short tons	Value	Year	Short tons	Value
1946	5,140	$424,900	1949	6,128	$276,564
1947	8,337	432,980	1950	3,935	304,321
1948	7,269	392,959	1951	5,067	263,944

JEWEL BEARINGS [3]

Jewel bearings manufactured from synthetic corundum have largely replaced natural mineral bearings used in watches and precision instruments. Jewel bearings made from synthetic spinel and glass also are used in small quantities. Compared with natural stones, synthetic corundum stones (ruby and sapphire) are of greater purity, usually flawless, and less expensive. Synthetic sapphires are produced from chemically pure, finely ground alumina (Al_2O_3). Small quantities of chromium oxide are added as a pigmentary material in the production of rubies. The aluminum oxide passes through a hydrogen-oxygen flame, and the molten oxide forms into a single bullet-shaped crystal or boule. The boule is removed from the furnace and is split longitudinally, sawed into blanks, ground into rondelles, drilled, cut to various shapes, polished, and glazed into a marketable jewel bearing.

The Swiss jewel-bearing industry, controlled by three separate unions and the Swiss Export Association, dominates world production. Most of the United States supply of jewel bearings is imported from Switzerland.

[1] Figures on imports and exports complied by M. B. Price and E. D. Page, of the Bureau of Mines, from records of the U. S. Department of Commerce.
[2] Prepared by J. C. Arundale.
[3] Prepared by R. D. Thomson.

Jewel bearings are in group I on the Munitions Board's List of Critical and Strategic materials. Three different classifications have been stockpiled, but there were no new purchases for the National Stockpile in 1951.

TABLE 2.—Salient statistics of the jewel bearing industry in the United States, 1948–51

[Number]

	1948	1949	1950	1951
Production:				
Blanks	680,400	249,600	795,400	1,200,503
Finished jewels [1]	2,576,095	2,725,103	3,327,206	9,876,654
Consumption:				
Blanks	7,503,199	6,678,922	7,008,289	11,415,514
Semifabricated jewels	1,729,100	1,603,900	3,331,500	7,884,500
Finished jewels [1]	66,212,629	68,322,111	71,126,700	85,030,037
Stocks on hand Dec. 31:				
Blanks	7,297,087	7,684,765	5,796,014	2,618,650
Semifabricated jewels	405,225	243,454	529,540	710,479
Finished jewels [1]	72,945,750	98,213,655	107,432,348	97,390,081

[1] Includes finished jewels made from glass.

TABLE 3.—Consumption of raw materials by the jewel bearing industry in the United States, 1948–51

Type of raw material	Inventory at beginning of year (carats)	Receipts during year		Consumption (carats)	Shipments during year		Inventory at end of year (carats)
		Carats	Cost of material received		Carats	Market value of material	
1948:							
Synthetic sapphire	44,802	141,074	$8,105	145,000	2,383	$315	38,493
Synthetic ruby	69,493	21,016	1,051	82,238			8,271
Synthetic spinel	15,600			15,600			
Total	129,895	162,090	9,156	242,838	2,383	315	46,764
1949:							
Synthetic sapphire	38,493	52,275	637	70,299	284	602	20,185
Synthetic ruby	8,271	18,550	645	20,550			6,271
Synthetic spinel							
Total	46,764	70,825	1,282	90,849	284	602	26,456
1950:							
Synthetic sapphire	25,495	54,795	2,347	37,845	10,000	100	32,445
Synthetic ruby	6,422	2,200	610	4,300			4,322
Synthetic spinel							
Total	31,917	56,995	2,957	42,145	10,000	100	36,767
Synthetic sapphire rods (in inches)	627	735	(1)	1,152			210
1951:							
Synthetic sapphire	33,445	103,575	1,919	[2] 88,135			48,885
Synthetic ruby	4,322	16,500	360	[2] 18,651			2,171
Synthetic spinel							
Total	37,767	120,075	2,279	106,786			51,056
Synthetic sapphire rods (in inches)	210			[3] 210			

[1] Data not available.
[2] Partly estimated figure.
[3] Estimated figure.

Production.—Domestic production of jewel bearings in 1951 was less than 12 percent of the total consumption (tables 2 and 3). A total of 1,201,000 blanks and 9,877,000 finished jewels was produced in 1951, approximately 51- and 197-percent increases above the 1950 output. Essentially, no watch jewels are made in the United States, except for a small quantity of pallet stones. The only jewel bearings manufactured domestically in any appreciable quantities are cup jewels. The production of V-jewels, endstones, and ring-hole jewels is small. Jewel bearings are manufactured in several plants at Waltham, Mass.; Trenton and Perth Amboy, N. J.; and Lancaster, Pa.

Consumption.—Industry consumed 85,030,000 finished jewels during 1951, an increase of 20 percent compared with 1950. Jewel bearings are used where it is necessary to minimize the friction of moving small parts. The bearings find universal application in watches, gages, meters, indicators, fine scales and balances, time fuses, and other instrumentation. Synthetic sapphire is preferred for industrial bearings and synthetic ruby for watch jewels. The most common varieties of watch bearings are cap jewels, pallet stones, hole jewels, and roller pins. Standard types of industrial bearings are cup, vee, ring, and cap.

Stocks.—At the close of 1951, company stocks totaled 2,619,000 blanks, 710,000 semifabricated jewels, and 97,390,000 finished jewels. Although semifabricated jewels in stock increased 34 percent, both stocks of blanks and finished jewels decreased.

KYANITE, ANDALUSITE, SILLIMANITE AND DUMORTIERITE [4]

Production.—Only two companies produced kyanite in the United States in 1951, namely, Commercialores, Inc., 39 Cortlandt Street, New York, N. Y., (from deposits near Clover, S. C.), and Kyanite Mining Corp., Cullen, Va. (from a property near Farmville, Prince Edward County, Va.). Both companies reported increases in production in 1951 compared to 1950. The Bureau of Mines is not at liberty to publish figures on domestic production.

No production of andalusite and dumortierite was reported to the Bureau of Mines for 1951.

Consumption and Stocks.—Consumption of imported kyanite in 1951 was 16,508 short tons compared with 15,874 in 1950. Stocks at the end of 1951 were 1,891 short tons compared with 4,772 short tons in 1950.

Prices.—As reported by E&MJ Metal and Mineral Markets for December 1951, quotations on kyanite were as follows: Per short ton f. o. b. point of shipment, Virginia and Soutb Carolina, 35-mesh, carlots, in bulk, $29; in bags, $32; for 200-mesh, carlots, in bags, $40. Quotations on imported kyanite (57-to 59-percent grade), in bags, were $60 to $65 per short ton, c. i. f. Atlantic ports.

Foreign Trade.—Imports and exports of kyanite and allied minerals for 1951 are shown in table 4. India furnished 53 percent and British East Africa 41 percent of the total United States imports. India furnished about the same tonnage, whereas British East Africa furnished 32 percent more than in 1950.

[4] Prepared by B. L. Gunsallus.

TABLE 4.—Kyanite imported for consumption and kyanite and allied minerals exported from the United States, 1947–51

[U. S. Department of Commerce]

Imports			Exports		
Year and origin	Short tons	Value	Year and destination	Short tons	Value
1947	12,182	$150,674	1947	239	$20,553
1948	17,091	259,055	1948	462	21,813
1949	12,119	324,856	1949	1,039	46,725
1950			1950		
Australia	337	2,785	Canada	362	12,493
British East Africa	6,107	226,671	Greece	6	190
India	10,547	325,131	Italy	144	6,756
Mozambique	426	33,232	Mexico	412	13,311
			United Kingdom	17	3,000
Total	17,417	587,819	Total	941	35,750
1951			1951		
Australia	57	507			
British East Africa [1]	8,081	395,374	Argentina	106	12,000
India	10,370	339,437	Canada	523	18,474
Mozambique	1,062	72,366	Chile	15	510
United Kingdom	[2]	148	France	93	4,395
			Mexico	242	7,921
			Switzerland	11	462
Total	19,570	807,832	Total	990	43,762

[1] Includes 548 tons, $17,060 credited by the U. S. Department of Commerce to Union of South Africa.
[2] Less than 0.5 ton.

Synthetic Mullite.—Before World War II most of the kyanite-mullite refractories were made using imported Indian kyanite as the main constituent. However, since the end of the war changing political and economic conditions and the uncertainty of obtaining high-grade material have increased the demand for natural high-grade domestic aluminum silicate minerals or synthetic mullite except electrocast refractories. Although natural aluminum silicates are found in the Southeastern States, the intermountain area, the Southwest, and in the Pacific Coast States, most of the deposits are undeveloped, of low grade, inaccessible, or disadvantageously located with respect to consuming areas. Only 2 properties, 1 in Virginia and 1 in South Carolina, operated in 1951. Neither deposit contains material comparable to massive Indian kyanite.

The meager prospecting and exploration through 1951 indicated the improbability of locating adequate domestic sources of massive mullite-forming minerals. Concentrates obtained from disseminated ores can be used directly to produce many types of refractories, including high-temperature cements, and after pelletization can replace massive kyanite for some uses.

The development of synthetic mullite appeared to offer the best means for future fulfillment of needs being served by imported massive kyanite. The cost of mullite grain produced by sintering low-iron siliceous bauxite is comparable to mullite produced from first quality, imported kyanite. Mullite grain produced by the fusion process is of much higher quality than that produced by sintering and is used in certain applications even though it is much higher in price than any other mullite grain.

The Bureau of Mines Electrotechnical Laboratory at Norris, Tenn., continued to check kyanite and mullite materials offered for National stockpile purchasing and evaluated similar materials from private industry to determine their acceptability as substitutes for imported kyanite.

LITHIUM [5]

At present the four most important sources of lithium are the minerals spodumene, lepidolite, and amblygonite, which are recovered only from pegmatites, and the compound dilithium-sodium phosphate recovered from brine. Petalite is used in small quantities in certain ceramics. Zinnwaldite and triphylite-lithiophilite have been utilized but are limited in quantity available and low in lithium content.

The structure of pegmatites and its relation to exploration, development, and mining were discussed.[6]

During World War II military requirements pushed domestic production of lithium minerals and compounds to record levels. When Government contracts were canceled at the end of 1944, many producers were left with excess capacity, and at that time other markets of comparable size were not available. A few mines were put in standby condition, and others were abandoned. During the next few years the remaining producers intensified their research and market development programs. As a result, important new uses were developed, and the market for lithium minerals and compounds in such applications as glass, ceramics, and lubricants had greatly increased by the end of 1951. The lithium industry had expanded rapidly, and further expansions were underway.

TABLE 5.—Shipments of lithium ores and compounds from mines in the United States, 1935–39 (average) and 1947–51

Year	Ore (short tons)	Value	Li_2O (short tons)	Year	Ore (short tons)	Value	Li_2O (short tons)
1935–39 (average)	1,327	$48,280	88	1949	4,838	$345,970	475
1947	2,441	151,113	199	1950	9,306	579,922	747
1948	3,881	210,792	291	1951	12,897	[1] 896,000	956

[1] Partly estimated.

The properties of lithium minerals and their occurrence, production, and relation to research on thermonuclear reactions were described in an article.[7]

Production.—A number of firms reported production of lithium ores and compounds in 1951: American Potash & Chemical Corp., 3030 West 6th St., Los Angeles 54, Calif., recovered dilithium-sodium phosphate from the brine of Searles Lake, Calif. This material was processed in its plant at Trona on the edge of the lake. The raw brine contained only a trace of lithium, which was precipitated in the main plant cycle as dilithium-sodium phosphate and recovered by flotation.

[5] Prepared by J. C. Arundale.
[6] Jahns, Richard H., Geology, Mining, and Uses of Strategic Pegmatites: Trans. Am. Inst. Min. and Met. Eng., vol. 190, No. 1, January 1951, pp. 45–59.
[7] De Ment, Jack, Hunting Lithium for Hydrogen Bomb: Mineralogist, vol. 19, No. 9, September 1951, pp. 379–385, 402, 404, 406, 408.

In the fall of 1951, Foote Mineral Co., 18 West Chelten Ave., Philadelphia 44, Pa., began production of spodumene from extensive deposits in the vicinity of Kings Mountain, N. C. Most of this material was processed into lithium compounds at the firm's plant at Exton, Pa. Some was sold in mineral form, principally for use in ceramics.

Lithium Corp. of America, Rand Tower, Minneapolis, Minn., produced spodumene from the Edison mine in the Black Hills of South Dakota. The material was concentrated by the sink-float method and shipped to the firm's subsidiary, Metalloy Corp., near Minneapolis, for conversion to lithium compounds and metal.

Maywood Chemical Works, Maywood, N. J., recovered spodumene from the Etta mine in Pennington County, S. Dak. This operation was both underground and open pit, and the spodumene was hand-picked from the mined ore. Spodumene was converted to lithium compounds and metal at Maywood, N. J.

Black Hills Keystone Corp., produced spodumene and small quantities of amblygonite from the Ingersoll mine near Keystone, S. Dak. George C. Bland reported production of spodumene from the Beecher Lode in Custer County, S. Dak. John Fisher produced a small tonnage of amblygonite from the Dike Lode in Keystone County, S. Dak. Shipments of spodumene by Earl Anderson were reported from Castle Hot Springs, Ariz.

Technology.—Experiments in refining lithium metal were described. Commercial lithium metal containing about 0.5 percent sodium was vaporized at low pressure and condensed to yield a metal containing as low as 0.001 percent sodium. Operating data were given and equipment was described.[8]

Prices.—Trade-journal quotations in 1951 of prices for lithium ores were as follows: Amblygonite, air-floated, carlots, $110 per ton; lepidolite, 4 percent Li_2O, powdered, carlots, $80 per ton; spodumene, per short ton unit of lithium oxide contained, $6–$8 on 6-percent grade. These prices were all nominal.

American Potash & Chemical Corp. continued to offer dilithium-sodium phosphate at about $9 per unit of Li_2O.

Mozambique.—The Empresa Miniera do Alto Ligonha, S. A. R. L., leading beryl producer in Mozambique, reported the recovery of an appreciable amount of lepidolite in the hand-mining and sorting operations that produce the beryl, and the company stated that this lepidolite output could amount to over 250 tons monthly. An average analysis of the lepidolite was reported by the company to be as follows:[9]

	Percent
Li_2O	4.8
Al_2O_3	14.2
SiO_2	40.6
$Na_2O \cdot K_2O$	39.6
Total	99.2

[8] Rogers, R. R., and Viens, G. E., Refining Lithium by Vaporization at Low Pressure: Canadian Min. and Met. Bull., vol. 44, No. 465, January 1951, pp. 15–20

[9] Bureau of Mines, Mineral Trade Notes: Vol. 33, No. 1, July 1951, p. 27.

Belgian Congo.—Spodumene was a newcomer to the tabulated mineral exports from Belgian Congo. The statistics of production are not available, but this mineral occurs as an important constituent of the Manono and Kitotolo pegmatites where Geomines is mining tin, and the first exports, totaling 5,200 metric tons valued at fr.8,034, were made in the first quarter of 1951. Reportedly these exports went to Belgium.[10]

TABLE 6.—Lithium minerals produced in South-West Africa, 1948–51, in short tons [1]

Mineral	1948	1949	1950	1951
Amblygonite	176	130	292	578
Lepidolite	1,361	895	9,318	11,090
Petalite	179	133	180	174
Total	1,716	1,158	9,790	11,842

[1] Union of South Africa, Department of Mines, Industrial Minerals Quart. Inf. Circ., 1951.

MEERSCHAUM [11]

Meerschaum, or the mineral sepiolite, is a soft, fine-grained, earthy material used principally for making pipes and other smokers' articles. There has been a small, sporadic production in the United States, but virtually all the world supply for many years has come from Turkey. Imports from that source have increased steadily since 1947.

TABLE 7.—Meerschaum imported for consumption in the United States, 1946–51 [1]

[U. S. Department of Commerce]

Year	Pounds	Value	Year	Pounds	Value
1946	14,469	$21,785	1949	5,844	$13,897
1947	5,758	10,534	1950	9,621	18,549
1948	3,000	10,070	1951	11,289	13,384

[1] 1946–49 and 1951, all from Turkey; 1950: Italy: 20 pounds, $120; Turkey: 9,601 pounds, $18,429.

MINERAL-EARTH PIGMENTS [12]

Production.—Demand for mineral-earth pigments declined slightly in 1951, and sales of most products were lower than in 1950. Sales of mineral-earth pigments totaled 126,000 short tons valued at $14,987,000, approximately 2.2 percent less than that reported in 1950, as shown in table 8. Natural mineral-earth pigments accounted for 65 percent of the total tonnage sold in 1951. Red oxides represented 50 percent of the natural pigments sales, and yellow oxides represented 10.2 percent. Sales of synthetic pigments totaled 44,769 short tons or 35 percent of the total sales of mineral-earth pigments. Pure red oxides (98 percent or better Fe_2O_3) represented 48 percent of the synthetic sales, and pure yellow oxides (85 percent or better Fe_2O_3) 31 percent.

[10] Bureau of Mines, Mineral Trade Notes: Vol. 33, No. 4, October 1951, p. 35.
[11] Prepared by J. C. Arundale.
[12] Prepared by R. D. Thomson.

During the year, a survey was begun to study supply and demand and other problems of the pigment industry. Mineral-earth pigments was one of the groups included in this study.[13]

TABLE 8.—Natural mineral pigments and manufactured iron-oxide pigments sold by processors in the United States, 1950–51, by kinds

Pigment	1950		1951	
	Short tons	Value	Short tons	Value
Mineral blacks	20,615	$345,492	17,247	$342,013
Precipitated magnetic blacks	1,994	458,518	2,010	479,930
Natural brown oxides (metallic browns)	7,923	458,030	7,710	494,317
Vandyke brown (finished pigment)	209	39,901	150	29,102
Pure browns (96 percent or better iron oxides)	1,258	320,514	1,072	273,661
Natural red oxides	19,027	1,047,602	23,497	1,168,420
Pure red oxides (98 percent or better Fe_2O_3)	21,911	5,156,425	21,560	5,248,167
Venetian reds	5,721	528,287	4,910	490,295
Pyrite cinder	1,957	147,352	1,419	113,773
Other red iron oxides	18,012	2,265,249	17,096	2,230,449
Natural yellow oxides (high Fe_2O_3)	5,437	125,626	6,178	142,321
Pure yellows (85 percent or better Fe_2O_3)	12,767	2,425,927	13,798	2,747,668
Ochers (low Fe_2O_3)	3,506	132,374	2,188	105,628
Siennas:				
Burnt	1,256	209,417	1,108	195,848
Not burnt	1,477	216,031	1,458	234,867
Umbers:				
Burnt	4,130	506,844	3,473	424,760
Not burnt	963	106,343	817	86,954
Other	1,093	272,850	741	178,902
Total	129,256	14,762,782	126,432	14,987,075

Prices.—According to the Oil, Paint, and Drug Reporter, prices were quoted as follows during December 1951 (in cents per pound, bags, works, carlots, unless otherwise noted):

Mineral black, 1.6–6.75.
Metallic oxide, brown, 3.75.
Sap brown, crystals, 12.
Sap brown, powdered, 13.
Sienna, burnt, 4.25–15.25.
Sienna, raw, 4.5–13.
Umber, burnt, American (bbl.), 6.
Umber, Turkey type, 6.25.
Vandyke, brown, (bbl.), 11.
Metallic red (bbl.), 2.5.
Natural red iron oxide, 5.75–9.25.
Persian Gulf oxide, 6.75–7.
Spanish oxide (bbl.), ex dock, 5.75.
Natural yellow iron oxide, 1.41–2.50.
Natural yellow iron oxide, French type, 4.5.
Natural yellow iron oxide, Peruvian type, 1.85–2.10.
Golden American yellow ocher, 1.25–2.75.
Synthetic black iron oxide, 11.75.
Synthetic brown iron oxide (l. c. l.), 13.
Synthetic red iron oxide, 12.25–12.50.
Special, high color, red iron oxide, 6.
Venetian reds, 3.50–5.25.
Synthetic yellow iron oxide, 10.

Foreign Trade.—Imports of mineral-earth pigments in 1951 totaled 14,000 short tons valued at $1,008,000, an increase of 53 percent in quantity and 72 percent in value compared with 1950, as shown in table 9. Synthetic iron-oxide pigments represented 38 percent of the total imports, natural iron-oxides 25 percent, and umbers, crude and refined, 25 percent.

Exports of ocher, sienna, umber, and other iron-oxide pigments, principally to Canada, totaled 4,652 short tons valued at $738,000—a decrease of 16 percent in quantity and an increase of 4 percent in value from the 1950 figures. Data for 1948–51 are shown in table 10.

[13] Chemical and Engineering News, vol. 29, No. 4, Jan. 22, 1951, p. 302.

TABLE 9.—Selected mineral pigments imported for consumption in the United States, 1948–51

[U. S. Department of Commerce]

Pigments	1948		1949		1950		1951	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Iron oxide pigments:								
Natural	1,967	$138,169	1,194	$94,343	2,803	$143,894	3,476	$160,015
Synthetic	705	112,363	767	120,281	2,220	294,017	5,303	643,918
Ocher, crude and refined	89	4,975	89	5,058	157	6,759	815	37,494
Siennas, crude and refined	251	22,064	211	16,567	474	33,433	779	62,421
Umber, crude and refined	1,695	45,130	1,758	47,730	3,259	88,168	3,457	93,761
Vandyke brown	222	20,198	118	11,757	261	18,562	174	10,765
Total	4,929	342,899	4,137	295,736	9,174	584,833	14,004	1,008,374

TABLE 10.—Dry ocher, sienna, umber, and other forms of iron oxide for paint exported from the United States, 1948–51, by country of destination

[U. S. Department of Commerce]

Country	1948		1949		1950		1951	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Argentina	9	$1,904	9	$2,549	(1)	$1,082	(1)	$600
Austria	2	494	37	9,354	41	10,274	6	1,548
Belgian Congo	7	773			6	856	9	1,839
Belgium-Luxembourg	631	123,070	201	39,467	85	15,035	39	9,859
Bolivia	1	560	21	7,555	2	900	25	8,819
Brazil	103	25,665	155	43,575	27	16,056	93	18,185
Canada	2,974	259,540	3,076	248,780	2,945	274,311	2,528	282,136
Chile	110	25,664	80	14,801			37	8,322
China	87	27,044	21	5,081	[2] 13	[2] 7,970		
Colombia	112	33,501	110	38,891	114	39,986	120	46,179
Cuba	269	50,643	298	41,395	284	54,724	294	61,885
Dominican Republic	19	3,699	19	5,159	18	4,566	29	8,302
France			24	8,132	17	8,646	17	10,874
Greece	135	24,539	75	18,158	14	2,657	7	2,279
Guatemala	38	9,952	35	14,294	53	13,955	49	13,180
Haiti	41	4,014	42	4,242	63	6,133	52	12,761
Hong Kong	62	15,400	77	20,210	5	1,295	2	702
India	88	59,611	2	634	27	10,099		
Israel and Palestine			4	1,049	3	773	17	4,783
Italy	71	20,713	118	33,614	51	12,754	37	5,197
Japan			1	1,064	18	4,450	17	4,186
Mexico	123	28,417	124	30,191	85	25,323	106	48,629
Netherlands	824	96,546	452	44,026	227	9,029	341	13,766
Netherlands Antilles	14	3,754	17	5,097	11	2,266	21	6,354
Panama	94	6,770	8	2,103	61	5,965	17	3,456
Peru	19	3,057	21	4,827	12	3,760	29	9,694
Philippines	62	11,919	132	23,169	85	17,729	93	24,362
Portugal	32	7,933	38	9,118	7	1,587	2	1,126
Sweden	11	2,887	7	2,058	5	1,341	24	5,276
Switzerland	56	12,059	34	3,733	3	801	27	7,496
Union of South Africa	94	25,672	121	32,746	82	20,776	127	36,635
United Kingdom	469	18,750	807	31,312	809	30,926	275	14,867
Uruguay	82	18,580			39	9,066	7	2,078
Venezuela	159	41,370	141	41,571	257	70,111	104	29,785
Other countries	131	37,227	136	38,919	94	26,488	101	33,006
Total	6,929	1,001,727	6,443	826,874	[2] 5,563	[2] 711,690	4,652	738,166

[1] Less than 0.5 ton.
[2] Revised figure.

MINERAL WOOL [14]

The total value of mineral wool produced in the United States during 1951 from rock, slag, and glass was $134,128,000, compared with $115,664,000 (revised figure) in 1950 and $93,023,000 in 1949, according to the Bureau of the Census. Latest use statistics available are for 1947 and were published on page 1362 of Minerals Yearbook 1948. The average number of persons employed by the mineral-wool industry during 1951 was 10,374 compared with 9,244 in 1950 and 7,544 in 1949. Of the number reported in 1951, 8,583 were production workers.

Exports of mineral wool products from the United States during 1951 were valued at $1,511,486 compared with $1,132,454 in 1950.

Experiments showed the value of old slag piles as a source of raw material for mineral-wool manufacture.[15]

Materials for mineral-wool manufacture was the subject of a recent investigation by the Bureau of Mines.[16] Insulation of pellet-type rock-wool insulation [17] and use of mineral-wool insulation on steam turbines and boilers were described in technical magazines.[18]

OLIVINE [19]

In 1951 sales of olivine increased 115 percent in tonnage and 127 percent in value over 1950.

The same firms reported production in 1951 as reported in 1950: Harbison-Walker Refractories Co., Farmers Bank Building, Pittsburgh, Pa., from its Addie quarry near Addie, N. C.; The United Feldspar & Minerals Corp., Spruce Pine, N. C., from its Wray mine near Green Mountain, N. C.; and The H. P. Scheel Co. from its Big Slide mine, near Sedro-Woolley, Wash. Olivine is used in production of refractory brick, shapes, and high-temperature cements.

TABLE 11.—Olivine sold or used by producers in the United States, 1946–51

Year	Short tons	Value	Year	Short tons	Value
1946	7,649	$92,868	1949	3,528	$56,850
1947	10,838	129,094	1950 [1]	4,103	59,402
1948	4,766	86,230	1951	8,816	134,892

[1] Revised figures.

PERLITE [20]

Production of expanded perlite, a material virtually unknown on a commercial basis before World War II, was 33 times greater in 1951 than in 1946. Total output of expanded perlite in 1951 reached

[14] Prepared by H. P. Chandler.
[15] Engineering and Mining Journal, vol. 152, No. 2, February 1951, pp. 157–158.
[16] Gorski, C. H., White, O. D., and Moreland, M. L., Materials for the Mineral-Wool Industry: Bureau of Mines Rept. of Investigations 4821, 1951, 8 pp.
[17] James, P. E., and Davis, C. P., Jr., Method of Installing Pellet-Type (Rock Wool) Insulation: Refrig. Eng., vol. 59, No. 6, June 1951, p. 562.
[18] Power Engineering, How to Apply (Mineral Wool) Insulation on Steam Turbines: Vol. 55, No. 9, September 1951, pp. 76–77.
World Oil, Reclaimable (Mineral-Wool) Cement Insulates Boilers: Vol. 132, No. 7, June 1951, p. 120.
[19] Prepared by B. L. Gunsallus.
[20] Prepared by O. S. North.

134,000 short tons, and the quantity of expanded perlite sold or used was 133,000 short tons valued at $7,243,000. The quantity of crude rock sold or used by producers was 182,000 short tons valued at $810,000. The difference between the quantity of crude sold or used at own plant and the quantity of expanded material sold was accounted for by losses in transit, unexpandable material in the furnace feed, unsalable fines produced, stocks in transit or in storage, and the loss of moisture weight during furnacing.

In 1951 active mines were located in 7 Western States, with deposits in Nevada, New Mexico, and Colorado furnishing 88 percent of the total requirements of crude rock.

TABLE 12.—Crude and expanded perlite produced and sold or used by producers in the United States, 1947–51

Year	Crude perlite					Expanded perlite		
	Produced (short tons)	Sold		Used at own plant to make expanded material		Produced (short tons)	Sold	
		Short tons	Value	Short tons	Value		Short tons	Value
1947	10,500	550	$3,000	9,900	$55,000	9,700	7,700	$271,000
1948	22,200	4,400	29,000	17,700	105,000	21,200	18,600	742,000
1949	71,500	27,300	193,000	43,800	317,000	58,100	52,200	2,385,000
1950	110,694	59,802	411,205	41,734	237,957	88,892	86,962	4,741,383
1951	182,260	138,205	615,853	43,383	194,118	134,479	133,175	7,243,298

In 1951 perlite-processing plants were located in 27 States throughout the United States. California led in number of plants with 11, followed by Illinois and Texas with 5 each, and Pennsylvania and Utah with 4 each. There were 1 or 2 plants in each of 22 other States. Some 10 or 12 additional plants were reported to be under construction. As shown in table 13, the largest quantity of expanded perlite was produced and sold by firms in California; large tonnages were also produced and sold in Pennsylvania, Illinois, New Jersey, Oregon, Ohio, and Texas.

TABLE 13.—Expanded perlite produced and sold by producers in the United States, 1950–51, by States

State	1950				1951			
	Produced (short tons)	Sold			Produced (short tons)	Sold		
		Short tons	Value	Average per ton		Short tons	Value	Average per ton
California	20,363	20,179	$1,088,879	$53.96	25,850	25,648	$1,481,428	$57.76
Illinois	11,690	11,690	694,000	59.37	11,978	11,967	692,073	57.83
Pennsylvania	3,743	3,653	237,000	64.88	12,446	12,389	757,060	61.11
Texas	2,314	2,185	106,323	48.66	9,044	8,698	423,730	48.72
Other Western States [1]	27,698	26,481	1,121,530	42.35	32,640	32,584	1,467,831	45.05
Other Eastern States [2]	23,084	22,774	1,493,651	65.59	42,521	41,889	2,421,176	57.80
Total	88,892	86,962	4,741,383	54.52	134,479	133,175	7,243,298	54.39

[1] Includes Arizona, Arkansas, Colorado, Iowa (1951 only), Kansas, Louisiana, Minnesota, Missouri, Nevada, New Mexico, Oklahoma, Oregon, and Utah.
[2] Includes Indiana, Maryland (1951 only), Michigan, New Jersey, New York, North Carolina, Ohio, Tennessee, Virginia, and Wisconsin.

F. E. Schundler & Co., Inc., Joliet, Ill., completed its new perlite mill at Antonito, Colo. Raw perlite is mined from a deposit in the No Agua Mountains of northern New Mexico, a short distance from the mill. The rated capacity of the plant is 25 tons per hour of crushed, sized, and dried perlite, which was to be shipped to Schundler furnaces in Joliet and Long Island City, N. Y., for processing . Other outlets are in Metuchen, N. J., and West Des Moines, Iowa. This operation was described in detail in the nonmetallics trade press.[21]

Napa Perlite Co., San Francisco, Calif., began mining and crushing perlite on the Holt ranch, near St. Helena, Napa County, Calif.[22] Reserves of crude perlite on this property were said to be about 5 million tons.[23]

Another company, Perlite Aggregates, Inc., was reportedly mining and processing perlite in Conn Valley, near St. Helena, Calif. The deposit being mined was estimated to contain 125 million tons of crude rock. The expanded product was sold for use in plaster and stucco work in the San Francisco area.[24]

The operation of the Florence, Colo., mill of AleXitE Engineering Division, Alexander Film Co., Colorado Springs, Colo., was described in an article. The plant uses crude perlite from deposits near Rosita, which have been in production for several years.[25]

The two major domestic producers of crude perlite, Combined Metals Reduction Co., and Great Lakes Carbon Corp., operated during the year on their deposits at Pioche, Nev., and Socorro, N. Mex. respectively.

The discovery of extensive deposits of perlite near Cordelia, Solano County, Calif., was reported.[26]

A new perlite furnace, which uses the air-flow method of processing, was put on the market.[27] Three patents covering perlite furnaces were issued by the United States Patent Office. One is a bottom-fired, bottom-fed vertical unit,[28] whereas the second is a bottom-fired, side-fed vertical kiln.[29] Both of these furnaces were reported to be in use commercially. A third patent supplemented one issued in 1950.[30]

The press itemized perlite-processing plant developments in Arkansas,[31] Florida,[32] Texas,[33] and Wisconsin.[34] Other articles reviewed processing plant practices of Panacalite Perlite, Inc., Kansas City, Kans.,[35] and Utco Products Co., Salt Lake City, Utah.[36]

The mine value of crude perlite (crushed and sized) averaged $4.46

[21] Rock Products, Excavating and Processing Perlite: Vol. 54, No. 11, November 1951, pp. 62-63. Pit and Quarry, Schundler Mining Perlite from 8,900-ft.-High Bed in New Mexico Mountains: Vol. 44, No. 5, November 1951, pp. 117-119.
[22] Pit and Quarry, Precision Sizing Accomplished by New Separator at Napa Perlite: Vol. 44, No. 5, November 1951, p. 113.
[23] Pit and Quarry, vol. 43, No. 9, March 1951, p. 66.
[24] Utley, H. F., "Retired" Californian Operates 2,000-Bag-Per-Day Perlite Plant: Pit and Quarry, vol. 43, No. 10, April 1951, pp. 76, 100.
[25] Taylor, C. W., Processing Perlite Ore for Expansion: Rock Prod., vol. 54, No. 10, October 1951, pp. 138, 140.
[26] Mining World, vol. 13, No. 6, May 1951, p. 69.
[27] Rock Products, vol. 54, No. 1, January 1951, p. 80.
[28] Hammond, H., Apparatus for Treating Perlite Ore: U. S. Patent 2,536,742, Jan. 2, 1951.
[29] Howle, E. O., and others (secondary patentees assignors to E. O. Howle), Apparatus for Expanding Perlite and the Like: U. S. Patent 2,572,484, Oct. 23, 1951.
[30] Stafford, W. L., and others (assigned to Johns-Manville Corp.), Furnace for Heat-Expanding Perlite: U. S. Patent 2,550,877, May 1, 1951.
[31] Rock Products, vol. 54, No. 10, October 1951, p. 87.
[32] Work cited in footnote 22, p. 74.
[33] Pit and Quarry, vol. 43, No. 8, February 1951, pp. 49, 81; vol. 44, No. 5, November 1951, p. 80.
[34] Pit and Quarry, vol. 43, No. 8, February 1951, p. 64. Rock Products, vol. 54, No. 5, May 1951, p. 112.
[35] Brown, T., Kansas City Perlite Expanding Plant: Rock Prod., vol. 54, No. 6, June 1951, pp. 116-117.
[36] Utley, H. F., Utco Products Co. Processing Perlite at Salt Lake City: Pit and Quarry, vol. 43, No. 12, June 1951, pp. 95-96.

per short ton in 1951 compared to $6.39 in 1950. This apparent decline was largely due to the practice of assigning low book values to the crude material used by the same firm mining the material. At most perlite mines the price for sized perlite, f. o. b. cars, was between $6.50 and $9.00 per short ton, depending on specifications. The average value of expanded perlite in 1951 was $54.39 per short ton—slightly lower than the $54.52 shown for 1950. In general, the average values increased in the western States and declined in the eastern States.

The Perlite Institute sponsored fire and sound transmission tests on different units of construction;[37] conducted research on perlite concrete mix ratios,[38] strength,[39] thermal conductivity, and the like; published a news periodical, The Perlite Torch; and engaged in other activities in behalf of this growing industry.

Probably 75 percent of the expanded material produced during 1951 was used as a lightweight aggregate in hardwall and fireproofing plasters. About 20 percent was estimated to have been used as aggregate in the production of lightweight concretes,[40] principally poured-concrete roof decks and floor slabs, but increasingly as reinforced backup concrete cast on sheet steel or aluminum to produce large structural panels. Perlite was used as an aggregate for exterior cement stucco work and curtain walls,[41] as a drill mud additive (covered by an applicable patent),[42] in the manufacture of a partition tile,[43] and as a filler in paints, plastics, etc.[44] A patent was issued describing its use as an aggregate with a thermoplastic binder in the production of insulating products.[45]

Miscellaneous applications include: Loose fill; filtration medium; refractory brick; roofing tile; soil conditioner; and numerous lesser special purposes that utilize its light weight, insulating qualities, inertness, or other physical characteristics.

RADIO-GRADE QUARTZ [46]

Orders in 1951 for frequency control units for military communications caused a sharp increase in the consumption of radio-grade quartz and in the number of quartz piezoelectric units produced.

Total imports of uncut quartz crystal increased more than fourfold over 1950. Based on industry advices and interpolation from official Brazilian export statistics, it was estimated that about 66 percent (850,000 pounds) of the total imports was of radio- and optical-grade, and the balance (about 437,000 pounds) was of fusing grade. All of the fusing-grade and over 97.5 percent of the radio-grade quartz crystal imports were from Brazil. Small quantities of radio-grade quartz were imported from France, Japan, Madagascar, and Angola.

[37] Concrete, vol. 59, No. 11, November 1951, p. 9.
[38] Engineering News-Record, vol. 147, No. 11, Sept. 13, 1951, p. 42.
[39] Concrete, vol. 59, No. 9, September 1951, p. 46.
[40] Tellefsen, O., Lightweight Concrete Developments: Pit and Quarry, vol. 44, No. 1, July 1951, pp. 231–233.
[41] Engineering News-Record, vol. 146, No. 12, Mar. 22, 1951, p. 23.
Pit and Quarry, vol. 43, No. 9, March 1951, p. 190;
Rock Products, vol. 54, No. 4, April 1951, p. 101.
[42] Rock Products, vol. 54, No. 7, July 1951, p. 85.
Sidwell, C. V., Well Drilling: U. S. Patent 2,561,075, July 17, 1951.
[43] Nordberg, B., Packaged Central Mixing Plant: Rock Prod., vol. 58, No. 8, August 1951, pp. 225–228, 238.
[44] Chemical Engineering, vol. 58, No. 6, June 1951, p. 172.
[45] Watts, V. E. (assigned to Zonolite Co.), Porous Aggregate Mixes: U. S. Patent 2,565,107, Aug. 21, 1951.
[46] Prepared by W. F. Dietrich.

The imports from France probably originated in Madagascar, and those from Japan doubtless were surplus stocks from various sources.

Domestic production of radio-grade quartz crystal continued to be negligible. Considerable interest was aroused by the discovery of radio-grade quartz crystal on the Goshute Indian Reservation, Juab County, Utah. The Emergency Procurement Service of General Services Administration contracted for the entire output of the property for 12 months for the National Stockpile, but, after a small pocket of good-quality crystal was mined, production ceased.

The average number of finished piezoelectric units produced per pound of radio-grade quartz, as reported by consumers to the Bureau of Mines, was 11.7 in 1951, compared with 14.1 in 1950 and a peak of 20.3 in 1949. The relatively low yield in 1950 and 1951 was attributed to more rigid military specifications, higher losses during a period of transition to new types of units, and a continuing trend toward the use of smaller crystals from which a fewer number of units per pound of crystal could be cut. The optimum crystal weight for the production of the major part of the units in demand was about 250 grams, compared with 400–500 grams a few years before. Manufacturers used substantial quantities of crystals in the 50- to 100-gram weight range. The small sizes generally are selected on an "eye-clear" basis without further tests for twinning and flaws before slicing into wafers.

The declared value at port of export of the total imports of uncut quartz crystal in 1951 averaged $1.62 per pound, compared with $2.55 per pound in 1950. The value of the radio-grade quartz crystal imports after deducting the estimated quantity and value of fusing-grade quartz (about $0.10 per pound) averaged about $2.40 per pound in 1951 and $3.20 per pound in 1950. The decline in declared value in 1951 reflected the above-mentioned trend toward the use of smaller sizes, rather than changes in the price schedule. In May 1951 the declared value of 80 to 100 gram Brazilian eye-clear faced crystals, f. a. s. port of export, was $0.77 per pound. Faced crystals, 60 to 100 percent usability, 201/300 grams were valued at $4.36 per pound, 301/500 grams at $7.09 per pound, and 501/700 grams at $11.16 per pound.

The Signal Corps continued to sponsor research and pilot-plant work on quartz crystal syntheses and related problems. The Brush Development Co., Cleveland, Ohio, and Bell Telephone Laboratories, Inc., Murray Hill, N. J., both reported significant progress in the hydrothermal synthesis of quartz crystal in autoclaves operated above the critical point of water. The Brush Development Co. reported that pressures of 6,000 p. s. i. at 350° C. were being used.[47] Several articles were published in 1950 and 1951 on various aspects of synthetic quartz crystal growth,[48] as well as a treatise [49] on the principles of crystal growth.

[47] Chemical and Engineering News, Methods of Producing Synthetic Quartz Crystals Discussed: Vol. 28, No. 47, Nov. 20, 1950, p. 4082.

[48] Brown, C. S., Kell, R. C., Thomas, L. A., Wooster, Nora, and Wooster, W. A., Growth of Large Crystals: Nature, vol. 167, 1951, pp. 940–941.
Hale, Danforth R., Hydrothermal Synthesis of Quartz Crystals: Ceram. Age, vol. 56, No. 5, 1950, pp. 22–24.
Walker, A. C., Growing Piezoelectric Crystals: Ceram. Age, vol. 56, No. 5, 1950, p. 19.
Walker, A. C., and Buehler, E., Growing Large Quartz Crystals: Ind. & Eng. Chem., vol. 42, No. 7, 1950, pp. 1369-75.
Zerfoss, Samuel, Notes on the Growth of Single Crystals from the Melt: Ceram. Age, vol. 56, No. 5, 1950, p. 20.

[49] Buckley, W. E., Crystal Growth: John Wiley & Sons, Inc., New York, 1951, 571 pp.

Revised National Stockpile Material Purchase Specifications P–43 for raw quartz crystals for optical and electronic use were issued on September 12, 1951, superseding the issue of June 6, 1950. The most important revision was the lowering of the acceptable usability factor of 100/200 gram crystals from 80 percent for the class formerly designated as S8 to 60-percent usability for the new class L6. Another important change was a decrease in the acceptable minimum area of faced 100/200 gram crystals from ¾ square inch to ¼ square inch. Definitions were clarified, and some changes were made in inspection practices.

TABLE 14.—Imports of uncut quartz crystal, consumption of radio-grade quartz, and production of piezoelectric units in the United States, 1947–51

Year	Imports of uncut quartz crystal [1]		Consumption of radio-grade quartz (pounds)	Production of piezoelectric units [2] (number)
	Pounds	Value		
1947	473,788	$1,815,468	68,100	1,052,400
1948	1,238,820	4,209,531	61,600	1,225,400
1949	319,631	1,462,018	46,200	937,100
1950	310,251	791,412	114,300	1,614,000
1951	1,287,045	2,088,761	282,300	3,290,000

[1] Includes optical-grade quartz used in production of optical instruments.
[2] Includes oscillators, resonators, and other piezoelectric units.

STRONTIUM [50]

No domestic production of strontium minerals had been reported, except possibly sample lots, since 1946. However, it was reported that W. E. Caldwell and George Waterman were planning to explore and mine a deposit of strontium minerals on Fidalgo Island in Puget Sound.[51]

Before 1914 most of the available strontium compounds were produced in Germany. However, during World War I, when German supplies were not available, the United States established domestic facilities for processing ore imported from the United Kingdom. Domestic production of strontium minerals had been sporadic. In the past, some celestite had been mined in Texas for use as a weighting agent in well-drilling muds. Very little had been used for this purpose since the end of World War II.

In 1951 nearly all the strontium minerals consumed in the United States consisted of celestite imported from the United Kingdom and Mexico.

The bulk of the strontium minerals consumed is converted to various chemical compounds. These compounds burn with a characteristic brilliant red flame, and this property is utilized in several pyrotechnical applications—tracer bullets, fireworks, railway and truck fuzees, military flares, and rockets.

In the United States three firms convert strontium minerals into compounds: E. I. du Pont de Nemours & Co., Wilmington, Del.; Foote Mineral Co., Philadelphia, Pa.; and Barium Products, Ltd., Modesto, Calif.

[50] Prepared by J. C. Arundale.
[51] Western Industry, vol. 16, No. 6, June 1951, p. 93.

TABLE 15.—Strontium minerals [1] imported for consumption in the United States, 1949–51, by countries, in short tons

[U. S. Department of Commerce]

Country	1949		1950		1951	
	Short tons	Value	Short tons	Value	Short tons	Value
Canada	59	$788			38	$382
Mexico	1,158	14,690	1,975	$23,910	2,034	23,730
Spain	3,263	74,829				
United Kingdom	4,904	86,378	6,655	118,303	11,972	280,392
Total	9,384	176,685	8,630	142,213	14,044	304,504

[1] Strontianite or mineral strontium carbonate and celestite or mineral strontium sulfate.

Strontium metal is produced by King Laboratories, Inc., Syracuse, N. Y., and by Cooper Metallurgical Associates, Cleveland, Ohio. Only a very small quantity is made each year for use principally in removing traces of gases from electronic tubes. Metal Hydrides, Inc., Beverly, Mass., produces strontium hydride on a small scale.

The role of strontium compounds in enameling was described in an article.[52]

Prices.—Nominal prices quoted occasionally during the year for strontium minerals were as follows: Celestite, 92 percent $SrSO_4$, finely powdered, carlots, about $54 per ton; strontianite, minimum 84 to 86 percent $SrCO_3$, lump, carlots, about $55 per ton.

VERMICULITE [53]

The name vermiculite is applied to a group of micaceous minerals that expand or exfoliate to many times their original thickness when heated. It is a very lightweight product for which many industrial uses have been developed.

Production.—Sales of screened and cleaned vermiculite produced in the United States during 1951 showed a slight increase in tonnage and a decrease in value from the previous year.

TABLE 16.—Screened and cleaned vermiculite sold or used by producers in the United States, 1944–51

Year	Short tons	Value	Year	Short tons	Value
1944	54,116	$541,744	1948	138,635	$1,387,233
1945	64,808	648,077	1949	168,819	1,686,419
1946	86,390	867,973	1950	208,096	2,122,427
1947	131,385	1,338,572	1951	209,008	2,093,953

Montana, where production on a commercial scale had been carried on since 1921, continued to be the principal vermiculite-producing State. Near Libby, in Lincoln County, the Zonolite Co. had developed a large deposit.[54] South Carolina was second in order of

[52] Ceramic Industry, vol. 56, No. 2, February 1951, p. 49.

[53] Prepared by H. P. Chandler.

[54] Utley, H. F., From Remote Mountain Mine to World Wide Market: Pit and Quarry, vol. 44, No. 6, December 1951, pp. 78–82.
Rock Products, Mining Vermiculite for National Distribution: Vol. 54, No. 9, September 1951, pp. 64–66.

vermiculite production; several deposits near Travelers Rest in Greenville County are being mined. Production was also reported from North Carolina and Wyoming.

Exfoliation.—Commercial exfoliation of vermiculite is accomplished by passing a graded material through one of the several types of kilns in use. Exfoliation is produced most successfully at temperatures between 1,600° and 2,000° F. The charge is subjected to heat 4 to 8 seconds, followed by rapid cooling, which imparts pliability and toughness to the expanded particles, prevents the scorching or burning of containers, and permits manual handling. The increase in volume, owing to exfoliation, varies from 6 to 20 times that of the unexpanded material. In 1951 some 50 vermiculite exfoliation plants were operating in the United States.

Assuming an average price of $80 a ton for exfoliated material and a 5 percent loss in weight in the exfoliating process, the value of exfoliated and other vermiculite sold in the United States during 1951 would approximate 16 million dollars.

Uses.—Its low bulk density, comparatively high refractoriness, low thermal conductivity, and chemical inertness make vermiculite satisfactory for many types of thermal and acoustic insulation. One of its larger commercial uses is as an aggregate in lightweight concrete, and in the manufacture of prefabricated building units.[55]

Vermiculite aggregate finds an application in hardwall plaster because of its acoustic, thermal-insulating, and fire-resistant qualities; also as a plaster for fireproofing roofs, floors, columns, and steel beams.[56]

Refractory insulation, both in the form of loose vermiculite fill and vermiculite brick, is used in furnaces and kilns.[57]

Its use as a soil conditioner and in hot beds for sprouting seedlings and starting flowers is increasing. A study was made of the qualities imparted to soils by the addition of exfoliated vermiculite.[58]

Unexfoliated vermiculite has a few minor uses, such as when circulated in drilling muds "delaminated" vermiculite is said to assist in sealing off porous formations, thereby lessening the loss of the mud.

Prices.—Domestic screened and cleaned vermiculite in 1951 averaged about $10 a short ton, f. o. b. mines, whereas quotations on South African crude averaged $13.83 a ton, f. o. b. South African shipping points, and some $30 a ton, c. i. f. United States Atlantic ports.

The wholesale price of exfoliated vermiculite continued to average $80 a short ton during 1951. Price to jobbers was usually between 80 cents and $1.10 a 4-cubic foot paper bag, which usually weighed between 24 and 32 pounds. Different grades of exfoliated material sold at slightly different prices.

Africa.—Numerous deposits of vermiculite are known to exist in northern and eastern Transvaal, the largest being in the Palabora

[55] Concrete Products, Precast Lightweight Concrete Planks: Vol. 54, No. 9, September 1951, pp. 127, 140.
[56] Concrete, Zonolite Announces 4-Hour Fire Ratings for Vermiculite Uses: Vol. 59, No. 6, June 1951, pp. 32–33.
Concrete Products, Ready Mixed Insulating Concrete: Vol. 54, No. 2, February 1951, pp. 152–153.
Rock Products, Simulated Marble from Vermiculite Plaster: Vol. 54, No. 4, April 1951, p. 83; Producing Vermiculite Aggregate: Vol. 54, No. 12, December 1951, pp. 96–98.
[57] Weber, G., Gun-Applied (Vermiculite) Furnace Insulation: Oil and Gas Jour., vol. 50, No. 29, Nov. 22, 1951, pp. 60–61.
[58] Bureau of Mines, Mineral Trade Notes: Vol. 32, No. 3, March 1951, pp. 53–59.
Science News Letter, Vermiculite Filling: Vol. 59, No. 17, Apr. 28, 1951, p. 272.

area, some 200 miles by rail from the nearest shipping port of Lourenço Marques. No precise estimate of the reserves of vermiculite in the Palabora area was obtainable in 1951, but it was believed that there are several million tons of marketable material available.[59]

Other Occurrences.—Several promising discoveries of vermiculite in Ontario were reported in the Canadian technical press.[60]

Occurrences of vermiculite were reported from Kenya, Tanganyika, and Nyasaland in Africa; India; Queensland, South Australia; Western Australia; Argentina; Brazil; Japan; and the U. S. S. R.

WOLLASTONITE [61]

Production and sales of a small tonnage of wollastonite were reported from the deposit near Willsboro, N. Y., by the Willsboro Mining Co. Godfrey L. Cabot, Inc., 77 Franklin St., Boston, Mass., acquired this property and took possession late in 1951. Small shipments were made for enamel frit and various ceramic uses. Shipments were made for experimental market development to manufacturers of paint, rubber, plastics, tile, and for metallurgical flux.

Investigation of a ceramic body containing wollastonite, clay, and barium compounds showed a low electrical loss factor.[62]

Formulas for wollastonite bodies and glazes that gave low shrinkage and freedom from crazing and shivering were reviewed.[63]

[59] Department of Mines, Union of South Africa, Quarterly Information Circular, Statistical and Other Data on Industrial Minerals: January–March 1951, pp. 42–59.
[60] Canadian Chemistry and Process Industries, vol. 35, No. 3, March 1951, p. 174; Canadian Mining and Metallurgical Bull., vol. 44, No. 465, January 1951; Northern Miner (Toronto, Ontario), vol. 36, No. 44, Jan. 25, 1951, pp. 1, 16.
[61] Prepared by J. C. Arundale.
[62] Snyder, N. H., Wollastonite Bodies as Low-Loss Dielectrics: Ceram. Bull., vol. 30, No. 3, 1951, p. 108
[63] Jackson, W. M., One-Fire Wollastonite Tile Bodies: Ceram. Bull., vol. 30, No. 3, 1951, p. 107.

PART III. STATE REVIEWS

The Mineral Industry of Alaska

By Alfred L. Ransome and William H. Kerns

GENERAL SUMMARY

GOLD continued to be the commodity having the greatest value of output in Alaska in 1951, but a 17-percent decrease in production marked a return to the general downward trend that has characterized the industry since 1947. Despite this decline, the overall value of mineral production gained from $17,852,000 in 1950 to $19,569,000 in 1951, chiefly because of a record tonnage of coal mined (which ranked second in value of production) and a large output of sand and gravel. The mining of platinum continued to be an important factor in the mineral industry, and the production of crude platinum-group metals exceeded that for 1950. Silver output dropped to two-thirds of the total for 1950, and no copper, lead, or zinc was produced. Production of antimony was higher than in 1950, and shipments of ore mined during the year were greater than at any time since 1943. Output of tin was slightly less than in 1950, but the value increased.

TABLE 1.—Mineral production of Alaska, 1949–51

Mineral	1949		1950		1951	
	Quantity	Value	Quantity	Value	Quantity	Value
Antimony ore---short tons	74	$31,356			301	(1)
Coal, bituminous---do	433,533	3,309,303	412,455	$3,033,445	494,333	$3,766,987
Copper---do	4	1,576	6	2,496	[2] 1	387
Gold---troy ounces	229,416	8,029,560	289,272	10,124,520	239,637	8,387,295
Lead---short tons	51	16,116	149	40,230	[2] 21	7,266
Mercury---flasks (76 pounds)	100	7,946				
Sand and gravel---short tons	(1)	(1)	3,050,020	2,377,407	6,887,646	3,738,516
Silver---troy ounces	36,056	32,633	52,638	47,640	32,870	29,749
Tin (Sn content)---long tons	51	114,800	79	170,281	69	197,163
Tungsten (60-percent concentrates) (shipments)---short tons			13	(1)	10	(1)
Zinc---do	2	496	6	1,704	[2] 1	218
Undistributed [3]		4,005,086		2,054,735		3,441,090
Total		15,549,000		17,852,000		19,569,000

[1] Value included with "Undistributed."
[2] Produced in 1950, but not shipped until 1951 from a mine not active in 1951.
[3] Comprises value of pumice (1950–51), stone, platinum-group metals, and minerals whose value must be concealed for particular years (indicated in appropriate column by footnote reference 1).

Although gold mining continued to maintain its position in 1951 as the backbone of the mining industry in Alaska, the situation was becoming increasingly precarious. There was little doubt that if the

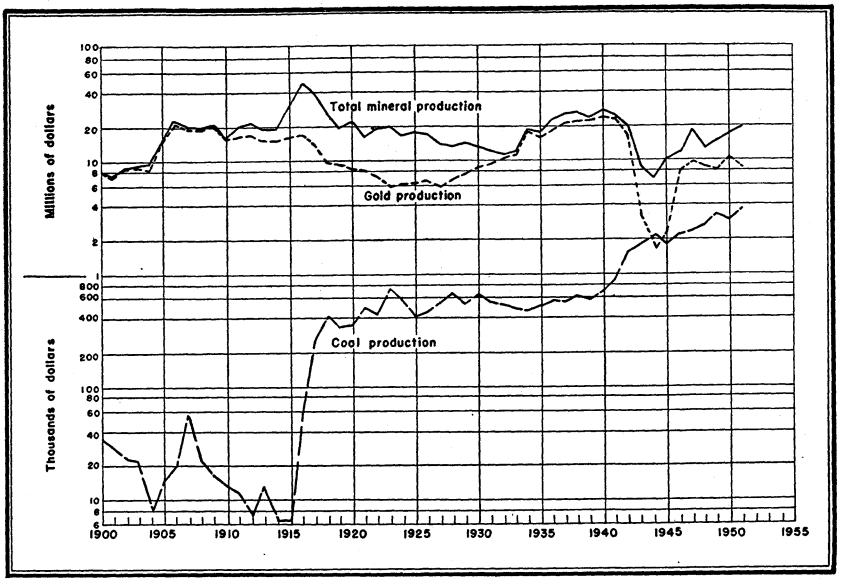

FIGURE. 1.—Value of gold and coal production and of total mineral production in Alaska, 1900–51. From 1911 to 1931 copper production accounted for most of the value of minerals other than gold and coal.

economic factors of high costs and an unchanged established United States Treasury price for gold of $35 per fine ounce continued—and no immediate change in conditions was indicated—the industry would soon relinquish its position as the leader in value of production. Coal, which was second in value of output in 1951, had been rapidly forging ahead as an important commodity; and, if 1951 trends continued as anticipated, it was expected that it would probably reach and might surpass gold as the commodity leader. Although sand and gravel ranked third to gold in 1951 as a value commodity, production had been variable and uncertain, depending upon the number and size of various projects in process of completion in Alaska calling for such materials as road metal for highway construction and aggregate for concrete structures (for civilian use and at military establishments).

Lode mining in the Territory continued to remain virtually at a standstill, with the still-minor exception of antimony and tin; and nonmetalliferous mining—other than coal and sand and gravel—was negligible. Noteworthy with respect to the Alaskan mineral industry was the renewed interest in the critical and strategic minerals during 1951. Although production was negligible or nil, as elsewhere noted, exploration activity and interest shown particularly with respect to chromite, mercury, and nickel (and cobalt) indicated a distinct possibility of active exploitation of these commodities. During 1951 three Government DMA exploration loans were made in Alaska on nickel and cobalt, tin, and tungsten properties; several additional applications for similar loans had been made by the end of the year; and one operating loan was granted for a lode-tin development.

GOLD, SILVER, COPPER, LEAD, AND ZINC

Data on production of gold, silver, copper, lead, and zinc in Alaska, by months in 1951, by years in 1947–51, and totals for 1880–1951, in terms of recoverable metal; the gold production at placer mines, by class of mine and method of recovery; mine production of gold, silver, copper, lead, and zinc, by regions; ore and old tailings sold or treated; and various metallurgical compilations based on output in 1951 are shown in tables 3 to 10, inclusive.

All tonnage figures are short tons and "dry weight"; that is they do not include moisture.

Yardage figures used in measuring material treated in placer operations represent "bank measure"; that is, the material is measured in the ground before treatment. Close control of bank measure is kept by operators of bucket-line dredges, but the quantity of material handled by other placer-mining methods in Alaska is largely estimated by the individual operators on the basis of the square feet of bedrock area worked and the average depth of gravel.

The value of gold, silver, copper, lead, and zinc production reported herein has been calculated at the prices shown in table 2.

TABLE 2.—Prices of gold, silver, copper, lead, and zinc, 1947–51

Year	Gold [1] (per fine ounce)	Silver [2] (per fine ounce)	Copper [3] (per pound)	Lead [3] (per pound)	Zinc [3] (per pound)
1947	$35.00	$0.905	$0.210	$0.144	$0.121
1948	35.00	.905+	.217	.179	.133
1949	35.00	.905+	.197	.158	.124
1950	35.00	.905+	.208	.135	.142
1951	35.00	.905+	.242	.173	.182

[1] Price under authority of Gold Reserve Act of Jan. 31, 1934.
[2] Treasury buying price for newly mined silver July 1, 1946, to date—$0.9050505 ($0.905 used in 1947 for calculating purposes).
[3] Yearly average weighted price of all grades of primary metal sold by producers. Price in 1947 includes bonus payments by Office of Metals Reserve for overquota production.

Gold.—The recorded production of gold in Alaska in 1951 was 17 percent below the output in 1950 and marked a return to the general downward trend that characterized the industry since the initial postwar upsurge that culminated in 1947. The surprising thing was that production was higher than might have been supposed, considering the adverse economic conditions under which the gold miners continued to operate. Higher-than-ever costs of supplies and equipment, scarcity of equipment and difficulty of obtaining replacement parts and more attractive wage rates offered by contractors connected with defense projects in areas adjacent together posed an almost insurmountable barrier to continued operation of many of the mines. The exceptions included those operations that could be classed as major producers (which, because of large investment in equipment requiring maintenance, have continued operating on a marginal profit or even at a slight loss) or those—large or small—that were fortunate enough to be mining ground rich enough to warrant continued exploitation despite such obstacles, coupled with an unchanged established price of $35 per fine ounce for gold. In 1951 only 6 operations classed

as lode-gold mines and 140 placer mines that produced gold were in operation compared with 11 and 216, respectively, in 1950, a startling drop of 36 percent in the total number of operations that produced gold, which had been the economic backbone of the Alaskan mining industry, almost without exception, since mining began there. It was expected that if conditions prevailing in 1951 continued, the downward trend in production of gold probably would be accelerated to the point where a limited output would reflect the work of but a handful of operators in business by virtue of being able to selectively mine a few high-grade deposits. In terms of the future economy of the Territory it was more than likely that the monetary-loss vacuum (in terms of dollar value of output) created by the drop in gold production would be filled—at least in part—by expanding developments of other mineral commodities, such as coal. However, the more serious economic aspect was the probability that marginal deposits of gold—which in the aggregate total many millions of dollars in potential reserves—would never be worked and thus could be considered to be permanently lost as a source of new wealth to the Territory.

The sale of unprocessed or "natural" gold by a few operators who hoped to gain by open-market transactions at prices exceeding $35 per fine ounce apparently was considerably greater in volume than in 1950. The recorded production for 1951 includes 18,082 fine ounces of gold contained in natural gold reported by 3 operators as having been sold on the open market and 825 ounces of gold that was probably sold as natural gold by 2 producers, but not specifically reported as such. One operator reported production of 900 ounces of natural gold, which was not sold. It is possible that some natural gold concerning which no information is available, was produced and sold; the quantities involved are believed to have been relatively small. An undetermined quantity of gold (possibly as much as several thousand ounces) reported sold in 1951—and included statistically in the record for the year—no doubt was produced in 1950, disposed of as natural gold or held speculatively and subsequently sold through the normal channels to the United States mints at the established United States Treasury price. Specific and accurate data regarding natural gold sales are not readily available, and the aforementioned figures giving the number of operators and quantities involved are incomplete. However, from these data it can be assumed that natural gold originating from Alaskan mines and sold in 1951 probably did not exceed 20,000 ounces. Information on prices received for open market sales was not available.

The unusual seasonal limitations to mining activity in Alaska, particularly with regard to placer operations, are indicated by the production of gold in 1951, by months, as shown in table 3. The data are based on mint and smelter receipts that have been adjusted to exclude 3,762 fine ounces of gold received during the first 4 months, which was credited to 1950 production, and to include 13,698 ounces received during the same period in 1952, which is a part of actual output in 1951. Also included and prorated for each month of the active mining season (May through October) was the 18,082 ounces of fine gold contained in natural gold reported sold and the 825 ounces probably sold, all of which did not appear as receipts at mints and

smelters. Production was probably somewhat less than shown during the last quarter of the year, particularly for December, but correspondingly higher for the period June through September, which represents the average season for greatest activity in mining in the Territory between the spring breakup or thaw and the fall freeze. The principal reason for the relatively high receipts at mints and smelters during the last 3 months is that numerous operators make their gold "cleanup" only once or twice during the active mining season; as a result, a substantial quantity of gold accumulated in the sluices over a period of several months is not recovered until late fall and often not reported as receipts at the mint or smelter until the following spring.

TABLE 3.—Mine production of gold, silver, copper, lead, and zinc in Alaska in 1951, by months, in terms of recoverable metal [1]

Month	Gold (fine ounces)	Silver (fine ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
January	278	64			
February [2]	82	1,766	1	21	1
March	311	81			
April	1,313	78			
May	7,779	1,159			
June	17,104	2,266			
July	32,965	4,072			
August	51,671	6,866			
September	48,543	6,181			
October	46,617	5,894			
November	18,175	2,496			
December	14,799	1,947			
Total	239,637	32,870	1	21	1

[1] Derived mostly from mint and smelter receipts; data are adjusted to exclude receipts during the first part of 1951 previously credited to 1950 production and to include receipts in 1952 that are a part of actual output in 1951.

[2] Includes 35 ounces of gold, 1,756 ounces of silver, 1 ton of copper, 21 tons of lead, and 1 ton of zinc actually mined in December 1950 but not shipped until 1951, from a mine not active in 1951.

The 15 leading gold-producing mines (all placer) in Alaska in 1951, listed in the accompaning tabulation, yielded 83 percent of the total recorded gold output of the Territory; the 5 leading producers (all using bucket-line dredges) supplied 67 percent. The Fairbanks district in the Yukon River Basin region and the Nome district in the Seward Peninsula region ranked first and second, respectively, in gold production in the Territory because of the bucket-line dredging operations of the United States Smelting, Refining & Mining Co.

Active mining at lode-gold mines in interior Alaska was limited to 1 mine, the Fern, in the Willow Creek district, operated by the Black Butte Mining Co., Inc. In Southeastern Alaska the LeRoy Mining Co. was active during the season at the Rainbow mine at Glacier Bay in the Juneau district. Small quantities of gold were recovered by reworking old tailings and mill cleanups at the Big Hurrah mine, Nome district, Seward Peninsula region; Gold Cord mine, Willow Creek district, Cook Inlet-Susitna region; and the Alaska Empire mine, Admiralty Island district, Chichagof mine, Chichagof Island district; and the Alaska Juneau mine, Juneau district, Southeastern Alaska region.

TABLE 4.—Fifteen leading gold-producing mines in Alaska in 1951, in order of output [1]

Rank	Mine	District	Region	Rank in 1950	Operator	Source of gold
1	Fairbanks unit	Fairbanks	Yukon River Basin.	1	United States Smelting, Refining & Mining Co.	Dredge.
2	Nome unit	Nome	Seward Peninsula	2	do	Do.
3	New York-Alaska Gold Dredging Corp.	Tuluksak-Aniak.	Kuskokwim	3	New York-Alaska Gold Dredging Corp.	Do.
4	Callahan Zinc-Lead	Tolovana	Yukon River Basin.	(2)	Callahan Zinc-Lead Co.	Do.
5	Brinker-Johnson Co.	Fairbanks	do	4	Brinker-Johnson Co.	Do.
6	Casa de Paga Gold Co.	Fairhaven	Seward Peninsula	7	Casa de Paga Gold Co.	Do.
7	Gold Placers, Inc.	Circle	Yukon River Basin.	11	Gold Placers, Inc.	Do.
8	Strandberg & Sons	Hughes	do	9	Strandberg & Sons	Placer.
9	do	McGrath	Kuskokwim	17	do	Dredge.
10	Colorado Creek Mining Co.	Innoko	Yukon River Basin.	12	Colorado Creek Mining Co.	Placer.
11	Alder Creek Mining Co.	Fairbanks	do	10	Alder Creek Mining Co.	Do.
12	Uotila and Hard	Innoko	do	45	Uotila and Hard	Do.
13	C. J. Berry Dredging Co.	Circle	do	6	C.J. Berry Dredging Co.	Dredge.
14	Innoko Dredging Co.	Innoko	do	8	Innoko Dredging Co.	Do.
15	Mohawk Association	Iditarod	do	14	North American Dredging Co.	Do.

[1] Based on known output, including "natural" gold sales in cases where fine gold content was calculable.
[2] Did not produce in 1950.

TABLE 5.—Mine production of gold, silver, copper, lead, and zinc in Alaska, 1947–51, and total, 1880–1951, in terms of recoverable metal [1]

Year	Mines producing		Material sold or treated [2] (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1947	19	260	13,891	279,988	$9,799,580	66,150	$59,866
1948	24	274	6,014	248,395	8,693,825	67,341	60,947
1949	18	223	78,839	229,416	8,029,560	36,056	32,633
1950	11	216	58,668	289,272	10,124,520	52,638	47,640
1951 [3]	6	140	[4] 13,870	239,637	8,387,295	32,870	29,749
1880–1951			([5])	27,370,136	670,969,362	20,045,353	14,312,426

Year	Copper		Lead		Zinc		Total value
	Short tons	Value	Short tons	Value	Short tons	Value	
1947	12	$5,040	264	$76,032	25	$6,050	$9,946,568
1948	16	6,944	329	117,782	22	5,852	8,885,350
1949	4	1,576	51	16,116	2	496	8,080,381
1950	6	2,496	149	40,230	6	1,704	10,216,590
1951	1	387	21	7,266	1	218	8,424,915
1880–1951	685,905	226,580,307	25,740	3,032,059	56	14,320	914,908,474

[1] Includes recoverable metal content of gravel washed (placer operations), ore milled, old tailings or slimes re-treated, and ore shipped to smelters during calendar year indicated.
[2] Does not include gravel washed.
[3] "Mines producing" includes all and only those mines known to have produced in 1951, for some of which no production data are included since such data are not available. However, 1951 production figures include a small amount of production known to have occurred in prior years.
[4] Excludes quantity of ore (included in 1950 figure) from which a small tonnage of concentrate shipped in 1951 was produced, recoverable content of which concentrate is included in 1951 production of metals shown.
[5] Figure not available.

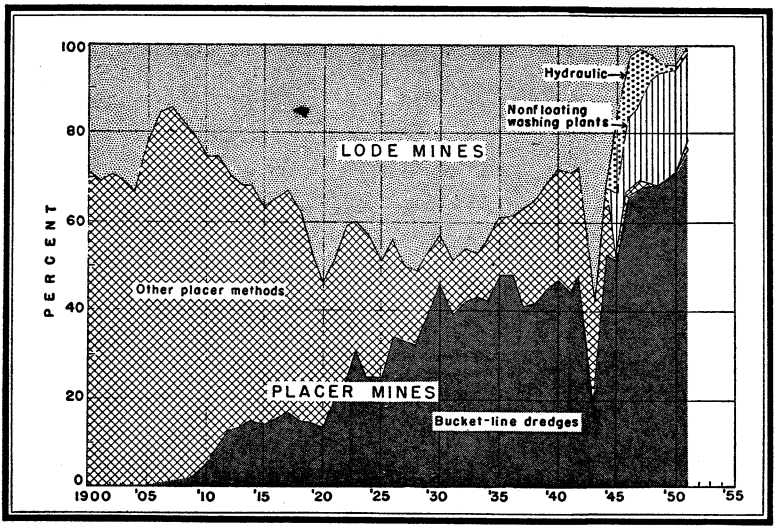

FIGURE 2.—Percentage of total Alaska gold produced at lode and placer mines and by various methods of placer mining, 1900–51; "other placer methods" includes hydraulic and nonfloating washing plants for which separate data are not available before 1943.

Silver.—The 32,870 fine ounces of silver credited to 1951 production (a 38-percent decrease from 1950) was almost entirely the byproduct of gold mining (95 percent); the remainder was lead ore. The most important producer of silver in Alaska in 1951 was the United States Smelting, Refining & Mining Co., which recovered silver as a byproduct of bucket-line dredging operations in the Fairbanks and Nome districts. The Riverside mine, a substantial producer of silver as a byproduct from lead ore in 1950, did not operate during 1951. The small percentage of silver from lead ore credited to 1951 came from this property; the material was produced in 1950 but not shipped until 1951.

Copper, Lead, and Zinc.—There was no production of any of the base metals (copper, lead, and zinc) in Alaska in 1951. The relatively minor output credited to 1951 came from ore produced at the Riverside mine near Hyder in Southeastern Alaska in 1950 but not shipped until 1951; the mine was inactive during 1951. In the Nizina district, Copper River region, extensive prospecting was in progress on the Nelson and Radovan copper claims near McCarthy during 1951. An investigation of Kasna Creek copper prospect, Bristol Bay region, by the Bureau of Mines was described in a report published in 1951.[1]

[1] Warfield, R. S., and Rutledge, F. A., Investigation of Kasna Creek Copper Prospect, Lake Kontrashibuna, Lake Clark Region, Alaska: Bureau of Mines Rept. of Investigations 4828, 1951, 10 pp.

TABLE 6.—Gold produced at placer mines in Alaska, 1947–51, by class of mine and by method of recovery

Class and method	Mines producing[1]	Washing plants	Material treated (cubic yards)	Gold recovered		
				Fine ounces	Value	Average value per cubic yard
Surface placers:						
Gravel mechanically handled:						
Bucket-line dredges:						
1947	22	28	$8,395,000	188,800	$6,608,000	$0.787
1948	23	31	11,300,000	171,161	5,990,635	.530
1949	21	29	14,663,000	157,306	5,505,710	.375
1950	20	28	12,557,000	205,641	7,197,435	.573
1951	15	23	14,560,000	187,216	6,552,560	.450
Dragline dredges:						
1947	2	2	148,000	3,715	130,025	.879
1948–51						
Nonfloating washing plants:[2]						
1947	75	75	2,905,000	45,990	1,609,650	.554
1948	106	106	4,170,000	56,076	1,962,660	.471
1949	117	117	3,392,000	57,979	2,029,265	.598
1950	116	116	4,908,500	68,199	2,386,965	.486
1951	84	84	2,667,000	47,244	1,653,540	.620
Gravel hydraulically handled:						
1947	114		2,371,000	36,769	1,286,915	.543
1948	82		1,220,000	14,493	507,255	.416
1949	33		252,500	5,087	178,045	.705
1950	24		135,300	2,097	73,395	.542
1951	17		166,500	2,798	97,930	.588
Small-scale hand methods (wet):						
1947	44		46,600	1,121	39,235	.842
1948	59		53,300	984	34,440	.646
1949	50		55,330	693	24,255	.438
1950	50		18,000	905	31,675	1.760
1951	20		17,000	1,026	35,910	2.112
Underground placers (drift):						
1947	3		400	48	1,680	4.200
1948	4		700	88	3,080	4.400
1949	2		170	24	840	4.941
1950	6		2,200	269	9,415	4.280
1951	4		500	243	8,505	17.010
Grand total placers:						
1947	260		13,866,000	276,443	9,675,505	.698
1948	274		16,744,000	242,802	8,498,070	.508
1949	223		18,363,000	221,089	7,738,115	.421
1950	216		17,621,000	277,111	9,698,885	.550
1951	140		17,411,000	238,527	8,348,445	.479

[1] Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.
[2] Includes all placer operations using power excavator and washing plant, both on dry land; when washing plant is movable, outfit is termed "dry-land dredge."

TABLE 7.—Mine production of gold, silver, copper, lead, and zinc in Alaska in 1951, by regions, in terms of recoverable metal[1]

Region	Mines producing		Gold (lode and placer)		Silver (lode and placer)		Total value
	Lode	Placer	Fine ounces	Value	Fine ounces	Value	
Cook Inlet-Susitna	2	7	847	$29,645	103	$93	$29,738
Copper River		4	712	24,920	67	60	24,980
Kuskokwim		9	20,051	701,785	1,722	1,559	703,344
Northwestern Alaska and Seward Peninsula[2]		29	60,298	2,110,430	6,773	6,130	2,116,560
Southeastern Alaska	4		601	21,035	1,971	1,784	[3] 30,690
Yukon River Basin		91	157,128	5,499,480	22,234	20,123	5,519,603
Total	6	140	239,637	8,387,295	32,870	29,749	[3] 8,424,915

[1] "Mines producing" includes all and only those mines known to have produced in 1951, for some of which no production data are included since such data are not available. However, production figures include a small amount of production known to have occurred in prior years.
[2] Combined to avoid disclosure of individual company operations.
[3] Includes value of 1 short ton of copper ($387), 21 tons of lead ($7,266), and 1 ton of zinc ($218).

MINING INDUSTRY

Bucket-line dredges (23 in 1951 compared with 28 in 1950) washed 84 percent of the total gravel mined for gold in Alaska in 1951 and recovered 78.5 percent of the placer gold, and 78 percent of the total gold (lode and placer). Placer mining produced 99.5 percent of the total gold output in Alaska in 1951 (96 percent in 1950). No dragline dredges (which include all operations using a floating washing plant and a dragline excavator) were reported in operation during 1951. Several so-called dry-land dredges (which include a power excavator and movable mechanical washing plant, both of which are on dry land) were operated at widely separated localities in the Territory during the year. Placer operations using combinations of bulldozer and hydraulic methods—in many cases supplemented with dragline equipment—were less in number than in 1950, but the mining method employed continued to be the preferred one in the Territory. In general, the gold-bearing material is bulldozed from the cut to the sluice boxes (or sluice plate, at the head of the sluice box, on which the gravel is dumped or pushed) and then washed through by the use of a hydraulic giant or other means of directing and controlling the flow of water. In many cases where the supply of water is unsufficient, it is utilized in a closed-circuit system, with a settling pond downstream below the sluices and a pump for return of the water. Dragline equipment—when used—is generally employed for disposing of tailing and in some cases for transporting gravel to elevated sluice boxes or washing plants. Occasionally draglines or bulldozers are used for removing overburden, but by far the greatest proportion of the overburden, in the form of frozen "muck," is washed off with hydraulic giants. The automatic hydraulic giant—"Intelligiant"—recently developed and first used during 1950, has been continually improved and has been found particularly useful in some areas under certain conditions for the purpose of disposing of frozen overburden. In 1951, combination methods of placer mining, in which gravel was moved by mechanical means to the washing plant or sluice box (classified as nonfloating washing plants), washed 15 percent of the total gravel mined and recovered 20 percent of the placer gold, a 46-percent decrease in gravel handled and a 31-percent decline in gold recovered compared with 1950; 84 such operations were active in 1951 (116 in 1950). Operations in which gold was recovered primarily by hydraulic methods (excluding hydraulic stripping of overburden) again showed a decrease in the number of mines, but the quantity of gravel washed and gold recovered increased 23 and 33 percent, respectively, above comparable totals for 1950. Gold output from a smaller number of small-scale hand operations increased 13 percent over 1950. Four drift mines produced only a small quantity of gold in 1951, but available reported data indicate that the average value per cubic yard of the ground worked by drifting was substantially higher than usual in 1951. The total yardage of gravel washed at gold placer mines decreased only 1 percent, whereas the gold recovered was 14 percent less than in 1950. The average recoverable gold content of gravel decreased 13 percent.

Activity at lode mines (gold, silver, copper, lead, and zinc) in Alaska in 1951 was conspicuous by its absence. Of the 6 operations included in the lode classification, only 2 actively mined and milled ore. The tonnage of material from lode-gold mines (no base-metal mines were operated) in Alaska treated in 1951 was 77 percent less than in 1950. The output of lode gold dropped 91 percent to the point where the total of 1,110 fine ounces recovered from the active lode mines, tailings re-treated at inactive mines, and mill cleanups comprised only 0.5 percent of the Territory total (lode and placer).

ORE CLASSIFICATION

All 13,870 tons of lode material (including 450 tons of ore and 13,420 tons of old tailing) sold or treated in 1951 was classed as dry gold ore. Definitions used in ore classification are given in the Gold and Silver chapter of this volume.

TABLE 8.—Mine production of gold, silver, copper, lead, and zinc in Alaska in 1951, by class of ore or other source material, in terms of recoverable metal

Source	Number of mines [1]	Material sold or treated (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Ore:							
Dry gold	4	[2] 450	601	128			
Lead		([3])	36	1,783	1,600	42,000	1,200
Other "lode" material: Old tailings [4]	2	13,420	473	111			
Total "lode" material	6	[5] 13,870	1,110	2,022	1,600	42,000	1,200
Gravel (placer operations)	140		238,527	30,848			
Total, all sources	146	[5] 13,870	239,637	32,870	1,600	42,000	1,200

[1] "Number of mines" includes all and only those mines known to have produced in 1951, for some of which no production data are included since such data are not available. However, production figures include a small amount of production known to have occurred in prior years.
[2] Does not include ore from which 115 ounces of gold and 64 ounces of silver were recovered.
[3] Ore reported in previous year, concentrates shipped in 1951.
[4] Dry gold.
[5] Excludes ore indicated in footnotes 2 and 3.

METALLURGICAL INDUSTRY

All the total ore and old tailings handled during 1951 was treated at mills (with or without concentrating equipment); no ore was shipped for direct smelting. Of the lode gold produced, 58 percent was recovered by amalgamation and 6 percent by cyanidation, largely from the re-treatment of tailings at inactive mines. Smelters in the United States received only 100 tons of concentrates (30 tons gravity, and 70 tons flotation) for smelting from Alaska operations of mines producing gold and lead (with silver, copper, and zinc as by-products). One shipment of concentrate (containing the base metals and some silver) originated from lead ore produced at the Riverside mine near Hyder, Southeastern Alaska, in 1950 and reported in that year.

TABLE 9.—Mine production of gold, silver, copper, lead, and zinc in Alaska in 1951, by method of recovery and type of material processed, in terms of recoverable metal

Method of recovery and type of material processed	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Lode:					
Amalgamation:					
Ore	444	54			
Old tailings	204	37			
Total	648	91			
Cyanidation: Old tailings	69	10			
Total recoverable in bullion	717	101			
Concentration, and smelting of concentrates:					
Ore	193	1,857	1,600	42,000	1,200
Old tailings	200	64			
Total	393	1,921	1,600	42,000	1,200
Placer	238,527	30,848			
Grand total	239,637	32,870	1,600	42,000	1,200

TABLE 10.—Mine production of gold, silver, copper, lead, and zinc in Alaska in 1951, by method of recovery (except placer) and class of material processed, in terms of recoverable metal [1]

	Material treated (short tons)	Recoverable in bullion		Concentrate shipped to smelters [2] and recoverable metal					
		Gold (fine ounces)	Silver (fine ounces)	Concentrate (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
BY REGIONS									
Cook Inlet-Susitna	[3] 410	315	21	24	125	20			
Seward Peninsula	300	69	10						
Southeastern Alaska	[4] 13,160	333	70	76	268	1,901	1,600	42,000	1,200
Total: 1951	[5] 13,870	717	101	100	393	1,921	1,600	42,000	1,200
1950	58,668	9,993	1,011	664	2,168	13,112	12,000	298,000	12,000
BY CLASS OF MATERIAL TREATED									
Dry gold:									
Ore	[6] 450	444	37	31	157	74			
Old tailings	13,420	273	64	23	200	64			
Lead: Ore	([7])			46	36	1,783	1,600	42,000	1,200
Total 1951	[5] 13,870	717	101	100	393	1,921	1,600	42,000	1,200
BY CLASS OF CONCENTRATE SHIPPED TO SMELTERS [2]									
Dry gold				54	357	138			
Lead				46	36	1,783	1,600	42,000	1,200
Total: 1951				100	393	1,921	1,600	42,000	1,200
1950				664	2,168	13,112	12,000	298,000	12,000

[1] All material treated at mills; no ore shipped directly to smelters in 1951.
[2] Excludes concentrates treated only by amalgamation and/or cyanidation.
[3] Excludes ore from which 21 tons of concentrate shipped in 1951 was produced. This ore is included in figure for 1950.
[4] Excludes ore from which 47 tons of concentrate shipped in 1951 was produced. This ore is included in figure for 1950.
[5] Excludes ore indicated in footnotes 3 and 4.
[6] Excludes ore (included in figure for 1950) from which 22 tons of concentrate shipped in 1951 was produced.
[7] Ore included in figure for 1950; concentrate shipped in 1951.

TABLE 11.—Mine production of gold, silver, copper, lead, and zinc in Alaska in 1951, by method of recovery (except placer) and class of material processed, in terms of gross metal content

Class of material	Quantity shipped or treated (short tons)	Gross metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
CONCENTRATE SHIPPED TO SMELTERS						
Dry gold	54	357	138	610	540	
Lead	46	36	1,783	1,737	43,013	1,404
Total: 1951	100	393	1,921	2,347	43,553	1,404
1950	664	2,168	13,112	16,331	348,859	17,740

REVIEW BY REGIONS

COOK INLET-SUSITNA

Because 2 major producers ceased operations at the close of the 1950 season, the total value of gold output from the Cook Inlet-Susitna region for 1951 was only 7 percent of that for 1950. The Alaska Pacific Consolidated Mining Co. closed the Independence lode-gold mine on Fishhook Creek in the Willow Creek district in January 1951 after being active since late in the season of 1949. Collinsville Mines (dry-land dredge with dragline equipment) on Mills Creek, which had been the largest producer in the Yentna-Cache Creek district for the previous 3 years, was not operated during 1951.

The small quantity of gold produced in the Cook Inlet-Susitna region in 1951 was recovered from 2 lode operations in the Willow Creek district and 7 placer operations in the Yentna-Cache Creek district.

Willow Creek District.—The Black Butte Mining Co. operated the Fern mine on Archangel Creek (under lease from the Fern Gold Mining Co.) throughout 1951. From 210 tons of gold ore treated in the 50-ton mill on the property, 270 ounces of gold and 15 ounces of silver were recovered by amalgamation. Renshaw & Brown did annual assessment work at the Gold Cord mine on Fishhook Creek and operated the 20-ton amalgamation-flotation mill for 15 days during August 1951. From 50 tons of gold ore and 150 tons of tailing milled, 45 ounces of gold and 6 ounces of silver were recovered as bullion by amalgamation; in addition, 3 tons of concentrate (containing 20 ounces of gold, 1 ounce of silver, and 7 pounds of copper), produced by flotation, was shipped to a smelter in the United States.

Yentna-Cache Creek District.—The largest producer of gold in the Yentna-Cache Creek district in 1951 was Mike Trepte, who operated on Bird Creek (under lease from the Alaska Exploration & Mining Co.) and recovered a moderate quantity of gold and silver by hydraulicking. Several other operators recovered small quantities of gold by small-scale hand and hydraulic methods.

COPPER RIVER

Of the 4 mines reported producing during 1951 in the Copper River region, all were placer-gold operations, 2 in the Chistochina district and 2 in the Yakataga district. The largest producer in the region was the Mount Kimball Construction Co., which operated on Slate Creek in the Chistochina district and recovered a substantial quantity of gold by a hydraulic-dragscraper-bulldozer combination method. Two operators, Eugene and Harvey Cline and B. B. Watson, recovered a moderate quantity of gold from the Yakataga Beach in the Yakataga district by small-scale hand methods.

KUSKOKWIM

Eight placer-gold mines were reported producing in the Kuskokwim region in 1951, with a total value of gold output equal approximately to that of 1950. Four-fifths of the gold produced in the region was recovered from 5 operations in the Tuluksak-Aniak district; the remainder came from 2 operations in the McGrath district and 1 in the Goodnews Bay district.

Goodnews Bay District.—The Goodnews Bay Mining Co. produced a moderate quantity of gold as a byproduct from crude platinum mined on the Salmon River by bucket-line dredging and by a hydraulic-bulldozer-dragline combination.

McGrath District.—Strandberg & Sons operated a flume-type bucket-line dredge on Candle Creek and produced more gold in 1951 than in 1950. This was a remarkable record, considering the difficult conditions under which they were working. A Government contract in the vicinity with a higher wage scale than a gold-mining operation could pay made it impossible for this operation to hire enough men to strip the ground ahead of the dredge. This necessitated turning away from virgin ground and reworking old tailing that had been previously dredged.

Tuluksak-Aniak District.—The New York Alaska Gold Dredging Corp., the largest gold producer in the region and the third largest in the Territory in 1951, as in 1949 and 1950, operated 2 electrically powered floating bucket-line dredges—1 on California Creek equipped with eighty 6-cubic-foot buckets and 1 on the Tuluksak River equipped with sixty-five 1½-cubic-foot buckets. Taylor Creek Placers recovered a substantial quantity of gold using a dragline-bulldozer-hydraulic combination with nonfloating washing plant on Taylor Creek. Three other operations in the district, Canyon Creek Mining Co. on Canyon Creek, Donlin Placers on Snow Gulch, and Russell Schaefer on Forty-Seven Creek, recovered a moderate quantity of gold using bulldozer-hydraulic combinations with nonfloating washing plants.

TABLE 12.—Mine production of gold, silver, copper, lead, and zinc in Alaska in 1951, by region and district, in terms of recoverable metal

Region and district [1]	Mines producing [2]		Ore and old tailings (short tons)	Gold (fine ounces)			Silver [3] (lode and placer fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
	Lode	Placer		Lode	Placer	Total					
Cook Inlet-Susitna region:											
Valdez Creek		[4]			18	18	2				$632
Willow Creek	2		[5] 410	440		440	41				15,437
Yentna-Cache Creek		7			389	389	60				13,669
Copper River region: Nizina		[4]			5	5					175
Kuskokwim region: Tuluksak-Aniak		5			16,101	16,101	1,444				564,842
Seward Peninsula region:											
Fairhaven		5			8,589	8,589	1,004				301,524
Kougarok		8			2,375	2,375	237				83,340
Nome	[4]	8	300	69	46,465	46,534	5,199				1,633,395
Serpentine River		1			113	113	13				3,967
Southeastern Alaska region:											
Admiralty Island	1		25	110		110	25				3,873
Chichagof Island	1		100	151		151	38				5,319
Hyder			[6]	36		36	1,783	1,600	42,000	1,200	10,745
Juneau	2		13,035	294		294	80				10,362
Ketchikan			[6]	10		10	45				391
Yukon River Basin region:											
Circle		12			10,317	10,317	1,547				362,495
Fairbanks		11			100,073	100,073	14,829				3,515,976
Fortymile		8			2,968	2,968	590				104,414
Hot Springs		7			1,477	1,477	299				51,966
Iditarod		9			6,096	6,096	927				214,199
Innoko		10			13,983	13,983	1,881				491,107
Koyukuk		11			373	373	27				13,079
Marshall		1			315	315	42				11,063
Rampart		3			1,242	1,242	94				43,555
Ruby		6			2,236	2,236	464				78,680
Tolovana		5			11,458	11,458	1,050				401,980
Other districts [7]		23			13,934	13,934	1,149				488,730
Total Alaska	6	140	[8] 13,870	1,110	238,527	239,637	32,870	1,600	42,000	1,200	8,424,915

[1] Only those districts shown separately for which Bureau of Mines is at liberty to publish figures; others producing listed in footnote 7 and their output included with "Other districts."

[2] Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property. Includes all and only those mines known to have produced in 1951 for some of which no production data are included since such data are not available. However, production figures include a small amount of production known to have been made in prior years.

[3] Sources of total silver as follows: 2,022 ounces from lode mines, and 30,848 from placers.

[4] Property not active; production was before, but not reported until 1951.

[5] Excludes ore from which 105 ounces of gold and 19 ounces of silver were produced. This ore was reported in figures for 1950; concentrate was shipped in 1951.

[6] Ore reported in previous year; concentrate shipped in 1951.

[7] Includes the following districts for which quantities and values cannot be shown separately (number of operations in parenthesis): Chistochina (2) and Yakataga (2), Copper River region; Goodnews Bay (2) and McGrath (2), Kuskokwim region; Kiana (1) and Shungnak (1), Northwestern Alaska region; Council-Bluff (2), Koyuk (2), and Port Clarence (1), Seward Peninsula region; Bonnifield-Nenana (1), Chandalar (2), Eagle (2), Hughes (1), Kantishna (1), and Melozitna (1), Yukon River Basin region.

[8] Excludes ore indicated in footnotes 5 and 6.

NORTHWESTERN ALASKA

Only 2 mines reported producing gold in the Northwestern Alaska region in 1951; Helcolican Mines, Inc., on Klery Creek in the Kiana district, operated a flume-type floating bucket-line dredge equipped with fifty-four 3-cubic-foot buckets, and Tronstad & Goodwick on Dahl Creek in the Shungnak district recovered a small quantity of gold by hydraulicking.

SEWARD PENINSULA

One-quarter of the Alaska placer-gold output in 1951 came from the Seward Peninsula region. Seven floating bucket-line dredges were operated in the region during 1951, 5 less than in 1950. Surprisingly, the total gold output for the region for 1951 was only 10 percent less than for 1950. Two-thirds of the gold produced in the region in 1951 came from the Nome district, where 4 floating bucket-line dredges were in operation. Two floating bucket-line dredges were operated in the Fairhaven district and one in the Council-Bluff district. Twenty-three other mines reported producing gold in the region in 1951 using hydraulic giants, bulldozers, dragline excavators, and small scale hand tools, either separately or in combination.

Council-Bluff District.—The Alaska Placer Co. operated a bucket-line dredge equipped with sixty 3-cubic-foot buckets on the Niukluk River from June 12 to October 4, 1951. Sourdough Dredging Co., formerly a substantial producer of gold by bucket-line dredging, did not report any production during 1951. The history of the "Sourdough" dredge, formerly known as the "Wild Goose," and its 41 years of operation on Ophir Creek were given in an article published in 1951.[2]

Fairhaven District.—The Casa de Paga Gold Co., operating 2 bucket-line dredges on the Inmachuk River from June 1 to October 15, 1951, was the largest producer of gold in the Fairhaven district and second largest in the region. Ranking second as a producer of gold in the district, the Candle Creek Mining Co. recovered a substantial quantity of gold from Candle Creek, using a dragline-bulldozer-hydraulic combination. Bernard & Dahl Exploration Co. on Bear Creek recovered a moderate quantity of gold, using a bulldozer-hydraulic combination with nonfloating washing plant.

Kougarok District.—Because of the shutdown of 4 major operations in the Kougarok district, the total gold production for 1951 was only about one-third of the previous year's output. Kougarok Consolidated Placers, Inc., the largest producer of gold in the district in 1950 (using a dragline-bulldozer-hydraulic combination), was inactive during 1951 (its bucket-line dredge was not operated during either year). Three bucket-line dredges, which were operated in the district in 1950 by the Gold Dust Mining Co. on the Kougarok River, North Fork Dredging Co. on Harris Creek, and Tolbert Scott & Son on Iron Creek, were inactive during 1951. N. B. Tweet & Sons bulldozer-hydraulic combination operation on claims 6 and 7 below Johnson's Discovery, Mascot Gulch (under lease from M. J. Walsh), was the largest producer of gold in the district in 1951. This

[2] Mining World, Wild Goose Makes Trip No. 3: Vol. 13, No. 8, July 1951, pp. 20-21.

property was worked by Noonan and Whitmore in 1950. Atlas Mines (George J. Waldhelm), operating on Atlas Creek with a dragline-bulldozer-hydraulic combination, washed 4,380 cubic yards of gravel from June 1 to October 1, 1951, to recover 225 ounces of gold and 24 ounces of silver. Lyman H. Madden recovered 108 ounces of gold and 11 ounces of silver by using a bulldozer-hydraulic combination with nonfloating washing plant on Garfield Creek during 1951. Other producers of a moderate quantity of gold in the district in 1951—all using combinations of dragline-bulldozer-hydraulic equipment—were Patrick J. Bliss on claim 8 on Quartz Creek, Grant Mining Co. on Coffee Creek, Trinity Mining Co. (Kanari & Carey) on Trinity Creek, and Wirum Bros. on Dome Creek.

Koyuk District.—The major producer in the Koyuk district in 1951, as in 1950, was the J. E. Baldwin and C. T. Moon operation on the Right Fork of Sweepstake Creek, where a substantial quantity of gold was recovered using bulldozer-hydraulic equipment.

Nome District.—Two-thirds of the gold produced in the Seward Peninsula region in 1951 came from the Nome district, where 4 floating bucket-line dredges were in operation. The United States Smelting, Refining & Mining Co. (Nome unit), operating 3 of its fleet of 4 bucket-line dredges in the vicinity of Nome from May 15 to November 23, 1951, was the largest producer of gold in the Nome district and Seward Peninsula region and ranked second in the Territory in 1951. The three dredges operated are electrically powered and equipped with 134, 109, and 78 9-cubic-foot buckets. Lee Bros. Dredging Co., the second largest gold producer in the district in 1951, operated 1 of its 2 bucket-line dredges on the Solomon River from June 17 to November 13, 1951. The dredge operated is the flume type, diesel-powered, and equipped with seventy-five 5-cubic-foot buckets. Other smaller operations in the district in 1951 used various combinations of power excavators, hydraulic equipment, and hand tools to recover a small quantity of gold.

Port Clarence District.—A small quantity of gold was recovered in 1951 as a byproduct of tin placer mining on Buck Creek by the Northern Tin Co. using dragline-bulldozer-hydraulic equipment.

Serpentine River District.—George Bodis recovered 113 ounces of gold and 13 ounces of silver from 4,500 cubic yards of gravel washed on Dick Creek, using bulldozer-hydraulic equipment with a nonfloating washing plant.

SOUTHEASTERN ALASKA

Half of the total Alaska lode-gold output reported in 1951 came from 4 operations in the Admiralty Island, Chichagof Island, and Juneau districts of the Southeastern Alaska region. Of these operations, 3 were either mill cleanup or re-treatment of old tailing; the LeRoy Mining Co. operation at the Rainbow mine on Reid Inlet in Glacier Bay in the Juneau district was the only active mine. The total gold output from lode operations for 1951 in the Southeastern Alaska region was only one-sixth of that for 1950. No gold placers were reported active in the region in 1951. The Riverside mine in the Hyder district, which had been the only producer of lead (with a substantial quantity of copper and some zinc recovered as byproducts) in the Territory for a number of years, was not operated

in 1951. A shipment of lead concentrate from the Riverside mine to a smelter in the United States in 1951 was produced from ore mined in 1950.

Admiralty Island District.—A total of 110 ounces of gold and 25 ounces of silver was recovered in 1951 as bullion and from concentrates shipped to a smelter in the United States from treatment of old tailing and a mill cleanup at the Alaska Empire Gold Mining Co. lode mine at Hawk Inlet on Admiralty Island preparatory to installing a new mill equipment.

Chichagof Island District.—Hayes & Whitely Enterprises recovered 151 ounces of gold and 38 ounces of silver (as bullion from amalgamation, and from gravity concentrate shipped to a smelter in the United States) from treatment of 100 tons of old tailing from the Chichagof mine on Chichagof Island during 1951.

Juneau District.—The Alaska Juneau mine at Juneau remained inactive during 1951. Hayes & Whitely Enterprises re-treated 13,020 tons of old tailing and recovered 196 ounces of gold and 35 ounces of silver by amalgamation; 3 tons of gravity concentrate (containing 57 ounces of gold, 28 ounces of silver, 11 pounds of copper, and 465 pounds of lead) was shipped to a smelter in the United States. The LeRoy Mining Co. operated the Rainbow mine in Glacier Bay from June through September 1951, and treated 15 tons of gold ore in an 18-ton gravity-concentration mill on the property. Table concentrate was amalgamated to recover 41 ounces of gold and 17 ounces of silver. The LeRoy Mining Co. was dissolved following the termination of mining on this property at the close of the 1951 season.

YUKON RIVER BASIN

Ninety-one gold-placer-mine operators in 17 districts in the Yukon River Basin region produced 66 percent of the total Alaska gold output in 1951. Eleven bucket-line dredges operating in the Yukon River Basin supplied 74 percent of the placer gold produced in the region and 49 percent of the placer gold produced in the Territory. The Fairbanks district continued to be the most important placer-gold-producing area in the region, furnishing 42 percent of the total placer-gold output recorded in the Territory. No lode-gold operations were reported active in the region in 1951.

Circle District.—Two bucket-line dredges were active in the Circle district during 1951. Gold Placers Inc., operating its diesel-powered dredge (equipped with sixty 4-cubic-foot buckets) on Coal Creek from April 15 to October 15, and C. J. Berry Dredging Co. operating its diesel-powered dredge on Lower Mammoth Creek from June 14 to October 19 ranked first and second respectively, in total gold output in the Circle district in 1951. The P. R. & H. Mining Co. followed in third place; 2,063 ounces of gold and 456 ounces of silver were recovered from 80,000 cubic yards of gravel washed from June to October from Lower Deadwood Creek, using a bulldozer to deliver gravel to bedrock sluice boxes. The company reported this to be the last season's activity at this location. R. R. Wilkinson on Miller Creek produced a moderate quantity of gold, using a bulldozer-hydraulic combination method of mining. Eight other placer operations in the Circle district produced small quantities of gold, using hydraulic or bulldozer-hydraulic combination methods.

Eagle District.—The Yukon Placer Mining Co., using bulldozer equipment, operated on Fourth of July Creek in the Eagle district from April 20 to September 12, 1951, and recovered a substantial quantity of gold. The company did not plan to operate the property in 1952. B. F. Hansen on Alder Creek recovered a moderate quantity of gold using a bulldozer-hydraulic combination.

Fairbanks District.—The United States Smelting, Refining & Mining Co. (Fairbanks unit) operated 5 bucket-line dredges in the Fairbanks district in 1951 and—as in previous years—was by far the largest producer of gold, not only in the district but in the Territory. The electrically powered dredges included three 6-cubic-foot Bethlehem, one 10-cubic-foot Bethlehem, and one 10-cubic-foot Yuba. The dredges were located near Fairbanks on Cripple, Engineer, Little Eldorado, and Fairbanks Creeks and Gold Hill, a bench on the Left Limit of Ester Creek. The dredge operated on Eva Creek during the 1950 season was moved 1¼ miles through a prepared channel to the Gold Hill bench at the beginning of the 1951 season. Other than the dredges, the company used 197 J-Hendie No. 2 hydraulic giants and an electrically powered Bucyrus 10W 8–12 cubic-yard dragline to remove over 8 million cubic yards of overburden.

Brinker-Johnson Co., the second largest producer of gold in the Fairbanks district and third largest in the Yukon River Basin region in 1951, operated its Walter W. Johnson Co. diesel-powered bucket-line dredge on Caribou Creek from June 12 to October 31. It was reported that this company completed repayment of the Reconstruction Finance Corporation loan during the 1951 season.

Of the producers of gold from placer mines using combination of dragline, bulldozer, and hydraulic equipment in the Fairbanks district in 1951, the Alder Creek Mining Co. operation on Fairbanks Creek was the largest and ranked third in the district among all placer operations. From 133,330 cubic yards of gravel washed between May 15 and October 15, 3,230 ounces of gold and 476 ounces of silver were recovered. The Wolf Creek Mining Co. on Wolf Creek was the fourth largest producer of gold in the district in 1951. A bulldozer was used to dig and deliver gravel to a 1½-cubic-yard Bucyrus diesel-powered dragline, which in turn delivered it to an elevated sluice box. Other producers of smaller quantities of gold in the district using various combinations of dragline, bulldozer, and hydraulic equipment were Hassel & Sticha on Ready Bullion Creek, R. V. Watkins at Hope mine on Faith Creek, Helmer Johnson on Cleary Creek, N. O. Kupoff on Pedro Creek, E. L. Maurer on First Chance Creek, Wickstrom & Co. on Gilmore Creek, and Fred Wildt on Homestake Creek.

Fortymile District.—The total gold output from the Fortymile district in 1951 (only 58 percent of that for 1950) was reported produced from 8 operations. The Wade Creek Dredging Co. on Wade Creek ranked first in total gold output in the district in 1951. At the close of the 1951 season the company discontinued operations on this property, and it was stated that equipment was being moved into Canada because conditions are more favorable for placer mining. The Franklin Mining Co. operation (dragline-bulldozer-hydraulic) on claim 2 below Discovery on Chicken Creek from June 1 to September 15 ranked second in production of gold in the district in 1951.

Other operators in the district that recovered 100 ounces or more of gold from placers worked by various combinations of dragline-bulldozer-hydraulic equipment were (in order of output): Uhler Creek Mining Co. on Stonehouse Creek, Squaw Creek Mining Co. on Squaw Creek, William Meldrum on Chicken Creek, and Purdy Bros. on claim 2 on Myers Fork. Purdy Bros. recovered 155 ounces of gold and 26 ounces of silver from 1,116 cubic yards of gravel washed between June 1 and August 10, 1951.

Hot Springs District.—The two largest producers of gold reported in the Hot Springs district in 1951, both bulldozer-hydraulic operations, were Enstrom & McDougal on American Creek and A. W. Pringle on Rhode Island Creek. Enstrom & McDougal did not operate the American Creek property during the 1950 season. Peter Johnson on Glenn Gulch and Tony Lanning on Omega Creek each produced a small quantity of gold using bulldozer-hydraulic combinations with nonfloating washing plants. L. McGee purchased the property formerly owned and operated by Cleary Hill Mines Co. on Sullivan Creek and Tofty Gulch. Although a large part of the summer was spent on development work, a moderate quantity of gold was recovered, using bulldozer-dragline elevated sluice-box equipment. Larson & Berg recovered a small quantity of gold by deep drift mining on Woodchopper Creek.

Hughes District.—The only producer of gold reported active in the Hughes district in 1951 was the Strandberg & Sons operation on Indian River. A substantial quantity of gold was recovered using dragline-bulldozer equipment with a dry-land washing plant. As an example of one major factor that contributes to the high cost of mining in Alaska, diesel oil for the equipment was air-freighted from Tanana 80 miles to the Utopia Creek Airfield, then hauled by trailer and bulldozer from the field 8 miles to the property.

Iditarod District.—North American Dredging Co., the largest producer of gold in the Iditarod district in 1951, as it had been for the past 3 years, operated its diesel-powered bucket-line dredge equipped with seventy 3½-cubic-foot buckets on the Mohawk Association property on Otter Creek. Miscovich Bros. operation on Discovery claim on Otter Creek, using bulldozer, hydraulic lift, hoe shovel, and hydraulic equipment, was the second largest producer of gold in the district. Patrick Savage, on the Alpha Association ground on Flat Creek, recovered 931 ounces of gold and 115 ounces of silver from 50,000 cubic yards of gravel, using a dragline-bulldozer-hydraulic combination from May 2 to October 10, 1951. The Happy Placers (John Bouquier, owner), using bulldozer equipment, worked on Happy Creek from June 1 to October 6 and recovered 408 ounces of gold and 62 ounces of silver from 8,000 cubic yards of gravel. Other placer operations producing 100 ounces or more of gold in the district in 1951 were Gust Backstrom on Flat Creek, Hatton & Turner on Willow Creek, and Prince Creek Mining Co. on Prince Creek.

Innoko District.—The Colorado Creek Mining Co. operation on Colorado Creek (using dragline-bulldozer equipment) was the largest producer of gold in the Innoko district in 1951, and the Uotila and Hard operation on claims 2 and 3 above Upper Discovery on Ophir Creek (using dragline-bulldozer-hydraulic equipment) ranked second. The Innoko Dredging Co. operated a diesel-powered bucket-line dredge

(equipped with forty-five 3½-cubic foot buckets) on Ganes Creek from May 15 to October 23, 1951. During part of the year the dredge reworked old tailing that had been dredged previously. Rosander & Reed worked placer ground on Yankee Creek, using dragline-bulldozer-hydraulic equipment, from April 22 to October 10 and recovered 1,934 ounces of gold and 223 ounces of silver from 238,000 cubic yards of gravel. Other placer operations in the district in 1951 that produced substantial quantities of gold, using various combinations of dragline-bulldozer-hydraulic equipment, were J. A. Degnan Mining Co. on Lower Little Creek, Gurtler & Myklebust on Little Creek, Eric Hard on Cripple Creek, Hugh Matheson & Co. on Spruce Creek, and Victor Creek Mining Co. on Victor Creek.

Kantishna District.—Hosler Mines operated on Moose Creek at the mouth of Eureka Creek from June 15 through September 1, 1951, using bulldozer-hydraulic equipment.

Koyukuk District.—Total gold production from 11 placers in the Koyukuk district in 1951 was only 10 percent of the 1950 output. No one operation reported gold recovery over 100 ounces.

Marshall District.—Lars Ostnes operated on Willow Creek in the Marshall district during 1951, using dragline-bulldozer-hydraulic equipment, and reported recovery of 403 crude ounces of gold.

Melozitna District.—The Iditarod Operating Co. produced a substantial quantity of gold from Golden Creek in the Melozitna district in 1951, using bulldozer-hydraulic equipment.

Rampart District.—The major part of the gold output in the Rampart district in 1951 was produced by the Little Minook Mining Co. on Little Minook Creek, using dragline-bulldozer-hydraulic equipment. It was reported that 60,000 cubic yards of gravel was washed to recover 1,380 crude ounces of gold. Other placer-mine operations in the district in 1951 were Swanson Bros. on Hunter Creek and Pioneer Mining Co. on Hoosier Creek.

Ruby District.—The Miscovich Bros. operation on Flat Creek was the largest producer of gold in the Ruby district in 1951. Automatic giants (a type invented and developed by John Miscovich) were used for stripping overburden. Bulldozers were used for digging and delivering gravel to a sump, where it was hydraulically lifted to an elevated sluice box. Tailing was stacked with a dragline, slime and excess water being discharged to the drain by a hydraulic lift and pump. The Long Creek Mining Co. operation on claim 8 above Discovery and Boston Bench on Long Creek produced a substantial quantity of gold, using a dragline-bulldozer-hydraulic combination. Using the bulldozer-hydraulic mining method, the Granite Creek Mining Co. recovered a substantial quantity of gold from Ophir Creek. Leonard Zaiser operated a drift placer mine on Timber Creek.

Tolovana District.—The Callahan Zinc-Lead Co. operated a floating bucket-line dredge on Livengood Creek in the Tolovana district under a working agreement with the Reconstruction Finance Corporation from May 17 to October 17, 1951. The diesel-powered dredge is equipped with eighty-eight 6-cubic-foot buckets. Olive Creek Mines, using dragline-bulldozer-hydraulic equipment on Olive Creek, was the second largest producer of gold in the district in 1951. Other operators in the district, all producing 100 ounces or more of gold and using various combinations of dragline-bulldozer-hydraulic equipment

either together or separately, were Four A. Mining Co. on Sumner Creek, John Radak on Ruth Creek, and Warwick Mines on Gertrude Creek.

OTHER MINERALS

Antimony.—Considerable interest in antimony was shown in 1951, and shipments of ore mined during the year were higher than at any time since 1943. The marked increase over the 1950 output was due mainly to the activity of Alamco, Inc., of Fairbanks, which productively operated 2 properties under lease during the year, the Sawtooth Mining Co. Sawtooth mine near Rampart, and Sam Gamblin's Rambler mine on Boulder Creek in the Tok district, both in the Yukon River Basin region. The largest output in the Territory was from the Sawtooth mine. However, all of that mine's ore was still stockpiled at the end of the year, awaiting favorable conditions for freighting overland by tractor train to Livengood and hence by truck to the railhead at Fairbanks. Of the smaller quantity of lower grade ore mined from the Gamblin property, most was shipped to a smelter in the United States. Some development work was undertaken by Alamco at an antimony property at Smith Creek near Wiseman; a few tons of ore was mined but not shipped.

Earl R. Pilgrim & Co. again operated the Stampede mine in the Kantishna district, Yukon River Basin region. A substantial tonnage of 53-percent ore was freighted by plane to Nenana for transshipment to a smelter in the United States.

Coal.—Coal mining was rapidly becoming the most important phase of the mining industry in Alaska. In 1951 the mines in the Territory produced 494,333 short tons of bituminous and subbituminous coal compared with 412,455 tons in 1950 and thus established an alltime record that surpassed the previous 1949 record of 433,533 tons by 14 percent. It was expected that the annual value of output of coal would soon reach if not surpass gold if the 1951 upward trend in production was maintained, particularly if the decrease in gold-mining activity continued. As in 1950, the greatest proportion of the output came from 3 mines operated by the Healy River Coal Corp. and Usibelli Coal Mine, Inc. in the Nenana (Healy) field and the Evan Jones Coal Co. in the Matanuska field.

The Evan Jones Coal Co., the largest producer in the Matanuska field and also the Territory, completed construction of a heavy-medium coal-separation plant at the Jonesville mine during the year and experimented with new types of underground mechanized equipment. Also in the Matanuska field, but in the western part, a relatively small quantity of coal was mined from the old Premier mine, formerly a major producer. The Duck Flat Co. operated the Duck Flat strip mine (formerly known as the Houston strip mine) on the Alaska Railroad north of Wasilla during the latter half of 1951 and supplied a limited quantity of coal to the military bases in the Anchorage area. The Buffalo mine, which had operated for a brief time in 1950, was inactive during 1951. The Bureau of Mines continued its diamond-drilling project in 1951 in the Wishbone Hill area of the Matanuska field to determine the minable reserves of bituminous coal. Operations for the season were concluded on October 1 owing to the unusually early and severe freeze.

Usibelli Coal Mines, Inc., the largest producer of coal from the Nenana field and second largest in the Territory in 1951, operated its strip mine on the Healy River at a steadily increasing rate from March through December, supplying coal under military contract for use in the Tanana Valley area. Mining in the main pit continued on the No. 1 bed, but in addition some coal was produced from a new strip operation on the south side of the Healy River. Adjacent to the Usibelli property, the Healy River Coal Corp. operated its Suntrana mine continuously throughout the year. Coal from this mine, the only underground operation in the field, supplied the rapidly expanding civilian demand in and around the city of Fairbanks and the Tanana Valley area. The company also produced some coal from a strip operation on the property. The Cripple Creek Coal Co. operated its strip mine on Cripple Creek during the spring of 1951 and fulfilled a contract with the Army. After several months of inactivity, additional ground was stripped in the late fall and some coal mined.

The Homer Coal Corp. operated its mine at the lower end of the Kenai Peninsula in the Homer field during the first half of 1951 to supply the limited demand of the local market; only a small quantity of coal was produced. The Alaska Native Service continued to operate its Mead River mine in the Point Barrow field to fill the limited local demand for coal in that part of the Northern Alaska region.

Because of the growing importance of coal in the economic pattern of Alaska, the history of the industry is briefly reviewed below. Coal in commercial quantity was produced first in Alaska from the Matanuska field (Doherty mine) in 1916 following completion of a branch of the Government-owned railroad to that area. It was not until 1920 that the present Evan Jones mine was opened and until 1922 that coal in commercial quantity was produced from the Nenana field. Until 1940 the Alaska Railroad was the principal consumer of coal largely from the Matanuska field, but subsequent ever-increasing demands for coal resulted from the establishment of military bases in the Anchorage and Fairbanks areas. By 1951 the military requirements exceeded all others, even though the consumption of coal for civilian use, particularly in power plants in the rapidly growing communities of Fairbanks and Anchorage, had increased markedly. The effects of these major events in the overall development of the Alaskan coal industry are shown graphically in figure 1.

Platinum Metals.—The Goodnews Bay Mining Co. continued to be the only producer of platinum in Alaska in 1951 and the only operator in the United States or its Territories that mined actively for platinum as a primary product. The company operated its electrically powered bucket-line dredge (with ninety-three 8-cubic-foot buckets) and a dragline (1¼-cubic-yard)-bulldozer-hydraulic combination on a bench of the Salmon River, Goodnews Bay district, Kuskokwim region, from May 2 to November 2. The recovery of crude platinum metals in 1951 was higher than in 1950; a small quantity of gold was obtained as a byproduct.

Pumice.—During 1951 a limited quantity of pumice was obtained by Stock & Grove from beach deposits at Geographic Bay off Shelikof Strait, Bristol Bay region. The material was shipped by barge to

Anchorage for subsequent use in the local manufacture of building blocks.

Sand and Gravel.—Production of sand and gravel in Alaska in 1951 amounted to 6,887,646 short tons. Producers were Alaska Concrete Products Co., Ketchikan; R. J. Sommers Construction Co., Juneau; the Alaska Road Commission; Bureau of Public Roads; Bureau of Reclamation; Naval Operating Base, Kodiak; and the Corps of Engineers, Department of the Army.

Tin.—Total production of tin in the Territory in 1951 was approximately 115 short tons of placer-tin concentrate containing 77 short tons (69 long tons) of tin. Although the output was 13 percent under that for 1950, the overall value increased 16 percent because of the higher average price per pound in 1951.

Tin mining in the Seward Peninsula region showed increasing activity in 1951. Although actual production from operating mines was less than in 1950, exploration and development projects, if carried through as planned, indicated that a much larger overall scale of operations could be expected in 1952. The U. S. Tin Corp. mined placer tin at its property on Lost River, Port Clarence district, during 1951; 40 short tons of tin-tungsten concentrate (containing 60.5 percent tin and 11 percent tungsten) recovered from 12,000 cubic yards of gravel washed was shipped but not sold. The company was developing a lode tin deposit on the property with the financial assistance of a Government operating loan, and expected to start producing tin concentrate from the new 100-ton mill early in 1952. The Northern Tin Co., Inc., recovered tin concentrate from its placer-tin operation on Buck Creek, Port Clarence district, using a dragline and jigs; the concentrate was shipped to the tin smelter at Texas City, Tex. Also in the Port Clarence district, but on Cape Creek near Tin City, the Zenda Gold Mining Co. started a program of placer tin exploration in 1951 with a $54,000 DMA 90-percent participation exploration loan. If results were to indicate sufficient reserves and favorable conditions, plans called for mining with a bucket-line dredge.

A small quantity of tin was recovered as a byproduct concentrate from placer-gold mining by several operators in the Yukon River Basin region. L. McGee, operating the property on Sullivan Creek and Tofty Gulch in the Hot Springs district formerly owned and worked by the Cleary Hill Mines Co., produced some concentrate. However, the material was not cleaned pending a more favorable price. In the same district Larson & Berg recovered a small quantity of tin from it's drift-mining operation on Woodchopper Creek; disposition of the concentrate was not reported. From Midnight Creek in the Ruby district John R. Campbell recovered a small quantity of tin concentrate left by previous operators who had mined the creek for gold; all of the material, which averaged 71 percent tin, was shipped to the tin smelter at Texas City, Tex.

Tungsten.—The Federal Government's tungsten-buying program, plus the strategic classification of the metal with possibility of obtaining a 75-percent Government participation exploration loan, resulted in an increased interest in tungsten in Alaska during 1951. Actual production was slight, being reported from only 3 properties. A small quantity of tungsten contained in tin-tungsten placer con-

centrate was shipped (but not sold) by the U. S. Tin Corp. from its property on Lost River, Port Clarence district, Seward Peninsula region. Rocky Mountain Mining Co. produced a small quantity of scheelite concentrate (60 percent WO_3) as a byproduct of placer-gold mining in the Nome district in 1951; the material was not shipped. Russell R. Schaefer recovered a minor quantity of scheelite as a byproduct from a placer-gold operation on Forty-Seven Creek, tributary to Holitna River, Tuluksak-Aniak district, Kuskokwim region.

The Alaska Metals Mining Co. obtained a $44,558.50 DMA 75-percent Government participation exploration loan in 1951 and began exploration work on a lode-tungsten deposit (including the Stepovich and Colbert properties) on Gilmore Dome near Fairbanks. Plans included eventual construction of two 25-ton mills, one of which would be made available for custom milling.

The Riverside mine, a lead-tungsten property near Hyder, Southeastern Alaska region, a former producer of tungsten, did not operate in 1951.

Miscellaneous Minerals.—Data on production of stone are not available for publication. There was no recorded production of asbestos, bismuth, chromite, gemstones (jade), iron ore, mercury, nickel, or petroleum in Alaska in 1951.

The occurrence of bismuth on Charley Creek, 35 miles north of Nome, Seward Peninsula region, has been known for many years, but not until recently has any interest been shown in the deposit. In 1951 exploratory work was continued on the property by Native Bismuth, Inc., formed for the purpose of developing the deposit. The chromite deposit at Red Mountain, Kenai Peninsula region, was under investigation by a private operator, and negotiations were in progress relative to actively mining the property under a lease from the U. S. Vanadium Co. Although known for many years, the deposits of jade (nephrite) in the Cosmos Hills, Shungnak district, Northwestern Alaska region, had not been commercially exploited since the Arctic Circle Exploration Co. shipped a few tons to Fairbanks in 1946. Reportedly in 1951 the Imperial Jade Co., Kotzebue, Alaska, planned to mine Alaskan jade following a period of prospecting and exploration in the area. Past experience has indicated that most of the jade, found as float in form of boulders, cannot be classed as semiprecious stone, although some of the material is stated to be of gem quality. During 1951 interest was shown in the occurrences of magnetite in Southeastern Alaska as a source of iron ore for possible export to Japan, but no active exploitation resulted. Although no mercury was produced in Alaska in 1951 the DeCoursey Mountain Mining Co., a recent producer from deposits in the Kuskokwim region, sold its interests; the new owner reportedly planned resumption of operations in 1952. The Admiralty-Alaska Gold Mining Co. was granted a $108,000 90-percent Government participation DMA exploration loan in 1951 to explore for nickel and cobalt which is known to occur with copper in the Funter Bay mine, Admiralty Island district, Southeastern Alaska region.

The large exploration project conducted by the Navy in the Naval Petroleum Reserve No. 4, north of the Brooks Range, Northern Alaska region, continued throughout 1951. An extensive area of

gas-producing sands was discovered in 1951, and this in addition to other promising results obtained, demonstrated the value of the project which was to be continued full scale in 1952. Interest in the old Katalla oil field in the Yakataga district, Copper River region, was revived in 1951. The Northern Development Co. obtained control of a large acreage of potential oil land in the Katalla-Yakataga area. Reportedly the Deep Rock Oil Co. planned an oil-well drilling program in the field in 1952.

Arizona
Gold, Silver, Copper, Lead, and Zinc

(MINE REPORT)

By Paul Luff

GENERAL SUMMARY

DESPITE strikes for brief periods in 1951, Arizona's output of copper totaled 415,870 short tons, the largest in the State's history and 3 percent more than in 1950. On the other hand, gold production declined from 118,313 fine ounces in 1950 to 116,093 in 1951, a 2-percent loss; silver from 5,325, 441 fine ounces to 5,120,985, a 4-percent loss; lead from 26,383 short tons to 17,394, a 34-percent loss; and zinc from 60,480 short tons to 52,999, a 12-percent loss. Most of the gold and silver produced in Arizona is a byproduct of copper and zinc-lead ores; in 1951 these two classes of ore yielded 105,703 ounces of gold and 4,231,061 ounces of silver compared with 103,311 and 4,459,176 ounces, respectively, in 1950. However, the loss in gold from lead ore and zinc-lead ore in 1951 more than offset the increase from copper ore. The decreased lead and zinc production resulted mainly from a decline in output of zinc-lead ore from the Copper Queen mine at Bisbee, where zinc-lead ore reserves are nearly depleted. The State remained the largest producer of copper in the United States; ranked fourth in silver, fifth in gold and zinc, and sixth in lead; and again ranked first in total value of the five metals.

The total value of the five metals was $235,289,045 in 1951, the highest in any year in the State's history and a 17-percent gain over the $201,033,694 in 1950. Gold production amounted to $4,063,255—nearly 2 percent of the State total value; silver, $4,634,750—2 percent; copper, $201,281,080—over 85 percent; lead, $6,018,324—over 2 percent; and zinc, $19,291,636—8 percent. The value of the metals recovered from copper ore was $201,685,281 in 1951 ($169,717,981 in 1950) or 86 percent of the State total, and that recovered from zinc-lead ore was $18,577,376 ($23,035,993 in 1950) or 8 percent of the total. About 92 percent of the gold production and 78 percent of the silver came from 6 districts—Ajo, Big Bug, Copper Mountain (Morenci), Pioneer (Superior), Verde (Jerome), and Warren (Bisbee); 99 percent of the copper came from 8 districts—Ajo, Copper Mountain (Morenci), Eureka (Bagdad), Globe-Miami, Mineral Creek (Ray), Pioneer (Superior), Verde (Jerome), and Warren (Bisbee); 90 percent of the lead came from 6 districts—Aravaipa, Big Bug, Harshaw, Old Hat, Pima, and Warren (Bisbee); and 96 percent of the zinc came from 10 districts—Aravaipa, Big Bug, Cochise (Dragoon), Eureka (Bagdad), Harshaw, Old Hat, Pima, Pioneer (Superior), Verde (Jerome), and Warren (Bisbee).

Outstanding features of Arizona's mining activities in 1951 were the record production of copper ore, especially from open pits; of

zinc-copper ore from the Cedar Valley, Cochise, Eureka, Pioneer, and Verde districts; of copper in the Mineral Creek district; and of zinc in the Verde district.

Arizona's producing mines declined in number from 333 (including 24 placers) in 1950 to 283 (including 18 placers) in 1951.

All tonnage figures reported herein are short tons and "dry weight"; that is, they do not include moisture. The value of production has been calculated at the prices shown in table 1.

TABLE 1.—Prices of gold, silver, copper, lead, and zinc, 1947–51

Year	Gold [1] (per fine ounce)	Silver [2] (per fine ounce)	Copper [3] (per pound)	Lead [3] (per pound)	Zinc [3] (per pound)
1947	$35.00	$0.905	$0.210	$0.144	$0.121
1948	35.00	.905+	.217	.179	.133
1949	35.00	.905+	.197	.158	.124
1950	35.00	.905+	.208	.135	.142
1951	35.00	.905+	.242	.173	.182

[1] Price under authority o fGold Reserve Act of Jan. 31, 1934.
[2] Treasury buying price for newly mined silver July 1, 1946, to date—$0.9050505 ($0.905 used in 1947 for calculating purposes).
[3] Yearly average weighted price of all grades of primary metal sold by producers. Price in 1947 includes bonus payments by Office of Metals Reserve for overquota production.

The average prices of copper, lead, and zinc all increased in 1951—copper to 24.2 cents a pound, lead to 17.3 cents, and zinc to 18.2 cents. The Treasury price of gold remained at $35 a fine ounce and of silver at $0.905+. On October 2 the price of lead rose from 17 cents a pound to 19 cents and zinc from 17.5 cents a pound to 19.5 cents.

TABLE 2.—Mine production of gold, silver, copper, lead, and zinc in Arizona in 1951, by months, in terms of recoverable metal [1]

Month	Gold (fine ounces)	Silver (fine ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
January	10,832	443,198	37,065	1,520	4,295
February	9,057	409,800	32,750	1,485	4,150
March	10,822	475,000	37,960	1,655	4,780
April	10,976	474,000	38,170	1,490	4,275
May	11,038	487,200	37,770	1,650	4,825
June	9,787	422,000	31,890	1,475	4,145
July	9,272	401,274	33,510	1,410	4,105
August	8,780	375,340	31,165	1,440	4,910
September	8,072	378,143	30,460	1,275	3,920
October	9,147	421,345	36,310	1,335	4,975
November	9,080	410,342	33,760	1,320	4,335
December	9,230	423,343	35,060	1,339	4,284
Total	116,093	5,120,985	415,870	17,394	52,999

[1] Mine production comprises ore, gravel, or other mineral material sold or treated and metal recovered as natural gold or as bullion from cyanidation or amalgamation and the estimated recoverable metal (or gross metal as indicated) contained in concentrates, ores, tailings, and other mineral materials shipped directly to smelters or sold to ore buyers within the year.

TABLE 3.—Mine production of gold, silver, copper, lead, and zinc in Arizona, 1947–51, and total, 1860–1951, in terms of recoverable metal [1]

Year	Mines producing		Material sold or treated (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1947	315	30	38,636,280	95,860	$3,355,100	4,569,084	$4,135,021
1948	360	39	39,925,686	109,487	3,832,045	4,837,740	4,378,399
1949	340	32	38,372,879	108,993	3,814,755	4,970,736	4,498,767
1950	309	24	42,709,272	118,313	4,140,955	5,325,441	4,819,793
1951	265	18	43,820,353	116,093	4,063,255	5,120,985	4,634,750
1860–1951			[2]	11,416,905	287,086,830	317,511,400	239,731,429

Year	Copper		Lead		Zinc		Total value
	Short tons	Value	Short tons	Value	Short tons	Value	
1947	366,218	$153,811,560	28,566	$8,227,008	54,644	$13,223,848	$182,752,537
1948	375,121	162,802,514	29,899	10,703,842	54,478	14,491,148	196,207,948
1949	359,010	141,449,940	33,568	10,607,488	70,658	17,523,184	177,894,134
1950	403,301	167,773,216	26,383	7,123,410	60,480	17,176,320	201,033,694
1951	415,870	201,281,080	17,394	6,018,324	52,999	19,291,636	235,289,045
1860–1951	13,097,612	4,136,395,112	509,867	91,041,204	570,729	135,080,057	4,889,334,632

[1] Includes recoverable metal content of gravel washed (placer operations), ore milled, old tailings or slimes retreated, and ore, old tailings, or copper precipitates shipped to smelters during the calendar year indicated.
[2] Figure not available.

TABLE 4.—Gold produced at placer mines in Arizona, 1947–51, by class of mine and method of recovery

Class and method	Mines producing	Material treated (cubic yards)	Gold recovered		
			Fine ounces	Value	Average value per cubic yard
Surface placers:					
Gravel mechanically handled:					
Nonfloating washing plants:[1]					
1947	2	2,700	34	$1,190	$0.44
1948	3	97,800	637	22,295	.23
1949	3	76,800	426	14,910	.19
1950	1	100	75	2,625	26.25
1951	1	150	61	2,135	14.23
Small-scale hand methods:					
Wet and dry:					
1947	19	6,500	241	8,435	1.30
1948	25	2,960	185	6,475	2.19
1949	27	4,365	130	4,550	1.04
1950	20	2,740	48	1,680	.61
1951	15	1,265	89	3,115	2.46
Underground placers:					
Drift:					
1947	9	200	39	1,365	6.83
1948	11	135	16	560	4.15
1949	2	320	9	315	.98
1950	3	450	19	665	1.48
1951	2	150	6	210	1.40
Grand total placers:					
1947	30	9,400	314	10,990	1.17
1948	39	100,895	838	29,330	.29
1949	32	81,485	565	19,775	.24
1950	24	3,290	142	4,970	1.51
1951	18	1,565	156	5,460	3.49

[1] Includes all placer operations using power excavator and washing plant, both on dry land; an outfit with movable washing plant is termed a "dry-land dredge."

Gold.—Arizona's gold production declined to 116,093 fine ounces in 1951, a loss of 2,220 ounces (2 percent) from 1950. A substantial increase in gold production from the Copper Queen mine of the Phelps Dodge Corp. prevented a greater loss. Most of the gold, as well as silver, produced in the State is a byproduct of copper ore and zinc-lead ore; in 1951 copper ore yielded 83,521 ounces of gold (72 percent of the total), an increase of 3,954 ounces over 1950, and zinc-lead ore 22,182 ounces (19 percent of the total), a decrease of 1,562 ounces. However, a decrease of 4,388 ounces of gold from lead ore and 1,823 ounces from gold, gold-silver, and silver ores more than offset the increase from copper ore. Gold from placers increased from 142 ounces to 156. The New Cornelia copper mine of the Phelps Dodge Corp. in Pima County continued to be the leading gold producer in the State; it was followed by the Copper Queen mine of the Phelps Dodge Corp. in Cochise County, the Iron King mine in Yavapai County, the Magma mine in Pinal County, the Morenci mine of the Phelps Dodge Corp. in Greenlee County, and the United Verde mine of the same corporation in Yavapai County; these six properties produced 92 percent of the total gold.

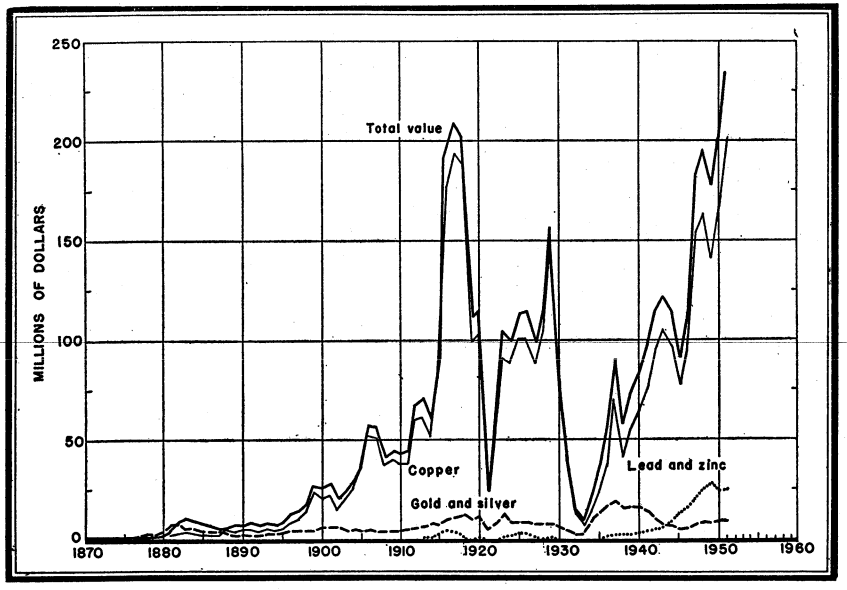

FIGURE 1.—Value of mine production of gold, silver, copper, lead, and zinc in Arizona, 1870–1951.

Silver.—A decline in the quantity of silver recovered from zinc-lead ore caused Arizona's silver production to decrease to 5,120,985 fine ounces in 1951—204,456 ounces (4 percent) less than in 1950. Copper ore yielded 3,087,865 ounces (60 percent of the State total), an increase of 234,266 ounces (8 percent) over 1950; and zinc-lead ore yielded 1,143,196 ounces (22 percent of the total), a decrease of 462,381 ounces (29 percent). Most of the remainder of the silver came from zinc-copper ore (602,083 ounces) and from silver ore (242,850 ounces). The Phelps Dodge Corp., with a slightly lower

output than in 1950, continued to be the chief silver producer in Arizona; its 4 properties (Copper Queen, Morenci, New Cornelia, and United Verde) produced 54 percent of the State total. Other large silver producers were Iron King, Magma, Ash Peak, Ray (Kennecott), Flux, and San Xavier (Eagle-Picher) properties.

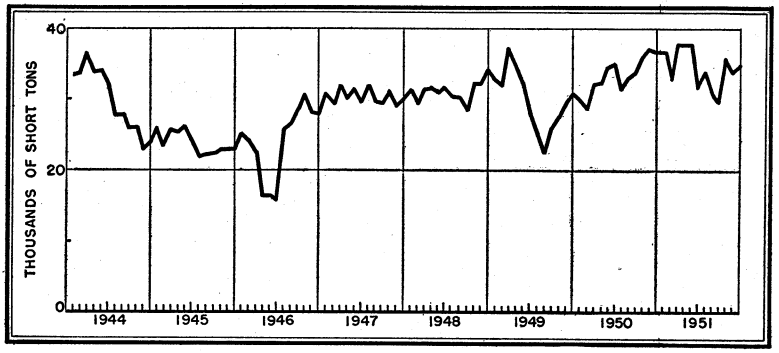

FIGURE 2.—Mine production of copper in Arizona, 1944–51, by months, in terms of recoverable metal.

Copper.—Arizona's output of recoverable copper was 415,870 short tons in 1951, the largest ever recorded and 12,569 tons (3 percent) more than in 1950. Substantial increases in output from the Globe-Miami, Mineral Creek, and Warren districts more than offset large decreases from the Copper Mountain, Eureka, Pioneer, and Verde districts. The Copper Mountain district, with an output of 143,921 tons, remained the leading copper-producing district in the State, although its output declined 7 percent, it was followed by the Globe-Miami district with 90,225 tons, Ajo with 63,093, Mineral Creek with 50,580, Warren with 27,271, Pioneer with 17,662, Verde with 9,742, and Eureka with 9,087. Copper production at the Ray property of the Kennecott Copper Corp. increased 14,189 tons (39 percent), and that at the Copper Queen mine of the Phelps Dodge Corp. 13,926 tons (104 percent). There were also substantial increases at the Castle Dome and Miami properties. The total copper yield of 809,781,829 pounds was obtained as follows: 38,545,214 tons of copper ore treated by concentration, 82 percent; 3,696,413 tons of copper ore leached and 24,331 tons of cement copper (from mine-water precipitates and underground leaching operations), 12 percent; and 542,761 tons of copper ore shipped crude to smelters, 6 percent. The Morenci mine (Phelps Dodge) was again the largest copper producer in Arizona, followed in order by the New Cornelia (Phelps Dodge), Ray, Inspiration Copper Queen, Miami, Castle Dome, Magma, United Verde (Phelps Dodge), and Bagdad properties. These 10 properties produced 99 percent of the State total.

Lead and Zinc.—Arizona's production of recoverable lead and zinc was much less than in 1950, lead dropped to 17,394 short tons—a decrease of 8,989—and zinc to 52,999 tons—a decrease of 7,481. These decreases resulted mainly from a decline in ouput of zinc-lead ore from the Copper Queen mine at Bisbee, where zinc-lead ore reserves are nearly depleted. Substantial increases in production from the

Magma, United Verde, Republic & Mammoth, and Old Dick properties prevented a greater loss in the State zinc output. The St. Anthony property at Tiger in Pinal County was the leading lead producer in 1951 followed by the Iron King mine at Humboldt, San Xavier mine near Sahuarita, Flux group near Patagonia, Copper Queen mine at Bisbee, and Aravaipa group near Klondyke. The leading zinc producer in 1951 was the United Verde mine of the Phelps Dodge Corp., followed by the Iron King, Magma, San Xavier, Copper Queen, Flux, St. Anthony, Republic & Mammoth, Old Dick, and Aravaipa properties. Large lead- and zinc-producing districts in 1951 were the Big Bug in Yavapai County, Old Hat in Pinal County, Pima in Pima County, Harshaw in Santa Cruz County, Warren in Cochise County, and Aravaipa in Graham County. Additional large zinc-producing districts were the Verde in Yavapai County, Pioneer in Pinal County, Cochise in Cochise County, and Eureka in Yavapai County. About 92 percent of the lead and 55 percent of the zinc came from zinc-lead ore; 5 percent of the lead came from lead ore, and most of the remainder of the lead came from zinc-copper ore and zinc-lead-copper ore; 42 percent of the zinc came from zinc-copper ore and most of the remainder from zinc ore and zinc-lead-copper ore.

TABLE 5.—Mine production of gold, silver, copper, lead, and zinc in Arizona in 1951, by counties, in terms of recoverable metal

County	Mines producing		Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Fine ounces	Value	Fine ounces	Value
Cochise	27	----	25,555	$894,425	1,332,655	$1,206,120
Gila	21	----	3,429	120,015	175,999	159,288
Graham	7	----	588	20,580	14,281	12,925
Greenlee	4	----	9,219	322,665	805,755	729,249
Maricopa	14	1	25	875	2,601	2,354
Mohave	20	----	212	7,420	18,621	16,853
Pima	32	1	33,852	1,184,820	596,581	539,936
Pinal	36	1	14,809	518,315	855,012	773,829
Santa Cruz	30	----	114	3,990	191,628	173,433
Yavapai	57	9	27,947	978,145	1,124,577	1,017,799
Yuma	17	6	343	12,005	3,275	2,964
Total	265	18	116,093	4,063,255	5,120,985	4,634,750

County	Copper		Lead		Zinc		Total value
	Short tons	Value	Short tons	Value	Short tons	Value	
Cochise	28,666	$13,874,344	1,975	$683,350	8,401	$3,057,964	$19,716,203
Gila	91,057	44,071,588	78	26,988	18	6,552	44,384,431
Graham	46	22,264	1,295	448,070	1,404	511,056	1,014,895
Greenlee	143,921	69,657,764	----	----	----	----	70,709,678
Maricopa	5	2,420	1	346	----	----	5,995
Mohave	489	236,676	203	70,238	765	278,460	609,647
Pima	63,877	30,916,468	2,847	985,062	5,414	1,970,696	35,596,982
Pinal	68,536	33,171,424	4,650	1,608,900	9,879	3,595,956	39,668,424
Santa Cruz	193	93,412	1,983	686,118	4,683	1,704,612	2,661,565
Yavapai	19,068	9,228,912	4,319	1,494,374	22,429	8,164,156	20,883,386
Yuma	12	5,808	43	14,878	6	2,184	37,839
Total	415,870	201,281,080	17,394	6,018,324	52,999	19,291,636	235,289,045

MINING AND METALLURGICAL INDUSTRY

Stimulated by high prices of copper and zinc, the output of copper ore and zinc-copper ore in Arizona in 1951 reached record peaks. The output of copper ore increased to 42,784,388 tons, a gain of 1,027,115 tons (2 percent) over 1950, and zinc-copper ore increased to 433,256 tons, a gain of 184,865 tons (74 percent). On the other hand, the output of zinc-lead ore declined to 503,300 tons, a loss of 114,247 tons (19 percent), and that of gold ore, silver ore, gold-silver ore, and lead ore also declined. The demand for copper was strong throughout the year, and during the first half of the year (with no interruptions by strikes) mining of copper ore was at a higher rate than at any time in the State's history; however, strikes interfered with operations a few days during the last quarter. Of the total ore, 42,744,404 tons (nearly 98 percent) was copper ore mined in the Ajo, Copper Mountain, Eureka, Globe-Miami, Mineral Creek, Pioneer, Verde, and Warren districts. The remainder comprised 494,949 tons of zinc-lead ore mined in the Aravaipa, Big Bug, Harshaw, Old Hat, Pima, and Warren districts; 432,364 tons of zinc-copper ore mined in the Cedar Valley, Cochise, Eureka, Pioneer, and Verde districts; and 66,540 tons of miscellaneous ores from districts throughout the State. Mining operations at 6 open pits—Ajo, Bagdad, Inspiration, Miami (Castle Dome), Morenci, and Ray—produced 34,839,237 tons of copper ore averaging 1.003 percent copper, compared with 33,358,059 tons of ore in 1950, averaging 1.033 percent copper. More copper ore was mined from open pits in 1951 than in any other year.

Steps were taken by the Federal Government in 1951 to stimulate production of critical and strategic minerals by assisting in the financing of exploration projects. Seven exploration projects were approved for Arizona, with the Government providing $314,275.60 of the cost and private industry $215,180.40. Minerals being sought include copper, lead, zinc, and asbestos. The Government's contribution will be repaid, without interest, through a royalty on net returns if ore is discovered or delineated during the exploration projects and the ore is mined within 10 years of the date of the contract.

Of the 43,820,353 tons of ore, old tailings, etc., mined and treated in 1951 in Arizona, 39,491,121 tons (90 percent) was treated at 36 milling plants, 3,696,413 tons (nearly 9 percent) at 1 straight-leaching (copper) plant, and 632,819 tons (over 1 percent) was shipped crude to smelters.

Crude ore treated at milling plants comprised chiefly 38,545,214 tons of copper ore, averaging 1.042 percent copper and carrying minor quantities of gold and silver per ton; 497,738 tons of zinc-lead ore, averaging 0.06 ounce of gold and 2.72 ounces of silver to the ton, 0.38 percent copper, 3.58 percent lead, and 7.53 percent zinc; and 433,256 tons of zinc-copper ore, averaging 0.04 ounce of gold and 2.00 ounces of silver to the ton, 2.57 percent copper, 0.40 percent lead, and 7.49 percent zinc. Copper ore from the Miami property was treated by a combination of leaching and concentration, and copper ore from the Inspiration mine was treated both by straight leaching and by leaching and concentration. The most important mills that operated nearly all year were the copper-concentration plants at Morenci (45,000 tons a day), Ajo (25,000 tons), Miami (18,000 tons), Inspiration (18,000 tons), Castle Dome (10,000 tons), Hayden (10,000 tons),

Bagdad (4,000 tons), Clarkdale (2,100 tons), and Superior (1,500 tons); the copper-leaching plants at Inspiration (9,000 tons) and Miami (3,000 tons); and the zinc-lead concentration mills at Bisbee (Copper Queen 900 tons), Humboldt (Iron King 670 tons), Sahuarita (Eagle-Picher 500 tons), Tiger (St. Anthony, 500 tons), Patagonia (Trench 200 tons), and Klondyke (Athletic 100 tons). The concentrators at Clarkdale and Superior, as well as those near Bagdad, Dragoon, and Yucca, also treated zinc-copper ore. Six copper smelters in Arizona—Phelps Dodge Corp. at Ajo, Douglas, and Morenci, International Smelting & Refining Co. at Miami, American Smelting & Refining Co. at Hayden, and Magma Copper Co. at Superior—operated nearly all year. Most of the copper concentrates produced at mills in Arizona were treated at smelters in the State. However, all the lead concentrates produced were shipped to the smelter at El Paso, Tex., and all the zinc concentrates were shipped to smelters at Amarillo, Corpus Christi, and Dumas, Tex.; Bartlesville and Henryetta, Okla.; St. Louis, Mo.; Anaconda and Great Falls, Mont.; and Canon City, Colo.

ORE CLASSIFICATION

Definitions used in ore classification are given in the Gold and Silver chapter of this volume.

TABLE 6.—Mine production of gold, silver, copper, lead, and zinc in Arizona in 1951, by class of ore or other source material, in terms of recoverable metal

Source	Number of mines[1]	Material sold or treated (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Ore:							
Dry gold	32	3,418	1,085	3,296	24,282	2,758	1,133
Dry gold-silver	4	186	68	2,064	1,409	1,350	----------
Dry silver	27	27,567	780	242,850	38,602	18,407	----------
Total	63	31,171	1,933	248,210	64,293	22,515	1,133
Copper	89	42,784,388	83,521	3,087,865	775,609,514	975	----------
Lead	73	5,809	297	20,839	22,911	1,603,484	74,988
Lead-copper	2	2	--------	9	132	1,100	----------
Zinc	9	8,859	15	5,705	73,482	35,802	2,390,756
Zinc-copper	11	433,256	7,507	602,083	18,793,528	966,278	44,769,830
Zinc-lead	40	503,300	22,182	1,143,196	2,537,980	31,970,799	58,358,337
Zinc-lead-copper	4	2,643	--------	6,640	137,905	144,326	397,400
Total	211	43,738,257	113,522	4,866,337	797,175,452	34,722,764	105,991,311
Other "lode" material:							
Old tailings, etc.[2]	10	50,925	482	6,427	327,940	42,721	5,556
Copper precipitates	6	----------	--------	----------	34,172,315	----------	----------
Total	16	50,925	482	6,427	34,500,255	42,721	5,556
Total "lode" material	265	43,820,353	115,937	5,120,974	831,740,000	34,788,000	105,998,000
Gravel (placer operations)	18	----------	156	11	----------	----------	----------
Total, all sources	283	43,820,353	116,093	5,120,985	831,740,000	34,788,000	105,998,000

[1] Detail will not necessarily add to totals because some mines produce more than one class of ore.
[2] Old tailings: Gold, 56 tons; gold-silver, 43,980 tons; copper, 6,682 tons; lead, 2 tons. Smelter cleanings: Copper, 41 tons; lead, 152 tons. Mill cleanings: Gold, 12 tons.

TABLE 7.—Mine production of gold, silver, copper, lead, and zinc in Arizona in 1951, by method of recovery and type of material processed, in terms of recoverable metal

Method of recovery and type of material processed	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Lode:					
Amalgamation [1]	329	115			
Concentration, and smelting of concentrates [1]	92,546	3,703,891	684,362,464	31,439,651	105,192,244
Direct smelting:					
Ore	22,580	1,410,541	50,102,884	3,305,628	800,200
Old tailings, etc	482	6,427	327,940	42,721	5,556
Copper precipitates [2]			34,172,315		
Total	23,062	1,416,968	84,603,139	3,348,349	805,756
Other: Straight leaching of copper ore [3]			62,774,397		
Placer	156	11			
Grand total	116,093	5,120,985	831,740,000	34,788,000	105,998,000

[1] Ore only; no old tailings, etc., processed by this method in Arizona in 1951.
[2] Distributed as follows: Cochise County, 248,000 pounds; Gila County, 18,340,085 pounds; Greenlee County, 8,665,000 pounds; Pinal County, 6,715,230 pounds; and Yavapai County, 204,000 pounds.
[3] All from one plant in Gila County.

TABLE 8.—Mine production of gold, silver, copper, lead, and zinc in Arizona in 1951, by method of recovery (except placer) and class of material processed, in terms of recoverable metal

A. For ore treated at mills

	Ore treated (short tons)	Recoverable in bullion		Concentrate shipped to smelters and recoverable metal					
		Gold (fine ounces)	Silver (fine ounces)	Concentrate (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
BY COUNTIES									
Cochise	231,367			61,825	6,680	251,009	16,469,085	3,261,582	16,707,715
Gila	7,991,567	2		148,665	3,136	162,422	99,132,231		
Graham	26,255			2,928	32	6,490	39,100	969,425	2,202,100
Greenlee	15,466,625			525,261	8,400	607,170	277,675,000		
Maricopa	100			20	19				
Mohave	22,153			4,859	175	15,984	943,850	219,934	1,499,136
Pima	9,231,925			228,031	33,449	579,917	126,613,621	5,651,108	10,826,225
Pinal	4,712,085	318	114	257,947	13,133	773,257	125,230,942	9,024,934	19,742,857
Santa Cruz	54,848			12,099	109	189,000	379,425	3,821,537	9,362,900
Yavapai	1,754,023	9	1	169,042	27,395	1,118,553	37,876,110	8,487,306	44,851,311
Yuma	173			36	18	89	3,100	3,825	
Total: 1951	39,491,121	329	115	1,410,713	92,546	3,703,891	684,362,464	31,439,651	105,192,244
1950	38,466,538	185	75	1,422,987	95,650	4,036,319	679,214,112	47,825,269	120,450,248
BY CLASS OF ORE TREATED									
Dry gold	2,214	329	115	70	212	62	3,100		
Dry gold-silver	90			6	6	627	696	785	
Dry silver	250			14	18	751	160	3,068	
Copper	38,545,214			1,196,458	63,204	1,952,872	662,877,431		
Lead	857			117	1	1,063	350	113,267	6,975
Zinc	8,859			2,640	15	5,705	73,482	35,802	2,390,756
Zinc-copper	433,256			93,279	7,507	602,083	18,793,528	966,278	44,769,830
Zinc-lead	497,738			117,556	21,583	1,134,088	2,475,812	30,176,125	57,627,283
Zinc-lead-copper	2,643			573		6,640	137,905	144,326	397,400
Total 1951	39,491,121	329	115	1,410,713	92,546	3,703,891	684,362,464	31,439,651	105,192,244
BY CLASS OF CONCENTRATE SHIPPED TO SMELTERS									
Dry gold				70	212	62	3,100		
Copper				1,240,853	68,461	2,415,797	680,059,771	155,230	180,600
Lead				35,025	15,023	901,657	1,629,691	27,742,953	4,564,491
Lead-copper				183		6,498	111,040	142,093	17,920
Zinc-lead-copper				19	5	220	1,077	2,354	3,220
Iron (from zinc-lead ore)				28,536	4,543	66,966	51,428	593,293	1,086,132
Total to copper and lead plants				1,304,686	88,244	3,391,200	681,856,107	28,635,923	5,852,363
Zinc concentrate to zinc plants				106,027	4,302	312,691	2,506,357	2,803,728	99,339,881
Total: 1951				1,410,713	92,546	3,703,891	684,362,464	31,439,651	105,192,244
1950				1,422,987	95,650	4,036,319	679,214,112	47,825,269	120,450,248

TABLE 8.—Mine production of gold, silver, copper, lead, and zinc in Arizona in 1951, by method of recovery (except placer) and class of material processed, in terms of recoverable metal—Continued

B. For copper ore treated by straight leaching

	Ore treated (short tons)	Recoverable metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
BY COUNTIES						
Gila	3,696,413			62,774,397		
Total: 1951	3,696,413			62,774,397		
1950	3,755,362			65,843,700		

C. For ore, old tailings, etc., shipped directly to smelters

	Material treated (short tons)	Recoverable metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
BY COUNTIES						
Cochise	375,171	18,875	1,081,646	40,862,915	688,418	94,285
Gila	46,180	291	13,577	20,207,372	156,000	36,000
Graham	4,664	556	7,791	52,900	1,620,575	605,900
Greenlee	90,671	819	198,585	10,167,000		
Maricopa	116	3	2,601	10,000	2,000	
Mohave	814	37	2,637	34,150	186,066	30,864
Pima	52,669	401	16,664	1,140,379	42,892	1,775
Pinal	59,441	1,356	81,641	11,841,058	275,066	15,143
Santa Cruz	638	5	2,628	6,575	144,463	3,100
Yavapai	1,422	470	6,023	259,890	150,694	6,689
Yuma	1,033	249	3,175	20,900	82,175	12,000
Total: 1951	632,819	23,062	1,416,968	84,603,139	3,348,349	805,756
1950	487,372	22,336	1,289,047	61,544,188	4,940,731	509,752
BY CLASS OF ORE, OLD TAILINGS, ETC.						
Dry gold:						
Ore	1,204	544	3,119	21,182	2,758	1,133
Old tailings and mill cleanings	68	56	264	200	2,870	5,556
Dry gold-silver:						
Ore	96	62	1,437	713	565	
Old tailings	43,980	363	4,647	235,000		
Dry silver	27,317	762	242,099	38,442	15,339	
Copper:						
Ore	542,761	20,317	1,134,993	49,957,686	975	
Old tailings and smelter cleanings	6,723	4	873	90,302		
Precipitates				34,172,315		
Lead:						
Ore	4,952	296	19,776	22,561	1,490,217	68,013
Old tailings and smelter cleanings	154	59	643	2,438	39,851	
Lead-copper	2		9	132	1,100	
Zinc-lead	5,562	599	9,108	62,168	1,794,674	731,054
Total 1951 to copper and lead plants	632,819	23,062	1,416,968	84,603,139	3,348,349	805,756

TABLE 9.—Mine production of gold, silver, copper, lead, and zinc in Arizona in 1951, by method of recovery (except placer) and class of material processed, in terms of gross metal content

Class of material	Quantity shipped or treated (short tons)	Gross metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
ORE TREATED AT MILLS						
Dry gold	2,214	611	237	4,000		
Dry gold-silver	90	8	800	1,000	1,000	
Dry silver	250	25	1,050	300	5,000	
Copper	38,545,214	78,835	2,426,880	803,626,242		
Lead	857	2	1,252	600	134,500	15,000
Zinc	8,859	37	10,701	121,755	80,511	2,961,295
Zinc-copper	433,256	16,413	868,467	22,250,279	3,493,102	64,863,720
Zinc-lead	497,738	29,735	1,352,585	3,790,272	35,605,071	74,970,036
Zinc-lead-copper	2,643		7,100	173,938	161,206	464,367
Total: 1951	39,491,121	125,666	4,669,072	829,968,386	39,480,390	143,274,418
1950	38,466,538	128,296	5,187,676	827,101,018	57,259,823	162,038,115
CONCENTRATE SHIPPED TO SMELTERS						
Dry gold	70	212	62	3,196		
Copper	1,240,853	69,396	2,483,260	696,777,846	1,324,974	7,013,430
Lead	35,025	15,023	901,657	1,917,618	28,723,282	5,875,770
Lead-copper	183		6,498	130,635	147,249	23,122
Zinc-lead-copper	19	5	220	1,255	2,440	4,130
Iron (from zinc-lead ore)	28,536	4,543	66,966	60,521	618,424	2,408,046
Total to copper and lead plants	1,304,686	89,179	3,458,663	698,891,071	30,816,369	15,324,498
Zinc concentrate to zinc plants	106,027	5,136	374,989	3,148,512	3,557,371	108,939,995
Total: 1951	1,410,713	94,315	3,833,652	702,039,583	34,373,740	124,264,493
1950	1,422,987	97,999	4,212,746	698,847,435	51,553,423	142,054,410
ORE TO STRAIGHT LEACHING PLANT						
Copper	3,696,413			72,936,589		
Total: 1951	3,696,413			72,936,589		
1950	3,755,362			75,705,759		
ORE, OLD TAILINGS, ETC., SHIPPED DIRECTLY TO SMELTERS						
Dry gold:						
Ore	1,204	544	3,119	21,535	2,968	1,462
Old tailings and mill cleanings	68	56	264	246	2,994	7,163
Dry gold-silver:						
Ore	96	62	1,437	757	925	
Old tailings	43,980	363	4,647	262,238		
Dry silver	27,317	762	242,099	40,242	21,922	1,240
Copper:						
Ore	542,761	20,317	1,134,993	51,744,359	1,615	10,800
Old tailings and smelter cleanings	6,723	4	873	98,822		
Precipitates				34,829,597		
Lead:						
Ore	4,952	296	19,776	26,551	1,547,569	88,474
Old tailings and smelter cleanings	154	59	643	2,880	41,840	
Lead-copper	2		9	155	1,265	
Zinc-lead	5,562	599	9,108	73,168	1,858,989	939,436
Total: 1951 to copper and lead plants	632,819	23,062	1,416,968	87,100,550	3,480,087	1,048,575
1950	487,372	22,346	1,289,532	63,963,347	5,128,608	708,023

REVIEW BY COUNTIES

COCHISE

In 1951 Cochise County ranked first in silver output in Arizona, third in gold and zinc, and fifth in copper and lead. The Copper Queen mine of the Phelps Dodge Corp. at Bisbee in the Warren district was by far the most important producer in the county, the corporation reporting that the mine produced 490,184 tons of copper ore and 40,426 of zinc-lead-silver ore in 1951 compared with 218,404 and 153,730 tons, respectively, in 1950. In addition, 311 tons of copper precipitates were produced. The zinc-lead-silver ore and 119,454 tons of copper ore were treated in the corporation 900-ton flotation mill at Bisbee; the remainder of the copper ore and the copper precipitates were shipped direct to the corporation smelter at Douglas.

According to the corporation annual report for 1951, the Copper Queen mine produced 55,837,413 net pounds of copper, 2,530,056 of lead, and 7,432,219 of zinc, compared with 21,203,333, 11,606,250, and 33,423,374 pounds, respectively, in 1950. The changeover during the year from mining important quantities of zinc-lead-silver ore to mining almost exclusively copper ore, was completed. This changeover began in 1950 as a result of virtual exhaustion of zinc-lead-silver deposits.

During 1951 the corporation began developing an open pit at the Bisbee East ore body (known as the Lavender pit). The ore body contains an estimated 41,000,000 tons of milling ore averaging 1.14 percent copper and 31,000,000 tons of leaching material averaging 0.42 percent copper.

Other county production included 64,654 tons of zinc-copper ore from the Republic and Mammoth mines of the Coronado Copper & Zinc Co. near Dragoon in the Cochise district. The company operated its 200-ton flotation mill all year and produced 4,295 tons of copper concentrate and 6,228 tons of zinc concentrate. The Abril group in the Turquoise district was operated under lease by Sherwood B. Owens, who shipped 5,427 tons of zinc ore to a custom mill in Deming, N. Mex. Zinc ore (295 tons) was also produced from the San Juan (Gordon) mine; zinc-copper ore (320 tons), copper ore (86 tons), and zinc-lead ore (14 tons) from the Shannon mine; and zinc-lead ore (102 tons) from the Defiance mine. Output from the California district was largely 525 tons of zinc-lead ore shipped from the Doran Sun Set waste dumps and 150 tons of lead ore from the Hilltop and Leadville mines. Copper ore (22 tons) was produced from the Tout group in the Dos Cabezas and Tevis district. Output from the Swisshelm district was 1,746 tons of lead ore from the Chance and Scribner mines. In the Tombstone district, production was mainly 665 tons of silver ore from the Tombstone group, 280 tons of zinc-lead ore from the Mary Jo group, and 87 tons of lead ore from the Gallagher-Bradshaw group.

GILA

Gila County, with a production of 182,114,000 net pounds of copper in 1951 (170,740,700 in 1950), continued to rank second among the copper-producing areas in Arizona. About 99 percent of the output came from the Globe-Miami district, where there are three large pro-

TABLE 10.—Mine production of gold, silver, copper, lead, and zinc in Arizona in 1951, by county and district, in terms of recoverable metal

Country and district	Mines producing		Material sold or treated (short tons)	Gold (fine ounces)			Silver (fine ounces)			Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
Cochise County:													
California	5		755				948		948	8,400	144,700	70,800	$40,810
Cochise (Dragoon)	1		64,654	23		23	23,475		23,475	2,700,000		6,486,000	1,855,903
Dos Cabezas and Tevis	1		22	9		9	200		200	7,800			2,384
Hartford (Huachuca Mountains)	2		9				157		157	900	1,000		533
Smelter	(1)		91	4		4	758		758	19,700	10,200		7,358
Swisshelm (Elfrida)	2		1,746	136		136	6,699		6,699	2,700	432,400		86,281
Tombstone	10		1,066	25		25	5,762		5,762	5,400	95,100	51,200	33,167
Turquoise	5		6,250	20		20	1,937		1,937	44,700	55,300	1,172,000	236,141
Warren (Bisbee)	1		531,945	25,338		25,338	1,292,719		1,292,719	54,542,400	3,211,300	9,022,000	17,453,626
Gila County:													
Banner (Christmas)	5		37,388	256		256	10,932		10,932	1,658,600	128,000	20,000	446,019
Dripping Springs [2]	1		138	33		33	158		158	1,300	25,000	13,700	8,431
Globe-Miami	13		11,696,590	3,138		3,138	164,899		164,899	180,449,700	3,000	2,300	43,928,837
Green Valley	1		7	2		2							70
Summit [3]	1		37				10		10	4,400			1,074
Graham County:													
Aravaipa	5		30,897	588		588	14,261		14,261	91,800	2,587,700	2,808,000	1,014,431
Lone Star	1		2							200			48
Stanley Butte	1		20				20		20		2,300		416
Greenlee County:													
Ash Peak	1		19,309	699		699	193,419		193,419				199,519
Copper Mountain (Morenci)	3		15,537,987	8,520		8,520	612,336		612,336	287,842,000			70,510,159
Maricopa County:													
Big Horn	2		4				21		21	100			43
Cave Creek and Camp Creek	3		38				2,485		2,485	7,600			4,088
Estrella Mountains	1		36	3		3	10		10	100			138
Four Peaks	1		15				11		11	300			83
Osborn	1		8				11		11		1,200		218
Pikes Peak	1		1								800		138
San Domingo		1			3	3							105
Vulture	2		7				10		10	1,300			324
White Butte	1		100	19		19							665
White Picacho [4]	2		7				53		53	600			193
Mohave County:													
Bentley (Grand Wash Cliffs)	2		107	1		1	221		221	32,000			7,979
Cedar Valley	2		21,539	97		97	13,206		13,206	939,500	153,000	1,390,000	522,155
Chemehuevis	1		1				11		11		800		148
Maynard	1		2				11		11	800			204
Owens	1		59				537		537	100	33,300	1,600	6,562
San Francisco (Oatman)	1		4	25		25	43		43				914
Wallapai (Chloride, Cerbat, Stockton Hill)	12		1,255	89		89	4,592		4,592	5,600	218,900	138,400	71,685

Pima County:													
Ajo	1		9,204,497	33,805		33,805	437,675		437,675	126,185,000			32,116,063
Arivaca	1		2				21		21	200			67
Baboquivari (Fresnal)	1		3				11		11		2,200		391
Cababi (Comobabi)	5		246	10		10	2,844		2,844	12,900	800		6,184
Cerro Colorado	2		9				157		157	400			239
Coyote	1		30	1		1	31		31	2,600			692
Empire	1		2				21		21		1,100		209
Greaterville	1	1	74	4	2	6	85		85	200	14,400		2,826
Growler	1		198	5		5	1,748		1,748	59,800			16,229
Helvetia (Rosemont)	9		7,907	13		13	7,635		7,635	802,100			201,473
Old Hat (Oracle, Mammoth) [5]	2		102	4		4	390		390	21,400	7,000	1,000	7,065
Pima (Sierritas, Papago, Twin Buttes)	6		71,433	8		8	145,941		145,941	667,000	5,668,200	10,827,000	3,244,891
Silver Bell	1		91				22		22	2,400	300		653
Pinal County:													
Casa Grande	4		1,820				12,659		12,659	1,700	1,000		12,041
Cottonwood	1		16	4		4	22		22				160
Dripping Springs [2]	2		75				116		116	2,300	2,900	1,800	1,492
Goldfields	1	1	1,965	491	2	493	158		158				17,398
Martinez Canyon	1		573	1		1	621		621	800	200,300		35,443
Mineral Creek (Ray)	4		4,230,823	1,271		1,271	172,765		172,765	101,159,000	53,100		24,690,510
Mineral Hill	9		276	18		18	653		653	2,000	47,900	14,500	12,631
Old Hat (Oracle, Mammoth) [5]	4		103,396	813		813	85,340		85,340	558,400	8,475,600	7,166,100	3,011,334
Pioneer (Superior)	8		432,025	12,207		12,207	581,952		581,952	35,324,600	518,800	12,480,000	11,863,606
Summit [3]	1		34				10		10	4,200			1,025
Vekol	1		523	2		2	716		716	19,000	400	95,600	22,784
Santa Cruz County:													
Harshaw	4		46,971	108		108	152,366		152,366	180,500	3,336,800	8,152,000	2,246,290
Oro Blanco (Ruby)	1		4				53		53	100	1,000		245
Palmetto	1		4	1		1	105		105		2,900		632
Patagonia (Duquesne)	17		7,897				36,430		36,430	203,000	496,900	1,202,500	386,916
Tyndall	4		587	5		5	2,495		2,495	2,100	125,300	11,500	26,711
Wrightson	3		23				179		179	300	3,100		771
Yavapai County:													
Agua Fria	1		20				11		11	100	200	1,500	342
Big Bug	2	1	202,638	19,663	61	19,724	636,812		636,812	429,400	8,070,000	19,376,200	6,293,180
Black Canyon	4		484	173		173	622		622	7,100	600	29,800	13,864
Black Rock	6		315	35		35	622		622	13,100			4,958
Blue Tank	1	1	66	5	1	6				5,100			1,444
Castle Creek	1		7	4		4				700			309
Copper Basin	1	1	56	4	1	5	95		95	400	11,300	8,500	3,860
Eureka (Bagdad)	7		1,250,207	179		179	68,657		68,657	18,174,000	130,800	5,007,000	5,400,413
Hassayampa (Prescott, Groom Creek)	8	2	1,425	245	3	248	6,171		6,171	16,900	215,000	125,000	78,300
Humbug	2		21	10		10	126		126		400		533
Lynx Creek		2			3	3							105
Peck	2		5	1		1	190		190		600		311
Pine Grove (Crown King)	2		309	125		125	1,464		1,464	1,800			6,136
Silver Mountain	2		18	1		1	684		684	100	1,000		851
Tip Top	1		1							300			73
Turkey Creek	1		4				43		43		2,000		385
Verde (Jerome)	1		299,729	7,325		7,325	408,891		408,891	19,484,000	205,000	20,310,000	9,073,455
Walker	3	1	5	15	2	17	64		64				653
Walnut Grove	6		24	4		4	21		21	3,000	100		902
Weaver (Rich Hill, Octave)	5	1	108	85	2	87	73		73				3,111
White Picacho [4]	1		3				31		31		1,000		201

For footnotes, see end of table.

TABLE 10.—Mine production of gold, silver, copper, lead, and zinc in Arizona in 1951, by county and district, in terms of recoverable metal—Continued

Country and district	Mines producing		Material sold or treated (short tons)	Gold (fine ounces)			Silver (fine ounces)			Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
Yuma County:													
Alamo	1		18							900			$218
Castle Dome	4		49	1		1	168		168		6,600		1,329
Cienega	2		13	3		3				1,100			371
Ellsworth	3		717	249		249	1,317		1,317	21,000	8,300		16,425
Eureka (Silver Camp)	1		2				63		63		2,100		420
Fortuna	1		7	7		7	10		10				254
LaPaz		1			2	2							70
Middle Camp		1			1	1							35
Mineral Hills Wash	1		3	1		1				500			156
Plomosa	4	2	397	6	6	12	1,706		1,706	500	69,000	12,000	16,206
Trigo		2			67	67		11	11				2,355
Total	265	18	43,820,353	115,937	156	116,093	5,120,974	11	5,120,985	831,740,000	34,788,000	105,998,000	235,289,045

[1] Not counted as mine, production coming from smelter cleanings.
[2] Dripping Springs district lies in both Gila and Pinal Counties.
[3] Summit district lies in both Gila and Pinal Counties.
[4] White Picacho district lies in both Maricopa and Yavapai Counties.
[5] Old Hat district lies in both Pima and Pinal Counties.

ducers—Castle Dome, Inspiration, and Miami. The Inspiration property, with a yield of 78,249,439 net pounds of copper in 1951, remained the leading copper producer in the county and ranked fourth in the State. The Inspiration Consolidated Copper Co. reported that 3,696,413 tons of ore, averaging 0.987 percent copper, was treated in 1951 by acid ferric sulfate in the main leaching plant; 315,265 tons of slimes, removed from ore at the main leaching plant, was treated by flotation, and 7,932 tons of copper ore and 8,181 tons of cement copper were sent direct to the smelter at Miami. Ore production was from both underground and open pit: 2,043,125 tons was mined from underground and 1,983,297 tons from the open pit.

The Miami mine of the Miami Copper Co. and the Castle Dome Copper Co., Inc. (a wholly-owned subsidiary of the Miami Copper Co.) produced 101,668,368 net pounds of copper in 1951 (51,955,582 pounds from the Miami and 49,712,786 pounds from the Castle Dome). According to the annual report of the Miami Copper Co., copper was produced at the Miami mine by under ground mining followed by flotation and by acid leaching of material overlying the mined-out areas. The company 18,000-ton concentrator treated 3,812,045 tons of ore averaging 0.727 percent copper and containing small quantities of gold and silver; re-treatment of copper concentrate recovered 589,996 pounds of molybdenum. Ore reserves, as of January 1, 1952, were estimated to be 12,000,000 tons. The Castle Dome open pit and 10,000-ton concentrator were operated continuously in 1951; 3,864,250 tons of ore averaging 0.758 percent copper and containing small quantities of gold and silver was treated. As of January 1, 1952, ore reserves were estimated to be 7,033,468 tons. According to the same annual report, operations at the Copper Cities Mining Co. (wholly owned subsidiary of Miami Copper Co.) property had advanced sufficiently by June 1951 to allow the beginning of stripping. The in-place ore reserves, after establishment of final pit limits, are estimated at 33,000,000 tons.

The remainder of the Globe-Miami district output was largely 557 tons of copper ore from the Blue Bird, Copper Hill, Four Bagger, Free America, High Line, and Pontiac properties.

Output in the Banner district was chiefly 30,305 tons of high-lime fluxing ore, containing an average of 2.696 percent copper, and 6,682 tons of old siliceous copper tailings shipped from the Christmas property to the copper smelter at Hayden. Norman C. Grissom operated the "79" mine and shipped 275 tons of lead ore; 100 tons of copper ore was produced from the Chilito claim. In the Dripping Springs district, C. F. Moores worked the C–B claim and shipped 138 tons of zinc-lead ore. Output in the Summit district was 37 tons of copper ore from the Yan claim.

GRAHAM

Output in Graham County was mainly zinc-lead ore from the Aravaipa district, where the principal producer was the Aravaipa group of mines operated by the Athletic Mining Co. The company reported that 26,148 tons of zinc-lead ore was treated in its 100-ton flotation mill and that 2,195 tons of similar ore was shipped direct to the lead smelter at El Paso, Tex. Other producers of zinc-lead ore were the Sein Fein mine (1,868 tons), Santa Teresa mine (458 tons),

and Ben Hur group (107 tons). The Abe Reed mine produced 121 tons of lead ore.

GREENLEE

Greenlee County, with a production of 287,842,000 net pounds of copper in 1951 (309,378,100 in 1950), continued to be the chief copper-producing area in Arizona, as the Morenci mine of the Phelps Dodge Corp. at Morenci in the Copper Mountain district remained the outstanding producer of copper in the State, although its output was 6 percent less than in 1950. The corporation reported that 15,466,625 tons of copper ore from the Morenci mine was treated in the 45,000-ton concentrator in 1951 and that 525,261 tons of copper concentrate, 71,299 tons of crude copper ore, and 5,576 tons of copper precipitates were shipped direct to the Morenci smelter. In addition, 487 tons of molybdenum concentrate was produced, and the mine was also an important producer of gold and silver.

Other Copper Mountain district production was 57 tons of gold-silver ore from the Bell group and 6 tons of copper ore from the X. I. V. claim. In the Ash Peak district, the Ash Peak Lease continued to operate the Ash Peak mine near Duncan and shipped 19,309 tons of fluxing ore, averaging 0.036 ounce of gold and 10.017 ounces of silver to the ton and 80 percent silica.

MARICOPA

The principal output in Maricopa County was 100 tons of gold ore from the Charlotte mine in the White Butte district. Gold ore (36 tons) was produced also from the Altuda mine in the Estrella Mountain district, and copper-silver ore (33 tons) from the Red Rover mine in the Cave Creek and Camp Creek district.

MOHAVE

The most important operation in Mohave County was the mining of zinc-copper ore at the Antler and Copper World mines near Yucca in the Cedar Valley district. The Antler mine, operated all year by the Yucca Mining & Milling Co., produced 17,039 tons of ore that contained 120 ounces of gold, 12,500 ounces of silver, 800,000 pounds of copper, 240,000 pounds of lead, and 1,500,000 pounds of zinc. The Mountain States Metals Co. took over operation of the Copper World mine early in 1951, constructed a 75-ton flotation mill, and began milling zinc-copper ore in May; total ore milled was 4,500 tons. Other county production included 107 tons of copper ore from the Cox Ross and Grand Gulch properties in the Bentley (Grand Wash Cliffs) district; 59 tons of lead ore from the McCracken mine in the Owens district; and 666 tons of zinc-lead ore from the Banner, Champion, DeLa-Fountaine, and Fountain Head mines and 550 tons of lead ore from the Cupel, DeLaFountaine, Little Tennessee, New London, Western Union, and Wrigley properties in the Wallapai district.

PIMA

In 1951 Pima County ranked first in gold output in Arizona, third in lead, fourth in copper and zinc, and fifth in silver. Most of the output was copper ore from the New Cornelia mine of the Phelps Dodge

Corp. in the Ajo district and zinc-lead ore from the San Xavier property of The Eagle-Picher Co. (formerly Eagle-Picher Mining & Smelting Co.) in the Pima district. According to the annual report of the Phelps Dodge Corp., the open pit at the New Cornelia mine produced 9,164,309 tons of copper ore in 1951 compared with 8,790,024 in 1950. However, smelter production of copper from concentrates treated declined from 131,717,340 pounds to 129,553,788. In addition, 43,980 tons of old siliceous copper tailings was shipped to the Ajo smelter for fluxing purposes.

The San Xavier group near Sahuarita in the Pima district, one of the most important producers of zinc-lead ore in Arizona, was operated 11½ months. The Eagle-Picher Co. reported that the mine produced 71,182 tons of zinc-lead ore in 1951 compared with 67,456 tons in 1950. Other production in the Pima district included 120 tons of copper ore from the Vulcan mine, 74 tons of lead ore from the Old Powers and Red Hill properties, and 46 tons of zinc-lead ore from the Tit-for-Tat claim.

In the Cababi district the output was mainly 138 tons of copper ore from the Emperor & Duchess mine and 90 tons of gold-silver ore from the Cunquian mine. The S R K mine near Consair in the Coyote district produced 30 tons of copper ore. Phil Snyder worked the Conglomerate mine in the Greaterville district in 1951 and shipped 74 tons of lead ore. Output from the Growler district was 198 tons of copper ore produced from the Jeff Milton property. Lessees operated several mines in the Helvetia district and shipped 7,907 tons of copper ore (3,398 tons was produced from the King in Exile mine, 1,244 tons from the Old Dick mine, 1,212 tons from the Elgin mine, 1,095 tons from the Peach mine, 623 tons from the Mineral Hill mine, 204 tons from the Bulldozer mine, 74 tons from the Forbes claim, 36 tons from the South End claim, and 21 tons from the Daylight claim). Output from the Old Hat district in Pima County was 83 tons of copper ore from the Leatherwood mine and 12 tons of lead ore and 7 tons of zinc-lead ore from the Bluff claim.

PINAL

In 1951 Pinal County ranked first in lead output in Arizona, second in zinc, third in silver and copper, and fourth in gold. The most important operations were copper mining in the Mineral Creek district, copper mining and zinc-copper mining in the Pioneer district, and zinc-lead mining in the Old Hat district. Owing to extensive operations by the Kennecott Copper Corp. at the open pit of the Ray property, the mine made a record output of copper ore. The corporation reported that 3,061,636 tons of ore was mined from the open pit and 1,163,728 tons from underground—a total of 4,225,364 tons compared with 3,063,703 tons in 1950. The milling ore (4,213,154 tons), averaging 1.392 percent copper, was coarse-crushed at the mine, and the resulting product hauled by rail 26 miles to the corporation flotation mill at Hayden. In addition, 12,210 tons of crude smelting ore and 4,114 tons of copper precipitates were shipped to smelters in Arizona and New Mexico.

The remainder of the district output was 5,291 tons of siliceous ore, averaging 3.186 percent copper, produced from the Copper Butte open pit and 168 tons of oxide lead ore from the Ray Silver-Lead and Richard Arlyn properties.

In the Pioneer district, the Magma mine of the Magma Copper Co., one of the most important producers of gold, silver, copper, and zinc in Arizona, produced 307,590 tons of copper ore, 118,157 tons of zinc-copper ore, and 5,443 tons of siliceous silver fluxing ore in 1951, compared with 371,846, 50,527, and 6,342 tons, respectively, in 1950.

According to the company annual report for 1951, the Magma mine, mill, and smelter operated 6 days a week throughout the year, and labor supply was sufficient to maintain production at full capacity. The net metal produced from Magma crude smelting ore and concentrates comprised 10,962 ounces of gold, 491,223 ounces of silver, and 36,934,477 pounds of copper; 12,628 tons of zinc concentrate was produced, averaging 51.133 percent zinc. About 1 year's production of zinc-copper ore remained at the end of the year.

The rest of the district output was mainly 742 tons of gold-copper ore from the Lake Superior & Arizona group and 75 tons of silver ore from the Reymert Extension, Silver King, and Whetrock properties.

Output of zinc-lead ore in the Old Hat district declined from 115,357 tons in 1950 to 102,775 tons in 1951. Nevertheless, the district remained one of the most important producers of zinc and lead in Arizona. All but 89 tons of the zinc-lead ore came from the Mammoth-Collins group of the St. Anthony Mining & Development Co., Ltd. The company reported that 102,686 tons of ore, averaging 0.008 ounce of gold and 1.08 ounces of silver to the ton, 0.46 percent copper, 4.87 percent lead, and 5.30 percent zinc, were treated in its 500-ton gravity-flotation mill in 1951. The remainder of the district output was largely 482 tons of lead ore and 89 tons of zinc-lead ore from the Stove Lid claim.

No ore was produced in 1951 from the San Manuel property of the San Manuel Copper Corp. (wholly owned subsidiary of Magma Copper Co.) south of Tiger in the Old Hat district, but additional diamond drilling and churn drilling during the year increased proved ore reserves to a total of 479,500,000 tons averaging 0.77 percent copper.

Siliceous silver fluxing ore continued to be the principal output in the Casa Grande district; 1,813 tons of this ore was shipped from the Silver Reef mine. In the Dripping Springs (Troy) district, 38 tons of copper ore was produced from the Rattler group and 37 tons of zinc-lead ore from the Barton or 91 group. Output of the Goldfields district was virtually all gold ore (1,965 tons) produced from the old Mammoth mine near Apache Junction. The United Arizona Mines, Inc., worked the Silver Bell mine in the Martinez Canyon district, treated 330 tons of lead ore by concentration, and shipped 243 tons of similar ore direct to a smelter. Output of the Mineral Hill district comprised mainly 123 tons of zinc-lead ore from the Rock Cliff-Silver King group, 60 tons of gold ore from the Sunset and West mines, 52 tons of silver ore from the Silver Bar and Woodpecker claims, and 38 tons of lead ore from the Grey Eagle claim. The American mine in the Summit district produced 34 tons of copper ore. Lessees worked the old Reward mine in the Vekol district and shipped 389 tons of zinc ore to a custom mill in New Mexico and 134 tons of copper ore to smelters in Arizona and Texas.

SANTA CRUZ

Zinc-lead-silver ore from the Flux mine of the American Smelting & Refining Co. near Patagonia in the Harshaw district was the most

important output in Santa Cruz County. The mine and the company 200-ton flotation mill were operated continuously throughout the year; output of zinc-lead-silver ore increased from 46,365 tons in 1950 to 46,966 in 1951. The mill also treated custom ores totaling 8,004 tons.

Seventeen mines in the Patagonia district produced 7,897 tons of ore in 1951 containing 39,246 ounces of silver, 258,301 pounds of copper, 556,979 pounds of lead, and 1,417,183 pounds of zinc. The bulk of the output was the 4,496 tons of zinc-lead ore, 2,373 tons of zinc-lead-copper ore, 425 tons of zinc ore, and 122 tons of zinc-copper ore produced by lessees from 11 claims of the Duquesne group; all of the ore was treated in the flotation mill of the American Smelting & Refining Co. near Patagonia. Other district production was largely 270 tons of zinc-lead-copper ore from the Pride of the West mine and 138 tons of lead ore from the Mowry and Mudbank groups.

The Tyndall district produced 587 tons of ore—437 tons was lead smelting ore from the Bull Springs, Glove, and Wilkins properties and 150 tons zinc-lead ore and gold-silver ore from the Bull Springs and San Ramon groups.

YAVAPAI

In 1951 Yavapai County ranked first in zinc output in Arizona second in gold, silver, and lead, and sixth in copper. Most of the output was copper ore from the Bagdad mine in the Eureka district, zinc-copper ore and copper ore from the United Verde mine in the Verde district, and zinc-lead-iron ore from the Iron King mine in the Big Bug district.

In the Big Bug district the Iron King mine of the Shattuck Denn Mining Corp. at Humboldt was virtually the only producer. The corporation reported that the mine produced 202,581 tons of ore averaging 0.134 ounce of gold and 3.78 ounces of silver to the ton, 0.16 percent copper, 2.36 percent lead, 6.44 percent zinc, and 16.70 percent iron. The mine ore and 1,143 tons of custom ores were treated in the company 670-ton flotation mill.

Six mines in the Eureka district produced 1,250,207 tons of ore in 1951 containing 293 ounces of gold, 86,358 ounces of silver, 21,582,268 pounds of copper, 234,297 pounds of lead, and 6,472,245 pounds of zinc. The most important output was copper ore produced from the open pit at the Bagdad mine by the Bagdad Copper Corp. The corporation reported that 1,231,613 tons of ore, averaging 0.836 percent copper, was treated in its 4,000-ton flotation mill in 1951. Other district production was largely 15,528 tons of zinc-copper ore from the Old Dick mine, 2,186 tons of zinc ore from the Copper King mine, and 537 tons of zinc-lead ore from the Hillside and Mountain Springs properties.

In 1951 the Verde district produced 212,391 tons of zinc-copper ore, 87,338 tons of copper ore, and 159 tons of copper precipitates compared with 161,281, 199,803, and 141 tons respectively in 1950. All the output came from the United Verde mine of the Phelps Dodge Corp., where production of zinc-copper ore was 32 percent more than in 1950 but production of copper ore was 56 percent less. All the ore was treated in the corporation 2,100-ton flotation mill. The property ranked first in zinc production in Arizona in 1951, sixth in gold and silver, and ninth in copper.

The remainder of Yavapai County production was largely 1,074 tons of zinc-lead ore from the Cash and Combination mines, 227 tons of gold-lead ore from the Bodie mine, and 59 tons of zinc ore from the Evergreen claim in the Hassayampa district, 450 tons of zinc-copper ore from the French Lilly group near Cleator in the Black Canyon district; 313 tons of copper ore from the Abe Lincoln, Monte Cristo, and Unida mines in the Black Rock district; 308 tons of gold ore from the Gladiator mine at Crown King in the Pine Grove district; 108 tons of gold ore from the Dutchman, M. B., Monica, Octave, and Red Bird properties in the Weaver district; 66 tons of copper ore from the Golden Gate mine in the Blue Tank district; and 56 tons of zinc-lead ore from the U. S. Navy mine in the Copper Basin district.

YUMA

The principal output in Yuma County in 1951 was 702 tons of gold ore produced from the Bonanza and Magic mines near Wenden in the Ellsworth district, 317 tons of lead ore and 47 tons of zinc-lead ore from the Lucky Lead group near Bouse in the Plomosa district; 45 tons of lead ore from the Rialto mine in the Castle Dome district; and 61 ounces of placer gold from the Colorado River Valley property 50 miles north of Yuma in the Trigo district.

California

Gold, Silver, Copper, Lead, and Zinc

(MINE REPORT)

By R. B. Maurer and Leona Froehlich

GENERAL SUMMARY

SPURRED by the urgent need for base metals, California 1951 recoverable zinc production rose to the highest point since the war year 1945, whereas lead output fell but was second only to the State's record 1950 yield. Silver reflected its byproduct role, especially as a component of zinc and lead ores, and advanced over 1950. Copper output rose in 1951 owing to increases both as a byproduct metal and from copper ore. Gold, relatively unimportant quantitatively as a byproduct metal, declined to the lowest level since 1945 as a result of high operating costs plus progressive depletion of minable gravels and developed gold ore. The total value of gold, silver, copper, lead, and zinc recovered from materials sold or treated at 173 lode mines and 121 placer mines in 1951 was $21,700,575 compared with $22,081,859, the output of 243 lode mines and 186 placer mines in 1950, a drop of 2 percent.

Comparing 1951 with 1950, zinc output increased 27 percent in quantity and 63 percent in value; copper increased 43 percent in quantity and 66 percent in value; silver increased 7 percent in quantity and value; lead decreased 12 percent in quantity but increased 13 percent in value; and gold decreased 18 percent in quantity and value. Of the total value of the five metals gold comprised 55 percent; lead, 22 percent; zinc, 16 percent; silver, 5 percent; and copper, 2 percent.

Owing to its lead and zinc production, as well as important quantities of gold, silver, and copper, Inyo County led in total value of production of the five metals, contributing 35 percent of the State output. Nevada County ranked second in 1951, largely because of gold ore mined, and furnished more than 15 percent of the total value of the five metals. Sacramento County, third among the 32 producing counties, supplied nearly 15 percent, principally from gold dredging.

All tonnage figures reported herein are short tons and "dry weight"; that is, they do not include moisture. Yardage figures used in measuring material treated in placer operations are "bank measure"; that is, the material is measured in the ground before treatment. The value of metal production has been calculated at the prices shown in table 1.

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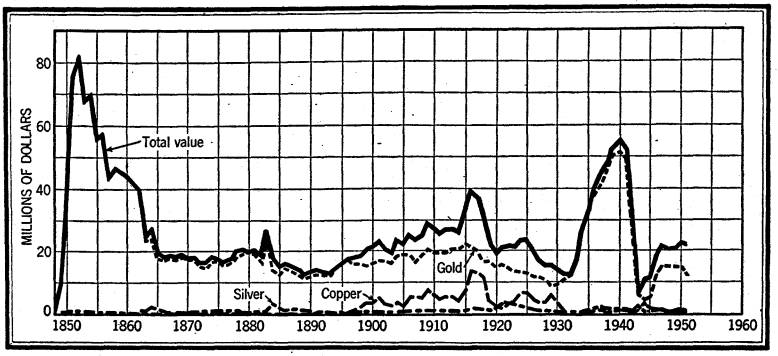

FIGURE 1.—Value of mine production of gold, silver, and copper, and total value of gold, silver, copper, lead, and zinc in California, 1848–1951.

TABLE 1.—Prices of gold, silver, copper, lead, and zinc, 1947–51

Year	Gold [1] (per fine ounce)	Silver [2] (per fine ounce)	Copper [3] (per pound)	Lead [3] (per pound)	Zinc [3] (per pound)
1947	$35.00	$0.905	$0.210	$0.144	$0.121
1948	35.00	.905+	.217	.179	.133
1949	35.00	.905+	.197	.158	.124
1950	35.00	.905+	.208	.135	.142
1951	35.00	.905+	.242	.173	.182

[1] Price under authority of Gold Reserve Act of Jan. 31, 1934.
[2] Treasury buying price for newly mined silver, July 1, 1946 to date—$0.9050505 ($0.905 used in 1947 for calculating purposes).
[3] Yearly average weighted price of all grades of primary metal sold by producers. Price in 1947 includes bonus payments by Office of Metals Reserve for overquota production.

TABLE 2.—Mine production of gold, silver, copper, lead, and zinc in California in 1951 by months, in terms of recoverable metal [1]

Month	Gold (fine ounces)	Silver (fine ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
January	33,148	100,446	96	1,233	761
February	33,435	91,957	74	1,245	758
March	33,479	94,376	73	1,284	810
April	30,602	107,633	70	1,240	701
May	31,662	100,142	70	1,129	709
June	28,588	92,072	56	1,074	782
July	26,127	91,153	63	1,184	748
August	26,468	81,394	100	919	741
September	23,263	76,076	52	903	671
October	24,414	101,745	77	1,193	1,004
November	23,193	107,242	124	1,371	1,110
December	25,353	100,983	66	1,192	807
Total	339,732	1,145,219	921	13,967	9,602

[1] Mine production comprises ore, gravel, or other mineral material sold or treated and metal recovered as natural gold or as bullion from cyanidation or amalgamation and the estimated recoverable metal (or gross metal as indicated) contained in concentrates, ores, tailings, and other mineral materials shipped directly to smelters or sold to ore buyers within the year.

Gold.—Gold output, including a relatively small quantity sold in the open market as "natural gold," deteriorated gradually in 1951 as the pinch of rising operating costs and manpower shortage became more acute.

The following 10 leading gold-producing properties in California in 1951, listing in order of output, yielded 81 percent of the total gold, the 5 leaders alone producing 61 percent: The Natomas Co., American River (Folsom) district, Sacramento County (dredging); Idaho Maryland Mines Corp. Brunswick-Idaho Maryland mine, Grass Valley-Nevada City district, Nevada County (gold ore); Yuba Consolidated Gold Fields Yuba unit, Yuba River district, Yuba County (dredging); Empire Star Mines Co., Ltd. Empire Star group, Grass Valley-Nevada City district, Nevada County (gold ore); Central Eureka Mining Co. Old Eureka mine, Mother Lode district, Amador County (gold ore); Yuba Consolidated Gold Fields Butte unit, Oroville district, Butte County (dredging); Capital Dredging Co., American River (Folsom) district, Sacramento County (dredging); the Original Sixteen to One Mine, Inc. Original Sixteen to One mine, Alleghany district, Sierra County (gold ore); Best Mines Co. Brush Creek mine, Downieville district, Sierra County (gold ore); and Fairview Placers, Trinity River district, Trinity County (dredging).

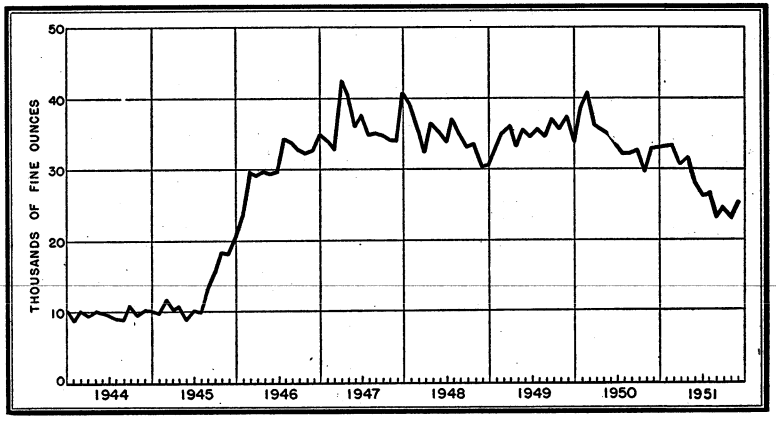

FIGURE 2.—Mine production of gold in California, 1944–51, by months, in terms of recoverable gold.

Silver.—The moderate rise in 1951 silver output reflected the stress on base-metal ore production, particularly lead, zinc-lead, and zinc ore. Of the State silver, 90 percent was derived from base-metal lode material and 10 percent from precious-metal lode material and gravels; only about 2 percent was recovered from straight silver ore.

The following five leading silver-producing mines, listed in order of output, yielded 85 percent of the State's total silver in 1951: Anaconda Copper Mining Co. Darwin group, Coso district (zinc-lead and lead ores) and Shoshone group, Resting Springs district (lead ore), both in Inyo County; Coronado Copper & Zinc Co. Afterthought mine, Cow Creek (Ingot) district, Shasta County (zinc ore); Penn Chemical Co., Inc. Penn mine, West Belt (Campo Seco) district, Calaveras County

(zinc ore); and L. D. Foreman & Co. Defense mine, Modoc district, Inyo County (lead ore).

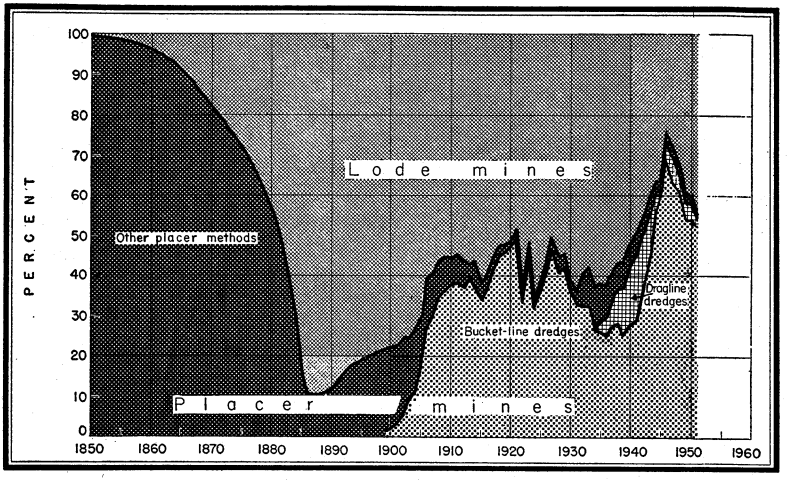

FIGURE 3.—Percentage of total California gold produced at lode and placer mine and by various methods of placer mining, 1850–1951.

TABLE 3.—Mine production of gold, silver, copper, lead, and zinc in California, 1947–1951, and total, 1848–1951, in terms of recoverable metal [1]

Year	Mines producing [2]		Material sold or treated (short tons) [3]	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1947	210	210	648,789	431,415	$15,099,525	1,597,442	$1,445,685
1948	241	195	526,776	421,473	14,751,555	724,771	655,954
1949	242	190	494,906	417,231	14,603,085	783,880	709,451
1950	243	186	547,241	412,118	14,424,130	1,071,917	970,139
1951	173	121	494,151	339,732	11,890,620	1,145,219	1,036,481
1848–1951			(4)	103,903,188	2,338,715,232	113,523,317	91,958,652

Year	Copper		Lead		Zinc		Total value
	Short tons	Value	Short tons	Value	Short tons	Value	
1947	2,407	$1,010,940	10,080	$2,903,040	5,415	$1,310,430	$21,769,620
1948	481	208,754	9,110	3,261,380	5,325	1,416,450	20,294,093
1949	649	255,706	10,318	3,260,488	7,209	1,787,832	20,616,562
1950	646	268,736	15,831	4,274,370	7,551	2,144,484	22,081,859
1951	921	445,764	13,967	4,832,582	9,602	3,495,128	21,700,575
1848–1951	630,928	203,483,764	218,958	39,174,877	115,309	26,012,720	2,699,345,245

[1] Includes recoverable metal content of gravel washed (placer operations), ore milled, old tailings or slimes re-treated, tungsten ore, and ore, old tailings, slag, flue dust, and pyritic ore residue shipped to smelters during calendar year indicated.
[2] Excludes itinerant prospectors, "snipers," "high-graders," and others who gave no evidence of legal right to property.
[3] Does not include gravel washed.
[4] Figure not available.

TABLE 4.—Gold production at placer mines in California, 1947–51, and total, 1848–1951, by class of mine and method of recovery [1]

Class and method	Mines producing [2]	Washing plants (dredges)	Material treated (cubic yards)	Gold recovered		
				Fine ounces	Value	Average value per cubic yard
Surface placers:						
Gravel mechanically handled:						
Bucket-line dredges:						
1947	22	35	95,478,000	271,165	$9,490,775	$0.099
1948	22	35	94,747,200	257,171	9,000,985	.095
1949	20	34	83,571,900	226,838	7,939,330	.095
1950	14	26	82,514,000	223,164	7,810,740	.095
1951	13	25	68,714,600	175,870	6,155,450	.090
Dragline dredges: [3]						
1947	41	35	5,718,000	26,617	931,595	.163
1948	27	27	3,033,000	17,029	596,015	.197
1949	28	24	2,906,600	14,616	511,560	.176
1950	16	14	[4] 3,417,900	15,499	542,465	[4] .156
1951	13	11	1,363,000	6,652	232,820	.166
Suction dredges:						
1947	7	5	60,000	485	16,975	.283
1948	5	6	83,000	453	15,855	.191
1949	10	11	267,000	1,364	47,740	.179
1950	16	13	263,300	1,407	49,245	.187
1951	13	9	180,500	717	25,095	.139
Nonfloating washing plants: [3 5]						
1947	25	25	[4] 182,000	3,916	137,060	[4] .206
1948	15	15	[4] 44,700	1,159	40,565	[4] .155
1949	25	26	[4] 95,000	3,452	120,820	[4] .903
1950	30	30	[4] 76,500	3,293	115,255	[4] 1.295
1951	16	16	99,900	2,210	77,350	.562
Gravel hydraulically handled:						
1947	23	----------	332,000	1,194	41,790	.126
1948	28		363,000	1,784	62,440	.172
1949	27	----------	447,900	1,587	55,545	.124
1950	32	----------	383,400	1,468	51,380	.134
1951	13	----------	55,000	440	15,400	.280
Small-scale hand methods: [6]						
1947	89	----------	682,600	8,937	312,795	.458
1948	85	----------	211,900	7,731	270,585	1.277
1949	68	----------	126,060	2,596	90,860	.721
1950	59	----------	204,050	3,029	106,015	.520
1951	43	----------	59,200	1,513	52,955	.895
Underground placers:						
Drift:						
1947	3	----------	1,400	224	7,840	5.600
1948	13	----------	14,100	229	8,015	.569
1949	12	----------	1,500	95	3,325	2.217
1950	19	----------	9,500	443	15,505	1.632
1951	10	----------	2,800	222	7,770	2.775
Grand total placers:						
1947	210	----------	[4] 102,454,000	312,538	10,938,830	.107
1948	195	----------	[4] 98,496,900	285,556	9,994,460	.101
1949	190	----------	[4] 87,415,960	250,548	8,769,180	.100
1950	186	----------	[4] 86,868,650	248,303	8,690,605	.100
1951	121	----------	70,475,000	187,624	6,566,840	.093
1848–1951	----------	----------	[7]	66,817,363	1,474,345,351	[7]

[1] For historical data by years, see Minerals Yearbook, Review of 1940, p. 219.
[2] Excludes itinerant prospectors, "snipers," "high-graders," and others who gave no evidence of legal right to property.
[3] Includes commercial rock plants and tungsten mines that produced byproduct gold from gravels. By product gold is included with gold recovered, but material treated and average value per cubic yard refer only to straight gold dredging.
[4] Revised figures.
[5] Includes all placer operations using power excavator and washing plant, both on dry land; when washing plant is movable, outfit is termed "dry-land dredge."
[6] Includes all operations in which hand labor is principal factor in delivering gravel to sluices, long toms, dip boxes, pans, rockers, dry washers, etc.
[7] Complete data not available.

Copper.—Development of small properties in 1951 in some of California's copper districts resulted in moderate output of copper that aided in increasing the relative minor yield of the metal over 1950; but the principal source of copper continued to be ores treated primarily for other metals. The leading producers of recoverable copper in order of output were: Coronado Copper & Zinc Co. Afterthought mine, Cow Creek (Ingot) district, Shasta County (zinc ore); Penn Chemical Co., Inc. Penn mine, West Belt (Campo Seco) district, Calaveras County (zinc ore); Anaconda Copper Mining Co. Darwin group, Coso district (zinc-lead and lead ore) and Shoshone group, Resting Springs district (lead ore) both in Inyo County; and Donald Love, Bagdad-Chase mine, Buckeye district, San Bernardino County (copper ore).

Lead.—The Anaconda Copper Mining Co. Inyo County properties, the Darwin group, Coso district and Shoshone group, Resting Springs district, dominated California lead output in 1951 and furnished a large percentage of the State total. Substantial quantities of lead were recovered from Coronado Copper & Zinc Co. Afterthought mine ore and from flue dust accumulated at the site of the abandoned Kennett copper smelter, both in Shasta County. Those producers with moderate lead output included L. D. Foreman & Co., Defense mine, and Finley & Vignich, Minnietta mine, Modoc district; and Lippincott Lead Mines, Lead King (Lippincott) mine, Ubehebe district, all in Inyo County.

Zinc.—The rise in California 1951 zinc output is attributable largely to steady operation at the three major zinc-producing mines: Anaconda Copper Mining Co. Darwin group, Inyo County; Coronado Copper & Zinc Co. Afterthought mine, Shasta County; and the Penn Chemical Co., Inc. Penn mine, Calaveras County. Lead ore and concentrates from Anaconda Copper Mining Co. Shoshone group, Inyo County and Kennett smelter site flue dust, Shasta County, shipped to a smelter-fuming plant contained recoverable zinc. Some oxidized zinc ore from the Carbonate King Zinc mine, Ivanpah district, San Bernardino County, was treated at a fuming plant.

TABLE 5.—Mine production of gold, silver, copper, lead, and zinc in California in 1951, by counties, in terms of recoverable metal

County	Mines producing[1]		Gold					
			Lode		Placer		Total	
	Lode	Placer	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value
Alpine	1							
Amador	7	3	15,439	$540,365	258	$9,030	15,697	$549,395
Butte	2	6	93	3,255	14,060	492,100	14,153	495,355
Calaveras	5	5	1,674	58,590	1,075	37,625	2,749	96,215
El Dorado	8	4	3,373	118,055	405	14,175	3,778	132,230
Fresno[2]		[2]1			(2)	(2)	(2)	(2)
Humboldt		2			6	210	6	210
Imperial	2		794	27,790			794	27,790
Inyo	29	1	4,843	169,505	3	105	4,846	169,610
Kern	18	4	8,746	306,110	296	10,360	9,042	316,470
Los Angeles	3	1	245	8,575	65	2,275	310	10,850
Madera	2	10	36	1,260	581	20,335	617	21,595
Mariposa[2]	8	[2]1	120	4,200	[2]3,082	[2]107,870	[2]3,202	[2]112,070
Merced		1			4,768	166,880	4,768	166,880
Modoc and Mono[3]	4		944	33,040			944	33,040
Nevada	7	14	[4]95,692	[4]3,349,220	1,593	55,755	[4]97,285	[4]3,404,975
Placer	1	9	291	10,185	428	14,980	719	25,165
Plumas	3	3	31	1,085	166	5,810	197	6,895
Riverside	6		37	1,295			37	1,295
Sacramento	1	10	31	1,085	91,554	3,204,390	91,585	3,205,475
San Bernardino	28	1	952	33,320	2	70	954	33,390
San Joaquin and Stanislaus[3]		3			6,090	213,150	6,090	213,150
San Mateo		(5)			4	140	4	140
Shasta	10	3	911	31,885	2,467	86,345	3,378	118,230
Sierra	9	10	17,449	610,715	196	6,860	17,645	617,575
Siskiyou	4	7	93	3,255	4,008	140,280	4,101	143,535
Trinity	3	15	38	1,330	7,733	270,655	7,771	271,985
Tulare	1							
Tuolumne	10	1	276	9,660	38	1,330	314	10,990
Yuba	1	6	(4)	(4)	48,746	1,706,110	[4]48,746	[4]1,706,110
Total	173	121	152,108	5,323,780	187,624	6,566,840	339,732	11,890,620

County	Silver					
	Lode		Placer		Total	
	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value
Alpine	1	$1			1	$1
Amador	3,649	3,302	32	$29	3,681	3,331
Butte	31	28	1,037	939	1,068	967
Calaveras	39,988	36,191	87	79	40,075	36,270
El Dorado	1,047	948	53	48	1,100	996
Fresno[2]			(2)	(2)	(2)	(2)
Humboldt						
Imperial	204	185			204	185
Inyo	856,232	774,933			856,232	774,933
Kern	33,200	30,048	75	68	33,275	30,116
Los Angeles	168	152	9	8	177	160
Madera	8	7	164	148	172	155
Mariposa[2]	68	62	[2]787	[2]712	[2]855	[2]774
Merced			511	462	511	462
Modoc and Mono[3]	1,388	1,256			1,388	1,256
Nevada	[4]31,098	[4]28,145	182	165	[4]31,280	[4]28,310
Placer	500	453	43	39	543	492
Plumas	4	4	11	10	15	14
Riverside	1,207	1,092			1,207	1,092
Sacramento	6	5	4,070	3,684	4,076	3,689
San Bernardino	12,081	10,934			12,081	10,934
San Joaquin and Stanislaus[3]			581	526	581	526
San Mateo			1	1	1	1
Shasta	148,253	134,177	290	262	148,543	134,439
Sierra	3,470	3,140	13	12	3,483	3,152
Siskiyou	27	24	479	434	506	458
Trinity	18	16	809	732	827	748
Tulare	37	34			37	34
Tuolumne	72	65	9	8	81	73
Yuba	(4)	(4)	3,219	2,913	[4]3,219	[4]2,913
Total	1,132,757	1,025,202	12,462	11,279	1,145,219	1,036,481

For footnotes, see end of table.

TABLE 5.—Mine production of gold, silver, copper, lead, and zinc in California in 1951, by counties, in terms of recoverable metal—Continued

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Alpine							$1
Amador	14,700	$3,557					556,283
Butte							496,322
Calaveras	487,400	117,951	89,100	$15,414	1,767,300	$321,648	587,498
El Dorado	3,700	895	13,300	2,301			136,422
Fresno [2]							[2]
Humboldt							210
Imperial							27,975
Inyo	346,400	83,829	26,079,500	4,511,754	11,176,900	2,034,196	7,574,322
Kern	300	73	2,500	432	7,800	1,420	348,511
Los Angeles							11,010
Madera	1,200	290					22,040
Mariposa [2]			600	104			[2] 112,948
Merced							167,342
Modoc and Mono [3]							34,296
Nevada							[4] 3,433,285
Placer							25,657
Plumas							6,909
Riverside			51,100	8,840			11,227
Sacramento							3,209,164
San Bernardino	104,400	25,265	309,700	53,578	132,400	24,097	147,264
San Joaquin and Stanislaus [3]							213,676
San Mateo							141
Shasta	879,800	212,912	1,388,200	240,159	6,119,600	1,113,767	1,819,507
Sierra	100	24					620,751
Siskiyou	100	24					144,017
Trinity	3,200	774					273,507
Tulare	400	97					131
Tuolumne	300	73					11,136
Yuba							[4] 1,709,023
Total	1,842,000	445,764	27,934,000	4,832,582	19,204,000	3,495,128	21,700,575

[1] Excludes itinerant prospectors, "snipers," "high-graders," and others who gave no evidence of legal right to property.
[2] Fresno and Mariposa County placer combined to avoid disclosure of individual output.
[3] Combined to avoid disclosure of individual output.
[4] Yuba County lode gold and lode silver included with Nevada County.
[5] From property not classed as a mine.

MINING INDUSTRY

The sharp drop in the number of California producing lode mines in 1951 is attributable largely to the decline in precious-metal mining. Owing to fixed prices for gold and silver, operators of lode mines retrenched, with the result that no extensive ore development was done at most mines and few new ventures were initiated. Placer mining, particularly dredging, likewise was adversely affected by the inflationary trend in the national economy coupled with the progressive exhaustion of profitable gravels. Also, higher freight rates and the growing competition for skilled manpower in the State's expanding industries, including tungsten mining, were deterrents to development at small marginal base-metal ore properties, particularly in more isolated regions of the State. Interest was shown in new base-metal properties, particularly West Belt district copper prospects, but the ore developed was not of great significance insofar as large reserves were concerned. The strike at nonferrous metal facilities from August 27 through September 6, 1951, caused some loss in California metal output, chiefly lead and zinc. Data on California mines were published.[1]

[1] Wiebelt, Frank J., Sanborn, W. C., Trengove, R. R., and Ricker, Spangler, Investigation of West Belt Copper-Zinc Mines, El Dorado, Amador, Calaveras and Mariposa Counties, Calif.: Bureau of Mines Rept. of Investigations 4760, 1951, 62 pp.

ORE CLASSIFICATION

California ores sold or treated in 1951 are classified in table 6. Definitions used in ore classification are given in the Gold and Silver chapter of this volume.

TABLE 6.—Mine production of gold, silver, copper, lead, and zinc in California in 1951, by class of ore or other source material, in terms of recoverable metal

Source	Number of mines [1]	Material sold or treated (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Ore:							
Dry gold	109	278,750	143,943	54,815	200	16,300	400
Dry gold-silver	2	1,645	699	13,802			
Dry silver	12	3,441	17	20,122	700	237,000	100
Total	119	283,836	144,659	88,739	900	253,300	500
Copper	8	1,553	442	4,109	151,900		
Lead	21	57,032	4,100	359,139	121,300	16,082,700	2,354,800
Lead-copper	1	55		730	3,000	14,700	3,500
Zinc	5	40,556	1,428	177,908	1,145,500	1,073,300	7,372,500
Zinc-lead	4	93,452	415	464,226	189,600	9,729,900	8,862,300
Total	35	192,648	6,385	1,006,112	1,611,300	26,900,600	18,593,100
Other "lode" material:							
Old tailings, etc. [2]	22	17,431	942	31,398	75,900	780,100	610,400
Copper precipitates	3	80			97,300		
Old slag and tungsten ore [3]	7	[4] 156	122	6,508	56,600		
Total	29	17,667	1,064	37,906	229,800	780,100	610,400
Total "lode" material	173	494,151	152,108	1,132,757	1,842,000	27,934,000	19,204,000
Gravel (placer operations)	121		187,624	12,462			
Total, all sources	294	494,151	339,732	1,145,219	1,842,000	27,934,000	19,204,000

[1] Detail will not necessarily add to totals because some mines produce more than one class of material.
[2] Metal recovered, by class of old tailings, flue dust, or pyritic ore residue, as follows: gold, 9,367 tons—507 ounces of gold, 1,003 ounces of silver, 7,500 pounds of copper; gold-silver, 2 tons—164 ounces gold, 2,253 ounces of silver; silver, 4,947 tons—165 ounces gold, 13,198 ounces silver, 11,700 pounds copper, 285,500 pounds lead; lead, 586 tons—3 ounces gold, 3,082 ounces silver, 800 pounds copper, 91,100 pounds lead; zinc-lead, 2,529 tons—103 ounces gold, 11,862 ounces silver, 55,900 pounds copper, 403,500 pounds lead, and 610,400 pounds zinc.
[3] Combined to avoid disclosure of individual output.
[4] Tungsten-ore tonnage not included.

METALLURGICAL INDUSTRY

Of the lode material from California mines sold or treated during 1951, 92 percent went to mills and 8 percent to smelters. Most of the ore milled was handled at company-owned metallurgical plants; the few mills that received custom material included: Burton Bros. Inc. (cyanidation), Butte Lode Mining Co. (cyanidation and amalgamation), and Mojave Mining & Milling Co. (concentration), Kern County; and Empire Star Mines Co., Ltd. (cyanidation), Nevada County. Improvements made at mills treating the complex base-metal ores in Shasta and Calaveras Counties resulted in higher zinc, lead, and copper content of concentrates produced. Addition of a 135-ton oxide section to Anaconda Copper Mining Co. Darwin flotation plant provided for expanded mine and mill production. Installation of a fuming unit at the American Smelting & Refining Co. Selby lead plant, Contra Costa County, was in progress. Recovery of

considerable zinc from slag piles was anticipated. During 1951 the Selby plant treated domestic material from 9 States and Alaska, as well as material from 14 foreign countries. The Lippincott Lead Co. reduced argentiferous lead ore in its blast furnace at Santa Ana, Orange County, operated in conjunction with a storage-battery plant; the furnace was moved to a site near Bonnie Clare, Nev., late in 1951. Data on California ores were published.[2]

TABLE 7.—Mine production of gold, silver, copper, lead, and zinc in California in 1951, by method of recovery and type of material processed, in terms of recoverable metal

Method of recovery and type of material processed	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Lode:					
Amalgamation:					
Ore	[1] 97,452	16,780	----------	----------	----------
Old tailings	127	22	----------	----------	----------
Total	97,579	16,802	----------	----------	----------
Cyanidation:					
Ore	44,806	48,980	----------	----------	----------
Old tailings	162	266	----------	----------	----------
Total	44,968	49,246	----------	----------	----------
Total recoverable in bullion	[1] 142,547	66,048	----------	----------	----------
Concentration, and smelting of concentrates:					
Ore	6,059	736,799	1,393,600	14,597,700	16,514,700
Old tailings	160	671	7,200	----------	----------
Total	6,219	737,470	1,400,800	14,597,700	16,514,700
Direct smelting:					
Ore	2,772	297,733	251,100	12,556,200	2,078,900
Old tailings, etc	320	27,635	67,500	759,600	610,400
Copper precipitates	----------	----------	97,300	----------	----------
Old slag	250	3,871	25,300	20,500	----------
Total	3,342	329,239	441,200	13,336,300	2,689,300
Placer	187,624	12,462	----------	----------	----------
Grand total	339,732	1,145,219	1,842,000	27,934,000	19,204,000

[1] Includes gold recovered and sold as "natural gold."

[2] Engel, A. L., Simple Treatment Methods for Oxide Gold and Silver Ores: Bureau of Mines Rept. of Investigations 4758, 1951, 14 pp. Simple Treatment Methods for Sulfide Gold and Silver Ores: Bureau of Mines Rept. of Investigations 4790, 1951, 17 pp.

TABLE 8.—Mine production of gold, silver, copper, lead, and zinc in California in 1951, by method of recovery (except placer) and class of material processed, in terms of recoverable metal

A. For material treated at mills

	Material treated (short tons)	Recoverable in bullion		Concentrate shipped to smelters [1] and recoverable metal					
		Gold (fine ounces)	Silver (fine ounces)	Concentrate (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
BY COUNTIES									
Amador	41,957	15,348	3,294	9	82	19			
Butte	150	65	9						
Calaveras	22,226	828	221	2,770	841	39,442	401,400	89,100	1,767,300
El Dorado	17,947	3,037	427	135	335	605		13,300	
Imperial	1,785	786	202						
Inyo	122,307	32	74	22,518	2,518	560,787	246,400	13,504,900	9,226,900
Kern	12,473	7,591	25,418	33	988	1,223	300	2,500	7,800
Los Angeles	354	107	51	5	116	111			
Madera and Mariposa [2]	495	103	26	17	53	50		600	
Modoc and Mono [2]	6,201	822	1,231						
Nevada	[3] 176,230	[3] 95,605	[3] 30,938	6	87	160			
Placer	212	291	500						
Plumas	90	31	4						
Riverside	489	37	21						
Sacramento	1	31	6						
San Bernardino	5,904	375	211	129	114	1,081	9,100	8,700	3,500
Shasta	21,077	55	7	7,627	667	133,863	743,400	978,600	5,509,200
Sierra	22,179	17,040	3,349	55	405	120	100		
Siskiyou	95	92	24	1	1	3	100		
Trinity	8	37	7						
Tuolumne	37	234	28	4	12	6			
Total:									
1951	452,217	142,547	66,048	33,309	6,219	737,470	1,400,800	14,597,700	16,514,700
1950	513,934	152,843	50,336	29,740	5,391	623,099	925,200	16,679,700	13,666,600
BY CLASS OF MATERIAL TREATED									
Dry gold:									
Crude ore	278,620	141,373	52,590	339	2,322	1,999	200	15,900	400
Old tailings and tungsten ore [2]	[4] 9,345	292	289	240	205	6,112	39,700		
Dry gold-silver ore	1,645	672	13,085	7	27	717			
Dry silver ore	477		2	39	7	3,897	200	26,900	
Lead ore	28,606			5,613	2,027	87,433	24,200	3,828,200	433,400
Lead-copper ore	36			13		431	1,900	8,700	3,500
Zinc ore	40,370	210	82	10,362	1,216	172,898	1,145,100	1,068,300	7,284,300
Zinc-lead ore	93,118			16,696	415	463,983	189,500	9,649,700	8,793,100
Total 1951	452,217	142,547	66,048	33,309	6,219	737,470	1,400,800	14,597,700	16,514,700
BY CLASS OF CONCENTRATE SHIPPED TO SMELTERS [1]									
Dry gold				246	2,336	1,767	300	2,900	
Dry gold-silver				2	13	510			
Copper				[5] 1,030	[5] 427	[5] 37,616	[5] 367,800	58,600	200
Lead				14,683	2,630	508,140	142,500	12,960,800	1,415,700
Zinc				14,410	357	85,496	234,800	650,200	14,272,200
Zinc-lead				14		100	300	2,500	7,800
Zinc-lead-copper				2,924	456	103,841	655,100	922,700	818,800
Total 1951				33,309	6,219	737,470	1,400,800	14,597,700	16,514,700

For footnotes, see end of table.

TABLE 8.—Mine production of gold, silver, copper, lead, and zinc in California in 1951, by method of recovery (except placer) and class of material processed, in terms of recoverable metal—Continued

B. For material shipped directly to smelters

	Material shipped (short tons)	Recoverable metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
BY COUNTIES						
Alpine	1		1			
Amador	152	9	336	14,700		
Butte	35	28	22			
Calaveras	329	5	325	86,000		
El Dorado	18	1	15	3,700		
Imperial	1	8	2			
Inyo	35,693	2,293	295,371	100,000	12,574,600	1,950,000
Kern	15	167	6,559			
Los Angeles	2	22	6			
Madera	1			1,200		
Modoc	26	122	157			
Riverside	181		1,186		51,100	
San Bernardino	2,611	463	10,789	95,300	301,000	128,900
Shasta	2,804	189	14,383	136,400	409,600	610,400
Sierra	2	4	1			
Trinity	40	1	11	3,200		
Tuolumne	19	30	38	300		
Tulare	4		37	400		
Total: 1951	41,934	3,342	329,239	441,200	13,336,300	2,689,300
1950	33,307	5,581	380,172	366,800	14,982,300	1,435,400
BY CLASS OF MATERIAL						
Dry gold:						
Crude ore	130	245	225		400	
Old tailings	21	50	42	300		
Old slag	1	8	2			
Dry gold-silver: Old slag	2	164	2,253			
Dry silver:						
Crude ore	2,964	10	16,223	500	210,100	100
Old tailings, etc	4,795	164	12,791	10,700	270,800	
Old slag	152	1	407	1,000	14,700	
Copper:						
Crude ore	1,553	442	4,109	151,900		
Precipitates	80			97,300		
Old slag	156	77	1,067	24,100		
Lead:						
Crude ore	28,426	2,073	271,706	97,100	12,257,500	1,942,100
Old tailings, etc	527	3	2,940	600	85,300	
Old slag	59		142	200	5,800	
Lead-copper ore	19		299	1,100	6,000	
Zinc ore	186	2	4,928	400	2,000	67,500
Zinc-lead:						
Crude ore	334		243	100	80,200	69,200
Old tailings, etc	2,529	103	11,862	55,900	403,500	610,400
Total: 1951	41,934	3,342	329,239	441,200	13,336,300	2,689,300

[1] Excludes concentrates treated only by amalgamation and/or cyanidation.
[2] Combined to avoid disclosure of individual output.
[3] Includes ore milled and contained recoverable metal from Yuba County.
[4] Tungsten ore tonnage not included with material treated.
[5] Includes concentrates and contained recoverable metal from tungsten ore.

TABLE 9.—Mine production of gold, silver, copper, lead, and zinc in California in 1951, by method of recovery (except placer) and class of material processed, in terms of gross metal content

Class of material	Quantity shipped or treated (short tons)	Gross metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
CONCENTRATE SHIPPED TO SMELTERS						
Dry gold	246	2,336	1,767	523	3,167	
Dry gold-silver	2	13	510	1	40	
Copper	[1] 1,030	[1] 427	[1] 37,616	[1] 377,330	102,716	206,094
Lead	14,683	2,630	508,140	167,810	13,185,370	1,769,615
Zinc	14,410	401	93,185	281,593	715,989	14,917,456
Zinc-lead	14		100	350	2,520	9,800
Zinc-lead-copper	2,924	456	103,841	770,756	938,623	1,023,503
Total: 1951	33,309	6,263	745,159	1,598,363	14,948,425	17,926,468
1950	29,740	5,411	625,266	1,028,529	17,022,991	14,757,966
ORE, ETC., SHIPPED DIRECTLY TO SMELTERS						
Dry gold:						
Crude ore	130	247	227	61	737	
Old tailings	21	50	42	396	48	
Old slag	1	8	2			
Dry gold-silver: Old slag	2	164	2,253			
Dry silver:						
Crude ore	2,964	10	16,223	756	215,714	5,886
Old tailings, etc	4,795	164	12,791	14,236	277,577	
Old slag	152	1	407	1,342	15,102	
Copper:						
Crude ore	1,553	442	4,109	155,565		547
Precipitates	80			100,308		
Old slag	156	77	1,067	24,852		48,172
Lead:						
Crude ore	28,426	2,073	272,256	117,508	12,485,100	2,480,545
Old tailings, etc	527	3	2,940	906	87,565	18,405
Old slag	59		142	236	5,993	
Lead-copper ore	19		299	1,555	6,295	2,495
Zinc ore	186	3	5,584	507	2,180	82,525
Zinc-lead:						
Crude ore	334		243	254	81,493	86,419
Old tailings, etc	2,529	103	11,862	64,835	410,341	762,518
Total: 1951	41,934	3,345	330,447	483,317	13,588,145	3,487,512
1950	33,307	5,582	381,059	389,281	15,254,409	2,021,855

[1] Includes concentrate and contained metal from tungsten ore.

REVIEW BY COUNTIES

ALPINE

Anaconda Copper Mining Co. acquired the Leviathan mine, Monitor district, a source of both copper and sulfur ores in prior years. The company planned to utilize sulfur ore to manufacture sulfuric acid at its Yerington, Nevada, copper project.

AMADOR

There was no lode mining of any consequence other than at the Central Eureka Mining Co. Old Eureka mine, Mother Lode district, where 38,400 tons of gold ore was milled compared to 39,993 tons in 1950. The Lorentz & Swingle dragline dredge, Cosumnes River district, led in production of placer gold.

BUTTE

Lode gold and silver produced was from small mines worked sporadically. Principal producers of placer gold were Yuba Consolidated Gold Fields' three bucket-line dredges, Oroville district, and the Thurman & Wright dragline dredge No. 3, Butte Creek district, moved from Mariposa County and put into operation October 16, 1951.

CALAVERAS

West Belt district base-metal mines overshadowed those of other County districts in 1951. The Penn mine (Penn Chemical Co., Inc.) produced copper, zinc, and gold concentrates from 19,873 tons of ore milled which yielded 771 ounces of gold, 39,020 ounces of silver, 441,100 pounds of copper, 87,200 pounds of lead, and 1,767,300 pounds of zinc. The Star and Excelsior mine (Trebor Corp.) and the Donner mine (Sierra Copper Co.), both copper properties, were under development in 1951 and made small shipments of ore. The Blackstone mine, East Belt district, was the leading lode-gold producer and the Mountain Gold Dredging Co. dragline dredge at Valley Springs, West Belt district (838 ounces of gold and 82 ounces of silver from 126,000 cubic yards of gravel) and the Gold Bar Mining Co. (successor to Alta Mining Co.), Altaville drift mine, Mother Lode district, led in placer-gold output.

EL DORADO

The Hazel Creek Mining Corp. Hazel Creek mine, East Belt district, was the outstanding producer of gold and silver in El Dorado county in 1951. In addition some lead was recovered from concentrate smelted. Calivada Development Co. prepared the El Dorado Copper mine, West Belt district, for further development and in addition to stockpiling 500 tons of milling ore shipped 18 tons of direct-smelting copper ore, which grossed 1 ounce of gold, 15 ounces of silver, 3,756 pounds of copper, and 547 pounds of zinc. The Bureau of Mines explored this property in 1944 and 1945. The River Pine Mining Co., Ltd., dragline dredge, Mother Lode district, leading producer of placer gold, operated 2 months only.

FRESNO

Some gold and silver were produced along the San Joaquin River, Friant district, by suction dredging and in conjunction with sand- and gravel-plant operation.

IMPERIAL

Holmestake Mining Co., Cargo Muchacho district, ceased milling Cargo Muchacho group gold ore in March 1951 to pursue tungsten-ore mining and milling.

INYO

The Anaconda Copper Mining Co. Darwin group, Coso district, continued as California's leading producer of silver, lead, and zinc, although the ore mined in 1951 was lower grade than 1950. To provide for increased output a 135-ton oxide section was added to the mill, and several additions were made to the surface establishment, including 10 new housing units. Shipments of tailings, slag, and dump ore from old workings by lessees augmented the group's total recoverable metal output. Anaconda's Shoshone group, Resting Springs district, followed the Darwin group closely in output, being the State's second-largest producer of silver and lead as well as an important producer of recoverable zinc and gold. Other Inyo County base-metal mines with important, although moderate output, owing largely to limited developed ore reserves, included the Defense mine, lead ore, the Minnietta mine, lead ore and lead concentrate, Modoc district; the Lippincott mine, zinc-lead and lead ores, and the Ubehebe mine, lead ore, Ubehebe district. Considerable tonnages of tailings and dump ore from inactive mines in the Cerro Gordo (Swansea) and Slate Range districts were consigned to a lead smelter. There was little activity in mining gold and silver ores.

KERN

Production of gold and silver in the Mojave district held up well owing largely to operation of Burton Bros., Inc., custom mill where ore from the Tropico and Cactus Queen mines, worked by Burton Mines, Inc., and lessees, the Whitmore group (Red Ink Mining Co.), and the Golden Queen group (N. W. Sweetser et al.), in addition to several smaller properties, was cyanided. Some high-grade silver ore from the Wegman group (Bert Wegman) was shipped directly to the smelter. The Yellow Aster mine (King Solomon Lease) led in Randsburg district gold production followed by the Butte Lode Mining Co. which also operated a custom mill. Basin Mining Co. produced moderate quantities of gold and silver at the Joe Walker mine, Green Mountain (Piute) district. Placer gold and silver was recovered incidental to sand and gravel operations in the Kern River district, and from Randsburg district dry washers and pannings. Mill tests were made on Black Hawk mine, Agua Caliente district, zinc ore.

LOS ANGELES

Lode gold and silver mining was small-scale and sporadic. By-product placer gold and silver were recovered at the Azusa Rock & Sand Co., San Gabriel district.

MADERA

Suction dredging was continued throughout 1951 in the Chowchilla River, Fresno River, Friant, and Hildreth districts; the Howell Bros. dredge, Chowchilla River district, led in production of gold and silver. Some copper precipitates were produced from the Daulton mine water, West Belt district.

TABLE 10.—Mine production of gold, silver, copper, lead, and zinc in California in 1951, by county and district, in terms of recoverable metal

County and district	Mines producing [1]		Lode material (short tons)	Gold (fine ounces)			Silver (lode and placer,[2] fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
	Lode	Placer		Lode	Placer	Total					
Alpine County: Monitor (Mogul)	1		1				1				$1
Amador County:											
Cosumnes River [3]		1			115	115	15				4,038
East Belt [4]	4	2	110	41	111	152	24				5,342
Mother Lode [5]	2	(6)	41,850	15,393	32	15,425	3,308				542,869
West Belt [7]	1		149	5		5	334	14,700			4,034
Butte County:											
Butte Creek	1	2	150	65	(8)	[9] 65	[9] 9				[9] 2,283
Forbestown (Enterprise)	1	1	35	28	9	37	22				1,315
Honcut		(6)			4	4					140
Magalia		1			3	3					105
Oroville (Palermo)		2			(8)	(8)	(8)				(8)
Yankee Hill (Cherokee)		(6)			8	8	1				281
Calaveras County:											
East Belt [4]	1	1	2,350	896	35	931	646		1,900		33,499
Mother Lode [5]	1	3	(8)	(8)	194	[10] 194	21				[10] 6,809
West Belt (Campo Seco) (Jenny Lind) [7]	3	1	20,202	776	846	1,622	39,408	487,400	87,200	1,767,300	547,120
El Dorado County:											
American River (Folsom) [11]		1			85	85	5				2,980
East Belt [4]	2	1	(8)	(8)	1	[10] 1	(8)		(8)		[10] 35
Mother Lode [5]	4	2	13,138	624	(8)	[9] 624	[9] 87				[9] 21,919
West Belt (Pilot Hill) [7]	2	(6)	28	3	6	9	15	3,700			1,224
Fresno County: Friant [12]		1			(8)	(8)	(8)				(8)
Humboldt County:											
Gold Bluff		(6)			2	2					70
Orleans		2			4	4					140
Imperial County: Cargo Muchacho	2		1,786	794		794	204				27,975
Inyo County:											
Big Pine		1			3	3					105
Bishop (Pine Creek)	1		tungsten ore	(8)		(8)	(8)	(8)			(8)
Cerro Gordo (Swansea)	5		1,325				5,344	800	136,300		28,610
Chloride Cliff	1		48	58		58	29				2,056
Confidence	1		(8)				(8)		(8)		(8)
Coso (Darwin)	3		108,842	545		545	570,595	217,200	14,382,200	9,439,300	4,794,128
Deep Springs	1		10	2		2	1				71
Fish Springs	1		4	1		1	7		800		179
Independence	1		8	12		12	57				472
Lee	1		77	2		2	4,221	400	3,000	20,700	8,273
Modoc	3		2,374	29		29	29,935	7,900	634,000		139,702
Resting Springs	1		(8)	(8)		(8)	(8)	(8)	(8)	(8)	(8)
Sherman	1		1	2		2	1				71
Slate Range [13]	1		2,059	147		147	4,153	10,100	106,000		29,686
South Park	1		25	23		23	24			400	900

Ubehebe	2		(8)				(8)	(8)	(8)	(8)	(8)
Wild Rose	5		95	17		17	235	400	600		1,009
Kern County:											
Agua Caliente (Amalie)	2		127	4		4	102	300	2,500	7,800	2,157
Green Mountain (Plute)	1		500	961		961	406				34,003
Kern River (Bakersfield)		1			(8)	(8)	(8)				(8)
Mojave	7		10,323	7,342		7,342	32,551				286,430
Rademacher	1		7	14		14	9				498
Randsburg [14]	7	3	1,531	425	150	575	168				20,278
Los Angeles County:											
Cedar	2		131	101		101	22				3,555
Neenach	1		(8)	(8)		(8)	(8)				(8)
San Gabriel		1			65	65	9				2,283
Madera County:											
Chowchilla River		3			511	511	144				18,015
Fresno River (Dennis)		3			48	48	15				1,693
Friant [2]		2			19	19	4				669
Hildreth		2			3	3	1				106
Potter Ridge	1		(8)	(8)		(8)	(8)				(8)
West Belt [7]	1		1					1,200			290
Mariposa County:											
East Belt [4]	3	(6)	317	76	10	86	53		600		3,162
Mother Lode [5]	4		128	24		24	11				850
West Belt (Hunter Valley) [7]	1	1	Cleanup	20	(8)	[9] 20	[9] 6				[9] 706
Merced County: Merced River		1			4,768	4,768	511				167,342
Modoc County:											
High Grade	2		34	26		26	14				923
Winter	1		(8)	(8)		(8)	(8)				(8)
Mono County: Masonic	1		(8)	(8)		(8)	(8)				(8)
Nevada County: [10]											
French Corral		5			753	753	62				26,411
Grass Valley-Nevada City [15]	4	1	169,448	[15] 94,086	25	[15] 94,111	[15] 30,825				[15] 3,321,784
Washington (North Bloomfield)	3	6	6,782	1,606	804	2,410	393				84,705
You Bet		2			11	11					385
Placer County:											
American River (Folsom) [11]		2			39	39	2				1,367
Auburn (Penryn)	1	(6)	212	284	23	307	503				11,201
Blue Canyon		1			1	1					35
Dutch Flat		(6)			79	79	7				2,771
Foresthill		1			67	67	7				2,351
Iowa Hill		2			41	41	6				1,441
Last Chance		2			119	119	10				4,174
Michigan Bluff	(6)	1	Cleanup	7	4	11	1				386
Ralston Divide		(6)			(8)	(8)	(8)				(8)
Plumas County:											
Butte Valley		(6)			5	5	1				176
Genesee	1	(6)	30	19	16	35	3				1,228
Greenville	(6)	(6)	Cleanup	3	7	10					350
Johnsville	1		10	7		7	1				246
La Porte		2			110	110	8				3,857
Quincy		(6)			8	8	1				281
Rich		(6)			12	12	1				421
Sawpit Flat		1			8	8					280
Virgilia	1		50	2		2					70

For footnotes, see end of table.

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TABLE 10.—Mine production of gold, silver, copper, lead, and zinc in California in 1951, by county and district, in terms of recoverable metal—Continued

County and district	Mines producing [1]		Lode material (short tons)	Gold (fine ounces)			Silver (lode and placer,[2] fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
	Lode	Placer		Lode	Placer	Total					
Riverside County:											
Dale (Montenegro) [16]	3		487	35		35	20				$1,243
Ironwood	1		181				1,186		51,100		9,913
Pinacate	2		2	2		2	1				71
Sacramento County:											
American River (Folsom) [11]	1	8	1	31	86,712	86,743	3,788				3,039,433
Cosumnes River [3]		2			(3)	(3)	(3)				(3)
San Bernardino County:											
Barstow	1		5,000	66		66	646	7,200			4,637
Belleville (Ord Mountain)	2		2	2		2	95				156
Black Hawk	1		121	214		214	89				7,570
Buckeye	1		(3)	(3)		(3)	(3)	(3)			(3)
Calico	1		470	165		165	15				5,789
Clark Mountain	4		1,307	31		31	5,481	9,800	274,200	61,300	67,012
Dale [16]	2		6	7		7	6				250
Ivanpah	1		109				707		2,000	67,500	13,271
Lava Bed (Newberry)	1		42				225		1,800		515
Morongo	1		3				6		1,100		195
Needles	1		5				38		2,700		501
New York Mountains	1		55				730	3,000	14,700	3,500	4,567
Providence	2		101	5		5					175
Randsburg [14]	1	1	158	27	2	29	7				1,021
Shadow Mountain	1		13				266		4,400		1,002
Silver Mountain	2		9	3		3	3				108
Slate Range [18]	1		4				11		200	100	63
Soda Lake	1		59	1		1	324	800	6,800		1,699
Solo	1		5				45		1,800		352
Whipple Mountains	2		21				10	2,000			493
San Joaquin County: Mokelumne River (Camanche)		1			(3)	(3)	(3)				(3)
San Mateo County: San Mateo (Beach)		(3)			4	4	1				141
Shasta County:											
Battle Creek		(3)			1	1					35
Bully Hill	1		156	77		77	1,067	24,100			9,493
Cottonwood		(3)			1	1					35
Cow Creek (Ingot)	1		(3)	(3)		(3)	(3)	(3)	(3)	(3)	(3)
Dog Creek		(3)			5	5					175
Flat Creek	3	(3)	2,645	111	1	112	13,315	112,300	409,600	610,400	225,102
French Gulch	1	(3)	160	5	6	11	2				387
Harrison Gulch		(3)			1	1					35
Igo	1		20	1		1					35

Redding	2	2	423	10	2,400	2,410	289				84,611
Rock Creek		(6)			19	19	3				668
Shasta	1	1	40	52	33	85	7				2,981
Sierra County:											
Alleghany	3	2	17,330	10,705	71	10,776	1,907	100			378,910
Downieville	3	3	4,578	6,685	54	6,739	1,553				237,270
Pike (Indian Hill)	1	1	250	45	30	75	20				2,643
Poker Flat (Port Wine) (Table Rock)		2			17	17	3				598
Poverty Hill (Scales)		2			24	24					840
Sierra City	2		23	14		14					490
Siskiyou County:											
Cottonwood (Ash Creek)		(6)			3	3	1				106
Klamath River	3	2	94	59	95	154	28	100			5,439
Salmon River		2			21	21	3				738
Scott River	1	3	1	34	3,885	3,919	474				137,594
Yreka		(6)			4	4					140
Stanislaus County:											
Stanislaus River		1			8	8	1				281
Tuolumne River		1			(8)	(8)	(8)				(8)
Trinity County:											
Forest Glen	1		39				11	3,200			784
Hayfork	1	1	8	37	3	40	7				1,406
New River		2			9	9	1				316
Trinity River	1	12	1	1	7,721	7,722	808				271,001
Tulare County: Camp Wishon	1		4				37	400			131
Tuolumne County:											
East Belt [4]	4	(6)	24	81	4	85	13				2,987
Mother Lode [5]	6	1	32	195	34	229	68	300			8,149
Yuba County:											
Browns Valley	1	(6)	(15)	(15)	11	[16] 11	[15] 2				[16] 387
Camptonville		3			47	47	7				1,651
Dobbins		2			16	16	3				563
Smartville		(6)			59	59	4				2,068
Strawberry		(6)			6	6					210
Yuba River		1			(8)	(8)	(8)				(8)
Undistributed [17]			75,864	8,937	77,153	86,090	387,326	934,600	11,808,500	7,225,700	6,947,818
Total California	173	121	494,151	152,108	187,624	339,732	1,145,219	1,842,000	27,934,000	19,204,000	21,700,575

[1] Excludes itinerant prospectors, "snipers," high-graders," and others who gave no evidence of legal right to property.
[2] Source of total silver as follows: 1,132,757 ounces from lode mines and 12,462 ounces from placer mines.
[3] Cosumnes River district lies in Amador and Sacramento Counties.
[4] East Belt district lies in Amador, Calaveras, El Dorado, Mariposa and Tuolumne Counties.
[5] Mother Lode district lies in Amador, Calaveras, El Dorado, Mariposa and Tuolumne Counties.
[6] From property not classed as a mine.
[7] West Belt district lies in Amador, Calaveras, El Dorado, Madera and Mariposa Counties.
[8] Included with "Undistributed" in order to avoid disclosure of individual company operations.
[9] Exclusive of placer output which is included with "Undistributed."
[10] Exclusive of lode output which is included with "Undistributed."
[11] American River (Folsom) district lies in El Dorado, Placer, and Sacramento Counties.
[12] Friant district lies in Fresno and Madera Counties.
[13] Slate Range district lies in Inyo and San Bernardino Counties.
[14] Randsburg district lies in Kern and San Bernardino Counties.
[15] Browns Valley district, Yuba County lode gold and lode silver included with Grass Valley-Nevada City district, Nevada County.
[16] Dale district lies in Riverside and San Bernardino Counties.
[17] Includes values and quantities which cannot be shown separately for certain individual districts as indicated in the appropriate column by footnote reference 8.

MARIPOSA

Except for moderate outputs of gold and silver and recovery of some lead in concentrates from the Marble Springs mine (Glenn-Steintorf Co.), East Belt district, lode mining was very small-scale and sporadic. Thurman & Wright dragline dredge No. 3, largest producer of county gold and silver, terminated operations in the West Belt (Hunter Valley) district in June 1951; the boat was moved to Butte County.

MERCED

Snelling Gold Dredging Co. bucket-line dredge operated throughout the year in the Merced River district.

MONO

Sarita group, Masonic district, gold ore was cyanided during 1951 by Sarita Milling Co.

NEVADA

The Grass Valley–Nevada City district continued to be the State's principal producer of lode gold, largely from the Idaho Maryland Mines Corp. Brunswick-Idaho Maryland mine and the Empire Star Mines, Co., Ltd., Empire Star group. The Ancho Erie Mining Co. closed the Ancho & Erie groups, Washington district, September 30, 1951. Chief placer mines were Minona Mining Co., French Corral district, and Crescent Pacific Mining Co., Washington (North Bloomfield) district. Gravel at both properties was moved mechanically to nonfloating washing plants.

PLACER

The Mary Len mine (A. H. L. Mining Co.), Auburn (Penryn) district, operated from January to July 1951; 212 tons of ore milled yielded values in gold and silver. The American Hill mine, Last Chance district, sluiced by W. B. Pendleton, led in output of placer gold.

RIVERSIDE

Precious-metal mining was small scale. Dan Figueroa & Sons developed the Bald Eagle mine, Ironwood district, and shipped 181 tons of direct smelting ore that grossed 1,186 ounces of silver, 52,415 pounds of lead, and 1,901 pounds of zinc.

SACRAMENTO

The American River (Folsom) district, by virtue of dredging and gold recovered at commercial sand and gravel plants, was the State's leading placer district; the Natomas Co. seven bucket-line dredges, the Capital Dredging Co. bucket-line dredge, and the General Dredging Co. dragline dredge were the principal producers of placer gold. Cosumnes Gold Dredging Co. bucket-line dredge, Cosumnes River district, closed late in 1951, also had important gold output.

SAN BERNARDINO

Several small properties developed precious-metal ores, but the largest output was from the Rambler & Hill Top claims, Black Hawk district; 121 tons of gold ore milled grossed 228 ounces of gold and 111 ounces of silver. Base-metal mines also operated on a small scale and included the Bagdad-Chase, Buckeye district, copper ore; Carbonate King mine, zinc-lead and lead ores, and Mohawk mine, lead ore, Clark Mountain district; Carbonate King Zinc mine, Ivanpah district, zinc ore; and Sagamore mine, New York Mountains district, lead-copper ore. Some copper was recovered at Barstow, by milling Hoffman Estate tailings, largely from the old Bagdad-Chase mine.

SAN JOAQUIN

The Gold Hill Dredging Co. Lower Comanche bucket-line dredge, the county's sole operation producing gold and silver, closed in June 1951.

SHASTA

Led by the Coronado Copper and Zinc Co. Afterthought mine, Cow Creek (Ingot) district, which produced gold, silver, copper, lead, and zinc from its dwindling reserves of zinc ore, metal output rose sharply in 1951. Considerable zinc, lead, and copper, as well as gold and silver, were recovered from slag and flue dust shipped from sites of abandoned copper smelters in the Bully Hill and Flat Creek districts. Following a study of the area by the U. S. Geological Survey, exploration was begun December 1951 at the Bully Hill and Rising Star mines, Bully Hill district, which had substantial outputs of copper, zinc, gold, and silver, before 1928. The Mountain Copper Co. planned expansion of operations at its pyritic ore body in the Flat Creek district with eventual extraction of contained metals by leaching. Lode gold mining was quiescent, and placer mining waned after April 1951, when the Thurman Gold Dredging Co. bucket-line dredge, Redding district, leading producer of placer gold, was dismantled.

SIERRA

The Original Sixteen to One mine, Alleghany district, and Brush Creek mine (Best Mines Co.) led in production of gold and silver from gold ore milled.

SISKIYOU

Lode-gold mining was sporadic, and placer-mining output fell sharply after March 1951, when Yuba Consolidated Gold Fields Siskiyou unit bucket-line dredge, leading producer of gold in Siskiyou County, terminated dredging in the Scott River district.

STANISLAUS

The La Grange Gold Dredging Co. bucket-line dredge No. 4, the only boat that operated in the county in 1951, terminated dredging in the Tuolumne River district June 1951.

TRINITY

The Fairview Placers bucketline dredge at Minersville, Trinity River district, led the county in producing gold and silver. Bucketline dredges worked, respectively, at Coffee Creek and near Weaverville, Trinity River district, closed before December 1951. Hydraulic mining waned, and lode gold mining was small scale. Ore depletion terminated activity at the Copper King copper mine, Forest Glen district; 39 tons of direct smelting ore shipped grossed 11 ounces of silver and 3,338 pounds of copper.

TUOLUMNE

Gold and silver produced was largely from pocket mines worked in the East Belt and Mother Lode districts.

YUBA

Except the operation of Yuba Consolidated Gold Fields Yuba unit, Yuba River district, comprising five bucket-line boats engaged principally in deep dredging, placer mining declined in other districts. The Empire Star Mines Co., Ltd., lessee-operated Browns Valley group, Browns Valley district, produced gold and silver in conjunction with the company's Nevada County mines.

OTHER COUNTIES

Rehabilitation of the Alta copper mine, Low Divide district, Del Norte County, worked between 1860 and 1870, was begun. Occasional operation of small properties resulted in minor outputs of gold and silver from Humboldt, Modoc, and Plumas Counties. San Mateo County beach sands yielded minor quantities of gold and silver. Test shipments of copper ore to smelters were made from the Powell mine, Camp Wishon district, Tulare County.

Colorado
Gold, Silver, Copper, Lead, and Zinc

(MINE REPORT)

By A. J. Martin

GENERAL SUMMARY

ECONOMIC factors that affected production of gold, silver, copper, lead, and zinc in Colorado in 1951 were essentially the same as during the closing months of 1950, after prices of most commodities had risen sharply and larger expenditures for national defense had been authorized by Congress as a result of the outbreak of fighting in Korea. The rise in wages and cost of materials, with no change in the domestic price of gold, accentuated the depression in straight gold mining. On the other hand, the advance in prices of and strong demand for copper, lead, and zinc stimulated mining in the districts producing chiefly base metals or gold and silver along with important quantities of the base metals. The output of zinc was the largest in quantity since 1917 and the highest in value since commercial recovery of zinc from Colorado ores was begun in 1885. Lead production, increasing for the fifth consecutive year, was the largest in quantity since 1927 and, like zinc, established a new record for value. Gains in quantity over 1950 were 22 percent for zinc and 12 percent for lead. Copper output increased 2 percent in quantity. Gold production decreased 11 percent and silver 20 percent from 1950. The total value of the output of the five metals, of which 79 percent was in zinc and lead, was $38,931,539 in 1951 compared with $29,323,268 in 1950.

The decrease in the State output of gold and silver was due mainly to a decline in the average gold and silver content of the base-metal and complex ores mined; some of the decrease in gold was due to lower production from placer operations. Mining on a substantial scale was resumed in the Cripple Creek gold district in April 1951, when the new 1,000-ton Carlton custom mill of the Golden Cycle Corp. completed preliminary test runs and began buying ore.

All tonnage figures reported herein are short tons and "dry weight"; that is, they do not include moisture. The value of production has been calculated at the prices shown in table 1.

Gold.—Production of gold in Colorado totaled 116,503 fine ounces in 1951 compared with 130,390 ounces in 1950. The average gold content of the base-metal ores mined declined sharply, and less gold was recovered from placers. Gold production in the Cripple Creek district increased from 5,779 ounces in 1950 to 27,699 ounces in 1951 owing to reopening of a number of mines that had shut down early in 1949 to await completion of the 1,000-ton Carlton custom mill of the

TABLE 1.—Prices of gold, silver, copper, lead, and zinc, 1947–51

Year	Gold [1] (per fine ounce)	Silver [2] (per fine ounce)	Copper [3] (per pound)	Lead [3] (per pound)	Zinc [3] (per pound)
1947	$35.00	$0.905	$0.210	$0.144	$0.121
1948	35.00	.905+	.217	.179	.133
1949	35.00	.905+	.197	.158	.124
1950	35.00	.905+	.208	.135	.142
1951	35.00	.905+	.242	.173	.182

[1] Price under authority of Gold Reserve Act of Jan. 31, 1934.
[2] Treasury buying price for newly mined silver July 1, 1946, to date—$0.9050505 ($0.905 used in 1947 for calculating purposes).
[3] Yearly average weighted price of all grades of primary metal sold by producers. Price in 1947 includes bonus payments by Office of Metals Reserve for overquota production.

Golden Cycle Corp. The mill began commercial operations in April 1951.

The Upper San Miguel district again ranked first in gold production, Cripple Creek second, California (Leadville) third, Fairplay fourth, and Animas fifth. Dry gold and silver ores yielded 35 percent of the total gold; zinc-lead and zinc-lead-copper ores 49 percent; other ores, old slag, old tailings, and mill clean-ups 4 percent; and placers 12 percent. The leading gold-producing properties, in order of rank, were: Treasury Tunnel-Black Bear (Idarado) group in San Miguel County; Resurrection group at Leadville; Smuggler Union group (Telluride Mines) at Telluride; South Platte Dredging Co. connected-bucket dredge near Fairplay; and Ajax (Golden Cycle Corp.) group at Cripple Creek.

Silver.—Colorado mines produced 2,787,882 fine ounces of silver in 1951 compared with 3,492,278 ounces in 1950. The decrease was due to a decline in the average silver content of the complex and base-metal ores mined. Zinc-lead and zinc-lead-copper ores yielded 54 percent of the total silver in 1951; dry gold and silver ores 31 percent; and other ores, old slag, old tailings, mill clean-ups, and placer gravel 15 percent. The leading producers of silver were the Treasury Tunnel-Black Bear (Idarado) group in San Miguel County, Eagle mine in Eagle County, Shenandoah-Dives group near Silverton, Emperius Mining Co. group at Creede, and Resurrection group at Leadville.

TABLE 2.—Mine production of gold, silver, copper, lead, and zinc in Colorado in 1951, by months, in terms of recoverable metal [1]

Month	Gold (fine ounces)	Silver (fine ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
January	10,125	293,895	337	2,801	4,798
February	8,462	249,772	265	2,268	4,420
March	9,009	296,948	378	2,788	5,375
April	6,639	229,848	294	2,768	4,932
May	8,731	225,347	272	2,485	4,485
June	8,740	228,440	282	2,551	4,701
July	10,006	242,094	249	2,528	4,344
August	9,523	234,562	243	2,619	4,982
September	10,104	235,222	260	2,568	4,796
October	12,515	182,273	212	2,457	4,404
November	10,483	179,345	207	2,293	4,401
December	12,166	190,136	213	2,210	4,076
Total	116,503	2,787,882	3,212	30,336	55,714

[1] Mine production comprises ore, gravel, or other mineral material sold or treated and metal recovered as natural gold or as bullion from cyanidation or amalgamation and the estimated recoverable metal (or gross metal as indicated) contained in concentrates, ores, tailings and other mineral materials shipped directly to smelters or sold to ore buyers within the year.

TABLE 3.—Mine production of gold, silver, copper, lead, and zinc in Colorado, 1947–51, and total, 1858–1951, in terms of recoverable metal [1]

Year	Mines producing		Material sold or treated [2] (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1947	290	33	1,544,694	168,279	$5,889,765	2,557,653	$2,314,676
1948	271	23	1,438,119	154,802	5,418,070	3,011,011	2,725,117
1949	255	27	1,262,355	102,618	3,591,630	2,894,886	2,620,018
1950	202	30	1,372,744	130,390	4,563,650	3,492,278	3,160,688
1951	196	21	1,578,466	116,503	4,077,605	2,787,882	2,523,174
1858–1951			[3]	39,730,535	884,445,689	745,170,388	580,913,798

Year	Copper		Lead		Zinc		Total value
	Short tons	Value	Short tons	Value	Short tons	Value	
1947	2,150	$903,000	18,696	$5,384,448	38,745	$9,376,290	$23,868,179
1948	2,298	997,332	25,143	9,001,194	45,164	12,013,624	30,155,337
1949	2,403	946,782	26,853	8,485,548	47,703	11,830,344	27,474,322
1950	3,141	1,306,656	27,007	7,291,890	45,776	13,000,384	29,323,268
1951	3,212	1,554,608	30,336	10,496,256	55,714	20,279,896	38,931,539
1858–1951	263,915	71,993,747	2,589,917	279,571,199	1,572,300	269,760,926	2,086,685,359

[1] Includes recoverable metal content of gravel washed (placer operations), ore milled, old tailings or slimes re-treated, and ore, old slag or tailings shipped to smelters during the calendar year indicated.
[2] Does not include gravel washed.
[3] Figure not available.

Copper.—The State output of recoverable copper in 1951 was 3,212 short tons compared with 3,141 tons in 1950. The Idarado Mining Co., which makes a copper concentrate from complex gold-silver-copper-lead-zinc ore mined in San Miguel County, was again the only substantial producer of copper in the State.

Lead.—The mine output of lead in Colorado, increasing for the fifth year in succession, rose from 27,007 short tons in 1950 to 30,336 tons in 1951. San Miguel County contributed 27 percent of the total, Lake County 20, San Juan 15, Eagle 14, Dolores 7, Ouray and Mineral

TABLE 4.—Gold and silver produced at placer mines in Colorado, 1947–51, in fine ounces, in terms of recoverable metal

Year	Small-scale hand methods [1]		Gravel mechanically handled				Total	
			Nonfloating washing plants [2]		Bucket-line and dragline dredges			
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
1947	243	52	930	156	16,400	3,243	17,573	3,451
1948	106	29	662	103	12,479	2,680	13,247	2,812
1949	137	33	775	116	12,231	2,652	13,143	2,801
1950	83	21	1,246	196	18,084	3,522	19,413	3,739
1951	30	7	[3]	[3]	[3] 13,563	[3] 2,288	13,593	2,295

[1] Includes all operations in which hand labor is principal factor in delivering gravel to sluices, long toms, dip boxes, pans, rockers, dry washers, etc.
[2] Includes all placer operations using power excavator and washing plant, both on dry land; when washing plant is movable, outfit is termed "dry-land dredge."
[3] Production by nonfloating washing plants included with that by bucket-line dredges; Bureau of Mines not at liberty to publish separately.

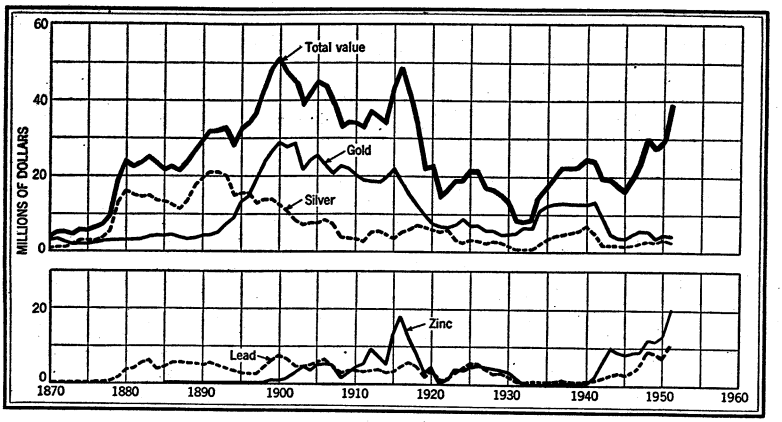

FIGURE 1.—Value of mine production of gold, silver, lead, and zinc and total value of gold, silver, copper, lead, and zinc in Colorado, 1870–1951. The value of copper has been less than $2,000,000 annually, except in a few years.

each 4, and other counties together 9 percent. Zinc-lead and zinc-lead-copper ores yielded 69 percent of the lead; zinc ore 14; gold and silver ores 9; lead ore 7; and copper ore, old slag, mill cleanings, and old tailings 1 percent. The larger lead-producing mines, in order of rank, were: Resurrection group; Treasury Tunnel-Black Bear (Idarado) group; Eagle mine; Smuggler Union (Telluride Mines) group; and Shenandoah-Dives group.

Zinc.—Production of recoverable zinc in Colorado in 1951 was 55,714 tons—an increase of 22 percent over 1950. Eagle County produced 52 percent of the total, San Miguel County 17, Lake 15, Dolores 5, San Juan 3, Gunnison 2, and other counties 6 percent. Zinc, zinc-lead, and zinc-lead-copper ores yielded 98 percent of the total production.

All the State's principal producers operated steadily throughout the year. The total number of mines, prospects, and dumps that contributed to the output of recoverable zinc was 100, the same as in 1950. The leading zinc-producing mines, in order of rank, were: Eagle mine at Gilman, Resurrection group at Leadville, Treasury Tunnel-Black Bear (Idarado) in San Miguel County, Smuggler Union (Telluride Mines) at Telluride, and Rico Argentine at Rico.

MINING AND METALLURGICAL INDUSTRY

The rank in value of the individual metals recovered from Colorado ores and gravels has changed greatly in recent years. Gold ranked first from 1858 to 1873, silver from 1874 to 1896, gold again from 1897 to 1942, and zinc from 1943 to 1951. Until 1943 the combined value of the copper, lead, and zinc had not exceeded that of the gold and silver except in 1916 and from 1925 to 1930. In 1941 gold and silver represented 77 percent and the base metals 23 percent of the total value of the five metals, but in 1951 gold and silver represented only 17 percent and the base metals a record high of 83 percent.

TABLE 5.—Mine production of gold, silver, copper, lead, and zinc in Colorado in 1951, by counties, in terms of recoverable metal

County	Mines producing		Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Fine ounces	Value	Fine ounces	Value
Adams		6	1,279	$44,765	179	$162
Boulder	9	1	749	26,215	120,306	108,883
Chaffee	4		40	1,400	558	505
Clear Creek	22		1,802	63,070	85,793	77,647
Custer	1		6	210	1,011	915
Denver		1	1	35		
Dolores	4		220	7,700	131,912	119,387
Eagle	1		2,793	97,755	412,788	373,594
Fremont					21	19
Garfield	1		1	35	158	143
Gilpin	3	4	171	5,985	1,240	1,122
Gunnison	5		87	3,045	119,748	108,378
Hinsdale	3		10	350	916	829
Jefferson		5	263	9,205	42	38
Lake	10		19,323	676,305	272,355	246,495
Larimer	1				11	10
Mineral	3		804	28,140	236,652	214,182
Ouray	17		2,168	75,880	129,216	116,947
Park	8	2	13,266	464,310	10,121	9,160
Pitkin	5		17	595	10,142	9,179
Saguache	7		119	4,165	24,623	22,285
San Juan	28		9,998	349,930	453,327	410,284
San Miguel	9	1	35,320	1,236,200	706,007	638,972
Summit	29		367	12,845	66,120	59,842
Teller	26	1	27,699	969,465	4,636	4,196
Total	196	21	116,503	4,077,605	2,787,882	2,523,174

County	Copper		Lead		Zinc		Total value
	Short tons	Value	Short tons	Value	Short tons	Value	
Adams							$44,927
Boulder	13	$6,292	208	$71,968			213,358
Chaffee			16	5,536	19	$6,916	14,357
Clear Creek	9	4,356	391	135,286	477	173,628	453,987
Custer			16	5,536	5	1,820	8,481
Denver							35
Dolores	51	24,684	2,231	771,926	2,527	919,828	1,843,525
Eagle	278	134,552	4,274	1,478,804	29,200	10,628,800	12,713,505
Fremont			1	346	1	364	729
Garfield			1	346	4	1,456	1,980
Gilpin			8	2,768			9,875
Gunnison	25	12,100	992	343,232	1,255	456,820	923,575
Hinsdale	2	968	12	4,152	7	2,548	8,847
Jefferson							9,243
Lake	155	75,020	5,996	2,074,616	8,144	2,964,416	6,036,852
Larimer					8	2,912	2,922
Mineral	25	12,100	1,167	403,782	892	324,688	982,892
Ouray	256	123,904	1,211	419,006	1,101	400,764	1,136,501
Park	15	7,260	62	21,452	260	94,640	596,822
Pitkin			57	19,722	29	10,556	40,052
Saguache	37	17,908	392	135,632	269	97,916	277,906
San Juan	551	266,684	4,532	1,568,072	1,842	670,488	3,265,458
San Miguel	1,790	866,360	8,149	2,819,554	9,228	3,358,992	8,920,078
Summit	5	2,420	620	214,520	446	162,344	451,971
Teller							973,661
Total	3,212	1,554,608	30,336	10,496,256	55,714	20,279,896	38,931,539

The shift to mining of predominantly base-metal ores was brought about during World War II by Government restrictions upon production of gold and the subsidies to producers of copper, lead, and zinc. In 1947 the prices of the base metals were decontrolled and could be raised to meet the rising cost of labor and materials, whereas, because of the fixed price of gold, straight gold or gold-silver mining became unprofitable, except for unusually rich mines.

In 1951 the favorable outlook for sustained demand for copper, lead, and zinc stimulated activity in exploration and development. Several mining companies carried on intensive development campaigns on their properties, and the Bureau of Mines continued driving the Leadville drainage tunnel.

A new program of Government assistance in financing exploration in search of reserves of strategic and critical minerals, authorized by the Defense Production Act of 1950, was undertaken by the Defense Minerals Administration. Colorado projects for copper, lead, and zinc approved under the program during 1951 totaled 22, involving $879,042 in combined Government and private capital, to be contributed on a 50–50 basis. Three of the projects, involving a total of $88,446, were canceled by mutual agreement, leaving $790,596 spent or available as of December 31, 1951. Repayment of the Government's contribution, without interest, through a royalty on net returns from products sold, is required if ore is discovered or delineated and the ore is mined within 10 years of the date of the contract.

Mills in Colorado operating all or part of the year on ores of gold, silver, copper, lead, and zinc totaled 31 in 1951 and 32 in 1950. Those active in 1951 comprised 27 flotation mills—6 with daily capacities ranging from 600 to 1,100 tons and 21 ranging from 50 to 300 tons, and 4 gravity mills of 50, 30, 15, and 5 tons capacity. The foregoing include the new 1,000-ton Carlton custom mill of the Golden Cycle Corp. in the Cripple Creek district, which employs roasting (in fluosolids reactor) and cyanidation to recover gold in the form of bullion from gold-pyrite flotation concentrate, with cyanidation of the flotation tailings. Some of the other flotation mills use jigs in the ball-mill classifier circuit to recover coarse gold for amalgamation.

Markets for custom zinc-lead and complex milling ores were provided by mills of the Resurrection Mining Co. at Leadville, the Shenandoah-Dives Mining Co. at Silverton, and the American Zinc, Lead & Smelting Co. at Ouray. Several scattered small mills treated custom ore on the basis of a fixed charge per ton, usually $4 for bulk concentration and $5 for selective concentration.

The Arkansas Valley smelter at Leadville purchases most of the lead, lead-copper, and siliceous gold-silver concentrates and direct-smelting ores. Custom mills and smelters in the Salt Lake Valley, Utah, purchase zinc-lead milling ores, bulk concentrates, and lead concentrates from some Colorado areas. Zinc concentrates are shipped to Amarillo, Corpus Christi, and Dumas, Tex.; Depue, Ill.; Palmerton, Pa.; and Anaconda and Great Falls, Mont. Copper concentrate is shipped to the Garfield, Utah, and El Paso, Tex., smelters.

ORE CLASSIFICATION

Definitions used in ore classification are given in the Gold and Silver chapter of this volume. Tables 6, 7, 8, and 9 show details of Colorado ores milled and smelted in 1951, by class of ore and by method of metal recovery.

TABLE 6.—Mine production of gold, silver, copper, lead, and zinc in Colorado in 1951, by class of ore or other source material, in terms of recoverable metal

Source	Number of mines [1]	Material sold or treated (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Ore:							
Dry gold	43	115,081	28,362	6,720	185	7,588	----------
Dry gold-silver	18	258,929	12,298	650,078	1,369,372	5,199,255	1,302,985
Dry silver	17	12,751	377	217,085	12,768	395,499	69,962
Total	77	386,761	41,037	873,883	1,382,325	5,602,342	1,372,947
Copper	4	659	28	9,592	46,105	28,590	----------
Lead	56	22,512	1,743	154,663	126,913	3,999,422	304,795
Zinc	11	322,198	1,983	216,041	106,615	8,568,055	58,953,160
Zinc-lead [2]	75	833,699	57,243	1,498,142	4,757,537	42,022,001	50,731,918
Total	124	1,179,068	60,997	1,878,438	5,037,170	54,618,068	109,989,873
Other "lode" material:							
Old slag: lead	--------	11,983	66	28,267	----------	410,800	----------
zinc-lead	--------	6	----------	21	----------	2,000	2,000
Old tailings, etc.[3]	--------	648	810	4,978	4,505	38,790	63,180
Total	--------	12,637	876	33,266	4,505	451,590	65,180
Total "lode" material	196	1,578,466	102,910	2,785,587	6,424,000	60,672,000	111,428,000
Gravel (placer operations)	21	----------	13,593	2,295	----------	----------	----------
Total, all sources	217	1,578,466	116,503	2,787,882	6,424,000	60,672,000	111,428,000

[1] Detail will not add to totals because some mines produce more than one class of ore.
[2] Includes zinc-lead-copper ore, for which the Bureau of Mines is not at liberty to publish separate figures.
[3] Includes 415 tons gold mill cleanings, 38 tons lead mill cleanings, 31 tons lead tailings, 164 tons zinc-lead tailings.

TABLE 7.—Mine production of gold, silver, copper, lead, and zinc in Colorado in 1951, by method of recovery and type of material processed, in terms of recoverable metal

Method of recovery and type of material processed	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Lode:					
Amalgamation:					
Ore	21,694	9,761	----------	----------	----------
Mill clean-up	96	17	----------	----------	----------
Total	21,790	9,778	----------	----------	----------
Cyanidation [1]	14,985	1,949	----------	----------	----------
Total recoverable in bullion	36,775	11,727	----------	----------	----------
Concentration, and smelting of concentrates [1]	62,368	2,415,903	5,860,424	58,695,473	111,344,430
Direct smelting:					
Ore	2,987	324,708	559,071	1,524,937	18,390
Old slag:					
Lead	66	28,267	----------	410,800	----------
Zinc-lead	----------	21	----------	2,000	2,000
Old tailings, etc.[2]	714	4,961	4,505	38,790	63,180
Total	3,767	357,957	563,576	1,976,527	83,570
Placer	13,593	2,295	----------	----------	----------
Grand total	116,503	2,787,882	6,424,000	60,672,000	111,428,000

[1] Ore only; no old tailings, etc., processed by this method in Colorado in 1951.
[2] Includes 414 tons gold mill cleanings, 38 tons lead mill cleanings, 31 tons lead tailings, and 164 tons zinc-lead tailings.

TABLE 8.—Mine production of gold, silver, copper, lead, and zinc in Colorado in 1951, by method of recovery (except placer) and class of material processed, in terms of recoverable metal

A. For material treated at mills

	Material treated (short tons)	Recoverable in bullion		Concentrate shipped to smelters [1] and recoverable metal					
		Gold (fine ounces)	Silver (fine ounces)	Concentrate (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
BY COUNTIES									
Boulder	8,295			[2] 1,073	713	120,248	25,400	415,000	
Chaffee	276	12	4	71	18	458		26,000	38,000
Clear Creek	30,023	694	253	2,064	1,092	84,634	17,667	756,312	954,000
Custer	108	1	5	21	2	303		10,600	10,000
Dolores	38,898	100	24	8,222	105	130,266	100,000	4,351,700	5,046,000
Eagle	320,153			72,356	774	208,507	77,980	8,504,620	58,400,000
Gilpin	954	12	1	139	114	1,227		16,000	
Gunnison	23,276			4,217	62	117,059	50,000	1,900,710	2,507,610
Hinsdale	160			25	4	349	630	15,960	14,000
Lake	171,289	7,888	3,667	30,218	10,835	230,899	303,480	11,254,550	16,288,000
Larimer	55			19		11			16,000
Mineral	43,583			3,706	745	168,899	48,752	2,151,000	1,784,000
Ouray	50,444			5,043	2,136	113,730	474,330	2,229,225	2,202,000
Park	1,884	377	61	678	829	6,981	28,380	65,000	520,000
Pitkin	861			157		9,581		66,386	58,000
Saguache	3,272	30	119	1,167	72	14,686	49,770	519,060	538,000
San Juan	243,595			13,186	9,882	447,506	1,096,750	8,990,955	3,620,820
San Miguel	487,639	12,481	5,518	40,540	22,770	699,550	3,578,195	16,284,520	18,456,000
Summit	9,165	102	110	2,088	246	58,662	9,090	1,137,875	892,000
Teller	112,871	15,078	1,965	2,057	11,969	2,347			
Total: 1951	1,546,801	36,775	11,727	187,047	62,368	2,415,903	5,860,424	58,695,473	111,344,430
1950	1,330,705	29,577	13,648	159,203	71,836	2,713,963	5,566,568	51,415,568	91,456,357
BY CLASS OF MATERIAL TREATED									
Dry gold	114,994	15,767	2,169	2,235	12,432	4,467	185	5,960	
Dry gold-silver	247,399	8	2	7,518	10,236	442,980	891,352	5,092,245	1,302,985
Dry silver	10,603			487	320	144,754	11,425	264,309	69,962
Lead	17,989	4	2	3,516	1,056	119,507	93,835	2,763,203	302,405
Zinc	322,161	373	59	73,056	1,609	215,824	106,615	8,566,055	58,945,160
Zinc-lead [3]	833,654	20,527	9,478	100,235	36,715	1,488,371	4,757,012	42,003,701	50,723,918
Mill cleanup (gold)	1	96	17						
Total 1951	1,546,801	36,775	11,727	187,047	62,368	2,415,903	5,860,424	58,695,473	111,344,430

BY CLASS OF CONCENTRATE SHIPPED TO SMELTERS [1]						
Dry gold	2,191	12,354	3,348	10	1,920	
Dry gold-silver	42	82	1,335	55	2,660	
Dry silver	4	2	501		43	
Copper	5,358	6,460	164,948	2,581,400	317,700	63,100
Lead	54,584	36,589	2,011,517	2,457,684	55,114,292	32,018
Lead-copper	270	19	5,214	64,623	241,461	
Zinc-lead	93	25	2,720	4,955	58,390	36,000
Dry iron [4]	1,328	3,600	35,790	14,150	1,199,804	2,777
Total to copper and lead plants	63,870	59,131	2,225,373	5,122,877	56,936,270	133,895
Zinc concentrates to zinc plants	123,177	3,237	190,530	737,547	1,759,203	111,210,535
Total: 1951	187,047	62,368	2,415,903	5,860,424	58,695,473	111,344,430
1950	159,203	71,836	2,713,963	5,566,568	51,415,568	91,456,357

For footnotes, see end of table.

TABLE 8.—Mine production of gold, silver, copper, lead, and zinc in Colorado in 1951, by method of recovery (except placer) and class of material processed, in terms of recoverable metal—Continued

B. For material shipped directly to smelters

	Material shipped (short) tons	Recoverable metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
BY COUNTIES						
Boulder	18	8	55	600	1,000	
Chaffee	32	10	96		6,000	
Clear Creek	28	16	906	333	25,688	
Custer	156	3	703		21,400	
Dolores	244	15	1,622	2,000	110,300	8,000
Eagle	10,450	2,019	204,281	478,020	43,380	
Fremont	6		21		2,000	2,000
Garfield	37	1	158		2,000	8,000
Gilpin	1	18	5			
Gunnison	176	25	2,689		83,290	2,390
Hinsdale	51	6	567	3,370	8,040	
Lake	15,333	600	37,789	6,520	737,450	
Mineral	1,839	59	67,753	1,248	183,000	
Ouray	1,006	32	15,486	37,670	192,775	
Park	266	72	1,015	1,620	59,000	
Pitkin	267	17	561		47,614	
Saguache	679	17	9,818	24,230	264,940	
San Juan	322	116	5,821	5,250	73,045	63,180
San Miguel	57	68	939	1,805	13,480	
Summit	264	19	7,348	910	102,125	
Teller	433	646	324			
Total: 1951	31,665	3,767	357,957	563,576	1,976,527	83,570
1950	42,039	9,564	760,928	715,432	2,598,432	95,643
BY CLASS OF MATERIAL						
Dry gold:						
Ore	87	163	84		1,628	
Mill cleanings	414	578	320			
Dry gold-silver	11,530	2,054	207,096	478,020	107,010	
Dry silver	2,148	57	72,331	1,343	131,190	
Copper	659	28	9,592	46,105	28,590	
Lead:						
Crude ore	4,523	683	35,154	33,078	1,236,219	2,390
Mill cleanings	38	93	3,031	1,140	5,765	
Old slag	11,983	66	28,267		410,800	
Old tailings	31	2	260	485	5,555	
Total lead materials	16,575	844	66,712	34,703	1,658,339	2,390
Zinc	37	1	158		2,000	8,000
Zinc-lead						
Crude ore	45	1	293	525	18,300	8,000
Old slag	6		21		2,000	2,000
Old tailings	164	41	1,350	2,880	27,470	63,180
Total zinc-lead materials	215	42	1,664	3,405	47,770	73,180
Total 1951	31,665	3,767	357,957	563,576	1,976,527	83,570

[1] Excludes concentrates treated only by amalgamation and/or cyanidation.
[2] Includes lead-silver-gold-copper concentrates recovered as byproducts in the beneficiation of fluorspar at 2 plants.
[3] Includes zinc-lead-copper ore, for which the Bureau of Mines is not at liberty to publish separate figures.
[4] From zinc-lead-copper, zinc-lead, lead, and gold-silver ores.

TABLE 9.—Mine production of gold, silver, copper, lead, and zinc in Colorado in 1951, by method of recovery (except placer) and class of material processed, in terms of gross metal content

Class of material	Quantity shipped or treated (short tons)	Gross metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
CONCENTRATE SHIPPED TO SMELTERS						
Dry gold	2,191	12,354	3,348	259	2,117	----------
Dry gold-silver	42	82	1,335	66	2,773	----------
Dry silver	4	2	501	----------	45	96
Copper	5,358	6,460	164,948	2,661,214	529,906	628,998
Lead	54,584	36,589	2,011,517	3,098,003	57,402,293	5,690,812
Lead-copper	270	19	5,214	80,308	251,018	122,998
Zinc-lead	93	25	2,720	5,827	59,399	45,182
Dry iron [1]	1,328	3,600	35,790	17,249	1,251,657	88,081
Total to copper and lead plants	63,870	59,131	2,225,373	5,862,926	59,499,208	6,576,167
Zinc concentrate to zinc plants	123,177	4,473	260,954	977,091	2,517,789	123,805,572
Total: 1951	187,047	63,604	2,486,327	6,840,017	62,016,997	130,381,739
1950	159,203	72,862	2,776,232	6,281,368	54,324,138	107,142,787
ORE, ETC., SHIPPED DIRECTLY TO SMELTERS						
Dry gold:						
Ore	87	163	84	133	1,736	832
Mill clean-up	414	578	320	105	2,892	----------
Total gold materials	501	741	404	238	4,628	832
Dry gold-silver	11,530	2,054	207,096	558,020	116,270	----------
Dry silver	2,148	57	72,331	1,685	136,778	4,146
Copper	659	28	9,592	46,907	47,664	----------
Lead:						
Crude ore	4,523	683	35,154	41,734	1,286,337	87,578
Mill cleanings	38	93	3,031	1,475	6,162	90
Old tailings	31	2	260	604	5,788	5,420
Old slag	11,983	66	28,267	----------	427,938	----------
Total lead materials	16,575	844	66,712	43,813	1,726,225	93,088
Zinc	37	1	158	----------	3,056	9,756
Zinc-lead:						
Crude ore	45	1	293	615	18,892	10,079
Old tailings	164	41	1,350	3,387	27,944	78,973
Old slag	6	----------	21	6	2,040	2,500
Total zinc-lead materials	215	42	1,664	4,008	48,876	91,552
Total: 1951	31,665	3,767	357,957	654,671	2,083,497	199,374
1950	42,039	9,564	760,928	795,238	2,779,690	255,587

[1] From zinc-lead-copper, zinc-lead, lead, and gold-silver ores.

REVIEW BY COUNTIES

ADAMS

Placer gold was recovered as a byproduct in sluices at 6 sand and gravel plants on Clear Creek northwest of Denver.

BOULDER

The production of gold in Boulder County in 1951 was the lowest since 1945, but that of silver was the largest since 1922. The copper and lead output was recovered as a byproduct of gold, silver, and fluorspar mining. No zinc was recovered from Boulder County ores in 1951; production in 1950 was 3 tons.

The old Caribou mine in the Grand Island district, reopened in 1947 by the Consolidated Caribou Silver Mines, Inc., produced most of the county output of silver in 1951.

At Jamestown the Ozark-Mahoning and General Chemical companies recovered lead-silver-gold-copper concentrate as a byproduct in the beneficiation of fluorspar. The Cash mine at Gold Hill and the Franklin (Wood Mountain) and Nancy mines at Sugarloaf, formerly substantial gold producers, shipped some ore during the first few months of 1951.

CHAFFEE

At the Mary Murphy mine in the Chalk Creek district, an important producer in the past, S. E. and W. E. Burleson erected a new building, reconditioned other buildings and old mine workings, and did some stoping between the 1,400- and 1,300-foot levels; ore shipped in 1951 totaled 252 tons containing 28 ounces of gold, 465 ounces of silver, 26,906 pounds of lead, 1,864 pounds of copper, and 50,207 pounds of zinc.

CLEAR CREEK

The Mendota-Frostberg and Terrible-Dunderberg mines at Silver Plume and the Stevens mine and dump in the Argentine district each produced considerable zinc-lead ore in 1951. Most of the ore was treated in the Silver Spruce and Black Eagle mills near Idaho Springs, but part of the Terrible-Dunderberg ore was shipped to the Resurrection mill at Leadville. In the Trail Creek district the Montana Mining & Development Co. mill on the Lamartine property treated dump ore containing gold, silver, and some lead. The Nabob mine near Lawson shipped high-grade silver-lead ore, and the Franklin near Idaho Springs shipped zinc-lead-silver-gold ore. Gold output from the Dixie mine near Idaho Springs was less than in 1950. The mill of Front Range Mines, Inc., at Dumont treated company ore from the Mattie-King Solomon group in Clear Creek County and the Strong in Teller County and custom ore from three mines in Boulder County. Exploration projects with Government participation in financing on a 50-50 basis under a Defense Minerals contract were carried on at the Grizzly mine and the Burleigh tunnel.

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TABLE 10.—Mine production of gold, silver, copper, lead, and zinc in Colorado in 1951, by county and district, in terms of recoverable metal

County and district	Mines producing		Material sold or treated (short tons)	Gold [1] (fine ounces)	Silver [1] (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
	Lode	Placer							
Adams County		6		1,279	179				$44,927
Boulder County:									
Central (Jamestown) and Gold Hill [2]	3	1	65	[3] 247	[3] 10,829	[3] 19,400	[3] 306,000		[3] 76,079
Grand Island	2		7,823	267	109,206	6,000	110,000		128,664
Sugar Loaf	3		416	228	252				8,208
Ward	1		9	7	19	600			407
Chaffee County:									
Chalk Creek	2		303	32	548		31,800	38,000	14,033
Granite	1		3	4	8		200		182
Turret	1		2	4	2				142
Clear Creek County:									
Argentine	1		4,508	96	5,056	3,800	84,000	100,000	41,588
Cascade	2		208	63	611		1,000		2,931
Empire	1		71	2	95	100	1,800		491
Griffith	4		7,827	93	23,286	6,100	470,000	813,000	255,082
Idaho Springs	8		3,347	987	10,215	2,500	98,500	41,000	68,898
Montana	3		1,034	34	17,894	3,000	70,000		30,221
Trail Creek or Freeland (Lamartine)	3		13,056	527	28,636	2,500	56,700		54,776
Custer County: Hardscrabble	1		264	6	1,011		32,000	10,000	8,481
Denver County		1		1					35
Dolores County: Pioneer	4		39,142	220	131,912	102,000	4,462,000	5,054,000	1,843,525
Eagle County: Red Cliff	1		330,603	2,793	412,788	556,000	8,548,000	58,400,000	12,713,505
Fremont County: Arkansas River			6		21		2,000	2,000	729
Garfield County: Rifle Creek	1		37	1	158		2,000	8,000	1,980
Gilpin County: Northern and Southern [2]	3	4	955	171	1,240		16,000		9,875
Gunnison County:									
Elk Mountain	3		3,080	16	12,195	8,000	430,000	488,000	176,739
Gold Brick			3	22	105		300		917
Taylor Park (Tin Cup)	1		89	2	1,665		31,700		7,061
Tomichi	1		20,280	47	105,783	42,000	1,522,000	2,022,000	738,858
Hinsdale County:									
Galena	2		200	8	632	1,200	23,900	14,000	7,825
Lake	1		11	2	284	2,800	100		1,022
Jefferson County		5		263	42				9,243
Lake County:									
California (Leadville) [4]	9		186,619	19,315	272,352	310,000	11,991,900	16,288,000	6,036,552
Twin Lakes	1		3	8	3		100		300
Larimer: Manhattan	1		55		11			16,000	2,922
Mineral: Creede	3		45,422	804	236,652	50,000	2,334,000	1,784,000	982,892
Ouray County:									
Red Mountain	5		1,055	32	14,955	38,000	154,000	2,800	51,003
Sneffels	8		49,967	2,127	112,239	472,000	2,188,000	2,188,000	1,066,991
Uncompahgre	4		428	9	2,022	2,000	80,000	11,200	18,507

Park County:									
Alma Placers-Fairplay and Buckskin [2]	3	2	1,647	13,184	8,868	27,800	59,200	486,000	574,888
Consolidated Montgomery	4		487	55	1,232	2,200	63,600	34,000	20,763
Mosquito	1		16	27	21		1,200		1,171
Pitkin County:									
Independence	1		26	15	21		100		561
Roaring Fork	3		1,023	2	10,110		100,600	58,000	37,180
Spring Butte	1		79		11		13,300		2,311
Saguache County:									
Cochetopa	1		15	1	32	600	500	2,000	659
Embargo Creek	1		17		84		1,200	1,500	557
Kerber Creek	5		3,919	118	24,507	73,400	782,300	534,500	276,690
San Juan County:									
Animas	11		225,316	9,407	415,876	972,000	7,926,000	2,366,000	2,742,668
Eureka	17		18,601	591	37,451	130,000	1,138,000	1,318,000	522,790
San Miguel County:									
Iron Springs	4		35,884	1,289	84,750	50,500	282,000	500	182,916
Lower San Miguel		1		1					35
Upper San Miguel	5		451,812	34,030	621,257	3,529,500	16,016,000	18,455,500	8,737,127
Summit County:									
Breckenridge	4		3,534	244	8,341		492,000	732,000	234,429
Montezuma	18		5,544	78	56,924	10,000	734,000	128,000	206,947
Ten Mile	6		346	45	811		12,000	32,000	10,209
Wilkinson, Rock Creek, and Green Mountain	1		5		44		2,000		386
Teller County: Cripple Creek	26	1	113,304	27,699	4,636				973,661
Total Colorado	196	21	1,578,466	116,503	2,787,882	6,424,000	60,672,000	111,428,000	38,931,539

[1] Bureau of Mines not at liberty to show separate figures for placer production by districts in 1951.
[2] Bureau of Mines not at liberty to show production figures separately by districts.
[3] Includes amounts recovered from lead-silver-gold-copper concentrates produced as byproduct of beneficiation of fluorspar at 2 plants
[4] Small quantity of gold and silver from Sugar Loaf district is included with the California (Leadville) district.

CUSTER

In 1951 the Defender Mining Co. sank 80 feet of shaft and drove 396 feet of drifts at the Defender mine at Silver Cliff and shipped 264 tons of lead-zinc-silver ore.

DENVER

George W. Baugh sold some gold recovered in testing placer-mining equipment on Platte River.

DOLORES

All of the Dolores County output of gold, silver, copper, lead, and zinc in 1951 came from the Pioneer (Rico) district. The Rico Argentine Mining Co. group, equipped with a 135-ton mill, operated continuously, and its production (chiefly zinc, lead, and silver) was much larger than in 1950, when operations in the first half of the year were confined mostly to development. Lead-silver ore from the Forest-Wedge group and zinc-lead-silver ore from the Union Carbonate were shipped direct to smelters. The St. Louis mine produced some high-grade gold ore.

EAGLE

Red Cliff (Battle Mountain) District.—This District contributed the entire Eagle County output of the five metals in 1951. The Eagle mine of the New Jersey Zinc Co., Empire Zinc Division, at Gilman, operated continuously and at a higher production rate than in 1950. The mill is completely underground, in an excavation cut in granite in Eagle Canyon, and has a capacity exceeding 1,000 tons daily. The principal ore bodies occur as replacements in a flat-dipping bed of limestone. They are generally massive, with a core of iron-copper-silver-gold ore surrounded by an outer layer of zinc-lead ore. The zinc-lead ore is treated in the mill, and the iron-copper-silver-gold ore is shipped crude to smelters. The mine is opened by a main haulage tunnel on the 16th level (with its portal at the ore bins in Eagle Canyon), a vertical service shaft bottomed on the 16th level, raises from the 16th level, and a series of inclines from the 16th to the 24th levels. The entire operation is completely mechanized. Electric battery motors are used for underground haulage.

FREMONT

Some material containing zinc, lead, and silver was shipped from a slag dump at Florence.

GARFIELD

A car of zinc-lead-silver ore shipped late in 1950 from the Sunshine mine 15 miles north of Rifle was credited to 1951 production.

GILPIN

Mining in Gilpin County in 1951 was confined to small-scale operations. The producing properties were the West Notoway dump, Smith (Lone Star) group, We Got Em mine, and several small

placers. A lead-zinc exploration project was undertaken at the Gilpin-Eureka-Essex group, with Government participation under a Defense Minerals contract.

GUNNISON

The Callahan Zinc-Lead Co., Inc., operated its Akron-Erie group and 100-ton mill at Whitepine and was a steady shipper of zinc and lead-silver concentrates. Exploration was expanded under a Defense Minerals contract, providing joint financing by the company and the Government on a matching-funds basis. At the Keystone mine near Crested Butte the Park City Consolidated Mines Co. and the American Smelting & Refining Co. carried on development throughout the year; the ore removed in development was stockpiled at the mine. The Crested Butte Mining & Milling Corp. Daisy group, Slate River Mining Co. Macawber mine (reopened after having been idle for a long period), and Evans Basin Mining Co. Chautauqua mine shipped zinc-lead-silver ore, and the Star mine at Tin Cup (worked by John Lambertson) shipped lead-silver ore. The Kanarado Mining & Development Co. acquired the old Carter gold mine near Ohio and worked on remodeling the mill for handling sulfide ores containing lead and zinc.

HINSDALE

At the Ute and Ulay property in the Galena district the Colorado Standard Lead Zinc Mines, incorporated December 11, 1950, worked in 1951 on mine development, reconditioning old mine workings, repairing and improving the flotation mill, and installing a Diesel-electric power plant. The county output of ore, totaling 211 tons, came from the Yellow Medicine, Hoosier Boy, and Gold Quartz mines.

JEFFERSON

On Clear Creek east of Golden, W. B. Kerkling operated a placer mine, and several sand and gravel plants recovered gold as a byproduct.

LAKE

California (Leadville) District.—Nearly all the Lake County output of the five metals in 1951 came from the Leadville district. The bulk of the ore was produced by the Resurrection group of mines, operated since 1942 by the Resurrection Mining Co. The mine is opened by a 1,323-foot vertical shaft, six levels, and a 4-mile tunnel (old Yak) which intersects the shaft. The ore was concentrated in the company 600-ton selective-flotation mill, which also handled custom ores from Chaffee, Clear Creek, Custer, Gilpin, Lake, Park, Saguache, and Summit Counties.

The Arkansas Valley smelter of the American Smelting & Refining Co. operated continuously. The smelter treats lead, lead-copper, lead-copper-gold-silver, and gold and silver ores and concentrates purchased from operators in nearly all the active mining districts of Colorado and concentrates, residues from zinc smelters, and other material from outside the State. Receipts of purchased material in 1951 totaled 110,160 tons compared with 101,701 tons in 1950. Besides operating its smelter, the company continued its development

project in the Ibex-Sunday area at Leadville; ore produced in development was shipped to the Resurrection mill.

Other producers at Leadville included the Dolly B, Fortune, New Monarch, and Valley mines and several dumps.

The Leadville drainage tunnel, an unfinished World War II project of the Bureau of Mines on which driving was resumed September 20, 1950, with the Utah Construction Co. as contractor, had been advanced during 1950 from 6,600 feet from the portal to 7,440 feet as of December 20, 1950; at the end of December 1951 it had been lengthened to 10,730 feet. In addition, 291 feet had been driven on a Downtown lateral, 191 feet on a lateral connecting the tunnel with the Hayden shaft (which was reconditioned by the Cadwell Mining Co. in the course of an exploration project), and 36 feet on the Robert Emmet lateral. The peak flow of water from the tunnel was 3,765 gallons per minute on July 5; the flow at the end of December was about 2,580 g. p. m., and accumulated water in workings above the tunnel level in the Carbonate Hill and Freyer Hill basins was being drained at a satisfactory rate.

LARIMER

The Black Hawk No. 1 and No. 2 claims in the Prairie Divide district, under development by Cherokee Mines as a source of uranium, had an incidental output of 55 tons of zinc ore in 1951.

MINERAL

All the output of metals from Mineral County in 1951 came from the Creede district. The Emperius Mining Co. continued to operate its large group of mines and 120-ton flotation mill. Ore produced totaled 45,230 tons. Other district output comprised 98 tons of high-grade silver-lead ore from the Phoenix mine and 94 tons from the Solomon group.

OURAY

The Camp Bird mine in the Sneffels district, equipped with a 125-ton flotation mill, is the principal producer of metals in Ouray County. The mine, operated by King Lease, Inc., has been a steady producer since it was reopened by Joseph King in 1926; it was also very productive from 1896 to 1916.

There were 16 other small-producing mines and prospects in Ouray County in 1951. The American Zinc, Lead & Smelting Co. continued to buy ore for treatment in its custom flotation mill at Ouray. The Bachelor Development Co. worked on an exploration project, financed by the company and the Government on a 50–50 basis under a Defense Minerals contract.

PARK

The South Platte Dredging Co. continued to operate its electrically powered connected-bucket dredge on South Platte River near Fairplay and ranked fourth in the State in gold production in 1951. The only other substantial metal producer in Park County was the Buckskin Joe Mines, Ltd., which worked the Phillips group in Buckskin Gulch and shipped gold-zinc-lead-silver ore to the Resurrection mill at Leadville.

PITKIN

The Midnight Mining Co. operated its Midnight silver-lead-zinc mine at Aspen and ran the mill occasionally. Herron Bros. shipped some silver-lead ore from the Henry Clay group.

SAGUACHE

Operators in Saguache County shipped their ore to custom mills and smelters outside the county. The Antoro mine at Bonanza, operated since 1947 by S. E. and W. E. Burleson, shipped 2,696 tons of ore. The Rawley mine and five other small producers together shipped 1,255 tons of ore during the year.

SAN JUAN

The Shenandoah-Dives Mining Co. continued in 1951 to operate as a unit its Shenandoah-Dives-Mayflower consolidated group of claims and the leased Silver Lake group; ore produced was treated in the company 700-ton mill. Since the company began large-scale mining in 1928 it has mined and milled 4,034,797 tons of gold-silver-lead-copper-zinc ore on company account (to the end of 1951) and in addition 147,772 tons of custom ore mined by other operators. Company ore milled in 1951 totaled 196,097 tons and custom ore 26,118 tons.

The Lead Carbonate mine and 50-ton mill operated throughout the year. The Old Hundred Gold Mining Co., operating the Gary Owen-Old Hundred group, was a substantial producer of ore, part of which was shipped to custom mills and part of which was treated in the reconditioned company mill put in operation in July. Other producers of more than 1,000 tons of ore, in order of tonnage of ore shipped, were the Pride of the West mine, Green Mountain (mine and dump), Columbus, Galena Queen, Silver Ledge, May Day, Great Eastern-Sioux City, and Little Nation. A total of 2,842 tons of ore and clean-up material was shipped from 17 mines, prospects, and dumps and a mill site (not counted as a mine) that produced less than 1,000 tons each during the year.

SAN MIGUEL

San Miguel County again ranked first in the State in production of gold, silver, copper, and lead and second in zinc. Most of the output came from the Upper San Miguel district, reviewed separately in the next paragraph. However, the Silver Bell group in the Ophir district, operated since 1946 by the Silver Bell Mines Co., continued to be a substantial producer of gold-silver-lead-copper ore. The capacity of the mill, formerly 150 tons daily, was raised to 175 tons, and a tungsten concentrating section was nearly completed in 1951. The company also purchased the Carbonero mine and began preparing it for operation. The Andrus group in eastern San Miguel County shipped some ore in 1951.

Upper San Miguel District.—The Idarado Mining Co. increased the tonnage of ore mined from its Treasury Tunnel-Black Bear-Ajax group

for the sixth consecutive year and continued its extensive exploration and development campaign. The ore carries zinc, lead, gold, silver, and copper and is treated in the company 750-ton mill at the portal of the 12,000-foot Treasury tunnel, which extends from the mine workings into Ouray County. Products of the mill are zinc concentrate, lead concentrate, and copper concentrate (all enriched by gold and silver), and gold-silver bullion (obtained by amalgamating a jig hutch product).

Telluride Mines, Inc., operated its Smuggler Union-Montana group and 600-ton mill at about the same crude-ore tonnage rate as in 1950. The mill products were high-grade gold-lead-silver jig concentrate, gold bullion (obtained by amalgamating jig concentrate), flotation lead-gold-silver-copper concentrate, and flotation zinc concentrate. Completion of the ore pass connecting the new 7,000-foot mill-level tunnel with the mine workings 1,100 feet above permitted underground transportation of the ore to the mill instead of surface haulage by aerial tram as in the past. Mechanization of mining has been virtually completed.

SUMMIT

The largest individual producer in Summit County in 1951 was the Wellington mine at Breckenridge, which shipped 3,273 tons of ore. The next-largest producers were the Sts. John mine at Montezuma, with 2,326 tons; Chautauqua, with 953 tons; Allen Emory, with 734 tons; and Silver King, with 443 tons.

TELLER

Cripple Creek District.—Metal mining in Teller County is confined to the Cripple Creek gold district. Nearly all the ore produced in 1951 was treated in the new 1,000-ton Carlton custom mill of the Golden Cycle Corp. This mill was built to replace the old Golden Cycle mill at Colorado Springs as a market for Cripple Creek ore and began treating ore on a commercial basis early in April 1951. It was designed to include the latest improvements in methods of ore handling and gold recovery applicable to Cripple Creek ore. Several months of operation at less than rated capacity were required to test and adjust equipment and make changes and additions found necessary to achieve the best results throughout the mill, some sections of which use processes being applied commercially to Cripple Creek ore for the first time. The continued rise in wages and cost of materials, with no change in the domestic price of gold, retarded reopening of some mines that were shut down in 1949 to await completion of the mill and led to the closing of several of the mines that did reopen.

The principal district producers in 1951 were the Ajax mine (Golden Cycle Corporation), Cresson, United Gold Mines group (mine and dump ore), Strong (Front Range) mine, Tenderfoot-Mollie-Kathleen group, El Paso group (mine and dump ore), and Stratton Estate (Chicago Tunnel). About 24 other mines and dumps shipped some ore to the Carlton mill.

Georgia, North Carolina, and Tennessee Gold, Silver, Copper, Lead, and Zinc

(MINE REPORT)

By Robert W. Metcalf

GENERAL SUMMARY

PRODUCTION of copper and zinc in Tennessee was higher in 1951 than in 1950, whereas output of gold, silver, and lead in that State declined. Georgia produced a negligible quantity of gold, and North Carolina, which last produced any of the metals discussed in this chapter in 1949 (gold only), did not produce any of these metals. None of the other States in Region VII of the Bureau of Mines [1] have produced any of these metals since 1946.

The increased production of zinc and copper was due principally to an active operating year uninterrupted by major strikes. Contributing factors were augmented defense expenditures and an expanding level of business activity.

Data shown for output of recoverable copper in Tennessee include outputs for Pennsylvania and Vermont, to avoid disclosure of individual company operations. All tonnage figures reported herein are short tons and "dry weight"—that is, they do not include moisture. The prices for calculating the value of metal production are shown in table 1.

TABLE 1.—Prices of gold, silver, copper, lead, and zinc, 1947–51

Year	Gold [1] (per fine ounce)	Silver [2] (per fine ounce)	Copper [3] (per pound)	Lead [3] (per pound)	Zinc [3] (per pound)
1947	$35.00	$0.905	$0.210	$0.144	$0.121
1948	35.00	.905+	.217	.179	.133
1949	35.00	.905+	.197	.158	.124
1950	35.00	.905+	.208	.135	.142
1951	35.00	.905+	.242	.173	.182

[1] Price under authority of Gold Reserve Act of Jan. 31, 1934.
[2] Treasury buying price for newly mined silver July 1, 1946, to date—$0.9050505 ($0.905 used in 1947 for calculating purposes).
[3] Yearly average weighted price of all grades of primary metal sold by producers. Price in 1947 includes bonus payments by Office of Metals Reserve for overquota production.

[1] Region VII (Southeastern) of the Bureau of Mines is composed of the following States: Tennessee, North Carolina, South Carolina, Georgia, Alabama, Mississippi, and Florida.

Annual figures for the 5 years ended with 1951 and data showing the production of gold, silver, copper, lead, and zinc by months, in terms of recoverable metal, are given in tables 2 and 3.

TABLE 2.—Mine production of gold, silver, copper, lead, and zinc in Georgia and Tennessee in 1951, by months, in terms of recoverable metal [1]

Month	Gold [2] (fine ounces)	Silver [2] (fine ounces)	Copper [3] (short tons)	Lead [2] (short tons)	Zinc [2] (short tons)
January	9	2,080	1,249	----------	3,281
February	9	2,080	1,043	1	2,606
March	9	2,080	1,364	1	3,378
April	9	2,080	1,454	1	2,934
May	9	2,080	1,342	1	3,453
June	9	2,080	1,378	1	3,505
July	9	2,080	1,259	4	3,244
August	9	2,080	1,363	1	3,416
September	12	2,080	1,386	1	3,007
October	9	2,080	1,487	1	3,417
November	9	2,080	1,435	1	3,436
December	9	2,080	1,380	1	2,962
Total	111	24,960	16,140	14	38,639

[1] Mine production comprises ore, gravel, or other mineral material sold or treated and metal recovered as natural gold or as bullion from cyanidation or amalgamation and the estimated recoverable metal (or gross metal as indicated) contained in concentrates, ores, tailings, and other mineral materials shipped directly to smelters or sold to ore buyers within the year.

[2] All from Tennessee, except for 3 ounces of gold produced in Georgia in September. Data for Tennessee for gold and silver are estimated.

[3] Total for Pennsylvania, Tennessee, and Vermont; combined to avoid disclosing individual company operations.

TABLE 3.—Mine production of gold, silver, copper, lead, and zinc in Georgia, North Carolina, and Tennessee, 1947–51, in terms of recoverable metal [1]

Year	Mines producing		Crude ore sold or treated, (short tons)	Gold (lode)		Silver (lode)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1947	14	----------	2,149,010	379	$13,265	79,160	$71,640
1948	13	----------	2,165,202	175	6,125	39,695	35,926
1949	14	2	2,179,118	[2] 202	[2] 7,070	41,833	37,861
1950	12	----------	2,255,977	160	5,600	39,958	36,164
1951	14	----------	2,514,079	111	3,885	24,960	22,590

Year	Copper [1]		Lead		Zinc		Total value [1]
	Short tons	Value	Short tons	Value	Short tons	Value	
1947	12,686	$5,328,120	22	$6,336	31,212	$7,553,304	$12,972,665
1948	14,248	6,183,632	----------	----------	29,524	7,853,384	14,079,067
1949	13,449	5,298,906	257	81,212	29,788	7,387,424	12,812,473
1950	14,497	6,030,752	113	30,510	35,326	10,032,584	16,135,610
1951	16,140	7,811,760	14	4,844	38,639	14,064,596	21,907,675

[1] Data for copper in Pennsylvania and Vermont included with Tennessee to avoid disclosing individual company operations. The only production for North Carolina during the years shown here was 13 ounces of gold valued at $455 in 1949.

[2] Includes 27 ounces of placer gold valued at $945. No placer gold reported in other years shown.

Gold.—Most of the gold produced in southeastern United States is recovered as a byproduct from slimes in the electrolytic refining of copper. In 1951 production from Georgia and Tennessee in this region was 111 fine ounces compared with 160 ounces in 1950. One gold mine was operated in Georgia during 1951 and produced 3 fine ounces. The output of this mine constituted all the production from

gold ores in the region. No gold from placer operations was marketed during the year. As for many years, byproduct gold was obtained from copper ores from the Tennessee Copper Co. mines, Polk County, Tenn.

TABLE 4.—Mine production of gold in Southeastern region,[1] 1799–1951

State	Period	Fine ounces	Value
Alabama	1830–1951	49,495	$1,198,985
Georgia	1830–1951	870,663	18,089,052
North Carolina	1799–1951	1,164,601	24,328,298
South Carolina	1829–1951	318,801	7,562,125
Tennessee	1831–1951	21,863	512,835
Total	1799–1951	2,425,423	51,691,295

[1] Bureau of Mines, Region VII.

Silver.—All the silver produced in 1951 was recovered as a byproduct of copper ore mined in Tennessee. Silver recovered in this manner was 24,960 fine ounces, or 38 percent less than the 39,958 ounces reported in 1950.

Copper.—Output of copper in Pennsylvania and Vermont is included with that of Tennessee to avoid disclosure of individual company operations. Tennessee production was by the Tennessee Copper Co. (Pennsylvania and Vermont output was reported by Bethlehem Steel Co. and Vermont Copper Co., respectively). Combined output in Pennsylvania, Tennessee, and Vermont in 1951 totaled 16,140 short tons, an 11-percent increase over 1950. Copper production in each of these States in 1951 was somewhat larger than in 1950. The metal-mining industry in Tennessee was not seriously affected by labor strikes, and operation was virtually continuous during the year.

Lead.—A small quantity of lead ore was produced in 1951 by the Appalachian Zinc Co. from mines near Embreeville, Tenn. Small amounts of lead were recovered in 1951 as a byproduct of the smelting of zinc concentrates produced in Jefferson, Knox, and Polk Counties, Tenn. Lead output in 1951 totaled only 14 short tons compared with 113 tons in 1950.

Zinc.—Tennessee was the only State in the Bureau of Mines, Region VII, producing zinc. Production increased 9 percent in 1951 to 38,639 short tons compared with 35,326 tons in 1950. An extremely active year, virtually uninterrupted by strikes or work stoppages, contributed heavily to this rise in output. The leading producers in 1951 were The American Zinc Co. of Tennessee (operating the Mascot No. 2, Jarnagin, Grasselli, and Athletic mines), Universal Exploration Co., and The Tennessee Copper Co.

MINING AND METALLURGICAL INDUSTRY

Nearly all the ore (no tailings were reported as treated) in Tennessee was treated at concentration mills at or near the mines and shipped to smelters, refineries, or oxide plants. Of the total of 2,514,079 short tons of material mined in this State and Georgia, 2,513,847 tons was treated initially at a concentration mill, and 232 tons was shipped direct to smelters.

TABLE 5.—Mine production of gold, silver, copper, lead, and zinc in Georgia and Tennessee, in 1951, by States, in terms of recoverable metal

State	Mines producing (lode)	Ore (short tons)	Gold (lode)		Silver (lode)	
			Fine ounces	Value	Fine ounces	Value
Georgia	1	5	3	$105		
Tennessee	13	2,514,074	108	3,780	24,960	$22,590
Total	14	2,514,079	111	3,885	24,960	22,590

State	Copper		Lead		Zinc		Total value
	Short tons	Value	Short tons	Value	Short tons	Value	
Georgia							$105
Tennessee	[1] 16,140	[1] $7,811,760	14	$4,844	38,639	$14,064,596	[1] 21,907,570
Total	[1] 16,140	[1] 7,811,760	14	4,844	38,639	14,064,596	[1] 21,907,675

[1] Data for copper in Tennessee include output in Pennsylvania and Vermont to avoid disclosing individual company operations.

TABLE 6.—Mine production of gold, silver, copper, lead and zinc in Georgia and Tennessee in 1951, by class of ore, in terms of recoverable metal [1]

Class of ore	Number of mines	Material sold or treated (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
Gold ore (Georgia)	1	5	3				
Copper ore (Tennessee)	5	1,144,923	108	24,960	[2] 16,140		
Zinc ore (Tennessee)	7	1,369,128				10	[3] 38,639
Lead ore (Tennessee)	1	23				4	
Total, all sources	14	2,514,079	111	24,960	[2] 16,140	14	38,639

[1] Definitions used in ore classification are given in the Gold and Silver chapter of this volume.
[2] Data for copper in Pennsylvania (from magnetite-pyrite-chalcopyrite ore) and Vermont included with Tennessee to avoid disclosing individual company operations.
[3] Zinc from Tennessee copper ore included with that from zinc ore to avoid disclosing individual company operations.

TABLE 7.—Mine production of gold, silver, copper, lead, and zinc in Georgia and Tennessee in 1951, by method of recovery and type of material processed, in terms of recoverable metal

Method of recovery and type of material processed [1]	Gold (fine ounces)	Silver (fine ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
Amalgamation	3				
Concentration and smelting of concentrates	108	24,960	[2] 16,140	10	38,567
Direct smelting				4	72
Total	111	24,960	[2] 16,140	14	38,639

[1] All ore; no other lode material processed or placer recovery in 1951.
[2] Pennsylvania and Vermont production included with Tennessee to avoid disclosing individual operations.

The methods of treatment used in the mills and other operating details are given in the Review by States that follows.

Active smelters and refineries that treated primary materials produced in Tennessee include copper plants at Copperhill, Tenn., and Laurel Hill, N. Y.; a lead plant at Herculaneum, Mo.; and zinc plants at Fort Smith, Ark., Danville, East St. Louis, La Salle, and Depue, Ill.; Donora, Josephtown, New Castle, and Palmerton, Pa.; and Columbus, Ohio.

REVIEW BY STATES

GEORGIA

Gold has been mined intermittently in Georgia for many years. Production generally has been small. In 1951 the operation of one lode-gold mine was reported in Gwinnett County near Buford. A little over 3 ounces of gold was recovered.

NORTH CAROLINA

No production of gold, silver, copper, lead, or zinc has been reported from North Carolina since 1949, when small amounts of both lode and placer gold were recovered.

TENNESSEE

Copper and zinc output from Tennessee mines in 1951 rose 11 and 9 percent, respectively, compared with 1950. Gold, silver, and lead output decreased 33, 38, and 88 percent, respectively. Production was reported by 6 companies from 13 mines. Augmented metal output in 1951 was accompanied by an 11-percent increase in total tonnage of ore produced compared with 1950. Gold and silver are produced as byproducts of copper-zinc mining in Tennessee. These metals are virtually unassayable in the original ore and are allowed to accumulate in the copper smelter and the copper sulfate circuit, usually for several months, until there is enough to warrant casting high-gold-silver-copper anodes for shipment to an electrolytic refinery. Because of the practice of allowing gold and silver to accumulate for several months, the monthly and annual mine-production rates of these two metals are estimated. As in 1949 and 1950, lead was produced as a result of prospecting and exploration near Embreeville, Washington County, and not from regular mining. The decreased output of lead therefore was not significant.

The American Zinc Co. of Tennessee operated 3 mines in Jefferson County (Athletic or Mossy Creek, Grasselli, and Jarnagin) and 1 in Knox County (Mascot No. 2). All ore was beneficiated at the company mill at Mascot. Custom ore from the Universal Exploration Co. also was treated during 1951. Concentrates from this mill were shipped to five smelters or oxide plants. The American Zinc Co. reported the discovery of a large deposit of zinc ore in the same general area as its other mines, and a new mine was under development in this

area at the end of the year. Development at the mines of the American Zinc Co. of Tennessee included 4,287 feet of drift and 46,139 feet of diamond drilling at the Mascot No. 2; 413 feet of drift and 2,417 feet of diamond drilling at the Jarnagin; 2,262 feet of drift, 3,619 feet of diamond drilling, and 9,610 feet of churn drilling at the Grasselli; and 377 feet of drift at the Athletic.

The Tennessee Copper Co. operated five mines in Polk County throughout 1951—the Boyd, Burra Burra, Calloway, Mary, and Eureka. Development during the year included 1,430 feet of shaft, 13,719 feet of drifts, 4,967 feet of raises, and 15,674 feet of diamond drilling. Ore is initially beneficiated at the company London and Isabella flotation plants, which have a daily capacity of 3,200 tons. Copper, zinc, and iron concentrates were recovered by bulk flotation, followed by three stages of selective flotation. Zinc concentrates were shipped to smelters or oxide plants for further refining. Copper concentrates were converted to blister copper in the company 150-ton reverberatory furnace and cast chiefly as shot copper for the manufacture of copper sulfate.

In Jefferson County the Universal Exploration Co. operated the Davis-Bible group of mines. Ore was beneficiated in its 800-ton-per-day flotation mill. The company was reported to be expanding its mine and mill capacity at Jefferson City to 1,700 tons per day. Additional flotation capacity included sixteen 56-inch flotation machines. Mine development included 493 feet of shaft, 4,147 feet of drift, 18,581 feet of diamond drilling, and 2,063 feet of churn drilling. Most of the ore was treated at the company mill, but some ore was shipped to the Mascot mill of the American Zinc Co. of Tennessee.

The Appalachian Zinc Co. was reported to have shipped some zinc ore from near Embreeville. According to smelter returns, two other operators produced some zinc ore, including small shipments of carbonate ore from near Jefferson City. The Appalachian Mining & Smelting Co. had not yet begun active operations by the end of the year at its lead and zinc properties near Embreeville.

Small amounts of lead were recovered by the Athletic Mining & Smelting Co., Fort Smith, Ark., in smelting zinc concentrates produced by the Tennessee Copper Co. The Donora (Pa.) smelter of the American Steel & Wire Co. recovered small values in lead from zinc ores produced both by the American Zinc Co. of Tennessee and Universal Exploration Co. In addition, some lead ore was mined by the Appalachian Zinc Co. from the Embreeville area.

Idaho

Gold, Silver, Copper, Lead, and Zinc

(MINE REPORT)

By Philip B. Dettmer

GENERAL SUMMARY

COPPER was the only metal of the five nonferrous metals to show an increased output in 1951 (3 percent). This was due chiefly to the opening of the Blackbird-Chicago mine in Lemhi County by the Calera Mining Co., which added 295,000 pounds recoverable copper to the State copper total, as well as a substantial quantity of cobalt. Lead, zinc, silver, and gold—the principal metals mined in Idaho—each declined in 1951 output. Lead production dropped from 100,025 tons in 1950 to 76,713 tons in 1951, a decline of 23 percent; zinc from 87,890 tons in 1950 to 78,121 tons in 1951, a decline of 11 percent; silver from 16,095,019 ounces in 1950 to 14,748,188 ounces in 1951, a decline of 8 percent; and gold from 79,652 ounces in 1950 to 45,064, a decline of 43 percent.

The total value of the five metals produced in 1951 was $70,953,653, an increase of only 1 percent despite advances in market prices of copper, lead, and zinc. The total value of the gold output was $1,577,240, 2 percent of the State total value; silver $13,352,231 (19 percent); copper, $1,045,440 (2 percent); lead, $26,542,698 (37 percent); and zinc, $28,436,044 (40 percent). The State remained the largest producer of silver in the United States and was exceeded only by Missouri in lead production and by Montana in zinc output. About 92 percent of the State silver, 87 percent of the copper, 92 percent of the lead, and 96 percent of the zinc came from the Coeur d'Alene region of Shoshone County; the remaining silver, lead, and zinc came largely from the Warm Springs district of Blaine County, and the remaining copper from the Blackbird district of Lemhi County.

About 44 percent of the State gold output in 1951 came from the Yellow Pine mine in the Yellow Pine district, Valley County; the remainder came largely from a lode mine in the Middle Boise district, Elmore County, and dredging operations in the Yankee Fork district, Custer County, and the Boise Basin district, Boise County.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of the metal production reported herein has been calculated at the prices given in table 1.

TABLE 1.—Prices of gold, silver, copper, lead, and zinc, 1947–51

Year	Gold [1] (per fine ounce)	Silver [2] (per fine ounce)	Copper [3] (per pound)	Lead [3] (per pound)	Zinc [3] (per pound)
1947	$35.00	$0.905	$0.210	$0.144	$0.121
1948	35.00	.905+	.217	.179	.133
1949	35.00	.905+	.197	.158	.124
1950	35.00	.905+	.208	.135	.142
1951	35.00	.905+	.242	.173	.182

[1] Price under authority of Gold Reserve Act of Jan. 31, 1934.
[2] Treasury buying price for newly mined silver. July 1, 1946, to date: $0.9050505 ($0.905 used in 1947 for calculating purposes).
[3] Yearly average weighted price of all grades of primary metal sold by producers. Price in 1947 includes bonus payments by Office of Metals Reserve for overquota production.

TABLE 2.—Mine production of gold, silver, copper, lead, and zinc in Idaho in 1951, by months, in terms of recoverable metal [1]

Month	Gold (fine ounces)	Silver (fine ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
January	3,009	1,269,857	199	7,655	7,696
February	3,619	1,295,568	204	6,806	6,923
March	3,377	1,403,450	213	7,747	7,567
April	4,645	1,400,325	205	7,043	6,867
May	2,767	1,396,553	206	6,742	6,875
June	4,300	1,221,284	168	6,225	6,489
July	4,344	1,117,114	156	6,359	5,967
August	5,104	981,876	138	5,218	5,796
September	2,731	902,527	151	4,720	4,677
October	4,599	1,187,940	164	5,860	6,522
November	3,240	1,237,447	176	5,940	6,090
December	3,329	1,339,082	180	6,398	6,652
Total	45,064	14,753,023	2,160	76,713	78,121

[1] Mine production comprises ore, gravel, or other mineral material sold or treated; metal recovered as natural gold or as bullion from cyanidation or amalgamation; and the estimated recoverable metal (or gross metal as indicated) contained in concentrates, ores, tailings, and other mineral materials shipped directly to smelters or sold to ore buyers within the year.

TABLE 3.—Mine production of gold, silver, copper, lead, and zinc in Idaho, 1947–51, and total, 1863–1951, in terms of recoverable metal [1]

Year	Mines producing		Material sold or treated [2] (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1947	183	99	3,717,697	64,982	$2,274,370	10,345,779	$9,362,930
1948	194	78	3,981,846	58,454	2,045,890	11,448,875	10,361,810
1949	171	82	3,057,075	77,829	2,724,015	10,049,257	9,095,085
1950	155	75	3,300,215	79,652	2,787,820	16,095,019	14,566,805
1951	157	52	3,254,791	45,064	1,577,240	14,753,023	13,352,231
1863–1951			[3]	8,166,730	188,974,953	583,177,365	415,770,854

Year	Copper		Lead		Zinc		Total value
	Short tons	Value	Short tons	Value	Short tons	Value	
1947	1,640	$688,800	78,944	$22,735,872	83,069	$20,102,698	$55,164,670
1948	1,624	704,816	88,544	31,698,752	86,267	22,947,022	67,758,290
1949	1,438	566,572	79,299	25,058,484	76,555	18,985,640	56,429,796
1950	2,107	876,512	100,025	27,006,750	87,890	24,960,760	70,198,647
1951	2,160	1,045,440	76,713	26,542,698	78,121	28,436,044	70,953,653
1863–1951	116,756	36,839,219	6,363,909	788,920,824	1,705,574	326,660,789	1,757,166,639

[1] Includes recoverable metal content of gravel washed (placer operations), ore milled, old tailings, old slimes, and old slag re-treated, and ore shipped to smelters during calendar year indicated.
[2] Does not include gravel washed.
[3] Figure not available.

TABLE 4.—Gold produced at placer mines in Idaho, 1947–51, by class of mine and by method of recovery

Class and method	Mines producing	Material treated (cubic yards)	Gold recovered	
			Fine ounces	Value
Surface placers:				
Gravel mechanically handled:				
Bucket-line dredges:				
1947	8	3,381,351	14,112	$493,920
1948	5	3,139,168	14,969	523,915
1949	4	2,332,576	10,234	358,190
1950	4	2,005,000	13,549	474,215
1951	4	1,729,500	10,665	373,275
Dragline dredges:				
1947	4	577,000	2,939	102,865
1948	2	400,000	1,071	37,485
1949	2	406,000	1,409	49,315
1950	2	296,000	1,839	64,365
1951	5	137,000	938	32,830
Suction dredges:				
1947	5	19,590	103	3,605
1948	3	1,200	20	700
1949	2	11,765	54	1,890
1950	1	500	15	525
1951				
Nonfloating washing plants: [1]				
1947	8	444,490	2,232	78,120
1948	5	457,570	4,204	147,140
1949	5	259,500	3,064	107,240
1950	9	205,117	1,684	58,940
1951				
Gravel hydraulically handled:				
1947	9	32,560	152	5,320
1948	4	32,600	189	6,615
1949	5	14,800	87	3,045
1950	10	37,085	292	10,220
1951	9	17,250	93	3,255
Small-scale hand methods (wet):				
1947	58	10,607	218	7,630
1948	54	11,087	307	10,745
1949	60	20,866	218	7,630
1950	49	17,028	182	6,370
1951	34	7,261	154	5,390
Underground placers (drift):				
1947	7	2,333	20	700
1948	5	620	16	560
1949	3	1,330	12	420
1950–51				
Grand total placers:				
1947	99	4,467,931	19,776	692,160
1948	78	4,042,245	20,776	727,160
1949	[2] 82	3,046,837	15,078	527,730
1950	75	2,560,730	17,561	614,635
1951	52	1,891,011	11,850	414,750

[1] Includes all placer operations using power excavator and washing plant, both on dry land; an outfit with movable washing plant is termed a "dry-land dredge."
[2] A mine using more than one method of recovery is counted but once in arriving at total for all methods.

Gold.—The output of recoverable gold in Idaho in 1951 was 45,064, or 34,588 ounces less than in 1950, a decrease of 43 percent. This reverses the upward trend which began in 1946.

The sharp decline in gold output can be attributed partly to a 60 percent decline in gold production of the Bradley Mining Co. Yellow Pine mine in Valley County. The company reported that pit conditions made economic mining of ore difficult, resulting in a great variety of mill feed and poor metallurgical recovery. In addition to the decrease in Yellow Pine production, there was a drop of 8,044 ounces of gold in Idaho County output due primarily to the cessation of operations of the Wild Rose group of placers by the

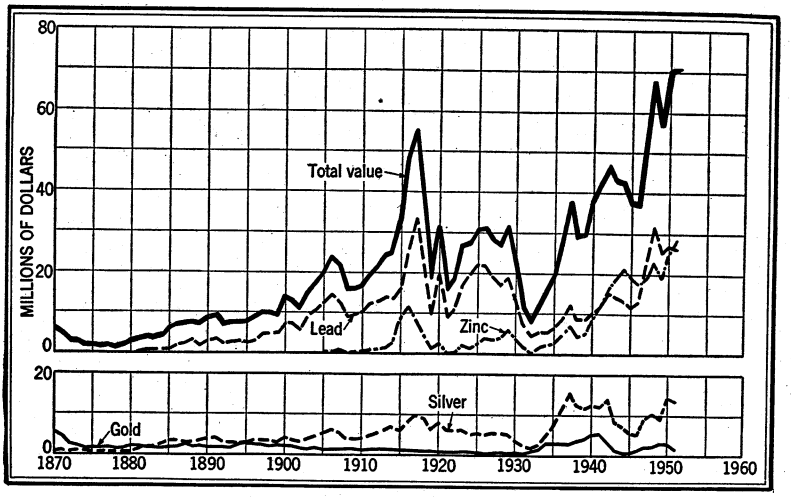

FIGURE 1.—Value of mine production of gold, silver, lead, and zinc, and total value of gold, silver, copper, lead, and zinc in Idaho, 1870–1951. The value of copper has been less than $2,000,000 annually, except in a few years.

Warren Dredging Co. A summer shortage of underground miners and a strike in late August and early September also contributed to the decreased production.

Gold produced from lode mines in 1951 was 33,214 fine ounces compared to 62,091 fine ounces in 1950, and that from placer properties was 11,850 fine ounces compared with 17,561 fine ounces. The Yellow Pine mine continued to be by far the largest producer of gold in Idaho; it was followed by the Boise-Rochester mine group at Atlanta operated by the Talache Mines Inc., a bucket-line dredge on the Yankee Fork placers property in Custer County operated by the Warren Dredging Co., and a bucket-line dredge at Idaho City operated by the Idaho-Canadian Dredging Co. Of the total gold produced in Idaho in 1951, nearly 64 percent came from gold ore, 24 percent from bucket-line dredging, 6 percent from zinc-lead ores, and 2 percent from dragline dredging. Four bucket-line dredges and 5 dragline dredges treated about 1,866,000 cubic yards of gravel in 1951 and recovered 11,603 fine ounces of gold and 4,789 fine ounces of silver.

Silver.—Idaho's output of recoverable silver in 1951 was 14,753,023 fine ounces, a decline of 1,341,996 ounces from the 1950 production. The State continued to be the largest producer of silver in the United States—a rank held since 1933. The Coeur d'Alene region produced 13,639,808 fine ounces of silver, or 92 percent of the State total silver output for 1951. This was 1,416,323 fine ounces less than the Region's 1950 output, the decline being caused by a summer shortage of underground personnel and the strike in late summer. Of the State total silver, silver ore yielded 66 percent, zinc-lead ore and old tailings 28 percent, lead ore 3 percent, and gold ore most of the remainder. The recovery of silver from silver ore increased 65,249 ounces in 1951, decreased 1,377,401 ounces from zinc-lead ores and 338,880 ounces from lead ores, and increased 4,781 ounces from gold ores. Nine

mines—the Sunshine, Polaris, Silver Summit, Bunker Hill, Silver Dollar group, Triumph, Page, Silver Syndicate, and Star mines produced 84 percent of the State total in 1951. Six properties (Sunshine, Polaris, Silver Dollar group, Silver Syndicate, Sunshine Consolidated, and Metropolitan, near Kellogg) operated by the Sunshine Mining Co. produced 7,990,034 ounces of silver in 1951, or 54 percent of the State total.

Copper.—The output of copper in Idaho in 1951 was 4,320,000 pounds, an advance of 106,000 pounds over the 1950 output. About 83 percent of the State copper output in 1951 was recovered as a byproduct in the treatment of zinc-lead ore and silver ore from mines in the Coeur d'Alene region and about 7 percent was recovered from copper concentrates produced by the newly opened Blackbird-Chicago mine operated by Calera Mining Co. in the Blackbird district of Lemhi County. The Sunshine mine near Kellogg in the Coeur d'Alene region continued to be the largest producer of copper in Idaho. It was followed by the Silver Summit, Polaris, Bunker Hill & Sullivan, and Silver Dollar properties.

Lead.—In 1951 the mines in Idaho produced 76,713 short tons of recoverable lead, 23,312 tons less than in 1950. The decline resulted principally from a shortage of underground miners in late summer and early fall and the strike in late August and early September. Ninety-two percent of the State total lead came from the Coeur d'Alene region; most of the remainder was produced in the Warm Springs district of Blaine County, Bayhorse district of Custer County, and the Texas district of Lemhi County. Zinc-lead ore and old tailings from the Coeur d'Alene region yielded 78 percent of the lead; and lead ore and silver ore from the same region accounted for over 11 percent of the 1951 State lead output.

The Bunker Hill & Sullivan mine at Kellogg was by far the largest producer of lead in Idaho in 1951, although its output was 33 percent less than in 1950. The combined lead output of the five largest

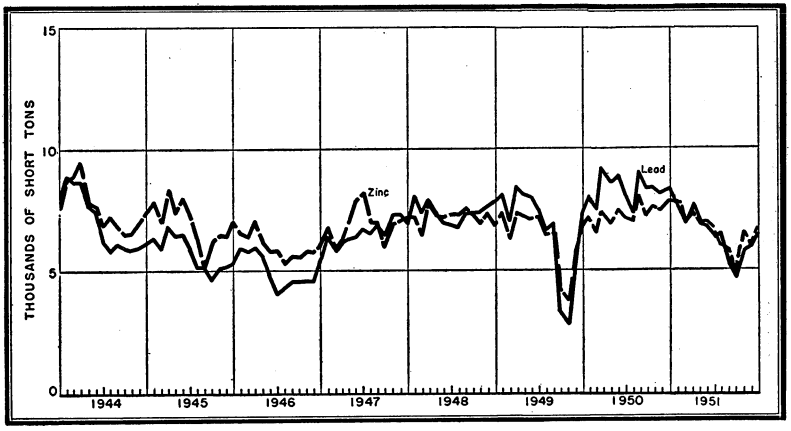

FIGURE 2.—Mine production of lead and zinc in Idaho, 1944–51, by months, in terms of recoverable metal.

TABLE 5.—Mine production of gold, silver, copper, lead, and zinc in Idaho in 1951, by counties, in terms of recoverable metal

County	Mines producing		Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Fine ounces	Value	Fine ounces	Value
Ada		1	5	$175		
Adams	1		2	70	232	$210
Bear Lake	1				21	19
Bingham		1	1	35		
Blaine	20		832	29,120	528,650	478,455
Boise	2	7	5,011	175,385	1,306	1,182
Bonner	8		245	8,575	84,066	76,084
Custer	22	2	5,513	192,955	215,462	195,004
Elmore	4	1	6,335	221,725	37,378	33,829
Gem	2		185	6,475	1,074	972
Idaho	7	22	1,801	63,035	1,053	953
Jerome		2	3	105		
Lemhi	14	3	568	19,880	94,292	85,339
Lewis		2	38	1,330	10	9
Nez Perce		1	9	315		
Owyhee	3	2	10	350	1,232	1,115
Shoshone	67		2,684	93,940	13,639,808	12,344,715
Twin Falls		2	13,	455		
Valley	1	4	19,614	686,490	141,044	127,652
Washington	1				148	134
Other counties [1]	4	2	2,195	76,825	7,247	6,559
Total	157	52	45,064	1,577,240	14,753,023	13,352,231

County	Copper		Lead		Zinc		Total value
	Short tons	Value	Short tons	Value	Short tons	Value	
Ada							$175
Adams	9	$4,356					4,636
Bear Lake			7	$2,422			2,441
Bingham							35
Blaine	48	23,232	3,182	1,100,972	1,931	$702,884	2,334,663
Boise							176,567
Bonner	3	1,452	114	39,444	27	9,828	135,383
Custer	21	10,164	2,101	726,946	1,040	378,560	1,503,629
Elmore							255,554
Gem	1	484	6	2,076	3	1,092	11,099
Idaho			1	346			64,334
Jerome							105
Lemhi	203	98,252	549	189,954	110	40,040	433,465
Lewis							1,339
Nez Perce							315
Owyhee			3	1,038	13	4,732	7,235
Shoshone	1,874	907,016	70,570	24,417,220	74,989	27,295,996	65,058,887
Twin Falls							455
Valley							814,142
Washington			13	4,498			4,632
Other counties [1]	1	484	167	57,782	8	2,912	144,562
Total	2,160	1,045,440	76,713	26,542,698	78,121	28,436,044	70,953,653

[1] Includes Bonneville, Boundary, Butte, Cassia, Clark, and Clearwater Counties for which Bureau of Mines is not at liberty to publish separate figures.

producing mines (each producing more than 6 million pounds of lead)—the Bunker Hill, Page, Star, Morning, and Triumph was 91,268,537 pounds, or 59 percent of the State total. Other important producers in 1951 were the Sidney group, Dayrock, Tamarack, Constitution, Sunshine, and Frisco group properties.

Zinc.—In 1951 the mines in Idaho produced 78,121 short tons of recoverable zinc, 9,769 tons less than the 1950 output or a decrease of 11 percent. About 96 percent of the State total zinc came from the Coeur d'Alene region and most of the remainder from the Triumph

mine in the Warm Springs district of Blaine County. Zinc-lead ore and old tailing concentrates yielded over 94 percent of the State total zinc; old zinc slag smelted and fumed, 5 percent; and lead ore, silver ore, and old lead tailings most of the remainder. The largest producer of zinc in the State in 1951 was the Star mine operated by the Sullivan Mining Co., with a production of 36,789,257 pounds of recoverable zinc, or 24 percent of the State total zinc. Nine other properties (each producing more than 5 million pounds of recoverable zinc)—the Bunker Hill, Page, Morning, Sidney Group, Bunker Hill smelter slag dump, Constitution, Tamarack, Monitor group, and Frisco group produced the bulk of the remaining output in 1951.

MINING INDUSTRY

Despite an appreciable advance in the price of copper, lead and zinc in 1951, gold output dropped 43 percent, silver 8, lead 23, and zinc 11. A shortage of underground miners in the late summer and early fall and a regional labor strike from late August to early September were the chief reasons for the decline in output of these metals. The drastic drop in gold output was due to pit conditions of the Yellow

TABLE 6.—Mine production of gold, silver, copper, lead, and zinc in Idaho in 1951, by class of ore or other source material, in terms of recoverable metal

Source	Number of mines[1]	Material sold or treated (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Ore:							
Dry gold	25	638,474	28,666	179,659	4,059	898	----
Dry gold-silver	1	219	267	4,310	----	----	----
Dry silver	10	280,809	674	9,786,292	2,600,915	8,348,251	664,292
Total	36	919,502	29,607	9,970,261	2,604,974	8,349,149	664,292
Copper	7	29,942	149	80,372	361,584	937	----
Lead	46	96,174	583	391,987	60,996	11,966,917	797,383
Lead-copper	2	41,133	10	62,795	92,089	169,022	----
Zinc	2	357	----	95	39	2,749	12,255
Zinc-lead	61	1,795,402	2,709	4,021,435	1,110,176	124,314,589	143,574,611
Total	110	1,963,008	3,451	4,556,684	1,624,884	136,454,214	144,384,249
Other "lode" material:							
Dry gold: Mill cleanup	1	1	7	----	----	----	----
Dry silver: Old tailings	1	83	3	790	81	2,452	----
Lead:							
Mill cleanup	2	223	1	3,037	1,010	73,637	16,680
Old tailings	3	32,907	32	34,633	25,794	1,528,146	287,697
Old slag	1	105	----	74	500	15,600	6,500
Zinc:							
Old slag	1	64,986	----	34,204	----	2,535,818	8,062,216
Old tailings	1	1,364	1	649	222	10,908	52,323
Zinc-lead:							
Mill cleanup	1	5	----	70	47	1,879	1,398
Old tailings	7	272,607	112	147,786	62,488	4,454,197	2,766,645
Total	16	372,281	156	221,243	90,142	8,622,637	11,193,459
Total "lode" material	157	3,254,791	33,214	14,748,188	4,320,000	153,426,000	156,242,000
Gravel (placer operations)	52	----	11,850	4,835	----	----	----
Total all sources	209	3,254,791	45,064	14,753,023	4,320,000	153,426,000	156,242,000

[1] Detail will not necessarily add to totals because some mines produce more than one class of ore.

Pine mine, a major producer, which made economic mining of ore difficult and resulted in poor metallurgical recovery. Copper was the only metal that showed an increase in 1951 (3 percent). The opening of the Blackbird-Chicago mine near the town of Cobalt, Idaho, by the Calera Mining Co. added 295,000 pounds of recoverable copper to the State total copper.

About 93 percent of the zinc-lead ore and old tailings (by far the chief ore output of the State), 97 percent of the silver ore, 91 percent of the lead ore and old tailings, and 100 percent of the zinc ore and old zinc slag were produced in the Coeur d'Alene region. Placer mining activity in Idaho declined in 1951. Nine dredges (5 dragline and 4 bucket-line) recovered 11,603 fine ounces of gold in 1951 compared with 16 dredges (11 dragline, including 9 nonfloating washing plants, 4 bucket-line, and 1 suction) in 1950 that recovered 17,087 fine ounces of gold.

Definitions used in ore classification are given in the Gold and Silver chapter of this volume.

METALLURGICAL INDUSTRY

Of the 3,254,791 tons of ore produced in Idaho in 1951, 3,172,257 tons (97 percent) was treated at milling plants and the remainder—82,534 tons (3 percent)—was shipped crude to smelters.

Milling plants in 1951 treated principally zinc-lead ore and old tailings (2,068,612 tons), gold ore (638,271 tons), silver ore (272,915 tons), lead ore (88,220 tons), and zinc ore (150 tons). Current hot zinc slag totaling 136,928 tons was fumed, and 64,986 tons of old dump lead-smelter slag was delivered for smelting and fuming. Metals

TABLE 7.—Mine production of gold, silver, copper, lead, and zinc in Idaho in 1951, by method of recovery and type of material processed, in terms of recoverable metal

Method of recovery and type of material processed	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Lode:[1]					
Amalgamation	3,503	2,667			
Cyanidation	2,190	137			
Total recoverable in bullion	5,693	2,804			
Concentration, and smelting of concentrates:					
Ore	26,239	14,319,419	4,165,477	141,656,913	144,057,780
Old tailings	153	207,972	98,217	6,405,353	3,819,343
Total	26,392	14,527,391	4,263,694	148,062,266	147,877,123
Direct smelting:					
Ore	1,118	179,818	54,668	2,734,348	278,083
Old tailings	11	3,897	1,138	77,968	18,078
Old slag		34,278	500	2,551,418	8,068,716
Total	1,129	217,993	56,306	5,363,734	8,364,877
Placer	11,850	4,835			
Grand total	45,064	14,753,023	4,320,000	153,426,000	156,242,000

[1] Ore only. No old tailings, etc., processed by this method in Idaho in 1951.

TABLE 8.—Mine production of gold, silver, copper, lead, and zinc in Idaho in 1951, by method of recovery (except placer) and class of material processed, in terms of recoverable metal

A. For material treated at mills

	Material treated (short tons)	Recoverable in bullion		Concentrate shipped to smelters [1] and recoverable metal					
		Gold (fine ounces)	Silver (fine ounces)	Concentrate (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
BY COUNTIES									
Blaine	89,673			9,175	797	525,102	94,963	6,315,188	3,839,729
Boise	70			2	76	59			
Bonner	1,711			163	38	6,650	2,158	122,926	44,114
Custer	50,252	12	12	4,759	147	149,749	30,487	2,865,835	2,057,557
Elmore	9,015	3,403	2,595	233	2,914	34,778			
Gem	53			21	7	631	127	11,678	6,000
Idaho	333	86	41	7	5	692		2,000	
Lemhi	63,330			2,205	116	62,886	387,800	168,800	
Owyhee	125	2	19	31	4	1,191		6,000	26,000
Shoshone	2,328,462			258,799	2,683	13,601,994	3,746,955	138,442,207	141,895,531
Valley	620,733			14,394	19,605	141,044			
Other counties [2]	8,500	2,190	137	97		2,615	1,204	127,632	8,192
Total: 1951	3,172,257	5,693	2,804	289,886	26,392	14,527,391	4,263,694	148,062,266	147,877,123
1950	3,231,079	2,906	1,956	346,809	57,529	15,869,845	4,083,601	195,130,503	165,985,336
BY CLASS OF ORE AND OLD TAILINGS TREATED									
Dry gold	638,271	5,635	2,769	14,703	22,792	176,332	2,103	529	
Dry gold-silver	200	9	12	8	63	975			
Dry silver	272,915			20,670	470	9,713,416	2,597,515	8,311,666	664,292
Copper	29,850			906	146	79,957	340,208	537	
Lead	88,220	49	23	8,661	76	295,458	34,857	9,522,754	759,833
Lead-copper	41,132			1,443	10	62,780	92,000	168,800	
Zinc	150			14		86	39	2,496	6,759
Zinc-lead	1,784,281			229,135	2,682	3,990,415	1,098,755	123,650,131	142,626,896
Lead old tailings	32,907			6,109	32	34,633	25,794	1,528,146	287,697
Zinc-lead old tailings	284,331			8,237	121	173,339	72,423	4,877,207	3,531,646
Total: 1951	3,172,257	5,693	2,804	289,886	26,392	14,527,391	4,263,694	148,062,266	147,877,123
BY CLASS OF CONCENTRATE SHIPPED TO SMELTERS [1]									
Dry gold				14,695	22,792	176,332	2,103	529	
Dry gold-silver				8	63	975			
Copper				3,430	394	2,000,057	1,181,804	21,220	19,918
Lead				112,883	1,817	4,439,422	770,942	133,882,406	12,034,686
Lead-copper				17,674	212	7,471,912	1,762,805	6,824,243	584,618
Dry iron [3]				849	41	2,947	1,700	12,888	28,278
Total to copper and lead plants				149,539	25,319	14,091,645	3,719,354	140,741,286	12,667,500
Zinc				140,201	1,071	433,666	543,681	7,276,660	135,093,862
Zinc-lead				146	2	2,080	659	44,320	115,761
Total to zinc plants				140,347	1,073	435,746	544,340	7,320,980	135,209,623
Total: 1951				289,886	26,392	14,527,391	4,263,694	148,062,266	147,877,123
1950				346,809	57,529	15,869,845	4,083,601	195,130,503	165,985,336

[1] Excludes concentrates treated only by amalgamation and/or cyanidation.
[2] Includes Bonneville, Boundary, Butte, Cassia, Clark, and Clearwater Counties for which Bureau of Mines is not at liberty to publish separate figures.
[3] From lead and zinc-lead ores.

TABLE 8.—Mine production of gold, silver, copper, lead, and zinc in Idaho in 1951, by method of recovery (except placer) and class of material processed, in terms of recoverable metal—Continued

B. For material shipped directly to smelters

	Material shipped (short tons)	Recoverable metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
BY COUNTIES						
Adams	74	2	232	18,000		
Bear Lake	30		21		14,000	
Blaine	334	35	3,548	1,037	48,812	22,271
Boise	3	7	14			
Bonner	7,985	207	77,416	3,842	105,074	9,886
Custer	5,187	222	62,393	11,513	1,336,165	22,443
Elmore	2	17	5			
Gem	158	178	443	1,873	322	
Idaho	19	18	36			
Lemhi	3,003	440	31,406	18,200	929,200	220,000
Owyhee	(4)	2	22			
Shoshone	65,477	1	37,814	1,045	2,697,793	8,082,469
Washington	42		148		26,000	
Other counties [5]	220		4,495	796	206,368	7,808
Total: 1951	82,534	1,129	217,993	56,306	5,363,734	8,364,877
1950	69,136	1,656	217,399	130,399	4,919,497	9,794,664
BY CLASS OF MATERIAL						
Dry gold:						
Ore	203	239	558	1,956	369	
Mill cleanup	1	7				
Total	204	246	558	1,956	369	
Dry gold-silver ore	19	195	3,323			
Dry silver:						
Ore	7,894	204	72,876	3,400	36,585	
Old tailings	83	3	790	81	2,452	
Total	7,977	207	73,666	3,481	39,037	
Copper ore	92	3	415	21,376	400	
Lead:						
Ore	7,954	458	96,506	26,139	2,444,163	37,550
Mill cleanup	223	1	3,037	1,010	73,637	16,680
Old slag	105		74	500	15,600	6,500
Total	8,282	459	99,617	27,649	2,533,400	60,730
Lead-copper ore	1		15	89	222	
Total to copper and lead plants	16,575	1,110	177,594	54,551	2,573,428	60,730
Zinc:						
Ore	89	1	815	366	7,718	18,354
Old slag	64,986		34,204		2,535,818	8,062,216
Total	65,075	1	35,019	366	2,543,536	8,080,570
Zinc-lead:						
Ore	879	18	5,310	1,342	244,891	222,179
Mill cleanup	5		70	47	1,879	1,398
Total	884	18	5,380	1,389	246,770	223,577
Total to zinc plants	65,959	19	40,399	1,755	2,790,306	8,304,147
Total 1951	82,534	1,129	217,993	56,306	5,363,734	8,364,877

[4] Less than 0.5 ton.
[5] Includes Boundary, Butte, and Clark Counties for which Bureau of Mines is not at liberty to publish separate figures.

recovered from the old dump slag were credited to the Bunker Hill smelter dump, and metals recovered from the hot slag were credited to various producers of the ores and concentrates that contributed during the year to the slag-making material.

The Bunker Hill & Sullivan Mining & Concentrating Co. operated its Bradley lead smelter and refinery on ore and concentrates, chiefly from mines and mills in the Coeur d'Alene region; both plants were closed on July 20 and from August 27 to September 6 owing to a strike, making a total of 12 days lost.

According to the Bunker Hill & Sullivan Mining & Concentrating Co.'s annual stockholders' report for 1951, continuous lead softening had been firmly established at Bunker Hill and was satisfactory. Construction of a new crushing and fine grinding plant was nearing completion. The company also operated its antimony and cadmium plants, 2,000-ton flotation mill (including a sink-and-float unit), 300-ton tailing-treatment plant for recovery of silver, iron, lead, and zinc from old jig tailings, and the 450-ton zinc slag-fuming plant at

TABLE 9.—Mine production of gold, silver, copper, lead, and zinc in Idaho in 1951, by method recovery (except placer) and class of material processed, in terms of gross metal content

Class of material	Quantity shipped or treated (short tons)	Gross metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
ORE AND OLD TAILINGS TREATED AT MILLS						
Dry gold	638,271	51,317	284,599	2,450	620	
Dry gold-silver	200	80	1,100			
Dry silver	272,915	604	9,903,921	3,506,475	8,628,113	988,757
Copper	29,850	184	82,003	438,209	1,200	
Lead	88,220	178	337,040	50,790	10,566,221	1,294,736
Lead-copper	41,132	20	73,225	185,000	233,000	
Zinc	150		100	48	2,900	7,900
Zinc-lead	1,784,281	6,723	4,412,118	1,403,776	135,728,869	167,932,023
Lead old tailings	32,907	40	50,870	35,774	2,153,992	650,721
Zinc-lead old tailings	284,331	186	266,025	123,737	7,487,279	5,069,840
Total: 1951	3,172,257	59,332	15,411,001	5,746,259	164,802,194	175,943,977
1950	3,231,079	78,625	16,758,556	5,782,129	215,933,455	191,625,549
CONCENTRATE SHIPPED TO SMELTERS						
Dry gold	14,695	22,792	176,332	2,474	551	
Dry gold-silver	8	63	975			
Copper	3,430	394	2,000,057	1,228,274	29,136	25,213
Lead	112,883	1,817	4,439,422	901,926	136,213,205	15,067,016
Lead-copper	17,674	212	7,471,912	2,077,703	6,943,560	739,585
Dry iron [1]	849	41	2,947	1,968	15,484	53,866
Total to copper and lead plants	149,539	25,319	14,091,645	4,212,345	143,201,936	15,885,680
Zinc	140,201	1,071	433,842	576,787	7,607,454	144,533,080
Zinc-lead	146	2	2,080	725	45,681	122,004
Total to zinc plants	140,347	1,073	435,922	577,512	7,653,135	144,655,084
Total: 1951	289,886	26,392	14,527,567	4,789,857	150,855,071	160,540,764
1950	346,809	57,529	15,869,845	4,642,206	198,821,859	175,421,139

[1] From lead and zinc-lead ores.

TABLE 9.—Mine production of gold, silver, copper, lead, and zinc in Idaho in 1951, by method of recovery (except placer) and class of material processed, in terms of gross metal content—Continued

Class of material	Quantity shipped or treated (short tons)	Gross metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
MATERIAL SHIPPED DIRECTLY TO SMELTERS						
Dry gold:						
Ore	203	239	558	2,021	615	
Mill cleanup	1	7				
Total	204	246	558	2,021	615	
Dry gold-silver ore	19	195	3,323			
Dry silver:						
Ore	7,894	204	72,876	3,532	67,139	
Old tailings	83	3	790	83	4,086	320
Total	7,977	207	73,666	3,615	71,225	320
Copper ore	92	3	415	22,391	648	
Lead:						
Ore	7,954	458	96,506	33,311	2,516,961	48,151
Mill cleanup	223	1	3,037	1,188	74,911	20,118
Old slag	105		74	575	15,829	8,162
Total	8,282	459	99,617	35,074	2,607,701	76,431
Lead-copper ore	1		15	91	370	
Total to copper and lead plants	16,575	1,110	177,594	63,192	2,680,559	76,751
Zinc:						
Ore	89	1	815	417	7,853	21,860
Old slag	64,986		36,172		2,591,457	10,158,445
Total	65,075	1	36,987	417	2,599,310	10,180,305
Zinc-lead:						
Ore	879	18	5,310	1,591	249,249	278,846
Mill cleanup	5		70	55	1,912	1,770
Total	884	18	5,380	1,646	251,161	280,616
Total to zinc plants	65,959	19	42,367	2,063	2,850,471	10,460,921
Total: 1951	82,534	1,129	219,961	65,255	5,531,030	10,537,672
1950	69,136	1,656	217,910	145,665	5,055,705	12,377,220

Bradley. The annual stockholders' report disclosed that the smelter produced 3,283 ounces of gold, 10,147,635 ounces of silver, 149,546 pounds of cadmium, 1,174 tons of copper, 723 tons of antimony, 13,372 tons of zinc, and 54,315 tons of lead. The Sullivan Mining Co. operated its 150-ton electrolytic zinc plant near Bradley, producing 54,468 tons of high-grade slab zinc and 272 tons of electrolytic cadmium. In addition, the plant recovered from residues and other byproducts, 8,480 tons of zinc, 3,441 tons of lead, 160 tons of copper, 515,660 ounces of silver, and 1,929 ounces of gold.

The Bradley Mining Co. operated its 2,200-ton flotation mill and antimony-gold smelter at Stibnite, Valley County, but reported that pit conditions resulted in a varied mill feed and a poor metallurgical recovery.

REVIEW BY COUNTIES

BLAINE

Warm Springs District.—The Triumph Mining Co.'s North Star mine in the Warm Springs district increased its production of zinc-lead ore 70 percent from 44,846 tons in 1950 to 76,176 tons in 1951. This gain resulted from opening in February the company's new mill, which replaced the plant destroyed by fire in 1947.

Since the company's mining capacity was 200 tons of ore per day, the mill, during much of the year, used dump material mixed with mine ore. It was planned to increase mining activity in 1952 to meet mill requirements. Ore treated in 1951 yielded 553 ounces of gold, 493,641 ounces of silver, 76,518 pounds of copper, 6,045,438 pounds of lead, and 3,571,700 pounds of zinc. This constituted 85 percent of the total ore production from Blaine County for 1951.

The New Hope mine worked by Sun Valley Lead-Silver Mines Co., Ketchum, Idaho, although reported to be only in the development stage, nevertheless, ranked second to the Triumph North Star mine in zinc and lead production in Blaine County. A total of 161 tons of zinc and lead concentrates was produced, which contained 9 ounces of gold, 5,951 ounces of silver, 1,166 pounds of copper, 78,890 pounds of lead, and 59,048 pounds of zinc. Tailings from the North Star mine milled by the United States Smelting, Refining & Milling Co., Utah, produced concentrates containing 20 ounces of gold, 4,815 ounces of silver, 1,685 pounds of copper, 33,125 pounds of lead and 66,082 pounds of zinc.

BOISE

The principal producer in Boise County continued to be the Idaho-Canadian Dredging Co., which operated its 6-cubic-foot bucket-line dredge on Moores Creek near Idaho City, Boise Basin district, from January to July 31, 1951. A total of 720,000 cubic yards of material was treated which yielded 4,914 ounces of gold and 1,231 fine ounces of silver.

BONNER

The Hope mine owned by the Hope Silver Lead Mines, Inc., and worked throughout 1951 by lessees, was the largest producer in the Clark Fork district, with an output of 201 tons of lead milling ore, 51 tons of zinc-lead smelting ore, and 7 tons of lead smelting ore, all of which yielded 969 ounces of silver, 313 pounds of copper, 79,739 pounds of lead, and 8,038 pounds of zinc. The Whitedelf mine produced 654 tons of lead milling ore which yielded 60,861 pounds of lead and 4,656 ounces of silver. The Weber mine in the Lakeview district was worked from July to October 1951. A total of 7,893 tons of silver ore containing 72,854 ounces of recoverable silver was produced. Output from the Keep Cool mine, operated by the Idaho Lakeview Mines, totaled 750 tons of zinc-lead ore compared with 7 tons of silver ore in 1950.

BOUNDARY

Various lessees operated the Idaho-Continental mine in the Port Hill district and shipped a total of 1,211 tons of lead ore during the year.

TABLE 10.—Mine production of gold, silver, copper, lead, and zinc in Idaho in 1951, by county and district, in terms of recoverable metal

County and district	Mines producing [1]		Material sold or treated (short tons)	Gold (fine ounces)			Silver (fine ounces)			Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
Ada: Highland		1			5	5							$175
Adams: Seven Devils	1		74	2		2	232		232	18,000			4,636
Bear Lake: Bear Lake	1		30				21		21		14,000		2,441
Bingham: Snake River		1			1	1							35
Blaine:													
Galena	1		225	1		1	1,591		1,591	200	17,800	14,800	7,296
Little Wood River	3		346	2		2	2,360		2,360	6,000	46,400	31,600	17,436
Mineral Hill and Camas	12		10,217	239		239	18,336		18,336	9,800	127,200	95,500	66,719
Warm Springs	4		79,219	590		590	506,363		506,363	80,000	6,172,600	3,720,100	2,243,212
Boise:													
Boise Basin	2	5	73	83	4,926	5,009	73	1,233	1,306				176,497
Grimes Pass		1			1	1							35
South Fork Payette River		1			1	1							35
Bonner:													
Clark Fork	3		1,027				9,605		9,605	500	160,000	10,600	38,423
Lakeview	3		8,644	242		242	74,408		74,408	5,300	64,400	40,000	95,517
Pend Oreille	2		25	3		3	53		53	200	3,600	3,400	1,443
Custer:													
Alder Creek	4		724	6		6	4,844		4,844	5,000	230,600	18,300	49,029
Alta	1		129				389		389	400	11,400	8,200	3,913
Bayhorse	10		30,016	64		64	178,410		178,410	28,100	3,463,200	1,335,900	1,012,778
Boulder	1		23,680	20		20	13,966		13,966	4,300	375,400	541,100	177,805
Seafoam	1		660	19		19	10,143		10,143	3,000	121,000	176,500	63,627
Stanley		1			2	2							70
Yankee Fork	5	1	230	272	5,130	5,402	4,402	3,308	7,710	1,200	400		196,407
Elmore:													
Bear Creek and Featherville	3		44	33		33	11		11				1,165
Boise River		1			1	1							35
Middle Boise	1		8,973	6,301		6,301	37,367		37,367				254,354
Gem: West View	2		211	185		185	1,074		1,074	2,000	12,000	6,000	11,099
Idaho:													
Burgdorff-Marshall		2			42	42		11	11				1,480
Dixie	1	1	1	7	1	8							280
Elk City	1	9	13	3	1,122	1,125		168	168				39,527
Florence and French Creek	1	2	3	5	9	14		10	10				499
Lower Salmon River		1			17	17							595
Simpson		3			9	9							315
Ten Mile	3	3	320	86	480	566	759	95	854		2,000		20,929
Warren	1	1	15	8	12	20	10		10				709
Jerome: Snake River		2			3	3							105

Lemhi:													
Birch Creek	1		33				105		105	200	15,100		2,755
Blackbird	1	2	22,168	101	3	104	106		106	295,800			75,320
Blue Wing	1		41,132	10		10	62,780		62,780	92,000	168,800		108,635
Gibbonsville		1			9	9							315
Indian Creek	1		30	5		5							175
Junction	1		4				84		84		4,000		768
Mackinaw	1		2	1		1	11		11	500			166
McDevitt	1		10				10		10	1,600			396
Nicholia	1		105				74		74	500	15,600	6,500	4,070
Spring Mountain	2		104	1		1	284		284	400	16,900	1,900	3,659
Texas	4		2,745	438		438	30,838		30,838	15,000	877,600	211,600	237,206
Lewis: Salmon River		2			38	38		10	10				1,339
Nez Perce: Deer Creek		1			9	9							315
Owyhee:													
Carson or French Creek	2	1	5	4	1	5	41		41				212
Snake River		1			1	1							35
South Mountain	1		120	4		4	1,191		1,191		6,000	26,000	6,988
Shoshone:													
Beaver	7		80,190	73		73	45,845		45,845	37,000	2,460,000	7,630,300	1,867,296
Eagle	1		390	2		2	895		895	2,400	83,700	1,700	16,250
Evolution	12		331,264	550		550	9,864,886		9,864,886	2,677,000	9,699,000	2,473,000	11,723,317
Hunter	9		378,552	395		395	618,476		618,476	270,000	27,355,200	49,955,900	14,463,341
Lelande	12		128,173	103		103	194,208		194,208	90,000	8,323,400	9,636,000	3,394,853
Placer Center	6		148,541	146		146	284,372		284,372	69,900	11,105,400	9,563,500	3,941,188
Summit	3		2,658	1		1	1,328		1,328	1,700	216,400	242,000	83,129
Yreka	17		1,324,171	1,414		1,414	2,629,798		2,629,798	600,000	81,896,900	70,475,600	29,569,513
Twin Falls: Snake River		2			13	13							455
Valley:													
Gold Fork Creek		1			2	2							70
North Fork Payette River		1			1	1							35
South Fork Salmon River		2			6	6							210
Yellow Pine	1		620,733	19,605		19,605	141,044		141,044				813,827
Washington: Heath	1		42				148		148		26,000		4,632
Other counties [1]	4	2	8,720	2,190	5	2,195	7,247		7,247	2,000	334,000	16,000	144,562
Total Idaho	157	52	3,254,791	33,214	11,850	45,064	14,748,188	4,835	14,753,023	4,320,000	153,426,000	156,242,000	70,953,653

[1] Includes Bonneville, Boundary, Butte, Cassia, Clark, and Clearwater Counties for which Bureau of Mines is not at liberty to publish separate figures.

CASSIA

Mining activity in Cassia County was confined to the Virginia group of mines, operated from March to December, 1951, by the Duvall Co. A new classifier, agitator tank, and storage tank were added during the year to the company's 225-ton cyanide plant.

CUSTER

The 1951 increase in the prices of copper, lead, and zinc resulted in a minor boom to Custer County, which recorded a 68 percent increase in overall value of the 5 metals as compared with 1950. The output of silver advanced 24 percent; copper, 63 percent; lead, 23 percent; and zinc 133 percent. The output of gold dropped 51 percent which was due primarily to decreased production at the Lucky Boy mine in the Yankee Fork district.

The Clayton mine in Bayhorse district, owned by the Clayton Silver Mines, produced 43 percent of the County ore output, making it the largest producer in Custer County. A total of 23,562 tons of zinc-lead ore milled in the company's 100-ton flotation mill yielded concentrates containing 42 ounces of gold, 116,688 ounces of silver, 20,932 pounds of copper, 2,277,050 pounds of lead, and 1,310,195 pounds of zinc.

Alder Creek District.—Principal district output in 1951 comprised lead smelting ore from the Champion mine operated by David Bell and the Homestake property owned by White Knob Mining Co.

Bayhorse District.—The principal output of the Bayhorse district was zinc-lead ore from the Clayton mine. The Red Bird mine, owned and operated by Buchman, Brecken, and Norden, shipped 3,930 tons of lead smelting ore, containing 16 ounces of gold, 42,483 ounces of silver, 1,203 pounds of copper, and 947,766 pounds of lead. The Bayhorse Mines, Inc., began working the McGregor mines in April. Activity was confined principally to construction of a 100-ton gravity and flotation mill and experimentation with mining methods.

Boulder District.—The Idaho-Custer Mines Co., Wallace, Idaho, bought all the assets of the Livingston Mines Inc. in 1951 and milled zinc-lead tailings from the Livingston mine located 16 miles south of Clayton, Idaho. This comprised the total output of the district. A total of 598 tons of lead concentrates and 586 tons of zinc concentrates was produced.

Seafoam (Greyhound) District.—The Mountain King mine worked by Fred and Earl Shirts was the only producing property in the district in 1951. A total of 660 tons of zinc-lead ore was shipped to a concentrating mill in Utah.

Yankee Fork District.—The major output of the Yankee Fork district was placer gold recovered by the Warren Dredging Corp. which operated a bucket-line dredge on the Yankee Fork placer. This property produced a total of 5,129 ounces of gold and 3,308 ounces of silver.

ELMORE

The Talache Mines, Inc., operated its Boise-Rochester group of claims 1 mile east of Atlanta, Idaho, in the Middle Boise (Atlanta) district, throughout the year and milled 8,973 tons of gold ore, which

was concentrated and amalgamated in its 400-ton amalgamation and concentration mill. A total of 6,301 ounces of gold and 37,367 ounces of silver was recovered.

IDAHO

The total value of gold and silver output from placer mines in Idaho County declined 83 percent in 1951. Gold output from bucket-line dredging dropped 92 percent, drag-line dredging, 49 percent, and hydraulic operations, 69 percent; whereas production by small-scale hand methods advanced 78 percent. Lode production fell off 15 percent from the 1950 figure.

LEMHI

Substantial increases in the production of copper and zinc were recorded in Lemhi County in 1951. Copper output advanced to nearly 4 times the 1950 output and zinc output to over 9 times the 1950 output. Silver production increased about 29 percent while that of gold and lead remained approximately the same.

The increase in copper output came primarily from the Blackbird-Chicago mine, owned and operated by the Blackbird Division of the Calera Mining Co., a subsidiary of Howe Sound Co. The property, a cobalt-copper producer, is located 9 miles from Cobalt, Idaho, in the primitive area of the Salmon National Forest. The 1,000-ton-per-day concentration mill was started in June 1951 on a 1-shift-per-day basis and treated dump material mixed with minor amounts of development ore from the Chicago ore zone. A total of 761 tons of copper concentrate containing 101 ounces of gold, 106 ounces of silver, and 302,107 pounds of copper was produced. Some cobalt was recovered but not shipped in 1951. This mine was expected to be one of Idaho's major copper producers in 1952.

Zinc output in Lemhi County increased largely as a result of expanded production at the United-Idaho mine located in the Texas district and operated by the United-Idaho Mining Co.

The Texas district contributed 55 percent of the total value of gold, silver, copper, lead, and zinc produced in the County in 1951. The principal producers in the Texas district were the Hill Top mine operated by Joe Hamilton and the United-Idaho property.

SHOSHONE (COEUR D'ALENE REGION)

Output of gold, silver, copper, lead, and zinc in Shoshone County in 1951 decreased from the 1950 level. Production of gold dropped 21 percent; silver, 9 percent; copper, 1 percent; lead, 25 percent; and zinc, 13 percent. Due to advances in the market prices of copper, lead, and zinc in 1951 the value of the metal output of the region showed an increase of $502,940. Shoshone County continued to contribute 92 percent of the output of Idaho in terms of dollar value of gold, silver, copper, lead, and zinc. The region remained the largest silver producing area in the United States and second in lead and zinc; it produced 92 percent of Idaho's silver in 1951, 87 percent of the copper, 92 percent of the lead, and 96 percent of the zinc. The zinc output of the region exceeded that of lead by 8,838,000 pounds or 6 percent.

Of the total material (2,393,939 tons) produced in 1951 in the Coeur d'Alene region, 80 percent was zinc-lead ore and old tailings, 11 percent silver ore, and 3.5 percent lead ore. The chief zinc-producing properties, according to rank, were the Star, Bunker Hill, Page, Morning, Sidney group, Bunker Hill smelter slag dump, Constitution, and Tamarack mines. The chief silver-producing properties, according to rank, were the Sunshine (including the Chester Vein), Polaris, Silver Summit, Bunker Hill, and Silver Dollar group of mines. The chief producers of lead, according to rank, were, Bunker Hill, Page, Star, and Morning mines.

Beaver District.—Seven mines in the Beaver district produced 80,190 tons of zinc-lead ore. The largest producer in the district was the Monitor group (Carlisle, Interstate, Silver Tip, Amazon) worked by the Day Mines, Inc., throughout 1951. The zinc-lead ore was treated in the Carlisle 300-ton flotation mill near Wallace. Zinc production from the Monitor group increased considerably in 1951 owing to steady mining of the Amazon vein. The Blue Grouse property owned by Day Mines, Inc., was worked intermittently by Roy Smith, essee; the output was zinc-lead ore, which was treated at the Rex mill, Wallace. The Interstate Callahan property, as well as the Interstate dump, also owned by Day Mines, Inc., was worked intermittently by Zanetti Bros., and the zinc-lead ore produced was treated in the Rex mill operated by Zanetti Bros. Lessees worked the Parrott mine and shipped zinc-lead ore to the Rex mill for milling. The Sunset Lease (a partnership in which Day Mines, Inc., has a 70 percent interest with the Anaconda Copper Mining Co.) was operated the entire year by Korsage Bros. and Zanetti Bros., with some of the ore being treated in the Golconda Custom mill and the remainder in the Rex mill.

Evolution District.—Silver ore was the principal ouput of the Evolution district, with the Sunshine Mining Co. being the major producer. A total of 116,324 tons of silver ore from the Sunshine mine (including the Chester Vein) was treated in the company's 1,350-ton flotation mill, which yielded 125 ounces of gold, 4,106,777 ounces of silver, 1,017,553 pounds of copper, 3,403,888 pounds of lead, and 352,236 pounds of zinc. In addition to ores from the Sunshine mine, the mill treated the output of the Polaris Mining Co., Silver Syndicate, Inc., Silver Dollar Mining Co., Sunshine Consolidated, Inc., Metropolitan Mines Corp. and the Big Creek Apex Mining Co.

The Big Creek tailings deposit along the South Fork of the Coeur d'Alene river, the DeBlock tailings at the mouth of Lake Gulch, and the Osburn tailings deposits were worked by Zanetti Bros. and trucked to the company's tailings mill in Osburn.

The only copper ore produced in the district came from the Coeur d'Alene Mines Corp. Mineral Point mine. A total of 7,682 tons of ore was milled in the company's 600-ton flotation mill and yielded 45 ounces of gold, 79,851 ounces of silver, 44,408 pounds of copper, and 537 pounds of lead.

Hunter District (Mullan).—The Star mine of the Sullivan Mining Co. was the major producer of the Hunter district and in 1951 ranked first in zinc production and third in lead in the State. A total of 265,724 tons of zinc-lead ore was produced from this mine, which was

treated in the company's 1,000-ton flotation mill and yielded 9,787 tons of lead concentrates and 36,798 tons of zinc concentrates which together contained 180 ounces of gold, 227,073 ounces of silver, 124,394 pounds of copper, 15,608,945 pounds of lead, and 38,545,792 pounds of zinc.

Production from the Morning mine, owned and operated by the Federal Mining & Smelting Co., declined in 1951 as compared with 1950. A total of 88,817 tons of zinc-lead ore was treated in the company's 1,200-ton flotation mill and yielded 18,602 tons of concentrates containing 72 ounces of gold, 153,945 ounces of silver, 103,452 pounds of copper, 9,874,966 pounds of lead, and 14,422,558 pounds of zinc.

The Lucky Friday Silver-Lead Mines Co. worked the Lucky Friday mine during 1951 and shipped zinc-lead ore to the Golconda custom flotation mill in Wallace. Lead and zinc concentrates amounting to 1,431 and 174 tons, respectively, were produced from this ore and together contained 132 ounces of gold, 208,442 ounces of silver, 60,480 pounds of copper, 1,824,238 pounds of lead, and 413,154 pounds of zinc. Other important producing properties in the district included the Golconda, Hickory, and West Mammoth.

Lelande District (Burke, Mace, Frisco).—The Frisco group (Black Bear and Gem Veins) owned and operated by the Federal Mining & Smelting Co. was the largest producer in the Lelande district; 52,100 tons of zinc-lead ore containing 48 ounces of gold, 56,712 ounces of silver, 71,479 pounds of copper, 3,496,000 pounds of lead, and 6,214,200 pounds of zinc was shipped to the Morning mill for treatment. The upper levels of the Frisco mine were worked by the Hull lease; 28,441 tons of zinc-lead ore containing 22 ounces of gold, 9,962 ounces of silver, approximately 16,250 pounds of copper, 463,392 pounds of lead, and 4,300,840 pounds of zinc was milled in the Hull lease 90-ton flotation mill.

Day Mines, Inc., worked its Hercules mine and shipped zinc-lead ore to the Sherman mill for treatment. The Sherman mine and 300-ton flotation mill, also owned by Day Mines, Inc., recorded a drop in production of lead ore, its principal product. The remainder of the district output was chiefly zinc-lead ore from 13 other properties.

Placer Center District.—The Tamarack mine, owned and operated by the Day Mines, Inc., had the largest output in the district in 1951. The property was worked throughout the year and the zinc-lead ore was treated in the Tamarack 400-ton flotation mill at Dorn. The Day Mines, Inc., also operated its Dayrock, Option, Black Cloud, California, and Pan Handle groups, treating the lead ore in its 250-ton bulk flotation mill at Bunn. The Success group was worked throughout the year by lessee Wylie Gardner, and the zinc-lead ore produced was treated in the Rex Mill. The remaining district output consisted of lead ore from the Galena mine, lead tailings from the Rex tailings dump, and zinc-lead ore from Tamarack No. 5 mine.

Yreka District (Kellogg).—Mine output in Yreka district dropped appreciably in 1951 owing primarily to a shortage of underground

mine labor during the late summer months and early fall and a loss of productive time during a strike from August 27 to September 6. Ore production for the district in 1951 declined about 1 percent; gold, 24 percent; silver, 31 percent; copper, 26 percent; lead, 28 percent; and zinc, 13 percent. Despite price increases of copper, lead, and zinc in 1951, the total value of district metal output was $29,569,513, a decrease of 3 percent from the 1950 figure. The district remained by far the largest lead and zinc producing area in Idaho and ranked second in silver output.

The Bunker Hill & Sullivan mine at Kellogg continued to be the largest producer of ore in the district, as well as the largest producer of lead in Idaho. Output in 1951, according to the annual report to stockholders, totaled 1,703,121 ounces of silver, 22,478 tons of lead, and 10,298 tons of zinc in terms of gross metal content of concentrates. Zinc output in 1951 was 19 percent greater than in 1950, making the Bunker Hill & Sullivan mine the second largest producer of zinc in Idaho in 1951. The silver and lead output in 1951 decreased 36 percent and 33 percent, respectively, from the 1950 level.

John George continued leasing operations in the upper levels of the Bunker Hill & Sullivan mine and treated about 15,000 tons of lead ore in his 250-ton concentrator, producing lead concentrates containing 27,794 ounces of silver, 695 tons of lead, and 172 tons of zinc.

Production of the Page mine of the Federal Mining & Smelting Co. during 1951 was appreciably less than in 1950 as a result of the shortage of miners during the summer months and the strike in late August and early September. A total of 130,181 tons of zinc-lead ore was treated in the company's 500-ton flotation mill, a decrease of 18 percent from 1950 output. Silver production of the Page mine decreased 12 percent in 1951, lead 22 percent, and zinc 20 percent.

The Highland Surprise Consolidated Mining Co. operated its Highland Surprise mine on Stewart Creek throughout the year and reported the production of 25,100 tons of zinc-lead ore which, when treated in the company's 300-ton flotation mill, yielded concentrates containing a total of 64 ounces of gold, 16,314 ounces of silver, 11,200 pounds of copper, 1,033,015 pounds of lead, and 1,895,447 pounds of zinc in terms of recoverable metal. Sunset Minerals, Inc. worked the Liberal King mine during 1951 and produced 117 ounces of gold, 20,711 ounces of silver, 17,044 pounds of copper, 1,492,647 pounds of lead, and 3,223,986 pounds of zinc as recoverable metal. The Sidney Mining Co. operated its Sidney group and 300-ton flotation mill on Denver Creek near Kellogg throughout 1951 and produced 4,145 tons of lead concentrates and 10,347 tons of zinc concentrates, which together contained 125 ounces of gold, 115,763 ounces of silver, 33,836 pounds of copper, 5,596,205 pounds of lead, and 11,209,347 pounds of zinc as recoverable metal. From the Constitution mine, the Spokane-Idaho Mining Co. produced a total of 2,018 tons of lead concentrates and 8,072 tons of zinc concentrates, which together yielded 142 ounces of gold, 102,607 ounces of silver, 32,876 pounds of copper, 3,439,948 pounds of lead, and 7,983,859 pounds of zinc.

VALLEY

The Bradley Mining Co. worked its Yellow Pine mine in the Yellow Pine district throughout the year and produced 620,733 tons of gold-antimony ore which, when concentrated in the company's 2,200-ton flotation mill, yielded 14,394 tons of gold concentrate containing 19,605 ounces of gold and 141,044 ounces of silver. Compared with the 1950 production, this was a decrease of 60 percent in the gold output and an increase of 3 percent in the silver output. Nevertheless, the Yellow Pine property produced 59 percent of the State total gold in 1951.

TABLE 11.—Mine production of gold, silver, copper, lead, and zinc in the Coeur d'Alene region, Shoshone County, 1947–51, and total 1884–1951, in terms of recoverable metal

Year	Mines producing		Material sold or treated (short tons)	Gold, lode and placer (fine ounces)	Silver, lode and placer (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
	Lode	Placer							
1947	61	4	2,957,143	2,808	9,234,906	2,624,000	146,120,000	158,502,000	$49,226,932
1948	65	7	3,165,780	3,362	10,598,338	2,775,000	165,174,000	167,601,000	62,168,955
1949	61	1	2,282,614	2,438	9,146,146	2,341,000	148,304,000	148,739,200	50,699,924
1950	57	2	2,542,169	3,416	15,056,131	3,791,000	189,394,000	172,205,000	64,555,947
1951	67	-------	2,393,939	2,684	13,639,808	3,748,000	141,140,000	149,978,000	65,058,887
1884–1951	-----	-------	[1]	407,774	489,962,753	[2] 73,005	[2] 5,927,133	[2] 1,595,380	1,414,636,027

[1] Figure not available.
[2] Short tons.

Illinois, Kentucky, Maryland, New Jersey, New York, Pennsylvania, Vermont, and Virginia

Gold, Silver, Copper, Lead, and Zinc

(MINE REPORT)

By Samuel A. Gustavson

GENERAL SUMMARY

EACH of the States discussed in this chapter is a producer of one or more of the five metals—gold, silver, copper, lead, and zinc—within Region VIII of the Bureau of Mines. States in the area not producing these metals are: Connecticut, Delaware, Indiana, Maine, Massachusetts, New Hampshire, Ohio, Rhode Island, and West Virginia. Data for previous years will be found in earlier Minerals Yearbooks in chapters entitled "East of the Mississippi River" or "Eastern and Central States."

Production generally increased in 1951, except for Northern Illinois and Virginia. In Northern Illinois the Eagle-Picher Co., Mining and Smelting Division, operated steadily, but production was only about half that in 1950; and in Virginia a strike stopped production at the Austinville mine of the New Jersey Zinc Co. from April 1 to October 1. Both companies produce lead and zinc.

The value of the metal production reported herein, except that of zinc in New Jersey, has been calculated at the prices shown in table 1. The value of the New Jersey output is the total value of the zinc recoverable as metal and oxide after freight, haulage, smelting, and manufacturing charges are added.

TABLE 1.—Prices of gold, silver, copper, lead, and zinc, 1947–51

Year	Gold [1] (per fine ounce)	Silver [2] (per fine ounce)	Copper [3] (per pound)	Lead [3] (per pound)	Zinc [3] (per pound)
1947	$35.00	$0.905	$0.210	$0.144	$0.121
1948	35.00	.905+	.217	.179	.133
1949	35.00	.905+	.197	.158	.124
1950	35.00	.905+	.208	.135	.142
1951	35.00	.905+	.242	.173	.182

[1] Price under authority of Gold Reserve Act of Jan. 31, 1934.
[2] Treasury buying price for newly mined silver, July 1, 1946, to date—$0.9050505 ($0.905 used in 1947 for calculating purposes).
[3] Yearly average weighted price of all grades of primary metal sold by producers. Price in 1947 includes bonus payments by Office of Metals Reserve for overquota production.

TABLE 2.—Mine production of gold, silver, copper, lead, and zinc in Illinois, Kentucky, Maryland, New Jersey, New York, Pennsylvania, Vermont, and Virginia, 1947–51, in terms of recoverable metal [1]

Year	Mines producing	Material sold or terated (short tons)	Gold (lode)		Silver (lode)	
			Fine ounces	Value	Fine ounces	Value
1947	43	[2] 1,927,283	1,618	$56,630	55,531	$50,255
1948	45	[2] 2,051,754	2,304	80,640	61,476	55,639
1949	50	3,729,047	1,765	61,775	59,779	54,103
1950	34	4,305,103	1,930	67,550	73,397	66,428
1951	32	4,381,042	2,336	81,760	105,908	95,852

Year	Copper [1]		Lead		Zinc		Total value [3]
	Short tons	Value	Short tons	Value	Short tons	Value	
1947	12,691	$5,330,220	7,838	$2,257,344	138,356	$32,299,422	$39,993,871
1948	14,248	6,183,632	9,845	3,524,510	140,399	37,751,671	47,596,092
1949	13,449	5,298,906	8,641	2,730,556	121,215	31,860,350	40,005,690
1950	14,497	6,030,752	7,533	2,033,910	133,459	39,532,757	47,731,397
1951	16,140	7,811,760	6,275	2,171,150	135,533	50,711,969	60,872,491

[1] Data for copper production represent combined output of Vermont, Virginia (1947 only), Pennsylvania, and Tennessee; last State included to avoid disclosing individual company operations.
[2] Excludes magnetite-pyrite-chalcopyrite ore from Pennsylvania.
[3] Includes value of copper from Tennessee; *see* footnote 1.

TABLE 3.—Mine production of gold, silver, copper, lead, and zinc in Illinois, Kentucky, Maryland, New Jersey, New York, Pennsylvania, Vermont, and Virginia, in 1951, by States, in terms of recoverable metal

State	Mines producing	Material sold or treated (short tons)	Gold		Silver	
			Fine ounces	Value	Fine ounces	Value
Illinois	19	[1] 857,212			3,465	$3,136
Kentucky	5	[1] 66,119				
Maryland	1	1	1	$35		
New Jersey	2	404,424				
New York	2	500,490			47,568	43,051
Pennsylvania	1	2,083,658	2,179	76,265	13,575	12,286
Vermont	1	230,050	156	5,460	41,300	37,379
Virginia	1	239,088				
Total	32	4,381,042	2,336	81,760	105,908	95,852

State	Copper		Lead		Zinc		Total value
	Short tons	Value	Short tons	Value	Short tons	Value	
Illinois			3,160	$1,093,360	21,776	$7,926,464	$9,022,960
Kentucky			107	37,022	3,457	1,258,348	1,295,370
Maryland							35
New Jersey					62,917	[2] 24,279,745	[2] 24,279,745
New York			1,500	519,000	40,051	14,578,564	15,140,615
Pennsylvania	[3] 16,140	[3] $7,811,760					[4] 7,900,311
Vermont							[5] 42,839
Virginia			1,508	521,768	7,332	2,668,848	3,190,616
Total	[3] 16,140	[3] 7,811,760	6,275	2,171,150	135,533	50,711,969	[6] 60,872,491

[1] Includes fluorspar ore from which lead and/or zinc are recovered—Illinois 332,028 tons, Kentucky 45,478 tons.
[2] Estimated smelting value of recoverable zinc content of ore after freight, haulage, smelting, and manufacturing charges are added.
[3] Tennessee production and value included, to avoid disclosing individual company operations.
[4] Includes value of copper from Tennessee and Vermont; *see* footnote 3.
[5] Excludes value of copper, which is included under Pennsylvania; *see* footnote 3.
[6] Includes value of copper produced in Tennessee; *see* footnote 3.

TABLE 4.—Mine production of gold, silver, copper, lead, and zinc in Illinois, Kentucky, Maryland, New Jersey, New York, Pennsylvania, Vermont, and Virginia, 1951, by months, in terms of recoverable metal

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Gold (fine ounces):													
Maryland							1						1
Pennsylvania	150	130	180	205	190	215	165	185	190	195	195	179	2,179
Vermont	12	8	13	16	13	13	13	13	13	15	13	14	156
Total	162	138	193	221	203	228	179	198	203	210	208	193	2,336
Silver (fine ounces):													
Illinois	285	285	195	240	190	355	370	355	325	315	320	230	3,465
New York	3,280	3,864	3,964	4,628	3,582	2,976	2,689	6,360	2,812	6,001	3,022	4,390	47,568
Pennsylvania	930	810	1,140	1,260	1,160	1,320	1,040	1,140	1,190	1,225	1,235	1,125	13,575
Vermont	2,441	1,678	3,059	4,316	3,784	3,633	3,636	3,553	3,212	4,240	3,763	3,985	41,300
Total	6,936	6,637	8,358	10,444	8,716	8,284	7,735	11,408	7,539	11,781	8,340	9,730	105,908
Copper (short tons): Pennsylvania, Tennessee, Vermont [1]	1,249	1,043	1,364	1,454	1,342	1,378	1,259	1,363	1,386	1,487	1,435	1,380	16,140
Lead (short tons):													
Illinois:													
Northern	121	56	108	78	71	34	41	42	49	17	62	72	751
Southern	187	124	154	172	243	270	243	267	193	164	178	214	2,409
Total Illinois	308	180	262	250	314	304	284	309	242	181	240	286	3,160
Kentucky	7	8	10	8	9	8	9	10	10	9	11	8	107
New York	190	160	149	134	107	103	80	125	102	113	109	128	1,500
Virginia	277	280	240							274	235	202	1,508
Total	782	628	661	392	430	415	373	444	354	577	595	624	6,275
Zinc (short tons):													
Illinois:													
Northern	1,395	1,204	1,292	1,198	1,635	1,484	1,313	1,397	1,218	1,244	1,184	1,085	15,649
Southern	600	443	500	479	450	454	414	419	577	586	640	565	6,127
Total Illinois	1,995	1,647	1,792	1,677	2,085	1,938	1,727	1,816	1,795	1,830	1,824	1,650	21,776
Kentucky	257	220	331	375	379	304	229	318	222	296	279	247	3,457
New Jersey	6,402	4,885	4,529	4,705	5,125	5,364	5,018	5,614	5,015	5,900	5,370	4,990	62,917
New York	3,611	3,181	3,600	3,277	3,228	3,050	2,869	3,462	3,313	3,612	3,234	3,614	40,051
Virginia	1,494	1,394	1,424							1,077	1,064	879	7,332
Total	13,759	11,327	11,676	10,034	10,817	10,656	9,843	11,210	10,345	12,715	11,771	11,380	135,533

[1] Tennessee production included with that of Vermont and Pennsylvania to avoid disclosing individual company operations.

TABLE 5.—Mine production of gold, silver, copper, lead, and zinc in Illinois, Kentucky, Maryland, New Jersey, New York, Pennsylvania, Vermont, and Virginia, in 1951, by method of recovery and class of material processed, in terms of recoverable metal [1]

	Material sold or treated (short tons)	Gold recoverable in bullion (fine ounces)[2]	Concentrate shipped to smelters and recoverable metal					
			Concentrate (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
BY CLASS OF ORE TREATED								
Gold ore: Maryland	1	1						
Copper ore: Vermont	230,050		(3)	156	41,300	(3)		
Magnetite-pyrite-chalcopyrite ore: Pennsylvania	2,083,658		(3)	2,179	13,575	(3)		
Zinc ore:								
Illinois	525,184		29,615				751	15,649
Kentucky	20,641		5,604					2,996
New Jersey	404,424		310,838					62,917
New York	123,363		19,757					10,530
Total	1,073,612		365,814				751	92,092
Zinc-lead ore:								
Illinois	332,028		14,340		3,465		2,409	6,127
Kentucky	45,478		986				107	461
New York	377,127		60,498		47,568		1,500	29,521
Virginia	239,088		16,513				1,508	7,332
Total	993,721		92,337		51,033		5,524	43,441
Grand total	4,381,042	1	[4] 550,326	2,335	105,908	[4] 16,140	6,275	135,533
BY CLASS OF CONCENTRATE SHIPPED TO SMELTERS								
Copper:								
Pennsylvania			(3)	2,179	13,575	(3)		
Vermont			(3)	156	41,300	(3)		
Total			[4] 92,175	2,335	54,875	[4] 16,140		
Lead:								
Illinois			4,550				3,160	
Kentucky			162				107	
New York			2,513		47,568		1,500	
Virginia			2,136				1,508	
Total			9,361		47,568		6,275	
Zinc:								
Illinois			39,405		3,465			21,776
Kentucky			6,428					3,457
New Jersey			310,838					62,917
New York			77,742					40,051
Virginia			14,377					7,332
Total			448,790		3,465			135,533
Grand total			[4] 550,326	2,335	105,908	[4] 16,140	6,275	135,533

[1] All material treated at mills; no ore shipped directly to smelters in 1951. Definitions used in ore classification will be found in the Gold and Silver chapter of this volume.
[2] No silver recoverable in bullion in 1951.
[3] Figure withheld to avoid disclosing individual company operations.
[4] Copper concentrate from Tennessee included to avoid disclosing individual company operations.

METALLURGICAL INDUSTRY

During 1951 virtually all ore from the States reported in this chapter was treated in concentration mills at or near the mines and the product then shipped to smelters, refineries, or oxide plants. A total of 4,381,042 short tons of material was so treated, including 2,083,658 tons of magnetite-pyrite-chalcopyrite ore produced in Pennsylvania. This is also reported in the Iron Ore chapter of this volume. Fluorspar ore from all Southern Illinois mines and all Kentucky mines except the Hutson mine of Alcoa Mining Co. (*see* footnote 1, table 3) is duplicated in the Fluorspar chapter. In 1950, 4,305,103 tons of material was concentrated. About 1 ton of gold ore in 1951 and about 55 tons in 1950 were treated by amalgamation.

The methods of treatment used in some mills and other operating details are given in the Review by States that follows.

REVIEW BY STATES

ILLINOIS

Northern Illinois.—During 1951 five mines operated in Jo Daviess County. Production totaled 525,184 tons of crude ore, from which 28,539 tons of zinc concentrates containing 15,649 tons of recoverable zinc and 1,076 tons of lead concentrates containing 751 tons of recoverable lead were obtained. Tri-State Zinc, Inc., operated its Bautsch mine throughout the year and the Black Jack mine intermittently. The ore is concentrated in the company 850-ton jig and flotation mill. Output was slightly less than in 1950. The Eagle-Picher Co., Mining and Smelting Division (formerly the Eagle-Picher Mining & Smelting Co.), operated the Graham, Snyder, and Spillane mines and the 75-ton-per-hour jig and flotation mill throughout the year; output, however, was only about half that of 1950.

Southern Illinois.—Production of silver, lead, and zinc, virtually all from fluorspar mines, totaled 3,465 ounces of silver, 2,409 tons of lead, and 6,127 tons of zinc, an increase of 73, 65, and 4 percent, respectively, over 1950. Major reasons for the increases were a strong demand for fluorspar and higher prices for lead and zinc. The chief producers were the Ozark-Mahoning Co., Minerva Oil Co., Alcoa Mining Co., Crystal Fluorspar Co., and Rosiclare Lead & Fluorspar Mining Co.

KENTUCKY

A fivefold increase in zinc output from Kentucky mines in 1951 is attributable chiefly to the first full year's operation of the Alcoa Mining Co. Hutson zinc mine in Livingston County. The rest of the State output of zinc and all the lead were recovered as byproducts of fluorspar mining by the Ozark-Mahoning Co. and the United States Steel Co. (formerly United States Coal & Coke Co.), operating in Crittenden County; and the Inland Steel Co., operating in Livingston County.

MARYLAND

Philadelphia Mint receipts credited production of 1 ounce of gold from the Maryland mine in Montgomery County.

NEW JERSEY

The Franklin and Sterling Hill mines of the New Jersey Zinc Co. in Sussex County operated continuously thoughout the year, recording a zinc-production increase of 14 percent, in quantity and 41 percent in value over 1950. In 1950 the mines were idle from January 1 to January 26.

NEW YORK

In Lawrence County the St. Joseph Lead Co. operated the Balmat and Edwards mines nearly continuously throughout the year. Silver, lead, and zinc are produced from the Balmat mine and zinc from the Edwards mine. The State production of silver, lead, and zinc was greater in 1951, in spite of the loss of production from the Universal Exploration Co. Hyatt mine, which closed in May 1950.

PENNSYLVANIA

All the gold, silver, and copper produced in Pennsylvania for several years has been from the Cornwall mine of the Bethlehem Steel Co. in Lebanon County. Operation was continuous in 1951, and production of gold, silver, and copper increased 24, 29, and 28 percent, respectively, over 1950. The ore mineral is magnetite-pyrite-chalcopyrite.

According to the company's annual report, the New Jersey Zinc Co. had sunk the shaft at its zinc mine near Friedensville to within 175 feet of the objective depth of 1,260 feet.

VERMONT

Vermont has only one active producer of the metals discussed in this chapter. The chief product is copper, with gold and silver as relatively minor coproducts. Mining was carried on at a steady rate throughout 1951. In terms of recoverable metal, copper production was about 8 percent greater than in 1950 and gold and silver output 7 and 46 percent greater, respectively. An exploration contract between the Vermont Copper Co. and the Defense Minerals Exploration Administration for search for additional copper ore in Orange County was approved in August. The contract specified an expenditure of $51,382, the Government and the company each to furnish half.

VIRGINIA

Output of lead and zinc was 54 and 41 percent less, respectively, in 1951 than in 1950. A strike at the Austinville mine of the New Jersey Zinc Co. in Wythe County, which stopped production from April 1 to October 1, was the chief reason for the decrease.

No production was reported by the Timberville Mining Co. in Frederick County. The New Jersey Zinc Co. reported the starting of shaft-sinking operations preparatory to development of its property at Ivanhoe, Va., near Austinville. The ore from this property will be concentrated at Austinville.

Michigan and Wisconsin
Gold, Silver, Copper, Lead, and Zinc

(MINE REPORT)

By Samuel A. Gustavson

GENERAL SUMMARY

COPPER is currently produced in the Upper Peninsula of Michigan in Houghton and Keweenaw Counties from amygdaloid and conglomerate lode deposits and from re-treatment of old mill tailings. In 1951 production of copper (24,979 tons) was 2½ percent less than in 1950. During 1951 an estimated $568,193 in exploration contracts covering search for copper ore in Houghton and Keweenaw Counties was approved by the Defense Minerals Exploration Administration (DMEA), formerly part of the Defense Minerals Administration (DMA). The Government share of the cost was $284,096. Government price assistance was afforded several high-cost copper mines through agreements between companies and the Defense Materials Procurement Agency (DMPA), formerly DMA, which guaranteed with certain limitations floor prices ranging from 25.5 to 33.8 cents per pound. On November 15, 1951, the Reconstruction Finance Corporation (RFC) approved a $57,185,000 loan for developing the White Pine Copper deposit in Ontonagon County. Limited production is planned for the middle of 1954.

Zinc and lead are produced in the southwestern portion of Wisconsin in Grant, Iowa, and Lafayette Counties. Output of both metals in 1951—1,391 tons of lead and 15,754 tons of zinc—was over 2½ times that of 1950. Higher metal prices and/or Government assistance enabled new operators to start producing and stimulated increased output from others. Through DMPA a development loan of $80,000 was authorized in September 1951 to the Miffiin Mining Co., and at the year end DMEA had approved exploration contracts totaling $329,203.13.

There has been no production of gold in either Michigan or Wisconsin in recent years. Silver production was last reported in Michigan in 1947.

In this report all tonnage figures are short tons and "dry weight"; that is, they do not include mositure. The values have been calculated at the prices shown in table 1.

TABLE 1.—Prices of gold, silver, copper, lead, and zinc, 1947–51

Year	Gold [1] (per fine ounce)	Silver [2] (per fine ounce)	Copper [3] (per pound)	Lead [3] (per pound)	Zinc [3] (per pound)
1947	$35.00	$0.905	$0.210	$0.144	$0.121
1948	35.00	.905+	.217	.179	.133
1949	35.00	.905+	.197	.158	.124
1950	35.00	.905+	.208	.135	.142
1951	35.00	.905+	.242	.173	.182

[1] Price under authority of Gold Reserve Act of Jan. 31, 1934.
[2] Treasury buying price for newly mined silver July 1, 1946, to date—$0.9050505 ($0.905 used in 1947 for calculating purposes).
[3] Yearly average weighted price of all grades of primary metal sold by producers. Price in 1947 includes bonus payments by Office of Metals Reserve for overquota production.

TABLE 2.—Mine production of copper in Michigan and lead and zinc in Wisconsin in 1951, by months, in terms of recoverable metal, in short tons

Month	Michigan	Wisconsin	
	Copper	Lead	Zinc
January	1,913	80	1,023
February	1,975	101	872
March	2,444	139	1,247
April	2,064	131	1,143
May	1,995	101	1,440
June	2,021	98	1,299
July	1,886	99	1,235
August	2,415	134	1,430
September	1,840	87	1,237
October	2,074	124	1,488
November	1,933	135	1,530
December	2,419	162	1,810
Total	24,979	1,391	15,754

METALLURGICAL INDUSTRY

All the ore and old tailings produced in Michigan and Wisconsin were treated at concentrating mills at or near the mines, and then shipped to smelters or oxide plants. In Michigan, the Calumet & Hecla Consolidated Copper Co. shipped all of its copper concentrates to the company smelter at Hubbell. Copper Range Co. and Quincy Mining Co. copper concentrates were processed in the Quincy smelter at Hancock. Wisconsin lead and zinc concentrates were sold to American Smelting & Refining Co., American Zinc Co. of Illinois, Matthiessen & Hegeler Zinc Co., and New Jersey Zinc Co.

Definitions used in ore classification are given in the Gold and Silver chapter of this volume. Table 3 presents data concerning types of ores and concentrates produced in Michigan and Wisconsin.

TABLE 3.—Mine production of copper, lead, and zinc in Michigan and Wisconsin in 1951, by method of recovery and class of material processed, in terms of recoverable metal, in short tons[1]

	Material treated	Concentrate shipped to smelters and recoverable metal			
		Concentrate	Copper	Lead	Zinc
BY STATE					
Michigan	4,471,334	40,272	24,979		
Wisconsin	514,721	29,877		1,391	15,754
BY CLASS OF MATERIAL TREATED					
Copper (Michigan)	4,471,334	40,272	24,979		
Zinc (Wisconsin)	50,615	4,011		50	2,110
Zinc-lead (Wisconsin)	464,106	25,866		1,341	13,644
BY CLASS OF CONCENTRATE SHIPPED TO SMELTERS					
Copper (Michigan)		40,272	24,979		
Lead (Wisconsin)		1,900		1,391	
Zinc (Wisconsin)		27,977			15,754

[1] All material treated at mills in 1951; none shipped directly to smelters. Some mass copper is hand-sorted rom crude copper ore in Michigan and some galena (lead sulfide) from lead ore in Wisconsin. The material s usually sorted at the mill and is included herein as part of the concentrates produced.

REVIEW BY STATES

MICHIGAN

Production of copper from Michigan mines in 1951 totaled 24,979 tons, 2½ percent less than in 1950. Virtually all this copper was produced by three companies: Calumet & Hecla Consolidated Copper Co. operating several underground mines and two tailings reclamation plants; Copper Range Co. operating the Champion mine; and Quincy Mining Co. operating one tailings reclamation plant. All operated at a relatively steady rate throughout the year. Of significance to the future of copper mining in Michigan's Upper Peninsula was the approval on November 15 of a $57,185,000 loan by the Reconstruction Finance Corporation to the White Pine Copper Co. for development of the White Pine copper deposit.

Extracts from the producing companies' annual reports follow:

From report of Calumet & Hecla Consolidated Copper Co.:

Exploration contracts have been made with the Government whereby the Company and the Government will share equally in the cost of exploring for copper ore in Northern Michigan and for zinc-lead ore in the Wisconsin-Illinois district. * * * In Northern Michigan we have received some encouragement, but a great deal of additional work must be done to determine whether we have located new ore bodies of commercial grade as a direct result of the exploration contract.

Because the present ceiling price of copper is unrealistic and too low in relation to increased costs of labor and supplies resulting from general inflation, the Company was forced to take advantage of Government subsidy in respect to four of our highest cost mines in Northern Michigan. The output from these mines represents about one-third of our current underground copper production. Under

contracts with the Defense Materials Procurement Agency, effective December 1, 1951, these mines should continue to operate at least for terms ranging from 12 to 17 months.

Applications are on file with the Defense Materials Procurement Agency seeking Government financing of the unwatering and rehabilitation of two of the Company's copper mines that were shut down in the 1930's. There is no assurance that the Government will approve these applications but, in the event of approval, the projects will make available 40 to 50 million pounds of copper per year over a period of at least 15 years.

* * *

Our seven copper mines and two reclamation plants operated at capacity throughout 1951 although the average yield per ton of rock was low. Labor and supply costs increased appreciably during the year but the price of refined copper was frozen for the entire year by the Office of Price Stabilization. As a result, our mining operations showed only a modest profit for the year.

* * *

EXPLORATIONS

* * * Contracts were made under which the Government has agreed to pay half the cost of certain explorations, to be repaid on a royalty basis if production results. These agreements provide for a total expenditure of $568,193 on explorations in Michigan and $158,519 on explorations in Wisconsin during a two-year period.

In Michigan, the Government is participating in the cost of underground drifting and surface trenching. A drift, south of present workings on the Kearsarge Lode, has disclosed encouraging mineralization which justifies further work.

Without Government participation, the Company is exploring a part of the Knowlton Lode in Ontonagon County where spotty mineralization was discovered in 1939. Information will be sought on the pattern, grade and physical characteristics of the ore in order to determine whether the deposit can be exploited profitably.

From report of Copper Range Co.:

Mining was carried on throughout the year in the East Vein of the Champion Mine. The program of increasing tonnage was continued throughout the year although progress was not as rapid as desired. A total of 206,831 tons of ore were shipped to the mill. * * * Development and preparation work during the year was in excess of that required to replace the tonnage milled. Broken ore reserves were increased during the year from 101,000 tons to 133,000 tons at the end of the year.

* * *

On September 16th a wage increase was made subject to the approval of the Wage Stabilization Board. Concurrent increases in the cost of materials and supplies made it impossible to continue production on an economical basis at the ceiling price of 24.5 cents per pound. Consequently, the Company immediately began negotiations with the Defense Materials Procurement Agency for a subsidy to cover the current costs of production. By the end of the year an understanding had been reached with the Government whereby it agreed to pay to this Company subsidy payments with respect to copper produced from the East Vein (estimated during the two-year term of this contract at 6,372,000 pounds) equal to the difference between the ceiling price and 33.8 cents per pound. The understanding was formalized in an agreement with the Defense Materials Procurement Agency dated March 19, 1952 and is retroactive to January 1, 1952. The agreement terminates on December 31, 1953. Furthermore, it may be canceled on sixty days' notice by either the Government or the Company and will end automatically when copper price controls are removed.

The Mill at Freda operated throughout the year. In July regrind and concentrate cleaning circuits were put into operation which have raised the average grade of concentrate from 48 per cent to 60 per cent without increasing the overall milling costs and without additional capital expenditures. * * *

WHITE PINE COPPER COMPANY

The White Pine Copper Company, incorporated under the laws of the State of Delaware on November 21, 1950 and having an authorized capital of 300,000 shares of $10 par value, acquired 9,840 acres of the fee, mineral and surface rights initially required for the development of the project, including the ore body and all appurtenances, in consideration of the issue to Copper Range Company of 136,000 shares of its capital stock having an aggregate par value of $1,360,000. * * *

A loan in the amount of $57,185,000 was authorized by the Reconstruction Finance Corporation, acting under the Defense Production Act on November 15, 1951. Two amendments were made subsequently to reflect important changes in the terms and conditions of the original authorization. * * *

* * *

White Pine Copper Company has the right to require the Government to purchase up to 243,750 short tons (487,500,000 pounds) of the first 275,000 short tons of copper produced by the White Pine Copper Company at the floor price of 25.5 cents per pound, adjusted in accordance with changes in certain Government labor and commodity indices, reflecting changes in labor, material and other costs, as published by the United States Department of Labor, Bureau of Labor Statistics. The Government retains an option to buy all of the copper produced during the term of the contract at the higher of the then market price and the 25.5 cents floor price as adjusted by index changes. The contract terminates on December 31, 1961, subject to earlier termination upon certain contingencies.

* * *

During the year 2,788 tons of ore were mined at White Pine and sent to the pilot mill for testing purposes. * * *

From report of Quincy Mining Co.:

During 1951 operation of our Reclamation Plant has continued on a very satisfactory basis; the tons of stamp sands handled were somewhat less than during the previous year. The recovery of copper per tons of sands treated averaged 5.57 pounds, while this is very good it is about 5% less than for 1950. The waste tailings, discarded after treatment carried an average copper content of but 1.67 pounds per ton.

* * *

Our Reclamation Plant started the retreatment of stamp sands deposited in Torch Lake from our No. 1 Stamp Mill on November 1, 1943, and the dredge for pumping the sands from the Lake has been in continuous operation since that time; only a small tonnage remains to be treated from the number one mill sands, but there is probably enough to last until October 1952. At that time our dredging equipment will be moved to what is known as our No. 2 Stamp Mill sands. These are the waste tailings that were deposited in Torch Lake from our No. 2 Stamp Mill during the years between 1901 and 1920 at which time our No. 2 Stamp Mill was closed down. * * *

TABLE 4.—Mine production of copper in Michigan, 1947–51, in terms of recoverable metal

Year	Mines producing		Material treated		Copper	
	Lode	Tailings	Ore (short tons)	Tailings (short tons)	Short tons	Value
1947	11	4	1,962,258	3,167,516	24,184	$10,157,280
1948	11	3	2,165,112	2,325,124	27,777	12,055,218
1949	9	3	1,503,358	2,039,510	19,506	7,685,364
1950	9	3	2,148,919	2,237,555	25,608	10,652,928
1951	8	3	2,214,369	2,256,965	24,979	12,089,836

WISCONSIN

During 1951 Wisconsin mines produced and treated 499,971 tons of ore and an estimated 14,750 tons of tailings or boulder piles.

Twenty-five producers were active in 1951 compared with 11 in 1950, and production of lead and zinc was more than 2½ times that of 1950. Higher prices for both lead and zinc and Government assistance through exploration and development loans provided the chief incentives. Output in 1951 was 1,391 tons of lead and 15,754 tons of zinc. Tables 2, 3, and 5 give more detailed production data for the State.

The chief producers were: Calumet & Hecla Consolidated Copper Co. (an extract of the company annual report follows); Vinegar Hill Zinc Co.; Dodgeville Mining Co.; Mifflin Mining Co.; Benton Milling Co.; George M. Baker; and E. P. Scallon. Mifflin Mining Co. and E. P. Scallon were new operators in the State. Other producers include: Walter Kuhn; Pecatonica Mining Co.; Clarence F. Houtaker; Meekers Grove Mining Co.; Orthel Redfearn; Murray & Richards Co.; Whitechurch & Farr; Fred Hofer & Sons; Mayer & Thiede Mining Co.; and Mickey Mining Co.

The following is extracted from the annual report of the Calumet & Hecla Consolidated Copper Co.:

> Exploration contracts have been made with the Government whereby the Company and the Government will share equally in the cost of exploring for copper ore in Northern Michigan and for zinc-lead ore in the Wisconsin-Illinois district. If commercial ore is discovered and mined, repayment of the Government's share will be made on a royalty basis. We have been fortunate in discovering a substantial tonnage of new ore in Wisconsin. * * *
>
> * * *
>
> The Company's zinc mine at Shullsburg, Wisconsin, was placed on a production basis at the beginning of the year. With the installation of additional underground loading and trucking equipment, production gradually increased as the year progressed, and at the year-end had reached the capacity of the mill. During the year 14,155 tons of zinc and lead concentrates were shipped. The underground and surface equipment is in good condition, and no additional major capital expenditures are contemplated for the present plant in 1952.

EXPLORATIONS

> Explorations for copper and zinc ores were continued on the expanded scale started in 1950. Contracts were made under which the Government has agreed to pay half the cost of certain explorations, to be repaid on a royalty basis if production results. These agreements provide for a total expenditure of $568,193 on explorations in Michigan and $158,519 on explorations in Wisconsin during a two-year period.
>
> * * *
>
> Explorations in the Wisconsin-Illinois zinc district have disclosed more new ore than was mined during the year.

TABLE 5.—Mine production of lead and zinc in Wisconsin, 1947–51, in terms of recoverable metal

Year	Mines producing		Material treated		Lead		Zinc		Total value
	Lode	Tailings	Ore (short) tons)	Tailings[1] (short tons)	Short tons	Value	Short tons	Value	
1947	48	4	257,456	240,554	1,166	$335,808	12,224	$2,958,208	$3,294,016
1948	39	2	162,473	24,753	861	308,238	7,864	2,091,824	2,400,062
1949	45	1	165,962	8,000	857	270,812	5,295	1,313,160	1,583,972
1950	11	1	186,083	19,600	532	143,640	5,722	1,625,048	1,768,688
1951	22	3	499,971	14,750	1,391	481,286	15,754	5,734,456	6,215,742

[1] Partly estimated by author.

Missouri, Oklahoma, Kansas, Arkansas, and Texas[1]

Gold, Silver, Copper, Lead, and Zinc

(MINE REPORT)

By F. F. Netzeband

GENERAL SUMMARY

DEFENSE programs of all the world powers during 1951 created a singular demand for metals on the entire domestic mining industry. Resultant high metal prices allowed mine operators in the West Central States—Missouri, Oklahoma, Kansas, and Arkansas—to mine the extensive marginal ores of these areas at maximum rate. Total mine production from these four States amounted to 11,783,062 tons of crude ore in 1951, which was 9 percent more than that produced in 1950. The grade of crude ore declined, resulting in similar declines in output of silver, copper, and lead. Zinc output, on the other hand, increased 14 percent.

The Government maintained its controls on prices and the allocation of metals to consumers throughout 1951. The ceiling price of lead was 17 cents and that of zinc 17.5 cents from January 1 to October 1. Each metal advanced 2 cents to 19 and 19.5 cents, respectively, for the last 3 months of 1951. Lead-concentrate price in the Tri-State district was $218.42 per ton until October 2, when it advanced to $246.50, and on November 1 decreased to $245.95, reflecting an increase in smelting charge. Zinc concentrates were quoted at $115.00 a ton until October 2, when they advanced to $135.00 a ton, as the domestic ceiling price of zinc was advanced 2 cents.

The total value of the silver, copper, lead, and zinc from the West Central States in 1951 amounted to $87,154,403, or $17,871,824 (26 percent) more than in 1950. Silver production was valued at $166,913, 22 percent less than in 1950; copper, $1,172,248, 6 percent less than in 1950; lead, $51,642,922, 16 percent more than in 1950; and zinc $34,172,320, 47 percent more than in 1950.

Mining activities in Texas in 1951 were primarily exploration projects in the Shafter, Van Horn, and Sierra Blanca areas in the southwestern part of the State. The total value of the mine production of gold, silver, copper, lead, and zinc in 1951 was $26,467—$1,120 for gold, $1,250 for silver, $483 for copper, $14,878 for lead, and $8,736 for zinc.

[1] These are the gold-, silver-, copper-, lead-, and zinc-producing States within Bureau of Mines Region VI.

Additional zinc values, not included in the above figures for Texas, were obtained from the slag-fuming plant of the American Smelting & Refining Co. at El Paso, which processed old zinc-lead-bearing slags with current hot slag. In production statistics, the metals (principally zinc) recovered from the current hot slags are credited to the various shippers of concentrates on the basis of assay content and are apportioned to the States from which the ore shipments originated. Specific data on the quantity of metals recovered from the old slag are not available.

The values of the metals reported in this chapter have been calculated at the average yearly metal prices given in table 1. Tonnage figures are short tons and "dry weight"; that is, they do not include moisture. Statistics on Texas are shown separately from those of the West Central States to maintain continuity with past years.

TABLE 1.—Prices of gold, silver, copper, lead, and zinc, 1947–51

Year	Gold [1] (per fine ounce)	Silver [2] (per fine ounce)	Copper [3] per pound)	Lead [3] (per pound)	Zinc [3] (per pound)
1947	$35.00	$0.905	$0.210	$0.144	$0.121
1948	35.00	.905+	.217	.179	.133
1949	35.00	.905+	.197	.158	.124
1950	35.00	.905+	.208	.135	.142
1951	35.00	.905+	.242	.173	.182

[1] Price under authority of Gold Reserve Act of Jan. 31, 1934.
[2] Treasury buying price for newly mined silver July 1, 1946, to date—$0.9050505 ($0.905 used in 1947 for calculating purposes).
[3] Yearly average weighted price of all grades of primary metal sold by producers. Price in 1947 includes bonus payments by Office of Metals Reserve for overquota production.

TABLE 2.—Mine production of silver, copper lead, and zinc in Arkansas, Kansas, Missouri, and Oklahoma in 1951, by months, in terms of recoverable metal [1]

Month	Silver (fine ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
January	16,987	233	13,511	7,364
February	15,373	221	12,171	6,785
March	16,821	302	13,636	8,048
April	13,805	166	11,308	7,986
May	15,125	73	12,100	8,487
June	14,430	203	11,837	7,844
July	13,595	201	10,969	7,202
August	15,751	224	12,841	8,008
September	13,296	185	10,989	7,754
October	17,461	229	13,700	8,711
November	16,651	208	12,820	7,836
December	15,129	177	13,375	7,855
Total	184,424	2,422	149,257	93,880

[1] *See* footnote 2, table 3 for definition of mine production. References in that definition to gravel, gold, bullion, cyanidation, and amalgamation, however, are not applicable to the 4 States here covered, since gold has never been reported from these States and gold-extraction processes have not been used on their ores.

TABLE 3.—Mine production of gold, silver, copper, lead, and zinc in Texas in 1951, by months, in terms of recoverable metal [1]

Month	Gold (fine ounces)	Silver (fine ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
January	1	12		2	
February	10	152		8	
March	9	120		8	
April	5	268		7	
May	2	78		3	
June	2	78		3	
July	3	101		6	
August					
September				2	
October		270	1	2	8
November		152		1	8
December		150		1	8
Total	32	1,381	1	43	24

[1] Mine production comprises ore, gravel, or other mineral material sold or treated, metal recovered as natural gold or as bullion from cyanidation or amalgamation, the estimated recoverable metal (or gross metal as indicated) contained in concentrates, ores, tailings, and other mineral materials shipped directly to smelters or sold to ore buyers within the year.

TABLE 4.—Mine production of silver, copper, lead and zinc in Arkansas Kansas, Missouri, and Oklahoma in 1947–50 and in 1951 by States, in terms of recoverable metal [1]

	Mines producing	Material sold or treated		Silver	
		Crude ore (short tons)	Old tailings (short tons)	Fine ounces	Value
1947	254	11,837,403	6,041,783	93,600	$84,708
1948	294	8,537,796	3,760,259	114,187	103,345
1949	232	10,128,129	3,011,718	123,413	111,695
1950	255	10,766,495	1,993,428	236,273	213,839
1951					
Arkansas	9	7,900			
Kansas	78	1,733,827	80,150		
Missouri	54	6,499,122	1,574,379	184,424	166,913
Oklahoma	148	3,542,213	666,523		
Total 1951	289	11,783,062	2,321,052	184,424	166,913

	Copper		Lead		Zinc		Total value
	Short tons	Value	Short tons	Value	Short tons	Value	
1947	1,760	$739,200	153,838	$44,305,344	109,651	$26,535,542	$71,664,794
1948	2,370	1,028,580	127,614	45,685,812	85,892	22,847,272	69,665,009
1949	3,670	1,445,980	157,153	49,660,348	79,378	19,685,744	70,903,767
1950	2,982	1,240,512	164,846	44,508,420	82,112	23,319,808	69,282,579
1951							
Arkansas			33	11,418	50	18,200	29,618
Kansas			8,947	3,095,662	28,904	10,521,056	13,616,718
Missouri	2,422	1,172,248	123,702	42,800,892	11,476	4,177,264	48,317,317
Oklahoma			16,575	5,734,950	53,450	19,455,800	25,190,750
Total 1951	2,422	1,172,248	149,257	51,642,922	93,880	34,172,320	87,154,403

[1] Includes recoverable metal content of ore milled and old tailings or slimes retreated during the calendar year indicated.

TABLE 5.—Mine production of gold, silver, copper, lead, and zinc in Texas 1947–51, and total, 1885–1951, in terms of recoverable metal [1]

Year	Ore (short tons)	Gold		Silver	
		Fine ounces	Value	Fine ounces	Value
1947	4,552	45	$1,575	20,547	$18,595
1948	1,850	57	1,995	3,065	2,774
1949	2,140	40	1,400	2,691	2,435
1950 [2]	935	49	1,715	2,454	2,221
1951 [2]	750	32	1,120	1,381	1,250
1885–1951	(4)	8,513	231,900	23,298,501	23,442,336

Year	Copper		Lead		Zinc		Total value
	Short tons	Value	Short tons	Value	Short tons	Value	
1947	6	$2,520	78	$22,464	22	$5,324	$50,478
1948 [3]	23	9,982	170	60,860	----------	----------	75,611
1949 [3]	24	9,456	132	41,712	----------	----------	55,003
1950 [2 3]	2	832	129	34,830	----------	----------	39,598
1951 [3]	1	483	43	14,878	24	8,736	26,467
1885–1951	1,365	393,316	5,387	674,439	884	131,287	24,873,278

[1] Includes recoverable metal content of ore shipped during the calendar year indicated.
[2] All of 1950 production was from 1 mine in Presidio County, which produced lead ore.
[3] Does not include zinc and lead recovered by the slag-fuming plant at the El Paso smelter from old accumulated slag resulting from operations in previous years.
[4] Data not available.

Gold.—A small amount of gold—32 ounces valued at $1,120—was produced in Texas in 1951. In 1950 Texas produced 49 ounces valued at $1,715.

Silver.—The production of silver in the West Central States in 1951 was 184,424 fine ounces, which at the Treasury price of $0.9050505 per ounce was valued at $166,913 compared with 236,273 ounces valued at $213,839 in 1950. All the silver produced in these States in 1951 was recovered incidental to the smelting of lead and lead-copper concentrates. These concentrates usually contain 1 to 2 ounces of silver per ton; however, all of the pig lead was not desilverized.

Copper.—The copper produced in the West Central States in 1951 amounted to 2,422 short tons valued at $1,172,248. This was 19 percent less in quantity and 6 percent less in value than was produced in 1950. All this production came from the lead-copper ores of Southeastern Missouri.

Lead.—The mine production of lead in 1951 in the West Central States decreased 9 percent in quantity but increased 16 percent in value because a higher metal price prevailed during the year. Missouri, the principal lead-producing State in the Nation, accounted for 123,702 tons, 32 percent of the Nation's lead recovered from domestic ores and 83 percent of the four-State output. Oklahoma produced 16,575 tons (11 percent of the four-State output), Kansas 8,947 tons (6 percent), and Arkansas 33 tons. The important lead-producing area of Southeastern Missouri accounted for 122,318 tons (99 percent of the Missouri output and 82 percent of the four-State output), while Southwestern Missouri produced 1,384 tons or 1 percent of Missouri output. The decrease in lead production in both the Southeastern Missouri region and the Tri-State district was due

to the mining of lower grades of ore, as evidenced by a lead-concentrate recovery factor of 2.40 for Southeastern Missouri and a lead recovery factor of 0.61 for the Tri-State district in 1951, compared with 2.70 and 0.86, respectively, in 1950. A 7-week work stoppage occurred in 1951 at the Missouri and Kansas operations of the National Lead Co. during April and May. All other major mines of the four-State area operated continuously throughout the year.

Zinc.—The 93,880 tons of recoverable zinc produced in the West Central States in 1951 comprised 91,553 tons (98 percent) from the Tri-State district, 2,277 tons (2 percent) from Southeastern Missouri, and 50 tons from Arkansas. In 1950 the Tri-State output was 80,558 tons, Southeastern Missouri 1,546 tons, and Arkansas 8 tons. This increase in recoverable zinc in 1951 was attributable to the material increase in crude-ore production, notwithstanding a marked decline in zinc-concentrate recovery from Tri-State district crude ore from 3.10 percent in 1950 to 2.74 percent in 1951.

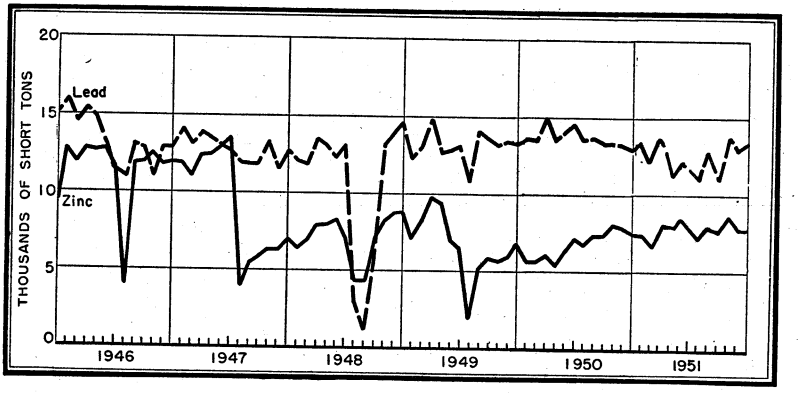

FIGURE 1.—Mine production of lead and zinc in Arkansas, Kansas, Missouri, and Oklahoma, 1946–51 by months, in terms of recoverable metal.

MINING AND METALLURGICAL INDUSTRY

Missouri, Oklahoma, Kansas, and Arkansas.—There were 289 mines, 25 mine mills, and 3 tailings mills operating in the West Central States in 1951 compared to 255 mines, 22 mine mills, and 4 tailings mills in 1950. Several mine mills of the St. Joseph Lead Co. in St. Francois County, Mo., operated on a mixed crude ore-tailings feed at intervals during the year. This company was also constructing 2 new mills, 1 at Hayden Creek and the other at Indian Creek. National Lead Co. was engaged in an extensive diamond- and churn-drilling campaign and in constructing an addition to its Madison mill to treat complex copper-cobalt-nickel-iron ores.

Extensive diamond and churn drilling was limited to the major mining companies in Southeastern Missouri, although in the Tri-State district 10 companies each reported churn drilling 1,000 feet or more. National Lead Co. drove a long development drift to open an ore body in an adjoining lease.

There were 4 horizontal retort zinc smelters, 1 zinc pigment plant, and 2 lead smelters active in the West Central States in 1951. There

were 29,700 retorts in the zinc smelters, having an annual rated capacity of more than 200,000 tons of metal. These smelters received concentrates from several western mining States, the Tri-State district, and foreign countries. Three of the smelters were in Oklahoma—Bartlesville, Blackwell, and Henryetta—and one at Fort Smith, Ark. The two lead smelters, 1 of which also had a refinery, were at Herculaneum, Mo., and Galena, Kans. Their combined annual capacity was 110,000 tons of pig lead. Smelter labor was adequate during 1951, few companies requiring over 2 percent of their labor force for full operation. A work stoppage closed the Herculaneum smelter of St. Joseph Lead Co. from October 18 to December 31, 1951.

Texas.—The total mine production of gold, silver, copper, lead, and zinc and their respective values for Texas from 1885 to 1951 are given in table 5. The early statistical records were compiled by the U. S. Geological Survey; the U. S. Bureau of Mines assumed responsibility for these records from 1924 to date.

The smelting industry of Texas in 1951 comprised 2 retort and 1 electrolytic zinc smelters, 1 copper smelter and 1 lead smelter. Ores and concentrates were received from various western mining States and foreign countries. In addition, these smelters treated substantial tonnages of smelter residues and matte.

The El Paso Smelting Works of the American Smelting & Refining Co. included a copper smelter and a lead smelter, each with an annual capacity of 300,000 tons of material, and a slag-fuming plant, which treated old cold slags and current hot slags, recovering zinc as an oxide fume and some lead. This company also operated a horizontal-retort zinc smelter at Amarillo and an electrolytic zinc smelter at Corpus Christi; these smelters had a combined annual capacity of about 100,000 tons of zinc.

The Phelps-Dodge Corp. operated its Nichols electrolytic copper refinery at El Paso, processing blister copper from its Arizona smelters into refined copper. This plant had an annual capacity of 240,000 tons of electrolytic copper.

The Machovec-retort zinc smelter of the American Zinc Co. of Illinois, which had an annual capacity of approximately 37,000 tons of zinc, processed ore and concentrates, as well as zinc fumes, from several western mining States and foreign countries. Smelter labor was adequate most of the year.

ORE CLASSIFICATION

Table 6 gives details on classes of ore, metal recovered by classes of ore, and the number of mines in each class for the West Central States in 1951. The basis of this classification is given in the Gold and Silver chapter of this volume. This classification allows comparison with ores produced in the western mining States as reported in State chapters. Additional data on tenor of ores, concentrates produced, metal content of both ore and concentrates, and average values are given in subsequent tables in the Tri-State District and Review by States section. Such tables are omitted for Arkansas and Texas because only small-scale intermittent production occurred for the past several years.

TABLE 6.—Mine production of silver, copper, lead, and zinc in Arkansas, Kansas, Missouri, and Oklahoma in 1951, by class of ore or other source material, in terms of recoverable metal

Source	Number of mines	Material sold or treated (short tons)	Silver (fine ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
Lead ore [1]	14	7,367,283	184,424	2,422	122,467	2,278
Zinc ore [2]	93	1,731,283	----------	----------	1,414	26,033
Zinc-lead ore	182	5,005,548	----------	----------	25,376	65,569
Total: 1951	289	14,104,114	184,424	2,422	149,257	93,880
1950	255	12,759,923	236,273	2,982	164,846	82,112

[1] Includes lead-copper ore from one mine; also 1,574,379 tons of old tailings remilled, concentrates from which were mixed with those from crude ore.
[2] Includes 746,673 tons of old tailings yielding 3,212 tons of recoverable zinc and 24 tons of recoverable lead.

TRI-STATE DISTRICT

Because of the marginal nature of the remaining ore reserves, mine production in the Tri-State district (Southwestern Missouri, Oklahoma, and Kansas) is largely determined by prevailing metal prices. With the Nation's defense program consuming large quantities of metals, resultant high metal prices for zinc and lead stimulated maximum production.

The majority of the mines in the Tri-State district operated throughout 1951; a few mines were, however, compelled to shut down for lack of ore reserves. The supply of mine labor was reported to be satisfactory all year.

TABLE 7.—Mine production of lead and zinc concentrates in the Tri-State district (Kansas, Oklahoma, and Southwestern Missouri), 1947–51

Year	Material milled (short tons)	Concentrates produced (short tons)		Concentrate recovery (percent)		Average assay of concentrates (percent)		Average value per ton of concentrates	
		Lead	Zinc	Lead	Zinc	Lead	Zinc	Lead	Zinc
FROM CRUDE ORE									
1947	6,229,702	31,842	181,662	0.51	2.92	77.41	59.68	$190.72	$107.42
1948	4,314,190	35,706	147,989	.83	3.43	76.64	59.09	231.85	87.10
1949	4,470,778	41,422	139,098	.93	3.11	76.00	59.44	188.76	77.53
1950	4,700,698	40,659	145,801	.86	3.10	78.10	59.74	153.45	93.10
1951	5,990,100	36,255	164,123	.61	2.74	75.65	59.80	212.77	123.56
FROM OLD TAILINGS REMILLED									
1947	5,740,459	164	22,406	0.003	0.39	45.12	58.31	107.09	101.69
1948	2,595,903	156	11,620	.006	.45	51.28	58.47	155.14	89.50
1949	1,602,620	49	8,080	.003	.50	59.18	57.98	119.22	81.71
1950	967,926	55	4,218	.006	.44	58.18	56.95	121.13	85.66
1951	746,673	45	6,140	.006	.82	53.33	58.13	144.91	121.22
DISTRICT TOTAL									
1947	11,970,161	32,006	204,068	0.27	1.70	77.25	59.53	190.30	106.79
1948	6,910,093	35,862	159,609	.52	2.31	76.53	59.04	231.51	87.27
1949	6,073,398	41,471	147,178	.68	2.42	75.98	59.36	188.68	77.76
1950	5,668,624	40,714	150,019	.72	2.65	78.08	59.66	153.40	92.89
1951	6,736,773	36,300	170,263	.54	2.53	75.62	59.74	212.69	123.48

TABLE 8.—Quoted prices for 60-percent zinc concentrates and 80-percent lead concentrates at Joplin in 1951

[E&MJ Metal and Mineral Markets]

Zinc concentrates		Lead concentrates	
Period	Price per short ton	Period	Price per short ton
Jan. 1–Oct. 1	[1] $115.00	Jan. 1–Oct. 1	[1] $218.42
Oct. 2–Dec. 31	135.00	Oct. 2–Oct. 31	246.50
		Nov. 1–Dec. 31	[2] 245.95

[1] Metal prices under OPS price ceilings throughout 1951.
[2] Drop due to increased smelter charge.

The district produced 170,263 tons of zinc concentrates valued at $21,023,818, and 36,300 tons of lead concentrates valued at $7,720,550 from 5,990,100 tons of crude ore and 746,673 tons of tailings in 1951. These concentrates yielded 91,553 tons of recoverable zinc and 26,906 tons of recoverable lead. The grade of ore declined in 1951, reversing the upgrading trend of the past 4 years. The average zinc-concentrate price received was $123.48 per ton, or 33 percent higher than in 1950, while the average lead concentrate price received was $212.69, or 39 percent higher.

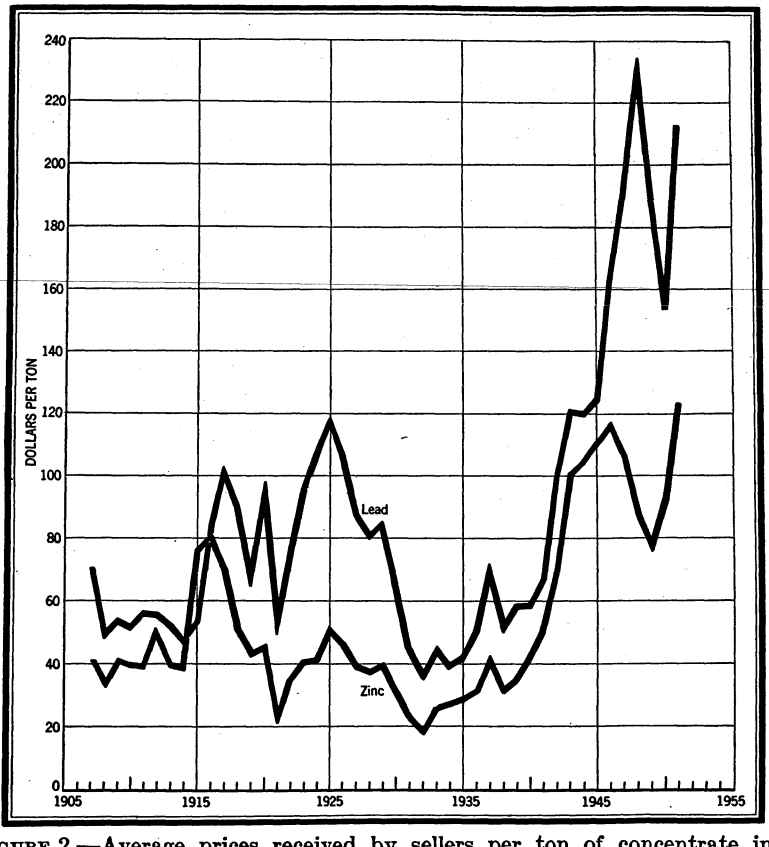

FIGURE 2.—Average prices received by sellers per ton of concentrate in the Tri-State district, 1907–51.

The five leading zinc-producing companies in the Tri-State district in 1951 were the Eagle-Picher Co. (Oklahoma and Kansas), American Zinc, Lead & Smelting Co. (Oklahoma), National Lead Co. (Kansas), Federal Mining & Smelting Co. (Oklahoma and Missouri), and Dale Mining Co. (Missouri).

The five principal lead-producing companies were the Eagle-Picher Co. (Oklahoma and Kansas), American Zinc, Lead & Smelting Co. (Oklahoma), National Lead Co. (Kansas), Federal Mining & Smelting Co. (Oklahoma and Missouri), and Bilharz Mining Co. (Kansas).

There were 280 mines, 19 mine mills, and 3 tailings mills operating in the district during 1951 compared to 248 mines, 16 mine mills, and 3 tailings mills in 1950. The depth of 328 producing shafts

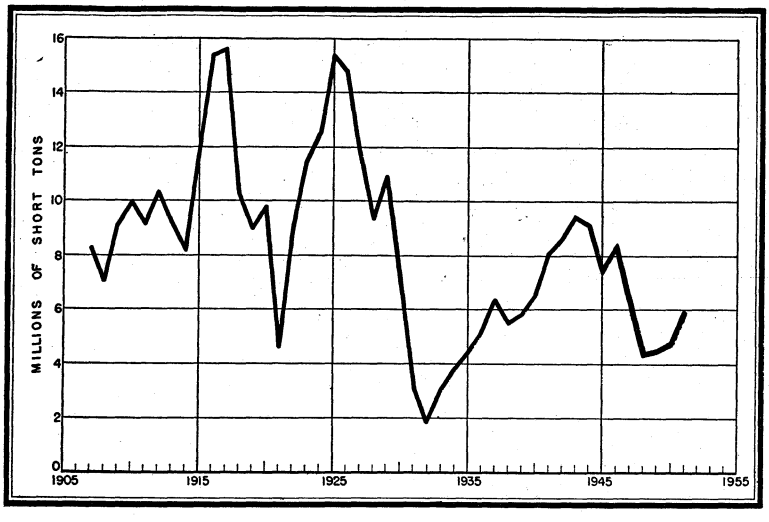

FIGURE 3.—Quantity of crude ore (rock) milled in the Tri-State district, 1907–51.

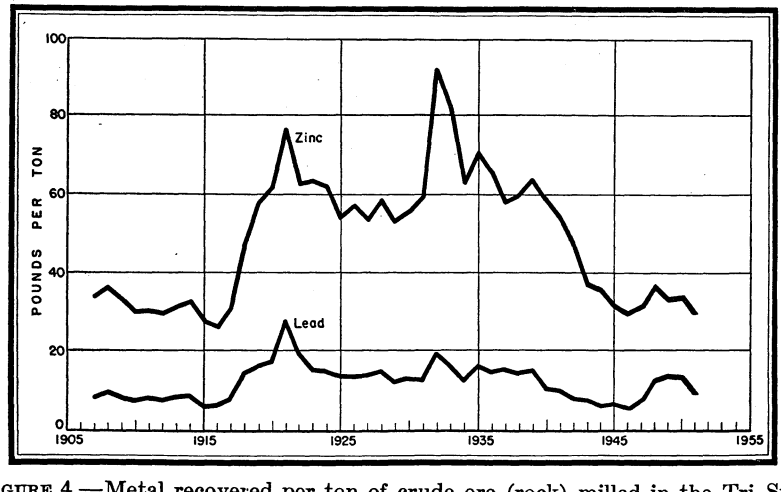

FIGURE 4.—Metal recovered per ton of crude ore (rock) milled in the Tri-State district, 1907–51.

ranged from 30 to 450 feet. The several open pits operating in Southwestern Missouri ranged in depth from 10 to 90 feet.

REVIEW BY STATES

MISSOURI

Missouri has been the chief lead-producing State in the Nation for 44 consecutive years and the St. Joseph Lead Co. of Bonne Terre, Mo., the largest individual lead-producing company. A summary of the State production of silver, copper, lead, zinc, and other minerals from the earliest records through 1947 was published in 1949.[2]

In 1951 Missouri produced 178,531 tons of lead concentrates, 99 percent in the Southeastern Missouri lead belt and 1 percent in Southwestern Missouri, and 21,845 tons of zinc concentrates, 80 percent originating in Southwestern Missouri and 20 percent in Southeastern Missouri. Silver and copper were also recovered as byproducts in the smelting of lead and of complex lead-copper-cobalt-nickel-iron concentrates produced in the Southeastern Missouri region. Silver recovery amounted to 184,424 fine ounces in 1951, a decline of 22 percent from 1950 recovery. Copper production in 1951 was 2,422 short tons, 19 percent less than that produced in 1950. No value was attributed to the silver in the sale of lead concentrates, as the amount recovered per ton of concentrates was so small.

Southeastern Missouri.—Work stoppages prevented the mining industry from continuous operation in 1951. Mine production increased 4 percent to 7,359,441 tons of crude ore, but lead production decreased 8 percent to 122,318 tons. The decline was due to a marked decrease in the grade of the ore mined in 1951 as compared with 1950 recovery. Zinc production, which is largely dependent on the re-treatment of old tailings, showed a 47-percent increase to 2,277 short tons.

St. Joseph Lead Co. operated its group of large mines and four mills, Bonne Terre, Desloge, Federal, and Leadwood in St. Francois County, the entire year. Development work in the St. Francois County mines consisted of 85,700 feet of tunneling, 1,375,000 feet of diamond drilling, and 32,000 feet of churn drilling. The company also operated the Mine LaMotte mine and 2,000-ton mill in Madison County. Development work at the mine amounted to 3,968 feet of tunnels, 34,000 feet of diamond drilling, and 6,100 feet of churn drilling.

The National Lead Co. operated its Madison lead-copper mine and 1,200-ton all-flotation mill at Fredericktown. Exploration and development work consisted of extensive diamond and churn drilling in the Fredericktown area.

The Catherine-Fleming mine at Fredericktown was operated by the Fredericktown Lead Co., whose holdings were acquired by the Blue Bonnett Mining Co. early in the year. This company later sold its holdings to the Midwest Mining & Milling Co. Exploration and development work of the 3 companies consisted of 32 feet of shaft work and 2,100 feet of churn and diamond drilling.

[2] Bishop, O. M., The Mineral Industry of Missouri in 1946 and 1947, With Total Production Summarized: Missouri Div. Geol. Surveys and Water Resources, Inf. Circ. 4., 1949, 93 pp.

TABLE 9.—Mine production of lead and zinc in Southeastern and Central Missouri, 1947–51, in terms of concentrate and recoverable metal [1]

Year	Lead concentrates (galena)		Zinc concentrates (sphalerite) [2]		Recoverable metal content [3]			
					Lead		Zinc	
	Short tons	Value [4]	Short tons	Value	Short tons	Value	Short tons	Value
1947	183,084	$31,762,029	560	$15,996	129,581	$37,319,328	[5] 295	$71,390
1948	145,364	30,396,488	567	55,231	100,691	36,047,378	[5] 1,022	271,852
1949	179,725	32,665,768	1,074	79,347	126,269	39,901,004	[6] 749	185,752
1950	191,439	28,522,322	2,742	260,600	133,680	36,093,600	[7] 1,546	439,064
1951	176,764	32,484,309	4,475	509,658	122,318	42,322,028	[7] 2,277	828,828

[1] Based on Southeastern and Central Missouri ore ("dirt") and old tailings treated at mills during calendar year indicated.
[2] Includes zinc-lead carbonate concentrates.
[3] In calculating metal content of the ores from assays allowance has been made for smelting losses of both lead and zinc. In comparing the values of concentrate ("ore") and metal it should be borne in mind that the value given for the concentrate is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average price for all grades.
[4] Values given are to a certain extent arbitrary, as part of the lead concentrates are smelted by the producer.
[5] Includes zinc recovered from lead-smelter slag.
[6] Includes zinc recovered from lead-smelter byproducts.
[7] Includes zinc recovered from byproduct matte from lead smelting as follows: 1950, 180 tons; 1951, 138 tons.

TABLE 10.—Tenor of lead ore and concentrates in Southeastern Missouri disseminated-lead district, 1947–51

	1947	1948	1949	1950	1951
Total lead ore [1] ..... short tons	5,856,334	5,384,861	7,066,443	7,091,257	7,359,441
Galena concentrate in ore ..... percent	3.12	2.70	2.54	2.70	2.40
Average lead content of galena concentrates ..... do	72.22	70.60	71.60	71.19	70.66
Average value per ton of galena concentrates	$173.49	$209.11	$181.75	$148.99	$183.77

[1] Includes lead-copper ore. Includes old tailings remilled: 1947—301,324 tons; 1948—1,164,356 tons; 1949—1,409,098 tons; 1950—1,025,502 tons; 1951—1,574,379 tons.

Southwestern Missouri.—Mining activities continued to increase in this region in 1951, particularly open-pit operations. Mine production increased 124 percent to 714,060 tons of ore, yielding 17,370 tons of zinc concentrates (42 percent increase) and 1,767 tons of lead concentrates (4 percent increase) when compared with 1950 production. Open-pit operations accounted for 43 percent of the crude-ore production, which yielded 18 percent of the zinc and 47 percent of the area's lead production. Federal Mining & Smelting Co. operated its Duenweg mines and mill and was the largest producer in the region. Potter-Sims Mines, Inc., operated the Snapp and Evans lease (old Sucker Flat) open pits most of the year, although adverse weather and stripping overburden curtailed production at intervals. B. F. & H. Mines, Inc., worked its Bull Frog open pit on the Swartz land near Joplin. Dale Mining Co. mines near Stark City were active all year.

TABLE 11.—Mine production of lead and zinc in Southwestern Missouri, 1947–51, in terms of concentrate and recoverable metal [1]

Year	Lead concentrates				Zinc concentrates				Recoverable metal content [2]			
	Galena		Carbonate		Sphalerite		Silicate		Lead		Zinc	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1947	3,412	$655,080	168	$23,866	31,480	$3,402,384	763	$49,235	2,665	$767,520	16,779	$4,060,518
1948	2,004	474,233	130	21,465	10,475	913,538	60	3,212	1,597	571,726	5,441	1,447,306
1949	1,574	340,038	14	1,618	9,667	774,272	20	777	1,253	395,948	5,162	1,280,176
1950	1,199	189,224	34	3,623	12,122	1,090,592	100	6,537	944	254,880	6,591	1,871,844
1951	1,767	423,857	------	--------	17,370	2,074,867	------	--------	1,384	478,864	9,199	3,348,436

[1] Based on Southwestern Missouri ore ("dirt") and old tailings treated at mills during the calendar year indicated.

[2] In calculating metal content of the ores from assays allowance has been made for smelting losses of both lead and zinc. In comparing the values of concentrate ("ore") and metal it should be borne in mind that the value given for the concentrate is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average price for all grades.

TABLE 12.—Tenor of lead and zinc ore, old tailings, and slimes milled and concentrates produced in Southwestern Missouri, 1950–51

	1950		1951, crude ore [1]
	Crude ore	Old tailings and slimes	
Total material milled—short tons	318,383	10,500	714,060
Total concentrate produced:			
Lead—do	1,233	2	1,767
Zinc—do	12,222	102	17,370
Ratio of concentrate to material milled:			
Lead—percent	0.39	0.02	0.25
Zinc—do	3.84	0.97	2.43
Metal content of material milled: [2]			
Lead—do	0.30	0.02	0.19
Zinc—do	2.30	0.55	1.29
Average lead content of galena concentrates—do	78.65	80.00	80.08
Average lead content of lead carbonate—do	55.80	----------	----------
Average zinc content of sphalerite concentrates—do	60.05	56.86	58.85
Average zinc content of silicates and carbonates—do	41.00	----------	----------
Average value per ton:			
Galena concentrates	$157.82	$198.00	$239.87
Lead carbonate concentrates	$106.56	----------	----------
Sphalerite concentrates	$89.97	$84.48	$119.45
Zinc silicates and carbonates	$65.37	----------	----------

[1] No old tailings and slimes milled in Southwestern Missouri in 1951.

[2] Figures represent metal content of crude ore ("dirt") only insofar as it is recovered in the concentrate; data on tailing losses not available.

OKLAHOMA

Oklahoma continued as the principal zinc- and lead-producing State in the Tri-State district for the thirty-eighth consecutive year. This record began in 1913, when the famous Picher field was brought into production. In 1951 the State produced 58 percent of the recoverable zinc and 62 percent of the recoverable lead output of the Tri-State district. The 4,208,736 tons of crude ore, old tailings, and slimes treated in Oklahoma in 1951 yielded 99,612 tons of zinc concentrates, 14 percent more than was produced in 1950, and 22,613 tons of lead concentrates, 17 percent less than that produced in 1950. The quantity of recoverable zinc was 53,450 tons and recoverable lead was

16,575 tons. The grade of both zinc and lead in the ore declined from that mined in 1950, while the grade of each in the tailings remilled in 1951 increased.

TABLE 13.—Mine production of lead and zinc in Oklahoma, 1947–51, and total, 1891–1951, in terms of concentrate and recoverable metal [1]

Year	Lead concentrates (galena)		Zinc concentrates (sphalerite)		Recoverable metal content [2]			
					Lead		Zinc	
	Short tons	Value	Short tons	Vaule	Short tons	Value	Short tons	Value
1947	18,857	$3,600,407	95,126	$10,699,593	14,289	$4,115,232	51,062	$12,357,004
1948	22,638	5,214,366	82,734	7,178,960	16,918	6,056,644	43,821	11,656,386
1949	26,910	5,020,076	82,522	6,407,589	19,858	6,275,128	44,033	10,920,184
1950	27,261	4,218,880	87,116	8,247,342	20,724	5,595,480	46,739	13,273,876
1951	22,613	4,714,358	99,612	12,297,096	16,575	5,734,950	53,450	19,455,800
1891–1951	1,568,179	144,167,343	9,314,282	447,044,135	1,207,155	171,838,341	4,910,339	714,194,948

[1] Based on Oklahoma ore ("dirt") and old tailings treated at mills during calendar year indicated.
[2] In calculating metal content of the ores from assays, allowance has been made for smelting losses of both lead and zinc. In comparing the values of concentrate ("ore") and metal it should be borne in mind that the value given for the concentrate is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average price for all grades.

TABLE 14.—Tenor of lead and zinc ore, old tailings, and slimes milled and concentrates produced in Oklahoma, 1950–51

	1950		1951	
	Crude ore	Oil tailings and slimes	Crude ore	Old tailings and slimes
Total material milled—short tons	2,850,880	855,681	3,542,213	666,523
Total concentrate produced:				
Galena—do	27,216	45	22,568	45
Sphalerite—do	83,541	3,575	95,233	4,379
Ratio of concentrate to material milled:				
Lead—percent	0.95	0.005	0.64	0.007
Zinc—do	2.93	0.42	2.69	0.66
Metal content of material milled:[1]				
Lead—do	0.74	0.003	0.47	0.004
Zinc—do	1.75	0.24	1.44	0.34
Average lead content of galena concentrates—do	77.61	55.56	74.81	53.33
Average zinc content of sphalerite concentrates—do	59.73	56.81	59.70	57.73
Average value per ton:				
Galena concentrates	$154.82	$118.40	$208.61	$144.91
Sphalerite concentrates	$95.06	$85.66	$123.54	$121.45

[1] Figures represent metal content of the crude ore ("dirt") only insofar as it is recovered in the concentrate; data on tailing losses not available.

The large custom Central mill of the Eagle-Picher Co. treated nearly 50 percent of the crude ore mined in the Tri-State district in 1951. About 70 percent of the Central mill's feed came from Oklahoma mines and 30 percent from Kansas mines. The Bird Dog mill continued to treat the slimes of the Central mill. The Eagle-Picher Co. operated 33 mines in Oklahoma during 1951. Other Oklahoma producers who shipped to the Central mill included Federal Mining & Smelting Co., Buffalo Mining Co., John Henderson, Frank Hudson, Tongaha Mining Co., Wesah Mining Co., and W. M. & W. Mining Co.

The American Zinc, Lead & Smelting Co. acquired the Nellie B. Mining Co. properties in October 1951, thus making it the second

largest producer in the district. The transaction involved the transfer of 1,360 acres of contiguous leases, including the Lawyers, Rialto, Evans-Wallower, and Admiralty, and 3 mine mills, with daily capacity exceeding 3,000 tons or ore.

Other Oklahoma producers in 1951 included the Harris, Helen H., Dines, C. & M., W. M. & W. and Beck mining companies.

The Sooner Milling Co. operated its Sooner tailings mill throughout the year. Britt and Britt operated their tailings mill until June 1951 when they dismantled the mill.

KANSAS

Kansas production in 1951 included 1,733,827 tons of crude ore and 80,150 tons of tailings, which yielded 53,281 tons of zinc concentrates (5 percent more than in 1950) and 11,920 tons of lead concentrates (2 percent less than in 1950). These mines produced 31 percent of the Tri-State district zinc concentrates and 33 percent of the district lead concentrates. Output of recoverable zinc in Kansas was 28,904 tons and of recoverable lead, 8,947 tons.

Approximately 55 percent of the crude ore mined in Kansas was concentrated at the Central mill of the Eagle-Picher Co. at Cardin, Okla. Kansas shippers to the Eagle-Picher Central mill in Oklahoma included Bilharz, C. K. & E., Bob White, Mark Twain, S. S. & C., Linda Lou and Midcontinent mining companies. Other Kansas producers were Bailey, Mid Century, Roanoke, Little Ben, Tiger, MacArthur, and Contack mining companies. Companies operating mills in Kansas were the W. M. & M. (Brewster), Dines Mining Co. (Blue Mound), and Wade-Rea Mining Co. (Wade-Rea).

TABLE 15.—Mine production of lead and zinc in Kansas, 1947–51, and total, 1876–1951, in terms of concentrate and recoverable metal [1]

Year	Mines producing	Lead concentrates (galena)		Zinc concentrates (sphalerite)		Recoverable metal content [2]			
						Lead		Zinc	
		Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1947	79	9,569	$1,811,269	76,699	$7,641,709	7,285	$2,098,080	41,497	$10,042,274
1948	79	11,090	2,592,500	66,340	5,833,441	8,386	3,002,188	35,577	9,463,482
1949	70	12,973	2,463,056	54,969	4,262,380	9,772	3,087,952	29,433	7,299,384
1950	66	12,218	1,833,537	50,579	4,581,839	9,487	2,561,490	72,176	7,717,984
1951	78	11,920	2,582,335	53,281	6,651,855	8,947	3,095,662	28,904	10,521,056
1876–1951	-------	796,021	65,073,020	5,219,281	241,711,613	607,444	78,482,161	2,710,051	378,457,088

[1] Based on Kansas ore ("dirt") and old tailings treated at mills during the calendar year indicated.
[2] In calculating metal content of the ores from assays allowance has been made for smelting losses of both lead and zinc. In comparing the values of concentrate ("ore") and metal it should be borne in mind that the value given for the concentrate is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average price for all grades.

The National Lead Co. operated its several mines and No. 8 Ballard mill during most of 1951; a brief work stoppage curtailed production temporarily. Its production was the second largest in the State in 1951.

Small lots of ore were reported from the Galena, Crest-line, and Waco areas during the year.

TABLE 16.—Tenor of lead and zinc ore and old tailings milled and concentrates produced in Kansas, 1950–51

	1950		1951	
	Crude ore	Old tailings	Crude ore	Old tailings
Total material milled.....short tons	1,531,435	101,745	1,733,827	80,150
Total concentrate produced:				
Galena.....do	12,210	8	11,920	----------
Sphalerite.....do	50,038	541	51,520	1,761
Ratio of concentrate to material milled:				
Lead.....percent	0.80	0.008	0.69	----------
Zinc.....do	3.27	0.53	2.97	2.20
Metal content of material milled:[1]				
Lead.....do	0.63	0.005	0.52	----------
Zinc.....do	1.95	0.31	1.61	1.17
Average lead content of galena concentrates.....do	79.22	57.58	76.59	----------
Average zinc content of sphalerite concentrates.....do	59.71	57.80	60.32	59.11
Average value per ton:				
Galena concentrates	$150.09	$117.25	$216.64	----------
Saphalerite concentrates	$90.64	$85.92	$124.99	$120.63

[1] Figures represent metal content of the crude ore ("dirt") only insofar as it is recovered in the concentrate data on tailing losses not available.

ARKANSAS

Production of zinc concentrates in Arkansas in 1951 amounted to 124 tons (mostly carbonates) compared with 17 tons in 1950. Lead-concentrates production amounted to 45 tons compared with 11 tons in 1950. Most of the production of zinc and lead came from the St. Joe district in Searcy County and the Rush district in Marion County. Small lots were also reported from Ponca in Newton County and near Harrison in Boone County.

The price increases of both zinc and lead stimulated prospecting activity, but failed to increase production materially.

TEXAS

Presidio County.—R. I. Carr, who has operated in Presidio County for the past several years, did considerable exploratory work on a large block of leases in the Shafter area in 1951. A prospect shaft and trenching showed evidence of lead mineralization over a considerable area. The old Presidio mine of the famous Shafter area produced over 30,000,000 ounces of silver from 1887 to 1942.

Culberson County.—Several small shipments of ore came from the exploratory projects of the Carpenter Exploration Co. during the latter part of 1951. Surface trenching and several prospect shafts on leases in the Van Horn and Sierra Diablo Mountains of Culberson and Hudspeth Counties, 30 miles south and west of Van Horn, Tex., exposed favorable evidence of copper and lead-zinc mineralization. Work was continuing at the year end to further develop these "shows" of ore.

Hudspeth County.—The D'Argon Mining Co. of Sierra Blanca had developed promising showings of lead and zinc ore in the old Bonanza mine, in the Quitman Mountains of Hudspeth County. A development raise and several hundred feet of drift yielded enough ore to warrant shipments to a concentrating mill. The company continued its development projects at the year end.

Montana

Gold, Silver, Copper, Lead, and Zinc

(MINE REPORT)

By Richard H. Mote

GENERAL SUMMARY

GOLD production in Montana in 1951 dropped to a near record low as output fell 41 percent from 1950. Not since 1862 has the quantity of the precious metal recovered from the State's ores and placers been so small. Contrasting the decline in gold-mining activity were increases of varying magnitudes in the production of the other major nonferrous metals. Zinc output reached the highest annual level since 1920, and lead production was the greatest of any year since 1940. Although the output of copper was the largest since 1948, production in 1951 was substantially below the high outputs of 1900–20, which did much to establish Montana as a leading copper-producing State.

The total value of the five metals increased from $54,956,689 in 1950 to $73,149,813 in 1951, a gain of 33 percent. Gold accounted

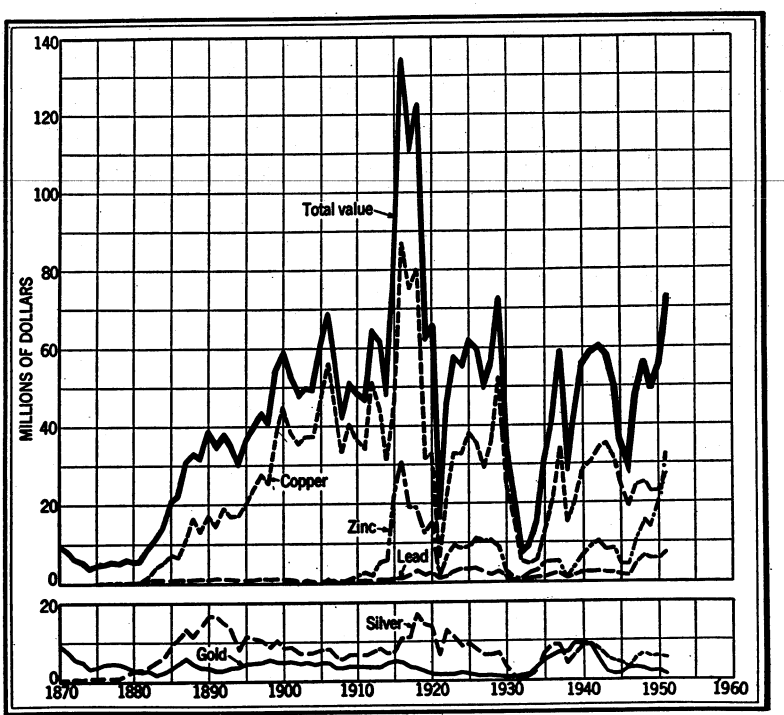

FIGURE 1.—Value of mine production of gold, silver, copper, lead, and zinc in Montana, 1870–1951.

TABLE 1.—Prices of gold, silver, copper, lead, and zinc, 1947–51

Year	Gold [1] (per fine ounce)	Silver [2] (per fine ounce)	Copper [3] (per pound)	Lead [3] (per pound)	Zinc [3] (per pound)
1947	$35.00	$0.905	$0.210	$0.144	$0.121
1948	35.00	.905+	.217	.179	.133
1949	35.00	.905+	.197	.158	.124
1950	35.00	.905+	.208	.135	.142
1951	35.00	.905+	.242	.173	.182

[1] Price under authority of Gold Reserve Act of Jan. 31, 1934.
[2] Treasury buying price for newly mined silver July 1, 1946, to date—$0.9050505 ($0.905 used in 1947 for calculating purposes).
[3] Yearly average weighted price of all grades of primary metal sold by producers. Price in 1947 includes bonus payments by Office of Metals Reserve for overquota production.

TABLE 2.—Mine production of gold, silver, copper, lead, and zinc in Montana in 1951, by months, in terms of recoverable metal [1]

Month	Gold (fine ounces)	Silver (fine ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
January	2,493	625,747	5,552	1,714	7,475
February	2,356	571,522	4,812	1,722	7,481
March	2,671	654,563	5,754	1,663	7,808
April	2,580	597,804	5,418	1,901	7,985
May	2,025	560,795	5,513	1,823	7,519
June	2,741	569,397	5,300	1,881	7,242
July	3,207	520,983	4,457	1,884	7,016
August	2,804	434,724	3,525	1,526	5,696
September	2,240	392,180	3,757	1,330	5,558
October	2,882	480,665	4,458	2,072	7,556
November	2,310	503,555	4,247	1,889	7,217
December	2,193	481,833	4,613	1,897	6,998
Total	30,502	6,393,768	57,406	21,302	85,551

[1] Mine production comprises ore, gravel, or other mineral material sold or treated and metal recovered as natural gold or as bullion from cyanidation or amalgamation and the estimated recoverable metal (or gross metal as indicated) contained in concentrates, ores, tailings, and other mineral materials shipped directly to smelters or sold to ore buyers within the year.

TABLE 3.—Mine production of gold, silver, copper, lead, and zinc in Montana, 1947–51, and total, 1862–1951, in terms of recoverable metal [1]

Year	Mines producing		Material sold or treated [2] (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1947	243	54	3,100,013	90,124	$3,154,340	6,326,190	$5,725,202
1948	250	34	3,020,307	73,091	2,558,185	6,930,716	6,272,648
1949	281	48	2,595,934	52,724	1,845,340	6,327,025	5,726,277
1950	245	39	3,608,036	51,764	1,811,740	6,590,747	5,964,959
1951	198	16	3,965,875	30,502	1,067,570	6,393,768	5,786,683
1862–1951			[3]	17,350,326	391,714,622	781,718,269	576,551,821

Year	Copper		Lead		Zinc		Total value
	Short tons	Value	Short tons	Value	Short tons	Value	
1947	57,900	$24,318,000	16,108	$4,639,104	45,679	$11,054,318	$48,890,964
1948	58,252	25,281,368	18,411	6,591,138	59,095	15,719,270	56,422,609
1949	56,611	22,304,734	17,996	5,686,736	54,195	13,440,360	49,003,447
1950	54,478	22,662,848	19,617	5,296,590	67,678	19,220,552	54,956,689
1951	57,406	27,784,504	21,302	7,370,492	85,551	31,140,564	73,149,813
1862–1951	6,863,000	2,024,152,128	788,434	106,848,696	2,174,486	379,997,906	3,479,265,173

[1] Includes recoverable metal content of gravel washed (placer operations), ore milled, old tailings retreated, and ore, old slag, and copper precipitates shipped to smelters during calendar year indicated.
[2] Does not include gravel washed.
[3] Figure not available.

for over 1 percent, silver 8, copper 38, lead 10, and zinc 43 percent of the total value.

All tonnage figures reported herein are short tons and "dry weight"; that is, they do not include moisture. The value of metal production has been calculated at the prices shown in table 1.

TABLE 4.—Gold produced at placer mines in Montana, 1947–51, by class of mine and by method of recovery

Class and method	Mines producing	Material treated (cubic yards)	Gold recovered	
			Fine ounces	Value
Surface placers:				
Gravel mechanically handled:				
Bucket-line dredges:				
1947	5	5,398,575	21,749	$761,215
1948	4	3,523,306	13,932	487,620
1949	2	2,604,905	7,758	271,530
1950	1	1,128,902	2,946	103,110
1951				
Dragline dredges:				
1947	3	478,194	2,329	81,515
1948	3	57,850	299	10,465
1949–50				
1951	3	692,423	996	34,860
Nonfloating washing plants: [1]				
1947	6	185,050	2,883	100,905
1948	8	707,700	2,177	76,195
1949	13	409,545	1,855	64,925
1950	6	93,048	287	10,045
1951				
Gravel hydraulically handled:				
1947	1	15,680	195	6,825
1948	1	750	48	1,680
1949	2	1,500	53	1,855
1950	1	500	13	455
1951	1	2,500	14	490
Small-scale hand methods (wet):				
1947	37	13,795	155	5,425
1948	16	3,805	66	2,310
1949	29	7,395	152	5,320
1950	29	9,765	182	6,370
1951	12	3,400	64	2,240
Underground placers (drift):				
1947	2	2,315	123	4,305
1948	2	200	19	665
1949	2	27	3	105
1950	2	40	6	210
1951				
Grand total placers:				
1947	54	6,093,609	27,434	960,190
1948	34	4,293,611	16,541	578,935
1949	48	3,023,372	9,821	343,735
1950	39	1,232,255	3,434	120,190
1951	16	698,323	1,074	37,590

[1] Includes all placer operations using power excavator and washing plant, both on dry land; an outfit with movable washing plant is termed a "dry-land dredge."

Gold.—Montana's gold output in 1951 dropped to the lowest level since 1862 when production totaled 29,025 ounces. Output declined sharply from both lode and placer operations. Of the State gold in 1951, 42 percent was derived from gold and silver ores (47 percent in 1950), 54 percent from base metal ores (47 percent in 1950), and nearly 4 percent from placers (6 percent in 1950). Ores milled yielded 74 percent of the total gold and ores shipped to smelters, over 22 percent.

Gold producers in Montana in 1951 with an output of 1,000 ounces or more were the properties of the Anaconda Copper Mining Co. (copper ore and waste materials and zinc-lead ore and dumps) at Butte, the Estelle mine of the McLaren Gold Mines Co. in Park County (gold ore), the Drumlummon mine of the St. Louis Drumlummon Mines in Lewis and Clark County (gold ore), the Cornucopia mine operated by Henry A. Schute (gold ore), and the American Pit (Victoria) mine of the Victoria Mines, Inc. (gold ore), both in Madison County. From these five properties came 78 percent of the State total gold in 1951.

Silver.—Production of silver decreased slightly in 1951. Yield of the metal from zinc-lead ores increased as compared with 1950, but the gain was more than offset by a substantial decline in recovery from copper ore. In 1951 operations of the Anaconda Copper Mining Co. at Butte supplied 93 percent of the State total silver output. Other important silver producers, in order of decreasing output, were the Mike Horse mine of the Mike Horse Mining & Milling Co. at Flesher in Lewis and Clark County, the Alta property of the Lahey Leasing Co. in Jefferson County, and the Contact Mining Co. Scratch Awl mine in Granite County. These four operations furnished 96 percent of the State's silver production in 1951.

Zinc-lead ore supplied 71 percent of the State silver in 1951, copper ore, 24 percent; gold and silver ores and old tailings, 3 percent; and lead, lead-copper and zinc ores and old slag together, 2 percent. Ore milled yielded 95 percent of the total silver, and smelting ores almost 5 percent. A small quantity of silver was recovered from placer operations.

Copper.—Output of copper in Montana in 1951 increased 5 percent over the 1950 production. Although operations at the Butte properties of the Anaconda Copper Mining Co. were handicapped by a shortage of skilled miners, the company supplied nearly 98 percent of the State copper mined in 1951. Other producers of copper in Montana, in order of decreasing output, were the Sarsfield mine worked by Ted Farrow and the Bullwhacker property operated by Norman Rogers, both in Silver Bow County, the Estelle mine in Park County, and the American Pit (Victoria) mine in Madison County.

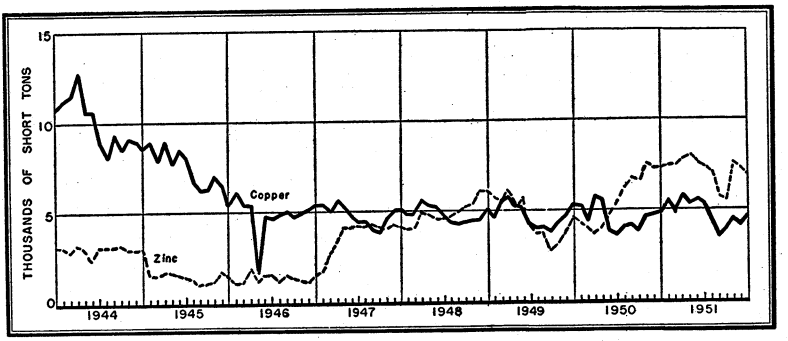

FIGURE 2.—Mine production of copper and zinc in Montana, 1944–51, by months, in terms of recoverable metal.

Lead.—Lead production in 1951 advanced 9 percent over 1950 and was the greatest in any year since 1940. Most of this gain was due to an increase in the tonnage of zinc-lead ore produced from mines operated by the Anaconda Copper Mining Co. and to a substantial rise in production from the Mike Horse mine, which was operated all of 1951 in contrast to 6-month operation in 1950. Anaconda company owned and leased operations in 1951 supplied 78 percent of the State lead; other operations that produced over a million pounds of recoverable lead each were the Mike Horse property and the American Smelting & Refining Co. Jack Waite mine, in Sanders County, and the Blacktail property of the Linton Mines in Missoula County. These four companies supplied 91 percent of the total lead produced in the State in 1951. Of the total lead 89 percent was recovered from zinc-lead ore, 7 percent from lead ore, 3 percent from gold and silver ores, and 1 percent from zinc ore and old slag.

Zinc.—Yield of zinc from Montana ores in 1951 advanced 26 percent over the 1950 figure and reached the highest annual level since 1920, largely the result of a substantial increase in production at the Butte Hill mines and dumps of the Anaconda Copper Mining Co. Also significant was the fact that 1951 marked the fourth year in the State's mining history in which zinc production exceeded the output of copper. During the year, Anaconda company owned and leased operations at Butte supplied 94 percent of the State's zinc output. Other important zinc producers, in order of decreasing output, were the East Helena old slag dump, the Mike Horse property, the Jack Waite mine, the Scratch Awl property, and the Taylor-Knapp Co. True Fissure mine in Granite County. These six operations produced over 99 percent of the State total zinc output. Zinc-lead ore supplied 96 percent of the State zinc in 1951, zinc ore and old slag nearly 4 percent.

TABLE 5.—Mine production of gold, silver, copper, lead, and zinc in Montana in 1951, by counties, in terms of recoverable metal

County	Mines producing[1]		Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Fine ounces	Value	Fine ounces	Value
Beaverhead	15		595	$20,825	24,318	$22,009
Broadwater	18	5	990	34,650	4,486	4,060
Cascade	4		13	455	9,722	8,799
Deer Lodge	2		595	20,825	21	19
Fergus	2				43	39
Flathead	1		5	175	401	363
Granite	14	1	437	15,295	83,433	75,511
Jefferson	45		1,448	50,680	139,643	126,384
Judith Basin	3		6	210	3,822	3,459
Lewis and Clark	22	5	2,539	88,865	91,458	82,774
Lincoln	4		37	1,295	53	48
Madison	26	1	2,883	100,905	43,571	39,434
Meagher	3	1	8	280	653	591
Mineral	6	2	77	2,695	20,992	18,999
Missoula	3		4	140	2,275	2,059
Park	5		5,030	176,050	9,541	8,635
Powell	7	1	88	3,080	1,696	1,535
Silver Bow	14		15,674	548,590	5,950,647	5,385,636
Other counties [1]	4		73	2,555	6,993	6,329
Total	198	16	30,502	1,067,570	6,393,768	5,786,683

County	Copper		Lead		Zinc		Total value
	Short tons	Value	Short tons	Value	Short tons	Value	
Beaverhead	15	$7,260	359	$124,214	68	$24,752	$199,060
Broadwater	1	484	27	9,342	124	45,136	93,672
Cascade	1	484	49	16,954	11	4,004	30,696
Deer Lodge							20,844
Fergus	7	3,388					3,427
Flathead	1	484					1,022
Granite	22	10,648	142	49,132	393	143,052	293,638
Jefferson	17	8,228	808	279,568	261	95,004	559,864
Judith Basin	1	484	54	18,684	18	6,552	29,389
Lewis and Clark	70	33,880	1,627	562,942	3,849	1,401,036	2,169,497
Lincoln			4	1,384	3	1,092	3,819
Madison	116	56,144	83	28,718	17	6,188	231,389
Meagher	1	484	27	9,342	1	364	11,061
Mineral	28	13,552	122	42,212	23	8,372	85,830
Missoula			620	214,520	6	2,184	218,903
Park	288	139,392	20	6,920	1	364	331,361
Powell	3	1,452	5	1,730	2	728	8,525
Silver Bow	56,826	27,503,784	16,630	5,753,980	80,500	29,302,000	68,493,990
Other counties [1]	9	4,356	725	250,850	274	99,736	363,826
Total	57,406	27,784,504	21,302	7,370,492	85,551	31,140,564	73,149,813

[1] Includes Ravalli and Sanders Counties, for which Bureau of Mines is not at liberty to publish separate figures.

MINING INDUSTRY

Although the number of producing mines in Montana in 1951 as compared with 1950, declined from 284 to 214, ore production increased 10 percent to 3,965,875 short tons, gains of varying magnitude in copper, lead, and zinc content were recorded also. Production was curtailed somewhat by labor shortages reported in several operating areas and the nationwide mine, mill, and smelter labor strike from August 27 to September 7; nevertheless, ore production at many properties advanced substantially over the 1951 level. Much of the increased activity in mining and development at established properties was stimulated by the sustained high level in market prices of copper, lead, and zinc and a strong demand for metals to support the Nation's defense program. At the Butte properties of the Anaconda Copper Mining Co. construction on the Greater Butte project proceeded on schedule. Work on surface facilities was substantially completed

during the year. The schedule of underground mine preparation for the project was maintained and initial mining operations by block-caving methods were expected to begin in early 1952.

The production of zinc-lead and zinc ores (including old slag) increased 19 and 16 percent, respectively, in the State in 1951, but copper ore mined declined 2 percent, and there was a drop of 37 percent in production of gold and silver ores and old tailings. Of the 3,965,875 tons of ore treated during the year, 68 percent was zinc-lead, lead, zinc, and lead-copper ores, 29 percent was copper ore, and 3 percent was gold and silver ores and old tailings and old lead blast furnace slag.

Field teams of the Defense Minerals Administration (Defense Minerals Exploration Administration after August 28, 1951, as a result of a presidential executive order) made up of Bureau of Mines engineers and geologists of the Federal Geological Survey, examined a number of Montana mining properties for eligibility under the Federal Government program of assisting in the exploration of unknown or undeveloped sources of strategic and critical minerals and metals. As a result of this activity, 14 exploration contracts totaling $460,424 were approved for properties producing copper, lead, or zinc. Data on mines and mineral deposits in several Montana counties were published.[1]

TABLE 6.—Mine production of gold, silver, copper, lead, and zinc in Montana in 1951, by class of ore or other source material, in terms of recoverable metal

Source	Number of mines[1]	Material sold or treated (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Ore:							
Dry gold	46	59,214	11,623	61,371	811,629	27,671	37,255
Dry gold-silver	18	3,379	403	14,017	3,198	118,310	41,660
Dry silver	35	18,139	699	112,841	20,451	933,243	267,865
Total	99	80,732	12,725	188,229	835,278	1,079,224	346,780
Copper	12	1,169,141	2,904	1,553,685	95,756,853	277	188
Lead	44	22,823	613	74,246	48,046	2,941,942	243,722
Lead-copper	3	9	2	443	1,460	1,720	174
Zinc	9	3,594	145	33,790	11,472	97,318	615,166
Zinc-lead	28	2,664,748	12,830	4,523,557	8,316,559	37,991,605	164,869,077
Total	96	3,860,315	16,494	6,185,721	104,134,390	41,032,862	165,728,327
Other "lode" material:							
Dry gold: Old tailings and mill cleanup[2]	2	189	54	41	287		2,100
Dry gold-silver: Old tailings	2	1,583	97	2,704	255	11,772	1,068
Dry silver: Old tailings	1	2,366	48	16,063	2,420	51,029	141,110
Copper:							
Smelter cleanup		2		23	199		123
Precipitates	2			16	9,836,739		
Old slag		20,688	10	834	2,432	429,113	4,882,492
Total	7	24,828	209	19,681	9,842,332	491,914	5,026,893
Total "lode" material	198	3,965,875	29,428	6,393,631	114,812,000	42,604,000	171,102,000
Gravel (placer operations)	16		1,074	137			
Total	214	3,965,875	30,502	6,393,768	114,812,000	42,604,000	171,102,000

[1] Detail will not necessarily add to totals because some mines produce more than 1 class of ore.
[2] Includes production from 169 tons of old tailings and 20 tons mill cleanup.

[1] Robertson, Almon F., and Roby, Robert N., Mines and Mineral Deposits (Except Fuels), Judith Basin County, Mont.: Bureau of Mines Inf. Circ. 7602, 1951, 48 pp. Robertson, Almon F., Mines and Mineral Deposits (Except Fuels), Cascade County, Mont.: Bureau of Mines Inf. Circ. 7589, 1951, 81 pp. Reed, Glenn C., Mines and Mineral Deposits (Except Fuels), Broadwater County, Mont.: Bureau of Mines Inf. Circ. 7592, 1951, 62 pp. Reed, Glenn C., Mines and Mineral Deposits (Except Fuels), Gallatin County, Mont.: Bureau of Mines Inf. Circ. 7607, 1951, 14 pp.

METALLURGICAL INDUSTRY

Of the 3,965,875 tons of material sold or treated in Montana in 1951, 3,856,554 tons (97 percent) went to mills and 109,321 tons (3 percent) to smelters, compared with 97 and 3 percent, respectively, in 1950. The 3,856,554 tons treated at mills were distributed as follows: 11 plants, 2,664,095 tons of zinc-lead ore; 3 plants, 1,124,434 tons of copper ore; 16 plants, 50,000 tons of gold and silver ore; 4 plants, 16,366 tons of lead ore; and 3 plants, 2,559 tons of zinc ore.

The Anaconda Copper Mining Co. copper concentrator, zinc concentrator, and copper smelter (all at Anaconda) and the two electrolytic zinc plants (at Anaconda and Great Falls) operated throughout the year. The zinc plants treated 446,276 tons of zinc concentrates from many sources containing 474,873,818 pounds of zinc, compared with 466,695 tons containing 494,909,180 pounds of zinc in 1950. The company slag-fuming plant at East Helena was operated throughout the year and treated 208,628 tons of hot slag and old lead-blast-furnace slag compared with the 222,892 tons in 1950; output of zinc-lead fume decreased from 37,754 tons in 1950 to 36,113 in 1951. The addition to zinc-plant facilities of a sixth unit at Anaconda was expected to be completed during 1952.

The lead smelter of the American Smelting & Refining Co. at East Helena operated throughout 1951 and treated chiefly lead-silver concentrates from mines in Idaho, crude ore, concentrates, and old tailings from numerous districts in Montana and residues from the electrolytic zinc plants at Anaconda and Great Falls.

Definitions used in ore classification are given in the Gold and Silver chapter of this volume.

TABLE 7.—Mine production of gold, silver, copper, lead, and zinc in Montana in 1951, by method of recovery and type of material processed, in terms of recoverable metal

Method of recovery and type of material processed	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Lode:					
Amalgamation [1]	825	42			
Concentration, and smelting of concentrates [1]	21,747	6,089,719	103,204,588	39,067,111	165,116,761
Direct smelting:					
Ore	6,666	298,867	1,767,174	3,096,004	1,099,456
Old tailings, etc	180	4,153	1,067	11,772	3,291
Copper precipitates		16	9,836,739		
Old slag	10	834	2,432	429,113	4,882,492
Total	6,856	303,870	11,607,412	3,536,889	5,985,239
Placer	1,074	137			
Grand total	30,502	6,393,768	114,812,000	42,604,000	171,102,000

[1] Ore only. No old tailings, etc., processed by this method in Montana in 1951.

TABLE 8.—Mine production of gold, silver, copper, lead, and zinc in Montana in 1951, by method of recovery (except placer) and class of material processed, in terms of recoverable metal

A. For ore treated at mills

	Ore treated (short tons)	Recoverable in bullion		Concentrate shipped to smelters and recoverable metal					
		Gold (fine ounces)	Silver (fine ounces)	Concentrate (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds	Lead (pounds)	Zinc (pounds)
BY COUNTIES									
Beaverhead	46			10		71	185	4,149	3,178
Broadwater	95	41	2						
Cascade	840			82	8	7,819	400	75,932	17,386
Deer Lodge	1,150	574	14	17	21	7			
Flathead	300			27	5	401	2,000		
Granite	4,779			1,815	57	67,818	14,095	254,397	731,671
Jefferson	248	87	16	50	18	664	335	12,083	13,832
Lewis and Clark	41,026	17		5,036	58	69,817	134,000	2,795,900	2,790,400
Lincoln	169	37		7		21		2,000	5,000
Madison	18,458	2		1,845	1,164	5,089	229,007		
Mineral	6,859			269	58	20,707	19,172	243,017	45,714
Missoula	10,125			968	3	2,275		1,240,000	12,000
Park	29,000			1,868	5,025	9,050	575,829		
Powell	74			6	8	97		1,211	317
Silver Bow	3,736,221	13	10	502,379	15,305	5,899,867	102,213,315	33,234,096	160,976,307
Other counties [1]	7,164	54		1,331	17	6,016	16,250	1,204,326	520,956
Total: 1951	3,856,554	825	42	515,710	21,747	6,089,719	103,204,588	39,067,111	165,116,761
1950 [2]	3,497,032	3,974	9,813	496,109	31,512	6,180,777	100,727,706	35,779,354	129,851,009
BY CLASS OF ORE TREATED									
Dry gold	49,012	825	42	1,868	6,229	14,220	804,836	491	43
Dry silver	88			8	1	79		705	548
Copper	1,124,434			294,234	2,625	1,526,021	94,062,169		
Lead	16,366			1,180	62	20,697	17,800	1,457,911	26,317
Zinc	2,559			845	25	12,198	7,828	50,812	322,147
Zinc-lead	2,664,095			217,575	12,805	4,516,504	8,311,955	37,557,192	164,767,706
Total 1951	3,856,554	825	42	515,710	21,747	6,089,719	103,204,588	39,067,111	165,116,761
BY CLASS OF CONCENTRATE SHIPPED TO SMELTERS									
Dry gold				1,865	1,193	5,128	229,007		
Copper				198,695	7,430	1,505,454	93,442,246		
Lead				24,878	3,605	1,396,463	3,079,576	25,877,078	3,220,723
Zinc-lead				10	3	137		9,300	3,000
Iron [3]				124,783	1,435	288,188	1,636,103	1,692,306	4,489,044
Total to copper and lead plants				350,231	13,666	3,195,370	98,386,932	27,578,684	7,712,767
Zinc concentrates to zinc plants				165,479	8,081	2,894,349	4,817,656	11,488,427	157,403,994
Total: 1951				515,710	21,747	6,089,719	103,204,588	39,067,111	165,116,761
1950				496,109	31,512	6,180,777	100,727,706	35,779,354	129,851,009

[1] Includes Ravalli and Sanders Counties for which Bureau of Mines is not at liberty to publish separate figures.
[2] Includes some old tailings.
[3] From copper, lead, and zinc-lead ore.

TABLE 8.—Mine production of gold, silver, copper, lead, and zinc in Montana in 1951, by method of recovery (except placer) and class of material processed, in terms of recoverable metal—Continued

B. For ore, old tailings, etc., shipped directly to smelters

	Material shipped (short tons)	Recoverable metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
BY COUNTIES						
Beaverhead	3,830	595	24,247	29,815	713,851	132,822
Broadwater	1,317	935	4,484	2,000	54,000	248,000
Cascade	80	5	1,903	1,600	22,068	4,614
Fergus	350		43	14,000		
Granite	2,430	250	15,594	29,905	29,603	54,329
Jefferson	24,167	1,343	138,963	33,665	1,603,917	508,168
Judith Basin	209	6	3,822	2,000	108,000	36,000
Lewis and Clark	25,764	1,584	21,526	6,000	458,100	4,907,600
Lincoln	10		32		6,000	1,000
Madison	5,597	1,709	38,482	2,993	166,000	34,000
Meagher	199	6	653	2,000	54,000	2,000
Mineral	196	3	284	36,828	983	286
Missoula	2	1				
Park	44	5	491	171	40,000	2,000
Powell	203	56	1,599	6,000	8,789	3,683
Sanders	201	2	977	1,750	245,674	27,044
Silver Bow	44,722	356	50,770	11,438,685	25,904	23,693
Total: 1951	109,321	6,856	303,870	11,607,412	3,536,889	5,985,239
1950	90,240	12,844	390,906	7,228,294	3,454,646	5,504,991
BY CLASS OF MATERIAL						
Dry gold:						
Crude ore	5,940	3,149	16,521	6,793	27,180	37,212
Old tailings and mill cleanup	189	54	41	287		2,100
Total	6,129	3,203	16,562	7,080	27,180	39,312
Dry gold-silver:						
Crude ore	7,367	1,794	43,220	2,872	118,310	41,660
Old tailings	1,881	126	4,089	581	11,772	1,068
Total	9,248	1,920	47,309	3,453	130,082	42,728
Dry silver	20,417	746	128,825	22,871	983,567	408,427
Copper:						
Crude ore	44,707	279	27,664	1,694,684	277	188
Smelter cleanup	2		23	199		123
Precipitates			16	9,836,739		
Total	44,709	279	27,703	11,531,622	277	311
Lead	6,495	555	53,990	30,546	1,501,193	221,555
Lead-copper ore	9	2	443	1,460	1,720	174
Zinc-lead ore	592	21	6,659	4,304	418,134	97,507
Total to copper and lead plants	87,599	6,726	281,491	11,601,336	3,062,153	810,014
Zinc:						
Crude ore	1,034	120	21,545	3,644	45,623	292,733
Old slag	20,688	10	834	2,432	429,113	4,882,492
Total to zinc plants	21,722	130	22,379	6,076	474,736	5,175,225
Grand total	109,321	6,856	303,870	11,607,412	3,536,889	5,985,239

TABLE 9.—Mine production of gold, silver, copper, lead, and zinc in Montana in 1951, by method of recovery (except placer) and class of material processed, in terms of gross metal content

Class of material	Quantity shipped or treated (short tons)	Gross metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
ORE TREATED AT MILLS						
Dry gold	49,012	9,408	6,948	278,577	554	58
Dry silver	88		92		821	760
Copper	1,124,434	2,837	1,422,358	99,950,339		
Lead	16,366	82	24,346	25,095	1,645,923	36,231
Zinc	2,559	98	28,421	9,816	55,238	409,205
Zinc-lead	2,664,095	19,793	5,665,101	11,751,424	46,330,922	188,569,145
Total: 1951	3,856,554	32,218	7,147,266	112,015,251	48,033,458	189,015,399
1950 [1]	3,497,032	48,817	7,388,531	112,826,556	44,594,115	154,680,883
CONCENTRATE SHIPPED TO SMELTERS						
Dry gold	1,865	1,193	5,128	236,485		
Copper	198,695	7,430	1,505,454	95,607,914		
Lead	24,878	3,605	1,396,463	3,348,761	26,325,072	3,978,498
Zinc-lead	10	3	137		9,454	3,906
Dry iron [2]	124,783	1,435	288,188	1,712,097	1,881,401	5,638,279
Total to copper and lead plants	350,231	13,666	3,195,370	100,905,257	28,215,927	9,620,683
Zinc concentrate to zinc plants	165,479	8,081	2,894,349	5,070,487	12,724,608	161,895,708
Total: 1951	515,710	21,747	6,089,719	105,975,744	40,940,535	171,516,391
1950	496,109	31,512	6,180,777	100,585,427	36,773,868	140,843,062
ORE, ETC., SHIPPED DIRECTLY TO SMELTERS						
Dry gold [3]	6,129	3,203	16,562	8,120	28,046	47,036
Dry gold-silver [4]	9,248	1,920	47,309	4,078	132,392	51,582
Dry silver	20,417	746	128,825	26,017	1,001,040	491,972
Copper [5]	44,709	279	27,687	1,756,426	282	375
Lead	6,495	555	53,990	35,123	1,526,964	268,614
Lead-copper	9	2	443	1,953	1,784	210
Zinc-lead	592	21	6,659	4,996	426,212	118,322
Precipitates			16	9,945,186		
Total to copper and lead plants	87,599	6,726	281,491	11,781,899	3,116,720	978,111
Zinc ore to zinc plants [6]	21,722	130	22,379	7,350	503,687	5,350,094
Total: 1951	109,321	6,856	303,870	11,789,249	3,620,407	6,328,205
1950	111,004	12,969	400,250	8,521,360	3,543,247	5,934,052

[1] Includes some old tailings.
[2] From copper, lead and zinc-lead ore.
[3] Includes 20 tons mill cleanup and 169 tons of old tailings.
[4] Includes 1,881 tons of old tailings.
[5] Includes 2 tons smelter cleanup
Includes 20,688 tons old slag.

REVIEW BY COUNTIES

BEAVERHEAD

Lead ore constituted nearly 70 percent of the total output of Beaverhead County in 1951; except for 18 tons shipped from the H & S mine in the Chinatown district, all of it came from mines in the Argenta district. Ida B. Hand, operating the Maulden mine throughout the year, recorded the largest production. A total of 2,294 tons

TABLE 10.—Mine production of gold, silver, copper, lead, and zinc in Montana in 1951, by county and district, in terms of recoverable metal

County and district	Mines producing		Material sold or treated (short tons)	Gold (fine ounces)			Silver (fine ounces)			Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
Beaverhead County:													
Argenta	10		3,601	582		582	19,369		19,369	26,000	708,000	135,400	$191,319
Chinatown	1		18	1		1	221		221		10,000	600	2,074
Vipond	4		257	12		12	4,728		4,728	4,000			5,667
Broadwater County:													
Backer	1	4	2	1	13	14							490
Beaver	6		379	162		162	568		568		6,000	5,000	8,132
Cedar Plains	6		624	115		115	2,001		2,001	2,000	32,000	235,000	54,626
Park or Indian Creek	5	1	407	698	1	699	1,917		1,917		16,000	8,000	30,424
Cascade County: Montana	4		920	13		13	9,722		9,722	2,000	98,000	22,000	30,696
Deer Lodge County: Georgetown	2		1,150	595		595	21		21				20,844
Fergus County:													
Cone Butte	1		344							14,000			3,388
Warm Springs	1		6				43		43				39
Flathead County: Hog Heaven	1		300	5		5	401		401	2,000			1,022
Granite County:													
Alps	1		10				53		53		600	600	261
Boulder and South Boulder	3		35	40		40	315		315	100	700	300	1,885
Dunkleberg	2		51	2		2	421		421		6,000	600	1,598
First Chance	1		558	108		108	590		590	28,000			11,090
Flint Creek	6		6,516	136		136	82,033		82,033	15,900	276,700	784,000	273,409
Gold Creek		1			130	130		21	21				4,569
Stony	1		39	21		21						500	826
Jefferson County:													
Amazon	7		236	17		17	2,212		2,212	1,800	16,100	3,700	6,491
Cataract	8		336	50		50	2,581		2,581	4,600	9,500	8,500	8,389
Clancy and Lump Gulch	5		268	5		5	10,353		10,353	200	8,000	15,000	13,707
Colorado	6		16,878	724		724	70,016		70,016	19,000	988,600	217,000	303,828
Elkhorn	6		5,612	366		366	52,660		52,660	5,800	455,200	251,500	186,397
Lowland	1		20	13		13	52		52				502
Montana City	2		23	5		5	53		53		2,200	500	695
South Elkhorn	1		53	2		2	137		137		600	1,300	535
Whitehall	8		889	65		65	1,358		1,358	2,400	133,100	23,800	31,443
Wilson and Ticer Creeks	1		100	201		201	221		221	200	2,700	700	7,877
Judith Basin County: Barker	3		209	6		6	3,822		3,822	2,000	108,000	36,000	29,389
Lewis and Clark County:													
Canyon Creek		1			8	8							280
Heddleston	1		40,975	54		54	69,817		69,817	134,000	2,795,900	2,790,400	1,089,050
Helena	3	2	351	73	32	105	106	3	109	400	300	2,100	4,305
Lincoln	1	2	25	10	840	850		112	112				29,851
Marysville	1		3,446	1,425		1,425	11,490		11,490	3,400		21,100	64,937
Rimini	9		498	40		40	4,117		4,117	600	16,300	9,300	9,784

Scratch Gravel	5		1,030	46		46	5,813		5,813	1,600	23,100	19,100	14,720
Smelter			20,439								418,400	4,856,000	956,175
Stemple-Gould	2		26	11		11							385
Lincoln County:													
Ruby Creek	1		3								600		104
Sylvanite [1]	2		91				53		53		7,400	6,000	2,420
West Fisher Creek	1		85	37		37							1,295
Madison County:													
Cherry Creek	2		23	3		3	73		73				171
McCarthy Mountain	3		284	6		6	1,938		1,938	400	81,900	6,500	17,316
Norris and Norwegian	4	1	97	58	8	66	106		106		100	300	2,575
Renova	2		72	48		48	52		52				1,727
Rochester	2		75	4		4	1,391		1,391		51,600	5,000	11,236
Sheridan	5		287	10		10	2,275		2,275	600	25,300	20,600	10,680
Silver Star	1		18,490	1,185		1,185	5,109		5,109	230,600			101,904
Tidal Wave	2		58	87		87	200		200		7,000	1,000	4,619
Virginia City	4		4,666	1,472		1,472	32,427		32,427	400	100	600	81,091
Washington	1		3	2		2							70
Meagher County:													
Beaver		1			2	2							70
Castle Mountain	2		188	6		6	653		653	200	54,000	2,000	10,555
Musselshell	1		11							1,800			436
Mineral County:													
Cedar and Trout Creeks	2	2	257	3	16	19	243	1	244	37,800	100		10,051
Iron Mountain	2		482				2,254		2,254	400	17,900	29,000	10,512
Keystone	1		6,060	57		57	17,935		17,935	17,600	213,000	16,000	62,247
Packer Creek	1		256	1		1	559		559	200	13,000	1,000	3,020
Missoula County:													
Copper Cliff	1		10,000				2,138		2,138		1,230,700	9,000	216,484
Elk Creek	1		2	1		1							35
Wallace	1		125	3		3	137		137		9,300	3,000	2,384
Park County: New World	5		29,044	5,030		5,030	9,541		9,541	576,000	40,000	2,000	331,361
Powell County:													
Big Blackfoot	1		24	4		4	32		32				169
Nigger Hill	3		114	16		16	1,411		1,411		8,700	2,500	3,797
Ophir Gulch	1	1	107	18	24	42	63		63	6,000			2,979
Yourname Creek	1		16	20		20	43		43				739
Zozell	1		16	6		6	147		147		1,300	1,500	841
Silver Bow County: Summit Valley	14		3,780,943	15,674		15,674	5,950,647		5,950,647	113,652,000	33,260,000	161,000,000	68,493,990
Other Counties [2]	4		7,365	73		73	6,993		6,993	18,000	1,450,000	548,000	363,826
Total	198	16	3,965,875	29,428	1,074	30,502	6,393,631	137	6,393,768	114,812,000	42,604,000	171,102,000	73,149,813

[1] Includes Sylvanite and Troy districts.
[2] Includes Ravalli and Sanders Counties, for which Bureau of Mines is not at liberty to publish separate figures

of lead ore, containing 71 ounces of gold, 9,248 ounces of silver, 28,313 pounds of copper, 625,387 pounds of lead, and 145,806 pounds of zinc were shipped to a smelter. W. I. Gardner and the Jack Group Mining Corp. worked the Jack mine in Clark Canyon, 18 miles northwest of Dillon, during most of the year and shipped 390 tons of lead smelting ore containing 135 ounces of gold, 7,206 ounces of silver, 784 pounds of copper, 62,320 pounds of lead, and 4,100 pounds of zinc.

BROADWATER

Important producers in the county included the North Star group in the Cedar Plains district, operated by Roy E. Nichols, and the Marietta claim in the Park or Indian Creek district, worked by Marietta Mines. Operations at the North Star group recovered 253 tons of zinc carbonate ore containing 2 ounces of gold, 784 ounces of silver, 1,993 pounds of copper, 16,937 pounds of lead, and 148,486 pounds of zinc, which were shipped to a smelter in Utah.

Cedar Plains District.—Zinc ore was the principal output of the Cedar Plains district in 1951. In addition to production from the North Star group, a total of 208 tons of ore containing 1 ounce of gold, 938 ounces of silver, 264 pounds of copper, 11,912 pounds of lead, and 90,795 pounds of zinc was shipped from the Ruby Silver property. Wayne Miller and James Holling worked the Keating mine during a portion of the year and shipped 132 tons of zinc ore containing 100 ounces of gold, 74 ounces of silver, 375 pounds of copper, 2,583 pounds of lead, and 28,974 pounds of zinc.

Park or Indian Creek District.—Except for a small quantity of gold recovered from placer gravel, all the district output came from gold ore, the principal producer of which was the Marietta mine.

CASCADE

Output for the year, all from the Montana district, comprised 182 tons of zinc-lead ore from the Broadwater-Moulton property, 720 tons of zinc-lead ore from the Galt mine, 11 tons of lead ore from the Hartley claim, and 7 tons of lead-copper ore from the Silver Dyke Group.

DEER LODGE

Gold ore continued to be the source of metal production in Deer Lodge County in 1951. Principal producer was the Acme Co., which operated the Gold Coin mine continuously throughout 1951. A total of 1,050 tons of gold ore, treated by amalgamation, yielded 574 ounces of gold and 14 ounces of silver.

GRANITE

Glen Hawe operated the Sunrise mine in the First Chance district from January 1 to May 5 and shipped 558 tons of copper smelting ore containing 108 ounces of gold, 590 ounces of silver, and 28,935 pounds of copper.

The Master Mining Co. did placer mining on upper Gold Creek in the Gold Creek and South Gold Creek district and washed about 25,000 cubic yards of gravel, which yielded 130 fine ounces of gold and 21 fine ounces of silver.

Flint Creek District.—The largest operation in the district and the county was the True Fissure mine and 80-ton mill, worked throughout 1951 by the Taylor-Knapp Co. A substantial tonnage of manganese ore, containing varied quantities of gold, silver, copper, lead, and zinc, was milled during the year in the company gravity- and magnetic-separation plant. Peter Antonioli, lessee, worked the Scratch Awl mine throughout 1951 and shipped 2,275 tons of zinc-lead ore containing 41 ounces of gold, 63,909 ounces of silver, 9,570 pounds of copper, 237,360 pounds of lead, and 610,681 pounds of zinc to a custom mill in Utah.

JEFFERSON

Colorado District.—The bulk of the mining activity within the county in 1951 was centered in the Colorado district where most of the output comprised 13,769 tons of dry silver ore from the Alta mine, 2,208 tons of gold-silver ore from the Gregory Mines dump, 299 tons of gold-silver tailings from the Flagstaff property, and 237 tons of silver ore from the Mount Washington dump.

Elkhorn District.—Louis Peura worked the Elkhorn dump during the year and shipped 2,366 tons of old silver tailings containing 48 ounces of gold, 16,063 ounces of silver, 2,873 pounds of copper, 51,912 pounds of lead, and 169,671 pounds of zinc to a smelter. The Elkhorn mine, operated 6 months during 1951 by the Elkhorn Mining Co., yielded 912 tons of silver smelting ore containing 10 ounces of gold, 8,913 ounces of silver, 832 pounds of copper, 20,948 pounds of lead, and 68,585 pounds of zinc. The New Elkhorn Queen Mining Co. shipped 2,089 tons of lead smelting ore and 221 tons of gold-silver dump ore from the Elkhorn Queen mine.

Most of the output in the Whitehall district in 1951 came from 555 tons of lead smelting ore shipped from the Carbonate mine, 189 tons of gold smelting ore from the Lucky Hit mine, and 110 tons of lead smelting ore from the Whitehall mine.

JUDITH BASIN

All metal production in the county in 1951 came from mines in the Barker district. Thorson and Brazee worked the Edwards lode all year and shipped 125 tons of zinc-lead smelting ore containing 4 ounces of gold, 2,899 ounces of silver, 507 pounds of copper, 75,929 pounds of lead, and 29,577 pounds of zinc.

LEWIS AND CLARK

Heddleston District.—The Mike Horse Mining & Milling Co. operated its Mike Horse mine throughout the year and treated 40,975 tons of zinc-lead ore in the company 300-ton flotation mill. A total of 2,235 tons of lead concentrate and 2,800 tons of zinc concentrate were recovered in the milling operation. Development at the property during the year included 209 feet of crosscuts and 116 feet of diamond drilling.

The second largest operation within the county in terms of ore tonnage was the Drumlummon mine in the Marysville district, worked by the St. Louis Drumlummon mines. Gold ore totaling

3,426 tons and containing 1,398 ounces of gold, 11,472 ounces of silver, 4,115 pounds of copper and 25,389 pounds of zinc, was shipped to a smelter.

The metals credited to the Smelter district came from 20,439 tons of old zinc slag, treated at the East Helena slag-fuming plant of the Anaconda Copper Mining Co. The tonnage treated in 1951 compares with 20,764 tons similarly treated in 1950.

Missoula Lincoln Metals Co. operated a dragline dredge and non-floating washing plant on the Abraham, Bluebird, Dollar, and Half Dollar placers in the Lincoln district and washed about 666,000 cubic yards of gravel.

MADISON

The Victoria Mines, Inc., American Pit (Victoria) mine in the Silver Star district continued in 1951 to be the largest producer in Madison County. During the year a total of 18,450 tons of gold ore containing 1,552 ounces of gold, 6,785 ounces of silver, and 278,218 pounds of copper were shipped to a custom mill for treatment.

In terms of ore output, the Virginia City district ranked second among the producing mining districts in the county in 1951. Henry A. Shute worked the Cornucopia property during most of the year and shipped 4,286 tons of gold-silver smelting ore containing 1,420 ounces of gold and 30,588 ounces of silver. Other properties operating in the Virginia City district, all of which produced gold and silver ore, included the Charles Ray, Easton Pacific, and Mountain Flower mines.

Lead and zinc production predominated in three districts in the county in 1951. In the McCarthy Mountain district, C. O. Dale & Sons worked the Rolly Jane and Bessie mine until November and shipped 277 tons of lead smelting ore containing 6 ounces of gold, 1,924 ounces of silver, 403 pounds of copper, 82,650 pounds of lead, and 7,553 pounds of zinc. A total of 67 tons of lead ore containing approximately 38 percent lead and 20 ounces of silver to the ton, was shipped from the Commonwealth mine in the Rochester District. Slightly less than half of the output from the Sheridan district was zinc-lead ore, most of which was recovered from the Toledo Buckeye group by Victoria Mines, Inc.

MINERAL

The western part of Mineral County adjoining Idaho's famed Coeur d'Alene mining region witnessed considerable revival of interest in long-dormant properties in 1951. Nancy Lee Mines, Inc., began production from the lower level of its Nancy Lee mine and recovered 202 tons of lead concentrate from lead ore treated in the company mill. Other important producers in the county were the Amador mine of the Amador Mining Co. in Cedar and Trout Creeks district, the Iron Mountain mine of the Federal Mining & Smelting Co. in the Iron Mountain district, worked by lessees intermittently during the year, and the Last Chance property in the Packer Creek district, worked by the Jupiter Mining Co.

MISSOULA

Copper Cliff (Cramer Creek) District.—Linton Mines operated the Blacktail open-pit mine and 500-ton sink-float plant beginning in April 1951 and treated 10,000 tons of lead ore, which yielded 958 tons of lead concentrate.

Other properties in the county that reported production during the year included the Lucky Boy mine in the Elk Creek district and the Charcoal property in the Wallace district.

PARK

Virtually all the production in the county in 1951 came from the open-pit Estelle mine of the McLaren Gold Mines Co., which was worked from June 1 to December 23. A total of 29,000 tons of gold ore was treated in the company 200-ton flotation mill.

SANDERS

Most of the metal production in Sanders County in 1951 came from the Jack Waite mine in the Eagle district, operated throughout the year by the American Smelting & Refining Co. Production totaled 7,124 tons of zinc-lead milling ore and 186 tons of zinc-lead smelting ore. The milling ore, all treated in the 300-ton flotation plant at the property, contained 6,511 ounces of silver, 1,251,800 pounds of lead, 645,800 pounds of zinc and small quantities of gold and copper.

SILVER BOW

Ore production in Silver Bow County in 1951 increased to 3,780,943 short tons, a 12 percent gain over 1950. The output of copper advanced 5 percent, lead 6 percent, and zinc 27 percent, whereas gold and silver production fell off 32 percent and 3 percent, respectively. The total value of the five metals produced was over 34 percent greater than in 1950 and represented 94 percent of the State total value. Table 11 gives the output of the mines in the county, which includes the Summit Valley (Butte) district, in 1947–51 and cumulative total from 1882 to date.

Summit Valley (Butte) District.—Operations of the Anaconda Copper Mining Co. are described in the following abstract from the company 1951 annual report to its stockholders:

> The construction of surface facilities for the Greater Butte Project was substantially completed during the year. The large ore tonnages from this project will be hoisted through the Kelly shaft, now full size to a depth of 1,370 feet and concrete-lined to a point 315 feet below the 600 level. Of the estimated total of 130,000,000 tons of ore in this project, approximately 56,000,000 tons will become available for haulage to the Kelly shaft on the 600 level, 1,300 level and 2,000 level. Underground mine preparation progressed on schedule and initial mining operations by block caving methods will begin in early 1952. Ore production at the rate of 6,000 tons per day is expected by mid-year. This output will be increased as rapidly as possible to an eventual production of 15,000 tons per day of low grade ores averaging about 20 pounds of recoverable copper per ton. Substantial remodeling of the copper concentrator at Anaconda for the treatment of the larger tonnages of Greater Butte Project low-grade ores proceeded on schedule during the year. In addition to this remodeling, a leach-precipitation-float section was constructed.

Zinc mine development during the year within the Butte district disclosed substantial additions to ore reserves at the Anselmo, Badger and Lexington mines. A tunnel 8½ by 9 feet, inside measurement, to connect the Alice and Lexington mines with railroad facilities is being driven.

Except for the Nation-wide strike in the non-ferrous metals industry, which closed the plants from August 27th to September 7th, there was no interference with mining and smelting operations. Butte mines maintained production at the maximum rate permitted by available manpower, resulting in an increase of approximately 7 percent in copper and 37 percent in zinc.

Company material treated at the copper concentrator of the Anaconda Copper Mining Co. at Anaconda comprised 1,038,679 tons of copper ore from the main Butte Hill mine (1,105,856 tons in 1950), 67,834 tons of special waste (50,744 tons in 1950), and 17,559 tons from the Greater Butte project. Direct smelting ores totaled 8,967 tons (20,246 tons in 1950) and mine-water precipitates 9,179 tons (5,823 tons in 1950).

Production of zinc-lead ore from the Butte Hill mines of the Anaconda Copper Mining Co. was 1,189,144 tons in 1951 (871,191 tons in 1950) and that from the Butte Hill dumps 955,372 tons (818,445 tons in 1950).

The Emma and Travona mines, operated by the Anaconda Copper Mining Co., produced manganese ore, which was milled to recover manganese concentrates and a zinc-lead middling concentrate. This middling concentrate was further milled to obtain zinc and lead concentrates totaling 16,855 tons from the Emma middling and 1,730 tons from the Travona middling.

Copper smelting ore and silver smelting ore constituted most of the remainder of the district output in 1951. Of the copper ore production, 18,402 tons came from the Bullwhacker claim, and 15,983 tons from the Sarsfield mine. The most important producers of silver smelting ore included the Marget Anne mine with an output of 1,068 tons, and the Magna Charta mine with 140 tons.

TABLE 11.—Production of gold, silver, copper, lead, and zinc in Silver Bow County, Mont., 1947–51, and total, 1882–1951, in terms of recoverable metal

Year	Mines producing	Ore (short tons)	Gold (lode and placer, fine ounces)	Silver (lode and placer, fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
1947	32	2,624,915	19,801	5,252,011	114,374,000	21,269,500	81,425,000	$42,379,878
1948	22	2,637,479	19,163	6,100,232	115,423,500	26,448,900	105,250,800	49,971,332
1949	15	2,297,584	15,757	5,636,112	111,890,500	22,979,600	95,963,100	43,225,091
1950	21	3,387,270	23,163	6,123,549	107,793,300	31,358,800	127,021,000	51,044,252
1951	14	3,780,943	15,674	5,950,647	113,562,000	33,260,000	161,000,000	68,493,990
1882–1951	--------	(1)	2,119,755	574,847,530	[2] 6,825,386	[2] 302,520	[2] 1,856,099	2,854,526,555

[1] Figure not available.
[2] Short tons

Nevada
Gold, Silver, Copper, Lead and Zinc

(MINE REPORT)

By R. B. Maurer and Leona Froehlich

GENERAL SUMMARY

RESPONDING to extraordinary demand for base metals, expansion of open-pit mining during 1951 resulted in a substantial increase in Nevada copper production compared with 1950. However, the output of lead and of zinc, reflecting a dearth of ore which could be developed rapidly and mined economically, fell considerably below 1950. With precious-metal lode mining at a virtual standstill because of unchanged gold and silver prices, gold production waned in 1951, and silver output was the lowest recorded from Nevada mines since 1899. The total value of gold, silver, copper, lead, and zinc recovered from materials sold or treated in 1951 was $41,280,596 compared with $38,181,872 in 1950, a gain of 8 percent, due largely to copper. Production in 1951 was from 199 lode and 12 placer mines, compared with 325 lode and 25 placer mines in 1950.

Comparing 1951 with 1950, the copper output increased 7 percent in quantity and 25 percent in value; zinc decreased 19 percent in quantity but increased 3 percent in value; lead decreased 24 percent in quantity and 3 percent in value; and gold decreased 32 percent and silver 36 percent both in quantity and value. Of the total value of the five metals, copper comprised more than 66 percent, zinc nearly 16 percent, gold 10 percent, lead 6 percent, and silver 2 percent.

White Pine County produced 72 percent of the State total value of the five metals reported from 17 counties in 1951; it was first in output of copper and gold, second in silver, fourth in zinc, and fifth in lead. Lincoln County, in second place with 19 percent of the State total, led in production of silver, lead, and zinc and was second in copper and fourth in gold.

All tonnage figures reported herein are short tons and "dry weight"; that is, they do not include moisture. Yardage figures used in measuring material treated in placer operations are "bank measure"; that is, the material is measured in the ground before treatment. The value of metal production has been calculated at the prices shown in table 1.

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TABLE 1.—Prices of gold, silver, copper, lead, and zinc, 1947–51

Year	Gold [1] (per fine ounce)	Silver [2] (per fine ounce)	Copper [3] (per pound)	Lead [3] (per pound)	Zinc [3] (per pound)
1947	$35.00	$0.905	$0.210	$0.144	$0.121
1948	35.00	.905+	.217	.179	.133
1949	35.00	.905+	.197	.158	.124
1950	35.00	.905+	.208	.135	.142
1951	35.00	.905+	.242	.173	.182

[1] Price under authority of Gold Reserve Act of Jan. 31, 1934.
[2] Treasury buying price for newly mined silver, July 1, 1946, to date—$0.9050505 ($0.905 used in 1947 for calculating purposes).
[3] Yearly average weighted price of all grades of primary metal sold by producers. Price in 1947 includes bonus payments by Office of Metals Reserve for overquota production.

TABLE 2.—Mine production of gold, silver, copper, lead, and zinc in Nevada in 1951, by months, in terms of recoverable metal [1]

Month	Gold (fine ounces)	Silver (fine ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
January	9,536	98,113	4,653	703	1,834
February	8,848	92,672	4,517	625	1,589
March	11,082	87,375	5,048	631	1,511
April	12,678	85,753	5,223	568	1,183
May	12,102	91,788	5,262	633	1,436
June	10,780	84,919	4,350	603	1,415
July	8,872	74,144	3,890	507	1,515
August	10,244	69,029	3,812	559	1,280
September	9,355	70,008	4,072	551	1,352
October	9,916	77,068	5,219	644	1,474
November	8,481	81,922	5,357	627	1,432
December	9,142	68,878	5,071	497	1,422
Total	121,036	981,669	56,474	7,148	17,443

[1] Mine production comprises ore, gravel, or other mineral material sold or treated and metal recovered as natural gold or as bullion from cyanidation or amalgamation and the estimated recoverable metal (or gross metal as indicated) contained in concentrates, ores, tailings, and other mineral materials shipped directly to smelters or sold to ore buyers within the year.

Gold.—Lode mines supplied 75 percent of the State's total gold in 1951 and placer mines 25 percent; but only 28 percent of the lode gold was derived from precious-metal ores and old tailings treated. The decline in lode-gold output began late in 1950 following the rise in prices of strategic metals and minerals—with consequent upsurge in their production—and continued progressively in 1951, when it became evident that no change in the fixed price of gold would be forthcoming. The slump in placer-gold output was largely the result of operating difficulties at Nevada's only bucket-line dredge.

The following six leading gold-producing mines in 1951, listed in order of output, contributed 88 percent of Nevada's output: Kennecott Copper Corp. Ruth pit, Robinson district, White Pine County (copper ore); Round Mountain Gold Dredging Co., Round Mountain district, Nye County (placer); London Extension Mining Co. Goldacres mine, Bullion district, Lander County (gold ore); Consolidated Coppermines Corp. Morris Brooks pit, Robinson district, White Pine County (copper ore); Natomas Co., Battle Mountain district, Lander County (dredging); and Consolidated Coppermines Corp. Ruth pit extension, Robinson district, White Pine County (copper ore).

Silver.—The sharp decline in 1951 silver output was significant in that only 18 percent of Nevada lode silver was derived from precious-metal ores, old tailings and slag; base-metal ores treated, except copper ore, had considerably lower silver content than in 1950.

The following five leading silver-producing mines in 1951, listed in order of output, furnished 69 percent of Nevada's output: Combined Metals Reduction Co. Pioche group, Pioche district, Lincoln County (zinc-lead ore); Summit King Mines, Ltd., Summit King group, Sand Springs district, Churchill County (gold-silver ore); Kennecott Copper Corp. Ruth pit, Robinson district, White Pine County (copper ore); Hill & Chiatovich, San Rafael mine, Quartz Mountain district, Nye County (zinc-lead and lead ores); and Copper Canyon Mining Co. Copper Canyon mine, Battle Mountain district, Lander County (zinc-lead ore).

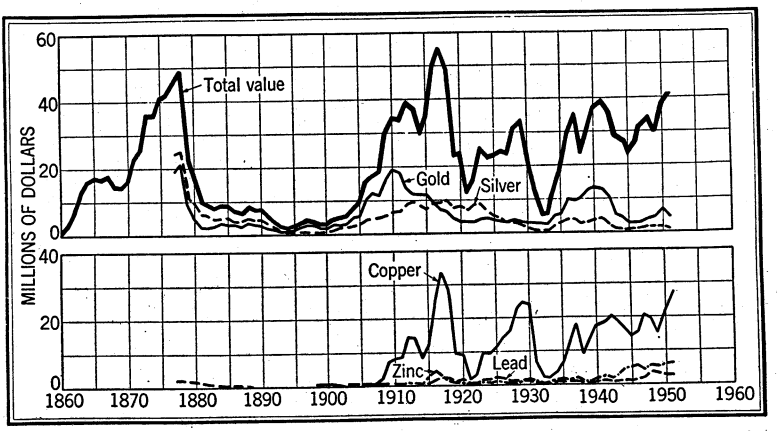

FIGURE 1.—Value of mine production of gold, silver, copper, lead, and zinc in Nevada, 1860–1951.

Copper.—The Robinson district, White Pine County, continued to be Nevada's main source of copper produced; the Kennecott Copper Corp. Ruth and Kimbley pits and Consolidated Coppermines Corp. Morris Brooks pit and Ruth pit extension furnished a preponderant percentage of the State's 1951 output; Kennecott Copper Corp. began development of its Ruth underground mine. Elsewhere in Nevada copper produced was largely a byproduct metal; those small properties that mined straight copper ore failed to develop reserves sufficient to support continuous mining. Anaconda Copper Mining Co. planned immediate development of the Yerington mine, Yerington district, Lyon County, a property with large known reserves of low-grade copper ore.

TABLE 3.—Mine production of gold, silver, copper, lead, and zinc in Nevada, 1947–51, and total, 1859–1951, in terms of recoverable metal [1]

Year	Mines producing [2]		Material sold or treated [3] (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1947	276	31	6,541,635	89,063	$3,117,205	1,377,579	$1,246,709
1948	350	36	7,172,611	111,532	3,903,620	1,790,020	1,620,058
1949	332	37	5,987,013	130,399	4,563,965	1,800,209	1,629,280
1950	35	27	7,745,119	178,447	6,245,645	1,537,217	1,391,259
1951	199	12	7,183,733	121,036	4,236,260	981,669	888,460
1859–1951 [4]			[5]	26,147,478	593,723,406	597,090,406	547,502,368

Year	Copper		Lead		Zinc		Total value
	Short tons	Value	Short tons	Value	Short tons	Value	
1947	49,603	$20,833,260	7,161	$2,062,368	16,970	$4,106,740	$31,366,282
1948	45,242	19,635,028	9,777	3,500,166	20,288	5,396,608	34,055,480
1949	38,058	14,994,852	10,626	3,357,816	20,443	5,069,864	29,615,777
1950	52,569	21,868,704	9,408	2,540,160	21,606	6,136,104	38,181,872
1951	56,474	27,333,416	7,148	2,473,208	17,443	6,349,252	41,280,596
1859–1951 [4]	2,024,614	610,368,782	591,300	74,181,235	444,238	82,547,084	1,908,322,875

[1] Includes recoverable metal content of gravel washed (placer operations), ore milled, old tailings or slimes retreated, and ore, old tailings, slag and copper precipitates shipped to smelters during calendar year indicated.

[2] Excludes itinerant prospectors, "snipers," "high-graders," and others who gave no evidence of legal right to property.

[3] Does not include gravel washed.

[4] From 1904 (when first satisfactory annual canvass of mine production was made) to 1951, inclusive, the output was as follows: Gold, 14,320,602 ounces valued at $349,240,173; silver, 308,677,557 ounces, $210,344,145; copper, 2,022,688 tons, $609,722,154; lead, 353,509 tons, $51,544,673; zinc, 444,238 tons, $82,547,084; total value, $1,303,398,229.

[5] Figure not available.

TABLE 4.—Gold and silver produced at placer mines in Nevada 1947–51, in fine ounces, in terms of recoverable metal

Year	Material handled (cubic yards)	Gold (fine) ounces	Silver (fine ounces)	Total value	Average gold value per cubic yard
1947	1,086,000	7,001	2,737	$247,512	$0.226
1948	762,500	8,178	1,463	287,554	.375
1949	1,382,140	7,942	1,676	279,487	.201
1950	5,243,450	36,378	9,800	1,282,099	.243
1951	6,165,850	30,509	14,017	1,080,501	.173

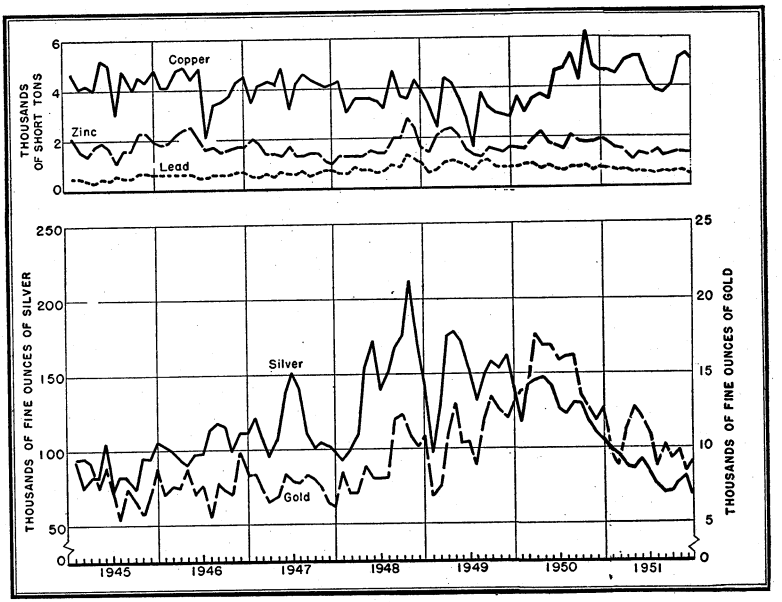

FIGURE 2.—Mine production of gold, silver, copper, lead, and zinc in Nevada, 1945–51, by months, in terms of recoverable metal.

Lead.—The 10-percent increase in lead from straight lead ore was overshadowed by the sharp decrease in yield from zinc-lead ore, the principal source of Nevada lead in 1951. Production was largely from relatively small mines; only one property had an annual output exceeding 400 tons of recoverable lead. Of the State's total, 66 percent was mined in the Pioche district, Lincoln County. The leading producers, in order of output, were: Combined Metals Reduction Co. Pioche group, and Ely Valley Mines, Inc., Ely Valley mine, Pioche district, Lincoln County; Hill & Chiatovich, San Rafael mine, Quartz Mountain district, Nye County; Copper Canyon Mining Co. Copper Canyon mine, Battle Mountain district, Lander County; and Bristol Silver Mines Co. Bristol group, Jack Rabbit district, Lincoln County.

Zinc.—With mine development and expansion of metallurgical facilities still in progress during 1951, the Pioche district, Lincoln County—source of 82 percent of Nevada's zinc in 1951—did not attain the 1950 level of output. The acceptance in 1951 by a Utah slag-fuming plant of larger tonnages of oxidized zinc ore from operating mines and the former Metals Reserve Company Clark County stockpile aided materially in preventing a greater slump in the State's yield of recoverable zinc. Leading producers, in order of output, were: Combined Metals Reduction Co. Pioche group and Ely Valley Mines, Inc., Ely Valley mine, Pioche district, Lincoln County; Cardinalli & Frank, Extension mine and Charles Vaccaro, Mountain View mine, Lone Mountain district, Eureka County; and Bristol Silver Mining Co. Bristol group, Jack Rabbit district, Lincoln County.

TABLE 5.—Mine production of gold, silver, copper, lead, and zinc in Nevada in 1951, by counties, in terms of recoverable metal

County	Mines producing [1]		Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Fine ounces	Value	Fine ounces	Value
Churchill	6	----	1,124	$39,340	114,844	$103,940
Clark	15	----	2,073	72,555	25,271	22,872
Douglas	(2)	----	3	105	1	1
Elko	18	2	172	6,020	36,781	33,288
Esmeralda	8	(2)	1,797	62,895	10,821	9,794
Eureka	7	----	78	2,730	13,097	11,853
Humboldt	8	----	2,293	80,255	11,014	9,968
Lander	14	[3]	[3] 47,368	[3] 1,657,880	[3] 63,917	[3] 57,848
Lincoln	13	----	3,584	125,440	450,523	407,746
Lyon	3	2	442	15,470	2,117	1,916
Mineral	9	----	496	17,360	18,018	16,307
Nye	24	(2)	[3] 739	[3] 25,865	[3] 44,432	[3] 40,213
Ormsby	1	----	3	105	123	111
Pershing	13	3	157	5,495	3,146	2,847
Storey	4	----	267	9,345	3,512	3,179
Washoe	6	1	268	9,380	814	737
White Pine	50	1	60,172	2,106,020	183,238	165,840
Total	199	12	121,036	4,236,260	981,669	888,460

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Churchill	----	----	1,700	$294	----	----	$143,574
Clark	9,000	$2,178	523,400	90,548	2,667,900	$485,558	673,711
Douglas	----	----	----	----	----	----	106
Elko	47,500	11,495	860,700	148,901	141,400	25,735	225,439
Esmeralda	1,000	242	39,500	6,834	300	54	79,819
Eureka	400	97	173,600	30,033	1,368,100	248,994	293,707
Humboldt	100	24	11,000	1,903	10,900	1,984	94,134
Lander	43,800	10,600	703,100	121,636	491,000	89,362	[3] 1,937,326
Lincoln	350,400	84,797	10,431,000	1,804,563	29,275,500	5,328,141	7,750,687
Lyon	47,900	11,592	----	----	----	----	28,978
Mineral	12,000	2,904	243,700	42,160	14,100	2,566	81,297
Nye	13,200	3,194	723,900	125,235	61,500	11,193	[3] 205,700
Ormsby	----	----	3,700	640	----	----	856
Pershing	3,000	726	6,800	1,176	15,900	2,894	13,138
Storey	----	----	100	17	----	----	12,541
Washoe	11,100	2,686	1,000	173	----	----	12,976
White Pine	112,408,600	27,202,881	572,800	99,095	839,400	152,771	29,726,607
Total	112,948,000	27,333,416	14,296,000	2,473,208	34,886,000	6,349,252	41,280,596

[1] Excludes itinerant prospectors, "snipers," "high-graders," and others who gave no evidence of legal right to property.
[2] From property not classed as a mine.
[3] Nye County placer combined with that of Lander County to avoid disclosure of individual output.

MINING INDUSTRY

Despite the uncertainties associated with the national emergency, Nevada's large, open-pit mines were expanded to allow a selectivity of ore which resulted in 7½ percent more copper produced in 1951 from virtually the same tonnage of ore that was mined in 1950. Development of the Robinson district, White Pine County, underground mine and the Yerington district, Lyon County, open-pit mine were outstanding in bolstering the State's reserves of copper ore.

Owing to increased freight rates and the paucity of high-grade ore, mines that shipped direct-smelting lead ore in 1951 (some containing zinc recoverable by fuming) were relatively small. Similarly, shippers of oxidized zinc ore were largely limited in output by the requirements of one fuming plant within reasonable shipping range. Principally,

mines with metallurgical facilities for producing zinc and lead concentrates or those reasonably near custom mills or concentrator-smelters had mine expansions in progress or projected. Some loss in Nevada base-metal output was occasioned by the nationwide strike at nonferrous metal facilities from August 27 through September 6, 1951. Precious-metal ore mining declined during 1951 to the extent that only one major operation—an open pit—was worked at the close of the year. Of the 12 placer mines that produced gold and silver 1 was worked by bucket-line dredge, 5 by power excavators and washing plants, 1 by underground methods, and 5 by small-scale hand methods.

ORE CLASSIFICATION

Nevada ores sold or treated in 1951 are classified in table 6. Definitions used in ore classification are given in the Gold and Silver chapter of this volume.

TABLE 6.—Mine production of gold, silver, copper, lead, and zinc in Nevada in 1951, by class of ore or other source material, in terms of recoverable metal

Source	Number of mines [1]	Material sold or treated (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Ore:							
Dry gold	50	191,211	22,948	5,567	400	7,700	3,900
Dry gold-silver	20	10,757	1,428	124,735	500	5,500	----------
Dry silver	26	2,688	86	32,338	5,300	63,500	6,000
Total	92	204,656	24,462	162,640	6,200	76,700	9,900
Copper	18	6,630,269	59,863	168,242	111,993,100	3,100	300
Lead	49	14,341	784	97,712	63,900	2,681,700	142,800
Zinc	10	[2] 9,729	[2] 24	[2] 15,861	[2] 1,200	[2] 418,600	[2] 4,238,500
Zinc-lead and zinc-lead-copper [3]	40	297,881	4,073	510,648	399,600	11,066,800	30,493,000
Total	108	6,952,220	64,744	792,463	112,457,800	14,170,200	34,874,600
Other "lode" material:							
Old tailings [4]	7	26,312	1,321	12,512	1,400	45,000	----------
Copper precipitates	2	499	----------	----------	482,600	----------	----------
Old slag (silver)	(5)	46	----------	37	----------	4,100	1,500
Total	9	26,857	1,321	12,549	484,000	49,100	1,500
Total "lode" material	199	7,183,733	90,527	967,652	112,948,000	14,296,000	34,886,000
Gravel (placer operations)	12	----------	30,509	14,017	----------	----------	----------
Total, all sources	211	7,183,733	121,036	981,669	112,948,000	14,296,000	34,886,000

[1] Detail will not necessarily add to totals because some mines produce more than one class of material.
[2] Includes 5,892 tons of ore and contained recoverable metal from the former Metals Reserve Company stockpile at Jean, Nev.
[3] Combined to avoid disclosure of individual output.
[4] Metal recovered, by class of old tailings, as follows: gold, 23,465 tons—1,180 ounces of gold, 3,639 ounces of silver; gold-silver, 1,943 tons—114 ounces gold, 3,401 ounces silver, 2,100 pounds lead; silver, 902 tons—23 ounces gold, 5,451 ounces silver, 1,400 pounds copper, 42,600 pounds lead; lead, 2 tons—4 ounces gold, 21 ounces silver and 300 pounds lead.
[5] From property not classed as a mine.

METALLURGICAL INDUSTRY

Although the percentage of lode material treated at mills remained virtually the same as 1950, the number of Nevada beneficiation plants operated in 1951 was considerably lower than in the previous year owing largely to the decline in precious-metal ore mining. Custom

milling of gold and silver ores was confined to treating, at operating mines, occasional lots of ore from small properties, largely as an accommodation. Combined Metals Reduction Co. milled by selective flotation zinc-lead ore on a custom basis for three Nevada mines and company zinc-lead ore at its Caselton mill near Pioche, Lincoln County. This company planned expansion of the existing mill to include facilities both for concentrating oxide ores and producing a manganese concentrate from local ores, some of which contain considerable values in zinc and lead. The rehabilitated Copper Canyon Mining Co. plant was converted to differential flotation during 1951; a bulk concentrate of lead and zinc formerly was produced. The Kennecott Copper Corp. treated all the copper milling ore produced by Consolidated Coppermines Corp. in addition to beneficiating its own ore at the McGill concentrator. Kennecott also operated the McGill copper smelter, Nevada's only smelter, treating in addition to copper materials, gold and silver ores from numerous Nevada mines used for fluxing. The Anaconda Copper Mining Co. Yerington project, Lyon County, included plans for integrated leaching-precipitation facilities at Yerington, Nevada, with eventual smelting and refining of copper precipitates in Montana. Metallurgical data on Nevada ores were published.[1]

TABLE 7.—Mine production of gold, silver, copper, lead, and zinc in Nevada in 1951, by method of recovery and type of material processed, in terms of recoverable metal

Method of recovery and type of material processed	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Lode:					
Amalgamation:					
Ore	2,806	1,707			
Cyanidation:					
Ore	18,319	113,579			
Old tailings	1,270	6,409			
Total	19,589	119,988			
Total recoverable in bullion	22,395	121,695			
Concentration, and smelting of concentrates:					
Ore	65,449	650,061	110,721,000	10,661,300	29,725,100
Old tailings	17	308		100	
Total	65,466	650,369	110,721,000	10,661,400	29,725,100
Direct smelting:					
Ore	2,632	189,756	1,743,000	3,585,600	5,159,400
Old tailings	34	5,795	1,400	44,900	
Copper precipitates			482,600		
Old slag		37		4,100	1,500
Total	2,666	195,588	2,227,000	3,634,600	5,160,900
Placer	30,509	14,017			
Grand total	121,036	981,669	112,948,000	14,296,000	34,886,000

[1] Engel, A. L., Experimental Treatment of Oxidized Lead-Silver Ore from Eureka, Nev.: Bureau of Mines Rept. of Investigations 4762, 1951, 9 pp. Simple Treatment Methods for Oxide Gold and Silver Ores: Bureau of Mines Rept. of Investigations 4758, 1951, 14 pp. Simple Treatment Methods for Sulfide Gold and Silver Ores: Bureau of Mines Rept. of Investigations 4790, 1951, 17 pp. Cyanidation of Gold-Silver Ore from Manhattan, Nev.: Bureau of Mines Rept. of Investigations 4819, 1951, 6 pp.

TABLE 8.—Mine production of gold, silver, copper, lead, and zinc in Nevada in 1951, by method of recovery (except placer) and class of material processed, in terms of recoverable metal

A. For material treated at mills

	Material treated (short tons)	Recoverable in bullion		Concentrate shipped to smelters [1] and recoverable metal					
		Gold (fine ounces)	Silver (fine ounces)	Concentrates (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
BY COUNTIES									
Churchill	9,412	1,113	111,542	2		848		200	
Clark	25,211	1,176	3,637	42	864	1,852	1,100	16,900	3,800
Douglas	cleanup	3	1						
Elko	1,213	15	7	150	9	8,549		86,900	72,500
Esmeralda	2,043	1	1	178	1,772	856	400	11,400	
Eureka	620			173	15	2,501	100	41,100	125,100
Humboldt	51,591	2,148	1,461	20	49	3,800		11,000	10,900
Lander	152,352	17,025	1,530	1,479	358	47,567	38,100	681,900	491,000
Lincoln	278,988			38,176	3,535	413,065	247,500	9,754,100	28,947,900
Lyon	16	4	56						
Mineral	200			18	2	1,916		2,400	2,400
Nye	955	356	140	161	59	2,888	1,000	48,600	55,400
Pershing	735	46	22	54	16	3,019	3,000	4,800	15,800
Storey	2,038	250	3,204	7	17	308		100	
Washoe	304	258	88						
White Pine	6,561,637		6	215,493	58,770	163,200	110,429,800	2,000	300
Total: 1951	7,087,315	22,395	121,695	255,953	65,466	650,369	110,721,000	10,661,400	29,725,100
1950	7,649,250	74,271	347,296	261,388	63,371	853,323	102,893,200	15,089,700	39,935,300
BY CLASS OF MATERIAL TREATED									
Dry gold:									
Crude ore	190,756	20,024	3,691	187	2,596	1,097	400		
Old tailings	23,463	1,176	3,637						
Dry gold-silver:									
Crude ore	9,538	1,101	111,585	2	52	863			
Old tailings	1,900	94	2,772	7	17	308		100	
Dry silver	1,682		10	80	8	6,327	3,400	40,600	6,000
Copper	6,561,621			215,489	58,770	163,141	110,429,800		
Lead	4,096			203	215,489	2,085	2,500	249,000	200
Zinc-lead	294,259			39,985	4,023	476,548	284,900	10,371,700	29,718,900
Total 1951	7,087,315	22,395	121,695	255,953	65,466	650,369	110,721,000	10,661,400	29,725,100
BY CLASS OF CONCENTRATE SHIPPED TO SMELTERS [1]									
Dry gold				187	2,596	1,097	400		
Dry gold silver				81	95	1,680	200	1,400	3,000
Dry silver				109	4	812	300	3,100	1,100
Copper				215,504	58,773	165,561	110,432,100		
Lead				11,173	3,040	346,764	75,000	9,593,100	1,058,500
Zinc				28,451	937	127,593	195,900	871,300	28,522,900
Zinc-lead				436	20	6,688	16,000	184,800	136,000
Zinc-lead-copper				12	1	174	1,100	7,700	3,600
Total: 1951				255,953	65,466	650,369	110,721,000	10,661,400	29,725,100
1950				261,388	63,371	853,323	102,893,200	15,089,700	39,935,300

For footnotes, see end of table.

TABLE 8.—Mine production of gold, silver, copper, lead, and zinc in Nevada in 1951, by method of recovery (except placer) and class of material processed, in terms of recoverable metal—Continued

B. For material shipped directly to smelters

	Material shipped (short tons)	Recoverable metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
BY COUNTIES						
Churchill	46	11	2,454		1,500	
Clark	[2] 7,467	[1] 33	[2] 19,782	[2] 7,900	[2] 506,500	[2] 2,664,100
Elko	3,419	108	28,217	47,500	773,800	68,900
Esmeralda	456	23	9,964	600	28,100	300
Eureka	2,558	63	10,596	300	132,500	1,243,000
Humboldt	216	96	5,753	100		
Lander	386	35	2,820	5,700	21,200	
Lincoln	2,899	49	37,458	102,900	676,900	327,600
Lyon	266	1	86	47,900		
Mineral	2,140	494	16,102	12,000	241,300	11,700
Nye	3,393	324	41,404	12,200	675,300	6,100
Ormsby	14	3	123		3,700	
Pershing	42	23	73		2,000	100
Washoe	144	8	725	11,100	1,000	
White Pine	72,972	1,395	20,031	1,978,800	570,800	839,100
Total: 1951	96,418	2,666	195,588	2,227,000	3,634,600	5,160,900
1950	95,869	4,427	326,798	2,244,800	3,726,300	3,276,700
BY CLASS OF MATERIAL						
Dry gold:						
Crude ore	455	328	779		7,700	3,900
Old tailings	2	4	2			
Dry gold-silver:						
Crude ore	1,219	275	12,287	500	5,500	
Old tailings	214	6	2,074		2,000	
Dry silver:						
Crude ore	1,006	78	26,003	1,900	22,900	
Old tailings	731	20	3,698	1,400	42,600	
Slag	46		37		4,100	1,500
Copper:						
Crude ore	68,648	1,093	5,101	1,563,300	3,100	300
Precipitates	499			482,600		
Lead:						
Crude ore	10,245	784	95,625	61,400	2,432,700	142,600
Old tailings	2	4	21		300	
Zinc	[2] 9,729	[2] 24	[2] 15,861	[2] 1,200	[2] 428,500	[2] 4,418,200
Zinc-lead and zinc-lead-copper [3]	3,622	50	34,100	114,700	685,200	594,400
Total 1951	96,418	2,666	196,588	2,227,000	3,634,600	5,160,900

[1] Excludes concentrates treated only by amalgamation and/or cyanidation.
[2] Includes 5,892 tons of ore and contained recoverable metal from the former Metals Reserve Company stockpile at Jean, Nev.
[3] Combined to avoid disclosure of individual output.

TABLE 9.—Mine production of gold, silver, copper, lead, and zinc in Nevada in 1951, by method of recovery (except placer) and class of material processed, in terms of gross metal content

Class of material	Material shipped or treated (short tons)	Gross metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
CONCENTRATE SHIPPED TO SMELTERS						
Dry gold	187	2,596	1,097	521		
Dry gold-silver	81	95	1,680	313	1,611	3,996
Dry silver	109	4	816	440	4,500	6,183
Copper	215,504	59,980	179,395	112,795,493	74	
Lead	11,173	3,040	346,764	88,995	9,768,469	1,345,563
Zinc	28,451	1,007	131,606	232,172	938,276	29,507,821
Zinc-lead	436	20	6,688	18,884	188,071	170,076
Zinc-lead-copper	12	1	174	1,303	7,793	4,525
Total: 1951	255,953	66,743	668,220	113,138,121	10,908,794	31,038,164
1950	261,388	64,372	865,447	105,126,604	15,435,710	41,546,586
ORE, ETC., SHIPPED DIRECTLY TO SMELTERS						
Dry gold:						
Crude ore	455	334	819	63	7,916	4,900
Old tailings	2	4	2			
Dry gold-silver:						
Crude ore	1,219	279	13,189	630	9,192	
Old tailings	214	6	2,222	95	3,357	
Dry silver:						
Crude ore	1,006	79	26,762	2,456	27,580	2,505
Old tailings	731	20	3,699	1,403	70,951	
Slag	46		37	92	4,138	1,839
Copper:						
Crude ore	68,648	1,115	5,402	1,596,913	4,405	941
Precipitates	499			492,999		
Lead:						
Crude ore	10,245	784	95,625	81,687	2,505,960	424,585
Old tailings	2	4	21	4	490	
Zinc	[1] 9,729	[1] 82	[1] 30,311	[1] 37,059	[1] 476,068	[1] 5,206,722
Zinc-lead and zinc-lead-copper [2]	3,622	50	34,442	136,325	697,788	967,397
Total: 1951	96,418	2,757	212,531	2,349,726	3,807,845	6,608,889
1950	95,869	4,523	339,187	2,386,729	3,845,275	4,274,156

[1] Includes 5,892 tons of ore and contained metal from the former Metals Reserve Company stockpile at Jean, Nev.
[2] Combined to avoid disclosure of individual output.

REVIEW BY COUNTIES

CHURCHILL

Summit King Mines, Ltd., Sand Springs district, second largest producer of Nevada silver in 1951, closed its Summit King group of mines and cyanide plant in August owing to ore depletion. Mining in other districts was small-scale and sporadic.

CLARK

Activity at zinc and lead mines in the Yellow Pine district was nominal. The Yellow Pine mine (L. F. Jacobson) was the leading producer; 945 tons of ore shipped to lead and fuming plants grossed 10 ounces of gold, 3,223 ounces of silver, 457 pounds of copper, 125,784 pounds of lead and 383,130 pounds of zinc. Metal recovered from 5,892 tons of the former Metals Reserve Company stockpiled oxidized zinc ore treated at a Utah fuming plant augmented the district total. Production of zinc-lead-copper bulk concentrates from low-grade ore at the Herland group, Eldorado Canyon district, by Golden Empire Mining Co., was unprofitable. The company reported an average mining and milling cost of $7.32 per ton. Searchlight Homestake Mining Co. developed the Quartette group, Searchlight district, throughout 1951; 36 tons of sorted ore shipped to a smelter contained 2 ounces of gold, 213 ounces of silver, 4,877 pounds of copper, 1,229 pounds of lead, and 360 pounds of zinc. Principal gold and silver production was from the Quartette and Duplex tailings and Red Bird group ore.

ELKO

Mining zinc-lead and lead ores predominated in 1951, although no important new reserves were reported. Lead production waned in the Delano district; McFarland & Hullinger closed down the Delno mine in January and prospected unsuccessfully for ore at the Cleveland mine. United Minerals Corp. rehabilitated the Rip Van Winkle mine, Merrimac district, shipped some zinc-lead ore to a concentrator-smelter, and initiated an exploration program. Lead & Copper Mines, Inc., worked the Aladdin mine, Railroad (Bullion) district. Activity in the Ruby Range and Spruce Mountain districts was sporadic. The Hicks district was prospected but zinc-lead ore developed was not significant. The Jackson mine (Frank Bullock), Tecoma district, largest producer of Elko County lead, shipped 1,200 tons of direct smelting ore.

ESMERALDA

The slump in gold and silver mining was reflected in overall county output. Although silver production was resumed at the Argentite (Mohawk) mine, Silver Peak district, in a new ore body of undisclosed magnitude, exhausted gold ore reserves closed the Goldfield Deep Mines Co. property in the Goldfield district.

EUREKA

Continued development of the Lone Mountain district oxidized-zinc ore body highlighted activities; 2,325 tons of ore was shipped from the Mountain View and Extension mines to a Utah fuming plant. Pro-

duction of lead-zinc ore at the Baldwin mine, Antelope district and Schultes mine, Cortez district was small-scale. Development of the Juniper lead prospect, Union district, was started. Eureka Corp., Ltd., chiefly did maintenance work at the flooded Richmond-Eureka Fad shaft, Eureka district.

HUMBOLDT

Conversion by Getchell Mine, Inc., Potosi district, to tungsten mining and milling deprived the county of its principal precious-metal source. Austin Jumbo Mines, Inc., worked the Austin Jumbo open-pit mine, Awakening district, until November 20; the company reported that amalgamating 50,372 tons of gold ore was unprofitable. The minor base-metal output was from the Pansy Lee mine, Winnemucca (Barrett Springs) district, where both zinc-lead and gold-silver ores were mined.

LANDER

Favorable base-metal prices hastened rehabilitation of the Copper Canyon mine and mill, Battle Mountain district [2], unproductive since the June 1950 shaft fire. A total of 15,740 tons of ore (including test lots of custom ore) grossing 426 ounces of gold, 39,804 ounces of silver, 65,660 pounds of copper, 583,980 pounds of lead, and 358,820 pounds of zinc, was milled. The nearby Iron Canyon mine (Cave Tunnel Lease) and Lucky Strike mine (United Minerals Corp.) were reopened after several inactive years; from the respective mines, 693 and 896 tons of zinc-lead ore were shipped to concentrator-smelters. The London Extension Mining Co. Goldacres open-pit mine, Bullion district, operated throughout the year on low-grade gold ore. Gold output from the Natomas Co. bucket-line dredge at Greenan Placers, Battle Mountain district, fell short of that in 1950, owing to delays occasioned by a slide of tailings into the dredge pond.

LINCOLN

Although still the center of Nevada silver, lead, and zinc production, output of metal from the Pioche and Comet districts fell considerably below 1950. Combined Metals Reduction Co. Caselton mill received 436,824 tons of company (Pioche and Comet groups) and custom ore compared to 452,401 tons in 1950. Significantly, ore from both sources in 1951 was of lower tenor. Ely Valley Mines, Inc., mined virtually the same ore tonnage as 1950, but the grade fell considerably in 1951. Ely Valley mine ore was milled at the company Pioche plant until August, when shipping to a custom mill was resumed. Improvements to expedite ore handling and expansion of ore reserves at Combined Metals Reduction Co. Pioche properties, as well as projected exploration for zinc-lead ore in the company Comet-district properties, and additional concentrating facilities at the Caselton mill for oxide ore were designed to reverse the downward production trend. Bristol Silver Mines Co. worked the Bristol group, Jack Rabbit district, dwindling ore reserves and shipped 1,947 tons of direct-smelting zinc-lead-copper ore while pursuing an intensive exploration program. The Groom mine (Dan Sheahan), Groom district, milled 3,948 tons of lead ore and shipped for direct smelting 563 tons of lead ore.

[2] Trengove, Russell R., Investigation of Copper Canyon Lead-Zinc Deposit, Lander County, Nev.: Bureau of Mines Rept. of Investigations 4774, 1951, 61 pp.

TABLE 10.—Mine production of gold, silver, copper, lead, and zinc in Nevada in 1951, by county and district, in terms of recoverable metal

County and district	Mines producing [1]		Lode material (short tons)	Gold (fine ounces)			Silver (lode and placer,[2] fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
	Lode	Placer		Lode	Placer	Total					
Churchill County:											
Desert	1		27	8		8	85				$357
Eastgate	1		20	16		16	13				572
Holy Cross	3		39	3		3	3,217		1,700		3,311
Sand Springs	1		9,372	1,097		1,097	111,529				139,334
Clark County:											
Bunkerville	1		6				3	1,000			245
Eldorado Canyon	4		409	4		4	868	1,100	7,700	3,600	3,179
Searchlight	4		24,850	2,041		2,041	5,352	4,800	800		77,579
Yellow Pine (Goodsprings)	6		[3] 7,413	[3] 28		[3] 28	[3] 19,048	[3] 2,100	[3] 514,900	[3] 2,664,300	[3] 592,708
Douglas County: Buckskin	(4)		cleanup	3		3	1				106
Elko County:											
Delano	2		(5)				(5)	(5)	(5)	(5)	(5)
Edgemont (Centennial)	1		7	74		74	82		1,200		2,872
Gold Basin (Hicks)	2		46	5		5	754		1,400	2,300	1,518
Gold Circle	3		33	31		31	497	100			1,559
Island Mountain		1			6	6	1				211
Merrimac	1		732	6		6	7,526		55,500	71,400	29,617
Mountain City (Cope) (Van Duzer)		1			34	34	7				1,196
Mud Springs	1		450				661		29,600		5,719
Railroad (Bullion)	1		1,883	2		2	18,952	43,000	292,700	65,100	90,114
Ruby Range	3		78	2		2	557	1,300	29,200	1,200	6,159
Spruce Mountain	2		56				295	100	6,900	1,000	1,667
Tecoma	1		1,200	11		11	5,391	2,500	420,500		78,615
Tuscarora	1		2	1		1	76				104
Esmeralda County:											
Goldfield	1		(5)	(5)		(5)	(5)	(5)			(5)
Klondyke	1		144	11		11	2,093	200	4,500		3,107
Lida (Tule Canyon)		(4)			1	1					35
Montezuma	1		147	2		2	1,367	200	22,200		5,196
Silver Peak	2		158	10		10	6,459	100			6,220
Sylvania	1		100				416		11,400		2,349
Weepah (Lone Mountain)	1		7				45	100	1,400	300	361
White Wolf	1		2	1		1	1				36
Eureka County:											
Antelope	1		459				219		32,200	109,700	25,734
Cortez	1		(5)	(5)		(5)	(5)	(5)	(5)	(5)	(5)
Eureka	2		64	7		7	672		10,500	10,400	4,562
Lone Mountain	2		2,325	1		1	840		109,000	1,243,000	245,878
Union	1		47				375		9,000		1,896

Humboldt County:											
Awakening	1		50,372	2,043		2,043	1,421				72,791
Battle Mountain [6]	1		1,000	69		69	7				2,421
Central	1		1				16	100			39
Gold Run	1		1	17		17	20				613
Winnemucca (Barrett Springs) (Ten Mile)	4		433	164		164	9,550		11,000	10,900	18,270
Lander County:											
Battle Mountain [6]	8	1	17,683	377	(5)	[7] 377	[7] 49,610	43,800	702,600	490,400	[7] 279,497
Buffalo Valley	1		27	16		16	10				569
Bullion	1		(5)	(5)		(5)	(5)				(5)
Hilltop	1		clean-up	4		4	2				142
Lewis	1		2				37		500	600	228
New Pass	1		126	50		50	9				1,758
Reese River	1		5				730				661
Lincoln County:											
Comet	2		5,241	20		20	3,472	18,700	88,800	248,100	68,883
Eagle Valley	1		57	1		1	1,344				1,251
Groom	1		4,511				3,437	3,400	409,400		74,760
Jack Rabbit	1		(5)	(5)		(5)	(5)	(5)	(5)	(5)	(5)
Pahranagat	1		(5)	(5)		(5)	(5)	(5)	(5)	(5)	(5)
Patterson	2		22				232	100	2,300		632
Pioche	5		270,099	3,540		3,540	415,622	226,800	9,502,800	28,700,900	7,422,494
Lyon County:											
Silver City		2			(5)	(5)	(5)				(5)
Talapoosa	1		(5)	(5)		(5)	(5)				(5)
Yerington	2		(5)	(5)		(5)	(5)	(5)			(5)
Mineral County:											
Broken Hills	1		241	4		4	3,009	100	3,100	2,400	3,860
Buena Vista	1		40				96		5,300	11,700	3,133
Candelaria (Columbus)	1		1,218	464		464	11,085	200	189,700		59,138
Cedar Mountain (Simon)	1		(5)				(5)	(5)	(5)		(5)
Pilot Mountains	1		729	20		20	3,684	1,400	42,600		11,743
Rawhide (Regent)	2		4	6		6	57		2,000		608
Silver Star	2		88	2		2	46	9,200			2,339
Nye County:											
Belmont	1		171	3		3	1,753				1,691
Bullfrog	1		90	100		100	60				3,554
Clifford	1		1	8		8	287				540
Currant	1		4	3		3	15				119
Danville	2		15				404				366
Johnnie	1		52	73		73	3				2,558
Lodi (Mammoth)	2		194	9		9	1,343	700	36,700	9,900	9,850
Manhattan	4	1	566	282	4	286	138				10,135
Oak Springs	1		8	10		10	594				888
Quartz Mountain	2		3,162	228		228	38,198	11,400	670,700	47,300	169,949
Round Mountain		1			(5)	(5)	(5)				(5)
Troy	(5)		1	2		2	1				71
Twin River (Millett)	3		42	1		1	380	100	6,500	2,300	1,947
Tybo	2		13	8		8	251		3,200	1,000	1,243
Union	2		16	11		11	112	1,000			728
Washington	1		13	1		1	895		6,800	1,000	2,203

For footnotes, see end of table.

TABLE 10.—Mine production of gold, silver, copper, lead, and zinc in Nevada in 1951, by county and district, in terms of recoverable metal—Continued

County and district	Mines producing [1]		Lode material (short tons)	Gold (fine ounces)			Silver (lode and placer,[2] fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
	Lode	Placer		Lode	Placer	Total					
Ormsby County: Delaware	1		14	3		3	123		3,700		$856
Pershing County:											
Antelope	2		654	3		3	2,892	3,000	4,300	15,800	7,068
Humboldt		(4)			2	2					70
Rochester	2	1	42	28	16	44	11				1,550
Scossa	1		(5)	(5)		(5)	(5)				(5)
Seven Troughs	2		15	25		25	29				901
Sierra	4		43	25		25	74		2,000	100	1,306
Star	1		12	1		1	109		500		221
Trinity		1			1	1	1				36
Willard	1		3	1		1	1				36
Willow Creek		1			53	53	27				1,879
Storey County: Comstock	4		2,038	267		267	3,512		100		12,541
Washoe County:											
Deephole	1		144	8		8	725	11,100	1,000		3,795
Olinghouse (White Horse)	5	1	304	258	2	260	89				9,181
White Pine County:											
Aurum	3		86	3		3	163	3,700	15,100		3,760
Chase	1		17				17		3,600		638
Cherry Creek	2		22	6		6	140				337
Cleve Creek	1		(5)	(5)		(5)	(5)				(5)
Duck Creek	1		6				12		4,900	1,000	1,041
Granite (Steptoe)	1		28				38		29,800		5,189
Osceola	2	1	58	64	7	71	31				2,513
Robinson	26		6,633,059	60,055		60,055	174,165	112,396,200	172,800	821,500	29,638,841
Taylor	1		190	4		4	1,411				1,417
Tungstonia (Regan)	1		2				14				13
Ward	1		47	2		2	1,111	2,000	7,100	4,400	3,589
White Cloud	2		19				53		2,600	300	553
White Pine	8		1,022	12		12	5,982	6,700	336,900	12,200	67,959
Undistributed [8]			139,584	18,862	30,383	49,245	55,607	151,700	465,300	331,900	1,951,518
Total Nevada	199	12	7,183,733	90,527	30,509	121,036	981,669	112,948,000	14,296,000	34,886,000	41,280,596

[1] Excludes itinerant prospectors, "snipers," "high graders," and others who gave no evidence of legal right to property.

[2] Source of silver as follows: 967,652 ounces from lode mines and 14,017 ounces from placers.

[3] Includes 5,892 tons of ore and contained recoverable metal from the former Metals Reserve Company stockpile at Jean, Nev.

[4] From property not classed as a mine.

[5] Included with "Undistributed" in order to avoid disclosure of individual company operations.

[6] Battle Mountain district lies in Humboldt and Lander Counties.

[7] Exclusive of placer output, which is included with "Undistributed."

[8] Includes values and quantities which cannot be shown separately for certain individual districts, as indicated in the appropriate column by footnote reference 5.

LYON

Lode mining virtually ceased in 1951. Minor output was reported from the Talapoosa gold-silver mine, Talapoosa district, and from the Mason Valley and McConnell copper properties, Yerington district. Anaconda Copper Mining Co., according to its 1951 annual report, planned to operate the Yerington mine, Yerington district, by open-pit methods in late 1953 at a rate of 60,000,000 pounds of copper per year, which will be increased to an annual rate of 66,000,000 pounds by 1955. The report stated this ore body contains approximately 35,000,000 tons of oxide ore having a grade of 0.97 percent copper available for open-pit mining, beneath which lies at least 15,000,000 tons of sulfide ore of similar grade. Dredging was resumed in the Silver City district by Gus Becker at Dayton and by R. M. Kolze working Carson River tailings. Each operation was a dragline and nonfloating washing plant.

MINERAL

The New Potosi mine (G. A. Peterson and C. A. Wethern, lessee), Candelaria (Columbus) district, which produced 1,218 tons of direct smelting ore grossing 464 ounces of gold, 11,085 ounces of silver, 307 pounds of copper, 196,976 pounds of lead, and 9,632 pounds of zinc throughout 1951, was the only continuous operation.

NYE

Although all large gold and silver lode mines ceased operation before 1951, numerous small properties either milled precious metal ores or shipped flux ore to the Kennecott Copper Co. smelter at McGill, White Pine County. Round Mountain Gold Dredging Corp., Round Mountain district, worked alluvial material by conveyor and stationary mill throughout the year, surpassing the 1950 yield of gold and silver, although operating conditions were difficult technically. The principal base-metal-ore mine was the San Rafael (Hill & Chiatovich), Quartz Mountain district. Formerly worked only for gold, silver, lead, and copper, zinc was encountered in depth, and 285 tons of zinc-lead ore was shipped to a concentrator-smelter in addition to 2,861 tons of direct-smelting lead ore in 1951. Prospects in the Twin River (Millett) and Tybo districts uncovered showings of zinc-lead ore.

ORMSBY

A small development of lead ore at the May mine (A. C. Wilson), Delaware district, was continued in 1951.

PERSHING

Except for token production from a few small mines, precious-metal-ore output was virtually at a standstill. Development of zinc-lead ore at the Antelope group and the extraction of copper concentrate from ore at the Majuba Hill mine, both in the Antelope district, and development of the Little Jupiter mine, Sierra district, gold ore and Silver Star mine, Star district, silver ore, both containing some values in lead and zinc, did not establish important workable base-metal-ore reserves.

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STOREY

The value of metal produced in 1951 was the lowest recorded in any year since 1859. Attempts by lessees to reopen gold- and silver-producing Comstock district mines were futile, owing to unavailability of custom mills. Central Comstock Mines Corp. closed its gold-silver tailings cyaniding plant in January 1951.

WASHOE

Small gold mines were moderately active in the Olinghouse (White Horse) district. Copper-ore shipments from the Silver Bell mine, Deephole (Granite Range) district, ceased in June 1951.

WHITE PINE

Expansion of copper production in the Robinson district overshadowed other Nevada mining activities in 1951. In exceeding the district 1950 copper output by 8 percent, Kennecott Copper Corp. Nevada Mines Division worked the Ruth (Liberty) pit, continued development of the Kimbley and Wedge test pits, both near Ingersoll Canyon, and initiated development of the Ruth underground property; Consolidated Coppermines Corp. operated its Morris Brooks pit vigorously, and company ore was mined from the Ruth pit extension by arrangement with Kennecott Copper Corp. District zinc and lead output fell compared with 1950. Mines in this category were largely small-scale-lessee-operated; the Columbia group worked by Sam Robison (808 tons of zinc and zinc-lead ore shipped to lead and fuming plants) and the Consolidated Coppermines Corp. Willard lease (329 tons of zinc silicate shipped) led in recoverable metal produced. Exploration was active in the White Pine district, particularly at the Dog Star mine (zinc-lead ore), Onetha mine (lead ore), Seligman mine (zinc-lead ore) and Belmont mine (lead ore). The Grand Deposit mine (lead and copper ores), Aurum district, Bellview mine (lead ore), Chase district, and Good Luck mine (lead ore), Ward district, also were explored, but no important discovery of ore was reported from these districts. County gold and silver output, exclusive of that recovered from base-metal ores, was largely from flux material shipped to smelters.

New Mexico

Gold, Silver, Copper, Lead, and Zinc

(MINE REPORT)

By A. J. Martin

GENERAL SUMMARY

MINE production of gold, silver, copper, lead, and zinc in New Mexico increased in 1951, reflecting the stimulating effect of high base-metal prices and continuous strong consumer demand for the base metals. The output of zinc was the largest in quantity since 1944, gold since 1946, and copper, lead, and silver since 1948. The largest increases over 1950 were 41 percent for lead and 55 percent for zinc; large percentage gains were to be expected for these metals, however, as output in 1950 was unusually low because most of the mines that shut down when metal prices declined in 1949 remained idle several months in 1950. The production of copper—principal metal mined in the State—increased 11 percent in quantity over 1950. The outputs of gold and silver, recovered mostly as byproducts from base-metal ores, increased 16 and 31 percent, respectively. The total value of the five metals, enhanced by the sharp rise in average base-metal prices, reached an all-time high of $54,697,048 compared with $37,437,915 in 1950 and the previous high of $46,799,576 in 1948.

The Central district, Grant County, produced 97 percent of the copper, 92 percent of the zinc, 54 percent of the lead, 53 percent of the silver, and 44 percent of the gold. The total value of the Central district output of these metals was $51,222,739—94 percent of the total value. The yearly production rate of the district in 1951 was still below the full capacity of the equipped mines, as labor strikes kept one important zinc producer idle throughout the year and interrupted operations 2 weeks at several other zinc and zinc-lead mines and the large Chino copper mine.

The Magdalena district, with an output valued at $1,275,971, mostly in zinc and lead, ranked second among New Mexico districts in total value of the five metals; it was followed by the Lordsburg district, with a value of $898,794, mostly in copper, and Hansonberg, with $264,809, nearly all in lead.

All tonnage figures reported herein are short tons and "dry weight"; that is, they do not include moisture. The value of production has been calculated at the prices shown in table 1.

TABLE 1.—Prices of gold, silver, copper, lead, and zinc, 1947–51

Year	Gold [1] (per fine ounce)	Silver [2] (per fine ounce)	Copper [3] (per pound)	Lead [3] (per pound)	Zinc [3] (per pound)
1947	$35.00	$0.905	$0.210	$0.144	$0.121
1948	35.00	.905+	.217	.179	.133
1949	35.00	.905+	.197	.158	.124
1950	35.00	.905+	.208	.135	.142
1951	35.00	.905+	.242	.173	.182

[1] Price under authority of Gold Reserve Act of Jan. 31, 1934.
[2] Treasury buying price for newly mined silver July 1, 1946, to date—$0.9050505 ($0.905 used in 1947 for calculating purposes).
[3] Yearly average weighted price of all grades of primary metal sold by producers. Price in 1947 includes bonus payments by Office of Metals Reserve for overquota production.

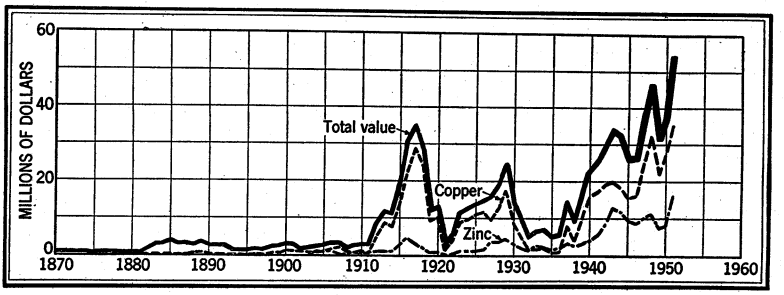

FIGURE 1.—Value of mine production of copper and zinc and total value of gold, silver, copper, lead, and zinc in New Mexico, 1870–1951. The value of gold, silver, and lead produced annually has been relatively small.

Gold.—Of the 3,959 fine ounces of gold produced in New Mexico in 1951, copper ore yielded 45 percent, lead and zinc-lead ores and old tailings 22 percent, zinc ore 17 percent, and gold and silver ores and placer gravel 16 percent. None of the individual mines was a large gold producer; the largest district output was 1,723 ounces from the Central district.

Silver.—The State output of silver in 1951 totaled 443,267 fine ounces compared with 338,581 ounces in 1950. Zinc and zinc-lead

TABLE 2.—Mine production of gold, silver, copper, lead, and zinc in New Mexico in 1951, by months, in terms of recoverable metal [1]

Month	Gold (fine ounces)	Silver (fine ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
January	247	31,814	6,388	446	3,509
February	254	30,081	6,087	474	3,156
March	283	33,234	5,960	564	3,542
April	489	37,467	6,188	467	3,635
May	332	41,767	6,952	484	4,254
June	424	39,752	6,408	446	4,227
July	389	40,842	6,311	498	4,368
August	510	38,387	4,589	469	3,612
September	202	36,462	4,774	465	3,020
October	244	41,883	6,687	531	4,096
November	371	40,200	6,614	506	4,004
December	214	31,378	6,600	496	3,996
Total	3,959	443,267	73,558	5,846	45,419

[1] Mine production comprises ore, gravel, or other mineral material sold or treated and metal recovered as natural gold or as bullion from cyanidation or amalgamation and the estimated recoverable metal (or gross metal, as indicated) contained in concentrates, ores, tailings and other mineral materials shipped directly to smelters or sold to ore buyers within the year.

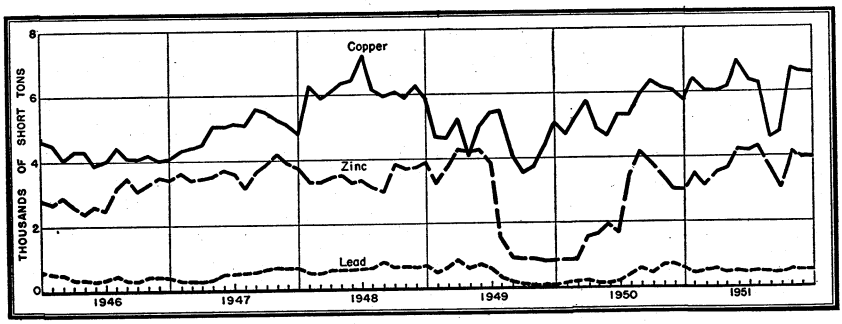

FIGURE 2.—Mine production of copper, lead, and zinc in New Mexico, by months, 1946–51, in terms of recoverable metal.

TABLE 3.—Mine production of gold, silver, copper, lead, and zinc in New Mexico 1947–51, and total, 1848–1951, in terms of recoverable metal [1]

Year	Mines producing		Material sold or treated [2] (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1947	82	3	7,352,945	3,146	$110,110	515,833	$466,829
1948	91	2	7,733,163	3,414	119,490	537,674	486,622
1949	77	3	6,539,602	3,249	113,715	380,855	344,693
1950	78	2	7,899,054	3,414	119,490	338,581	306,433
1951	83	3	8,670,489	3,959	138,565	443,267	401,179
1848–1951	----------	----------	[3]	2,200,017	50,334,788	69,970,941	54,950,954

Year	Copper		Lead		Zinc		Total value
	Short tons	Value	Short tons	Value	Short tons	Value	
1947	60,205	$25,286,100	6,383	$1,838,304	44,103	$10,672,926	$38,374,269
1948	74,687	32,414,158	7,653	2,739,774	41,502	11,039,532	46,799,576
1949	55,388	21,822,872	4,652	1,470,032	29,346	7,277,808	31,029,120
1950	66,300	27,580,800	4,150	1,120,500	29,263	8,310,692	37,437,915
1951	73,558	35,602,072	5,846	2,022,716	45,419	16,532,516	54,697,048
1848–1951	1,680,337	541,134,719	303,525	37,747,225	1,034,573	179,861,666	864,029,352

[1] Includes recoverable metal content of gravel washed (placer operations), ore milled, old tailings or slimes re-treated, and ore, old tailings, or copper precipitates shipped to smelters during the calendar year indicated.
[2] Does not include gravel washed or tonnage of precipitates shipped.
[3] Figure not available.

TABLE 4.—Gold and silver produced at placer mines in New Mexico, 1946–51, in terms of recoverable metal

Year	Gold		Silver		Total value	Year	Gold		Silver		Total value
	Fine ounces	Value	Fine ounces	Value			Fine ounces	Value	Fine ounces	Value	
1946	10	$350	2	$2	$352	1949	31	$1,085	9	$8	$1,093
1947	23	805	10	9	814	1950	6	210	--------	--------	210
1948	9	315	2	2	317	1951	4	140	--------	--------	140

ores yielded 69 percent of the total, copper ore and old tailings 26 percent, and lead, gold, gold-silver, and silver ores together 5 percent. The principal producers of silver, in order of output, were the Ground Hog and Bayard zinc-lead mines in Grant County, the Atwood and Bonney-Miser's Chest copper mines in Hidalgo County, and the Lynchburg zinc-lead mine in Socorro County.

Copper.—Production of copper in New Mexico increased from 66,300 short tons in 1950 to 73,558 in 1951. The Chino open-pit mine of the Kennecott Copper Corp. at Santa Rita in the Central district, which produces most of the State output of copper, operated 7 days a week throughout 1951, except during a strike from August 23 to September 6. The Bonney-Miser's Chest underground mine of the Banner Mining Co. in Hidalgo County, a substantial producer of copper, operated continuously. The Atwood mine in Hidalgo County and the Stauber in Guadalupe County (producing low-grade fluxing ore) shipped copper ore direct to the El Paso smelter. About 8,000 tons of old copper-bearing tailings was shipped to the smelter from the old Gillette mill site near Pinos Altos, Grant County. Copper ore and precipitates yielded 99 percent of the total copper in 1951.

TABLE 5.—Mine production of gold, silver, copper, lead, and zinc in New Mexico in 1951, by counties, in terms of recoverable metal

County	Mines producing		Gold (lode and placer)		Silver (all lode)	
	Lode	Placer	Fine ounces	Value	Fine ounces	Value
Dona Ana	4		5	$175	1,306	$1,182
Grant	28	3	2,560	89,600	291,945	264,225
Guadalupe	2					
Hidalgo	11		755	26,425	90,806	82,184
Lincoln	2		18	630	32	29
Luna	4		10	350	2,970	2,688
Otero	1				21	19
Sandoval	2				11	10
Santa Fe	7		50	1,750	853	772
Sierra	11		300	10,500	2,928	2,650
Socorro	9		260	9,100	52,196	47,240
Taos	1		1	35	73	66
Valencia	1				126	114
Total	83	3	3,959	138,565	443,267	401,179

County	Copper		Lead		Zinc		Total value
	Short tons	Value	Short tons	Value	Short tons	Value	
Dona Ana	5	$2,420	3	$1,038	128	$46,592	$51,407
Grant	71,588	34,648,592	3,554	1,229,684	42,679	15,535,156	51,767,257
Guadalupe	320	154,880	15	5,190			160,070
Hidalgo	1,521	736,164	233	80,618	33	12,012	937,403
Lincoln			2	692			1,351
Luna	3	1,452	232	80,272	261	95,004	179,766
Otero	3	1,452					1,471
Sandoval	2	968					978
Santa Fe	4	1,936	29	10,034	38	13,832	28,324
Sierra	2	968	22	7,612	4	1,456	23,186
Socorro	100	48,400	1,756	607,576	2,276	828,464	1,540,780
Taos	1	484					585
Valencia	9	4,356					4,470
Total	73,558	35,602,072	5,846	2,022,716	45,419	16,532,516	54,697,048

Lead.—Most of the output of lead in 1951 came from mines in the Central and Magdalena districts producing zinc-lead or zinc ore, although a substantial quantity of lead was recovered from lead and lead-barite ores mined in the Hansonberg district, Socorro County. Total production was 5,846 tons compared with 4,150 tons in 1950. Zinc and zinc-lead ores yielded 80 percent of the total, lead ore 18 percent, and other ores and old tailings 2 percent. The larger producers of lead, in order of output, were the Ground Hog and Bayard groups in the Central district and the Lynchburg in the Magdalena district, all producing zinc-lead ore, and the Portales and Mex-Tex lead mines in the Hansonberg district.

Zinc. Despite loss of operating time caused by labor strikes, mines in New Mexico produced 45,419 tons of recoverable zinc in 1951, the largest quantity in any year since 1944. In 1950 the output was only 29,263 tons, as most of the mines that shut down in 1949 because of the drop in the price of zinc remained idle for several months in 1950. In the Central district strikes kept the Hanover mine of the New Jersey Zinc Co., Empire Zinc Division, idle throughout 1951 and interrupted production for 2 weeks at several other mines. Zinc and zinc-lead ores yielded nearly all (99.88 percent) of the State output of zinc in 1951. The Central district contributed 92 percent of the zinc, Magdalena district 5 percent, and other districts 3 percent. The principal producers, in order of output, were the Ground Hog, Oswaldo, Bayard, Kearney, and Pewabic groups, all in the Central district, and the Lynchburg mine in the Magdalena district.

MINING AND METALLURGICAL INDUSTRY

Although the output of recoverable copper in New Mexico in 1951 was 8 percent less than the record high of 80,100 tons produced in 1942, the quantity of copper ore mined (8,024,111 tons) was 5 percent larger than the previous peak of 7,631,752 tons mined in 1942 and 7 percent larger than the 7,510,499 tons mined in 1950. The Chino open-pit mine of the Kennecott Copper Corp. in the Central district, which produced the bulk of the ore, operated 7 days a week throughout 1951, except during a 2-week strike. Other producers included the Bonney-Miser's Chest and Atwood underground mines in the Lordsburg district and the Stauber open-pit mine (producing low-grade fluxing ore) in Guadalupe County. The quantity of zinc, zinc-lead, and lead ores mined totaled 634,016 tons and was the largest since 1944, despite considerable loss of operating time in the Central district caused by strikes. The tonnage of straight gold and silver ores mined was small, as economic conditions continued to be unfavorable for gold mining.

Three New Mexico projects, involving expenditure of $405,055 in combined Government and private capital, had been approved up to December 31, 1951, under the Government program for aiding mineral exploration by matching private funds.

The largest ore-reduction mill in New Mexico is the 22,500-ton Chino concentrator of the Kennecott Copper Corp. at Hurley, Grant County, which treats copper ore from the Chino open-pit mine at Santa Rita. The only smelter operating in the State is the Chino copper smelter, also at Hurley, which treats concentrates from the Chino mill, siliceous copper ore (used as a flux) from the Chino mine,

TABLE 6.—Mine production of gold, silver, copper, lead, and zinc in New Mexico in 1951, by class of ore or other source material, in terms of recoverable metal

Source	Number of mines [1]	Material sold or treated (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Ore:							
Dry gold	8	1,500	352	75	1,579	80	
Dry gold-silver	5	1,723	260	10,668	14,964	2,936	
Dry silver	4	20	1	483	127	612	
Total	17	3,243	613	11,226	16,670	3,628	
Copper	17	8,024,111	1,794	103,027	[2] 107,803,927	153,737	
Lead	27	40,232	48	11,630	13,906	2,159,908	33,690
Zinc	15	548,686	680	228,752	1,374,783	6,270,219	85,293,540
Zinc-lead	21	45,098	290	77,288	137,638	3,058,638	5,436,800
Total	73	8,658,127	2,812	420,697	[2] 109,330,254	11,642,502	90,764,030
Other "lode" material:							
Old tailings, etc.[3]		9,119	530	11,344	85,470	45,870	73,970
Copper precipitates [4]	1	22,859			37,683,606		
Total	1	31,978	530	11,344	37,769,076	45,870	73,970
Total "lode" material	83	8,693,348	3,955	443,267	[2] 147,116,000	11,692,000	90,838,000
Gravel (placer operations)	3		4				
Total, all sources	86	8,693,348	3,959	443,267	[2] 147,116,000	11,692,000	90,838,000

[1] Detail will not necessarily add to totals because some mines produce more than 1 class of ore.
[2] Includes 82,080 pounds of copper contained in 57 tons of copper precipitates recovered from 30,000 tons of newly mined ore treated by heap leaching.
[3] Includes 8,826 tons copper tailings, 36 tons lead mill cleanings, and 257 tons zinc mill cleanings.
[4] Excludes 57 tons of precipitates recovered from newly mined ore treated by heap leaching, copper from which is included under copper ore.

TABLE 7.—Mine production of gold, silver, copper, lead, and zinc in New Mexico in 1951, by method of recovery and type of material processed, in terms of recoverable metal

Method of recovery and type of material processed	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Lode:					
Amalgamation [1]	326	58			
Cyanidation [1]	15				
Total recoverable in bullion	341	58			
Concentration, and smelting of concentrates:					
Ore	2,305	361,498	106,820,893	10,896,885	90,692,323
Mill cleanings		335	1,760	9,340	38,870
Total	2,305	361,833	106,822,653	10,906,225	90,731,193
Direct smelting:					
Ore	779	70,367	2,526,031	749,245	71,707
Copper precipitates			37,683,606		
Old tailings, etc.[2]	530	11,009	83,710	36,530	35,100
Total	1,309	81,376	40,293,347	785,775	106,807
Placer	4				
Grand total	3,959	443,267	147,116,000	11,692,000	90,838,000

[1] Ore only; no old tailings, etc., processed by this method in New Mexico in 1951.
[2] Includes 8,826 tons copper tailings and 36 tons lead mill cleanings.

and copper precipitates from company operations at Chino and at Ray, Ariz. The smelter produces fire-refined copper and some blister copper. Lead and copper concentrates and direct-smelting ores from other New Mexico operations are shipped to smelters in Texas, Arizona, and Illinois. Zinc concentrates are shipped to smelters in Arkansas, Illinois, Montana, Pennsylvania, and Texas.

Mills treating zinc and zinc-lead ores in 1951 comprised the United States Smelting, Refining & Mining Co. 600-ton Bayard mill in the Central district; the Peru Mining Co. 1,000-ton concentrator and the American Smelting & Refining Co. Deming milling unit (capacity recently increased from 400 tons daily to 650 tons) at Deming; and the

TABLE 8.—Mine production of gold, silver, copper, lead, and zinc in New Mexico in 1951, by method of recovery (except placer) and class of material processed, in terms of recoverable metal.

A. For material treated at mills

	Material treated (short tons)	Recoverable in bullion		Concentrate shipped to smelters and recoverable metal					
		Gold (fine ounces)	Silver (fine ounces)	Concentrate (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
BY COUNTIES									
Dona Ana	1,075			262	1	946	9,524	5,537	256,000
Grant	[1]8,419,959			329,093	1,698	267,554	[2]103,953,183	6,962,120	85,319,370
Hidalgo	62,797			5,737	355	41,814	2,734,935	285,262	66,000
Lincoln	50	18	1						
Luna	2,595			843	9	2,746	5,630	437,710	495,260
Santa Fe	395	35	7	105	2	594	706	46,506	69,713
Sierra	1,242	288	50	9		857	175	3,000	7,000
Socorro	69,040			6,975	240	47,322	118,500	3,166,090	4,517,850
Total: 1951	[1]8,557,153	341	58	343,024	2,305	361,833	[2]106,822,653	10,906,225	90,731,193
1950	7,791,669	90	35	325,082	2,259	248,984	97,262,000	7,501,553	58,455,100
BY CLASS OF MATERIAL TREATED									
Dry gold	1,425	341	58						
Copper	[1]7,924,475			243,171	1,332	51,317	[2]105,304,640	70	
Lead	37,569			1,201	9	4,813	5,505	1,609,332	18,500
Zinc:									
Crude ore	548,646			90,666	680	228,752	1,374,783	6,270,219	85,274,320
Mill cleanings	257			47		335	1,760	9,340	38,870
Total zinc materials	548,903			90,713	680	229,087	1,376,543	6,279,559	85,313,190
Zinc-lead	44,781			7,939	284	76,616	135,965	3,017,264	5,399,503
Total 1951	[1]8,557,153	341	58	343,024	2,305	361,833	[2]106,822,653	10,906,225	90,731,193
BY CLASS OF CONCENTRATE SHIPPED TO SMELTERS									
Copper				243,171	1,332	51,317	[2]105,304,640	70	
Lead				8,394	647	214,605	376,168	9,783,480	499,888
Lead-copper				6	1	680	2,670	3,584	1,350
Total to copper and lead plants				251,571	1,980	266,602	[2]105,683,478	9,787,134	501,238
Zinc concentrates to zinc plants				91,453	325	95,231	1,139,175	1,119,091	90,229,955
Total: 1951				343,024	2,305	361,833	[2]106,822,653	10,906,225	90,731,193
1950				325,082	2,259	248,984	97,262,000	7,501,553	58,455,100

[1] Includes 30,000 tons of newly mined ore treated by heap leaching.
[2] Includes 82,080 pounds of copper recovered from precipitates obtained from newly-mined ore treated in a heap-leaching plant.

TABLE 8.—Mine production of gold, silver, copper, lead, and zinc in New Mexico in 1951, by method of recovery (except placer) and class of material processed, in terms of recoverable metal—Continued

B. For material shipped directly to smelters

	Material shipped (short tons)	Recoverable metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
BY COUNTIES						
Dona Ana	19	4	360	476	463	
Grant	[3] 96,561	858	24,391	[4] 39,222,817	145,880	38,630
Guadalupe	25,498			640,000	30,000	
Hidalgo	10,098	400	48,992	307,065	180,738	
Lincoln	11		31		4,000	
Luna	198	1	224	370	26,290	26,740
Otero	179		21	6,000		
Sandoval	132		11	4,000		
Santa Fe	147	13	252	7,294	11,494	6,287
Sierra	212	12	2,021	3,825	41,000	1,000
Socorro	2,629	20	4,874	81,500	345,910	34,150
Taos	21	1	73	2,000		
Valencia	490		126	18,000		
Total: 1951	[3] 136,195	1,309	81,376	[4] 40,293,347	785,775	106,807
1950	[3] 127,313	1,059	89,562	[4] 35,338,000	798,447	70,900
BY CLASS OF MATERIAL						
Dry gold	75	11	17	1,579	80	
Dry gold-silver	1,723	260	10,668	14,964	2,936	
Dry silver	20	1	483	127	612	
Copper:						
Crude ore	99,636	462	51,710	2,499,287	153,667	
Old tailings	8,826	530	10,482	81,390	13,780	35,100
Precipitates [5]	22,859			37,683,606		
Total copper materials	131,321	992	62,192	40,264,283	167,447	35,100
Lead:						
Crude ore	2,663	39	6,817	8,401	550,576	15,190
Mill cleanings	36		527	2,320	22,750	
Total lead materials	2,699	39	7,344	10,721	573,326	15,190
Zinc	40					19,220
Zinc-lead	317	6	672	1,673	41,374	37,297
Total 1951	136,195	1,309	81,376	40,293,347	785,775	106,807

[3] Includes copper precipitates from mine water and leached dumps as follows: 1951—22,859 tons; 1950—19,928 tons.
[4] Includes copper contained in precipitates recovered from mine water and leached dumps as follows: 1951—37,683,606 pounds of copper; 1950—33,060,113 pounds of copper.
[5] Excludes 57 tons obtained from newly mined ore treated by heap leaching.

Minerals Operations 75-ton mill at the Hornet mine near Hachita. The Banner Mining Co. 500-ton mill at the Bonney-Miser's Chest mine near Lordsburg treated copper ore. The Portales 450-ton gravity-concentration mill at San Antonio treated lead ore from the Portales mine in the Hansonberg district, Socorro County. The Mex-Tex 250-ton jig-concentration mill at San Antonio handled lead-barite ore from the Mex-Tex group in the Hansonberg district. The Hanover zinc-lead mill of the New Jersey Zinc Co., Empire Zinc Division, in the Central district, closed by a strike October 17, 1950, remained idle throughout 1951 but was reopened in January 1952.

Definitions used in ore classification are given in the Gold and Silver chapter of this volume.

TABLE 9.—Mine production of gold, silver, copper, lead, and zinc in New Mexico in 1951, by method of recovery (except placer) and class of material processed, in terms of gross metal content.

Class of material	Quantity shipped or treated (short tons)	Gross metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
CONCENTRATE SHIPPED TO SMELTERS						
Copper	243,171	6,430	110,918	[1] 107,467,143	120	
Lead	8,394	647	214,605	445,021	10,196,822	884,841
Lead-copper	6	1	680	3,052	3,655	1,735
Zinc	91,453	405	148,976	1,829,810	1,732,153	100,514,184
Total: 1951	343,024	7,483	475,179	[1] 109,745,026	11,932,750	101,400,760
1950	325,082	7,024	300,686	100,711,039	7,909,405	65,773,199
ORE, ETC., SHIPPED DIRECTLY TO SMELTERS						
Dry gold	75	11	17	1,667	153	
Dry gold-silver	1,723	260	10,668	15,276	4,894	
Dry silver	20	1	483	206	882	
Copper:						
Crude ore	99,636	462	51,710	3,137,593	258,773	
Old tailings	8,826	530	10,482	83,897	22,970	350,977
Precipitates	[2] 22,859			38,437,866		
Total copper materials	[2] 131,321	992	62,192	41,659,356	281,743	350,977
Lead:						
Crude ore	2,663	39	6,817	11,118	575,166	20,134
Mill cleanings	36		527	2,727	23,698	
Total lead materials	2,699	39	7,344	13,845	598,864	20,134
Zinc	40					22,296
Zinc-lead	317	6	672	1,859	43,138	47,810
Total: 1951	[2] 136,195	1,309	81,376	41,692,209	929,674	441,217
1950	127,313	1,059	89,582	36,616,061	935,468	89,865

[1] Includes 84,623 pounds of copper contained in 57 tons of precipitates obtained from newly-mined ore treated in a heap-leaching plant.
[2] Excludes 57 tons obtained from newly-mined ore treated by heap leaching.

REVIEW BY COUNTIES

DONA ANA

The Merrimac mine in the Organ district, operated under lease by Wade White and Ira L. Wright, produced most of the ore shipped from Dona Ana County in 1951. The Defense Department (Air Force) included the site of the mine in the bombing range, and the mine was abandoned in May. The ore contained zinc as the principal mineral, with accessory silver, lead, and copper. The Texas Canyon, Barahoni, and Rickardite mines near Organ shipped some ore. Reports on the Torpedo Copper diamond-drilling research project of the Bureau of Mines at Organ, completed in April 1950, have been published.[1]

[1] Soulé, John H., Investigation of the Torpedo Copper Deposit, Organ Mining District, Dona Ana County, N. Mex.: Bureau of Mines Rept. of Investigations 4791, 1951, 10 pp.; Diamond Drilling at Torpedo Copper Mine, Organ Mining District, Dona Ana County, N. Mex.: Bureau of Mines Rept. of Investigations 4860, 1952, 21 pp.

GRANT

Central (Bayard, Fierro, Georgetown, Hanover, Santa Rita) District.—The Central district produced copper, zinc, lead, silver, and gold in 1951 valued altogether, in terms of recoverable metals, at $51,222,739, or 94 percent of the State total value of the five metals. From 1904, the first year for which segregated district figures are available, through 1951 the total Central district output of each metal was: Copper, 1,487,760 tons valued at $477,952,492; zinc, 638,753 tons valued at $125,900,118; lead, 86,938 tons valued at $13,511,646; silver, 7,762,426 ounces valued at $4,977,622; and gold, 127,589 ounces valued at $3,296,092—a total value of $625,637,970. The district has also produced a substantial quantity of iron ore.

The large Chino open-pit copper mine of the Kennecott Copper Corp. at Santa Rita operated 7 days a week throughout 1951, except during the August–September strike. A standard-gage railroad with 40 miles of track is used in the pit and on the dumps. Electric shovels handling 8 tons per dip are used on benches for loading broken ore and waste rock; about 45,000 tons of material, about half of which is ore, is generally handled daily, although considerably higher tonnages of waste rock are handled when extensive stripping is required to expand the area of pit operations. The ore is transferred from the

TABLE 10.—Mine production of gold, silver, copper, lead, and zinc in New Mexico in 1951,[1] by county and district, in terms of recoverable metal

County and district	Mines producing		Material sold or treated (short tons)	Gold (fine ounces)		
	Lode	Placer		Lode	Placer	Total
Dona Ana County: Organ	4		1,094	5		5
Grant County:						
Burro Mountain	1		4			
Central	12		8,491,443	1,723		1,723
Eureka	2		6,031	25		25
Pinos Altos	5	3	12,109	533	4	537
Steeple Rock	3		2,288	271		271
Swartz	4		4,642	4		4
Telegraph	1		3			
Guadalupe County: Pintado	2		25,498			
Hidalgo County:						
Fremont	1		6			
Lordsburg	8		72,107	755		755
San Simon	2		782			
Lincoln County:						
Red Cloud	1		11			
White Oaks	1		50	18		18
Luna County:						
Cooks Peak	1		2,714	10		10
Tres Hermanas	3		79			
Otero County: Sacramento	1		179			
Sandoval County: Nacimiento Mountains	2		132			
Santa Fe County:						
Cerrillos	3		369	9		9
San Pedro (New Placers)	4		173	41		41
Sierra County:						
Caballos Mountains	2		57	8		8
Chloride	3		134			
Hermosa	1		34			
Las Animas	4		1,214	289		289
Tierra Blanca	1		15	3		3
Socorro County:						
Hansonberg	2		36,583	6		6
Magdalena	7		35,086	254		254
Taos County: Picuris	1		21	1		1
Valencia County	1		490			
Total New Mexico	83	3	8,693,348	3,955	4	3,959

For footnote, see end of table.

TABLE 10.—Mine production of gold, silver, copper, lead, and zinc in New Mexico in 1951,[1] by county and district, in terms of recoverable metal—Continued

County and district	Silver[2] (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
Dona Ana County: Organ	1,306	10,000	6,000	256,000	$51,407
Grant County:					
Burro Mountain	874	200	2,300		1,237
Central	236,484	[3] 143,051,500	6,265,900	83,768,900	51,222,739
Eureka	19,526	5,800	353,400	402,700	154,380
Pinos Altos	16,104	90,800	148,300	426,700	158,660
Steeple Rock	11,259	19,700	36,400	36,700	37,418
Swartz	7,677	8,000	300,000	723,000	192,510
Telegraph	21		1,700		313
Guadalupe County: Pintado		640,000	30,000		160,070
Hidalgo County:					
Fremont	6		1,700		299
Lordsburg	89,610	3,041,000	287,300	31,000	898,794
San Simon	1,190	1,000	177,000	35,000	38,310
Lincoln County:					
Red Cloud	31		4,000		720
White Oaks	1				631
Luna County:					
Cooks Peak	2,939	6,000	456,000	495,400	173,513
Tres Hermanas	31		8,000	26,600	6,253
Otero County: Sacramento	21	6,000			1,471
Sandoval County: Nacimiento Mountains	11	4,000			978
Sante Fe County:					
Cerrillos	789	2,500	58,000	76,000	25,500
San Pedro (New Placers)	64	5,500			2,824
Sierra County:					
Caballos Mountains	74	2,800	8,000		2,409
Chloride	116	600	26,500		4,834
Hermosa	2,685	600	9,500	8,000	5,675
Las Animas	52				10,162
Tierra Blanca	1				106
Socorro County:					
Hansonberg	3,823	3,200	1,505,000		264,809
Magdalena	48,373	196,800	2,007,000	4,552,000	1,275,971
Taos County: Picuris	73	2,000			585
Valencia County	126	18,000			4,470
Total New Mexico	443,267	[3] 147,116,000	11,692,000	90,838,000	54,697,048

[1] The report of this series for 1929 (chapter of Mineral Resources of the United States, 1929, pt. 1, pp. 729–759) gives the yearly production of each important metal-producing district in New Mexico from 1904 to 1929, inclusive. Subsequent records, year by year, may be found in annual issues of Mineral Resources and Minerals Yearbook.

[2] All from lode mines.

[3] Includes copper recovered from precipitates.

mine railroad to the Atchison, Topeka & Santa Fe Railway branch line on the west side of the pit for delivery to treatment plants at Hurley, 10 miles from the mine. The concentrator has a daily capacity of 22,500 tons. Molybdenite is recovered in the mill as a byproduct. The copper concentrate is smelted in the company smelter adjacent to the mill, which also treats siliceous copper ore used as a flux and precipitates derived from dump leaching. The copper bullion contains minor quantities of gold and silver, which are not recovered from fire-refined copper, the major product of the smelter; the blister copper made contains some recoverable gold and silver.

The Oswaldo zinc mine of the Kennecott Copper Corp. operated throughout 1951 except for the 2-week strike. The ore produced was shipped to custom mills at Deming. Development during the year included 1,448 feet of drifts and 118 feet of raises; the total development in the group at the end of 1951 comprised two vertical shafts 490 and 705 feet deep, 14,796 feet of drifts and crosscuts, and 890 feet

of raises. Additional details on development and operation of the mine were published.[2]

The Ground Hog zinc-lead mine of the American Smelting & Refining Co. operated continuously in 1951, except for the strike. The system used in developing and mining the deep ore bodies was described in a recent publication.[3] Since December 1947, two new vertical shafts (the Star and the No. 5) have been sunk, and a 4,400-foot haulageway connecting the shafts on the 1,950-foot level has been excavated. The Star shaft, with four compartments, is 1,926 feet deep, and the No. 5, with three compartments, 2,210 feet deep. The old North shaft is vertical to the 600-foot level and has a winze from there to the 1,800-foot level. Development in 1951 included 8,725 feet of drifts, raises, and crosscuts and 25,870 feet of diamond drilling. The ore produced was shipped over the Atchison, Topeka & Santa Fe Railway branch line to the company Deming milling unit.

The Pewabic mine, operated by the Peru Mining Co., and the Kearney, operated by the New Mexico Consolidated Mining Co. (subsidiary of the Peru Mining Co.), were in production throughout 1951 except during the 2-week strike. The ore produced from both mines was concentrated in the 1,000-ton Peru mill at Deming. Development in the Pewabic group (opened by a 500-foot vertical shaft) in 1951 included 884 feet of drifts and 2,360 feet of diamond drilling. Development in the Kearney mine, opened by a 625-foot vertical shaft, included 2,718 feet of drifts and 6,291 feet of diamond drilling. The Peru Mining Co. also carried on an exploration project in the Grant County mine under a Defense Minerals contract.

The Bayard group of mines of the United States Smelting, Refining & Mining Co. operated continuously in 1951. The group includes the Bull Frog, Hanover-Bessemer, and Shingle Canyon properties. The mining was done by the company and lessees, and the milling by the company in its 600-ton flotation mill at the mine. Development during the year included 7,075 feet of drifts and crosscuts, 2,933 feet of raises, a 78-foot winze, and 18,664 feet of diamond drilling.

Douglas B. White treated by heap leaching 30,000 tons of copper ore mined with bulldozers from an open pit on the Zuniga (United States Smelting) property at Fierro; the yield was 57 tons of precipitates containing 84,623 pounds of copper. Some ore from the Dolomite, Little Goat, and Betty Jo mines and clean-up material from the old Combination mill site were shipped during the year.

The Hanover mine and mill of the New Jersey Zinc Co., Empire Zinc Division, closed by a strike October 17, 1950, remained idle throughout 1951 but were reopened in January 1952.

Other Districts.—There were a number of productive small-scale operations in other districts of Grant County in 1951. At Pinos Altos the Atlas No. 2 mine (Houston Thomas group), operated by Mathis & Mathis, shipped 3,218 tons of zinc-lead-silver ore. From the old Gillette mill tailings dump White & Wright shipped over 8,000 tons of old tailings containing copper, silver, lead, and gold. In the Eureka district Mineral Operations, Inc., continued to operate the Hornet zinc-lead mine and mill on a small scale. In the Steeple Rock district the Alabama and East Camp mines each produced several

[2] Mining World, Kennecott's Oswaldo Zinc Mine: Vol. 14, No. 4, April 1952, pp. 20–23.
[3] Mining World, ASARCO's Star Shaft: Vol. 14, No. 1, January 1952, pp. 26–30.

hundred tons of gold-silver ore, and the Carlisle group shipped gold-silver, lead, and zinc-lead ores totaling 1,259 tons. The Royal John mine in the Swartz district shipped zinc-lead-silver ore, and the Grand View and Patsy mines shipped zinc ore.

GUADALUPE

Drunzer & Casner operated the Stauber open-pit mine in the Pintado district 15 miles south of Santa Rosa from January to May and the Pintado in the same district during April; the output was low-grade siliceous copper fluxing ore, shipped to the El Paso smelter.

HIDALGO

Lordsburg District.—The Banner Mining Co. Bonney-Miser's Chest group, principal producer of ore in Hidalgo County since 1936, operated continuously in 1951. The ore was treated in the company 500-ton flotation mill and yielded copper concentrate containing silver and gold. The Atwood mine of C. H. & S. A. McIntosh, operated under lease by Ira L. Moseley, shipped crude copper-silver-gold-lead ore to the El Paso smelter. Other small producers included the Needmore-Homestake, Phoenix, Ruth, and Waldo.

The Silver Hill mine in the San Simon district and the Napane in the Fremont district shipped zinc-lead and lead ore, respectively.

LINCOLN

Two truckloads of lead-silver ore were shipped from the Little Wonder claim in the Red Cloud district and some gold ore was produced from the Old Abe mine at White Oaks.

LUNA

H. E. McCray operated the Mahoney group, including the Surprise (Bryan and Webster claims), in the Cooks Peak district and shipped 2,714 tons of good zinc-lead ore. In the Tres Hermanas district some ore was shipped from the Mahoney, Big Silver, and Measday & Schoepf properties.

At Deming the Peru Mining Co. continued to operate its 1,000-ton selective flotation mill. The bulk of the ore treated came from the Kearney, Pewabic, and Oswaldo mines in the Central district, but the mill continued to treat ore purchased from mine operators in various districts.

The Deming milling unit of the American Smelting & Refining Co. added equipment that increased the daily capacity of the mill from 400 to 650 tons. The mill treated company ore from the Ground Hog mine in the Central district and custom ore from 38 other mines—23 were in New Mexico, 7 in Arizona, 1 in Texas, and 7 in Mexico.

OTERO

E. S. Plumb shipped several cars of copper ore from the Courtney mine in the Sacramento district.

SANDOVAL

In the Nacimiento Mountains area the Zia Copper Co. shipped a few cars of low-grade copper ore from the San Miguel mine, and A. D. Miller shipped a little copper-silver ore from one of his claims.

SANTA FE

Near Cerrillos the Tom Payne and Pennsylvania mines each shipped several cars of good zinc-lead-silver ore in 1951. Other small producers included the Grand Central claim near Cerrillos and the Ora Quay and San Pedro groups near Golden.

SIERRA

Some gold was produced from the Snake, Black Peak, El Oro, and Portland claims at Hillsboro and the Lookout in the Tierra Blanca district. Small lots of ore containing base metals were shipped from the Regina and Black Rock claims (Caballos Mountains); Bald Eagle, Dobies, and St. Cloud (at Chloride); and Pelican (Hermosa district).

SOCORRO

Hansonberg District (Bingham).—The Portales Mining Co. operated its open-pit lead mine from February 1 through December. The ore was trucked 33 miles to the company 450-ton mill at San Antonio for treatment. The Mex-Tex Mining Co. shipped 13,967 tons of lead-barite ore from its open-pit mine. The ore was treated in the company 250-ton mill at San Antonio and yielded 321 tons of lead concentrate and 2,804 tons of barite.

Magdalena District.—The Lynchburg mine of the New Jersey Zinc Co., Empire Zinc Division, operated under lease by C. S. Elayer, continued to ship zinc-lead-silver ore to custom mills at Deming. Other producers were the Nitt mine, Waldo group (worked by lessees), Juanita, Queen, and Kelly groups and Bert Coon claim.

TAOS

The D. H. A. Mining Co. shipped 21 tons of copper-silver-gold ore from the Aztec group 8 miles northeast of Dixon.

VALENCIA

The Copper Hill Mining Co. shipped some low-grade copper fluxing ore from the Mirabel claim near Grants.

Oregon

Gold, Silver, Copper, Lead, and Zinc

(MINE REPORT)

By Richard H. Mote

GENERAL SUMMARY

GOLD production in Oregon in 1951 decreased 28 percent below the 1950 output. Silver production decreased 54 percent, copper 42 percent, lead 88 percent, and zinc 86 percent.

Total value of the gold, silver, copper, lead, and zinc (in terms of recoverable metals) produced in Oregon was $290,181 in 1951 compared with $417,765 in 1950, a decrease of 31 percent. The value of the gold produced was 96 percent of the total. Silver value was 2 percent; and combined copper, lead, and zinc values were 2 percent. Baker County continued to be the leading metal producer, supplying 69 percent of the total value. Grant County contributed 20 percent, Lane County 5 percent, and the other 5 producing counties 6 percent.

Placer mines yielded 90 percent and lode mines 10 percent of the gold produced in Oregon in 1951. In 1950 the ratio was placer mines 82 percent and lode mines 18 percent.

Yardage figures used in measuring material treated in placer operations are bank measure; that is, the material is measured in the ground before treatment. The value of metal production reported herein has been calculated at the prices shown in table 1.

TABLE 1.—Prices of gold, silver, copper, lead, and zinc, 1947–51

Year	Gold [1] (per fine ounce)	Silver [2] (per fine ounce)	Copper [3] (per pound)	Lead [3] (per pound)	Zinc [3] (per pound)
1947	$35.00	$0.905	$0.210	$0.144	$0.121
1948	35.00	.905+	.217	.179	.133
1949	35.00	.905+	.197	.158	.124
1950	35.00	.905+	.208	.135	.142
1951	35.00	.905+	.242	.173	.182

[1] Price under authority of Gold Reserve Act of Jan. 31, 1934.
[2] Treasury buying price for newly mined silver July 1, 1946, to date—$0.9050505 ($0.905 used in 1947 for calculating purposes).
[3] Yearly average weighted price of all grades of primary metal sold by producers. Price in 1947 includes bonus payments by Office of Metals Reserve for overquota production.

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TABLE 2.—Mine production of gold and silver in Oregon in 1951, by months, in fine ounces of recoverable metal [1]

Month	Gold	Silver	Month	Gold	Silver
January	666	1,936	August	568	320
February	493	126	September	590	293
March	690	780	October	390	195
April	697	169	November	330	94
May	831	260	December	291	81
June	1,651	1,477			
July	730	487	Total	7,927	6,218

[1] Mine production comprises ore, gravel, or other mineral material sold or treated and metal recovered as natural gold or as bullion from cyanidation or amalgamation and the estimated recoverable metal (or gross metal as indicated) contained in concentrates, ores, tailings and other mineral materials shipped directly to smelters or sold to ore buyers within the year.

Gold.—Oregon gold production in 1951 decreased 28 percent compared with 1950. Gold output from placer mines was 21 percent below 1950, due mainly to suspension of operations by one of the large bucket-line dredges in July 1951. Over 90 percent of the gold produced in the State was recovered by placer operations. Of the total placer output, 95 percent was recovered by bucket-line dredges, 1 percent by dragline dredges, and the remainder by hydraulic methods, drift mining, and small-scale hand methods.

Gold produced by lode mines decreased 63 percent compared with 1950. The principal producers, which together supplied nearly 88 percent of the gold recovered from lode mines, were the Champion mine in Lane County, the Buffalo mine in Grant County, and the Bourne Group in Baker County.

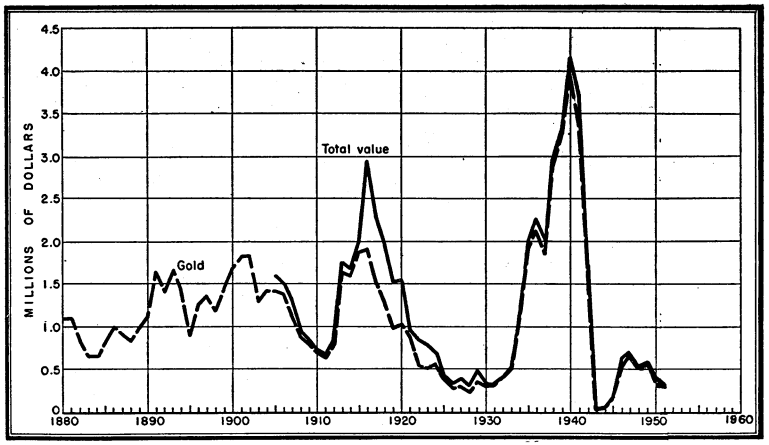

FIGURE 1.—Value of mine production of gold in Oregon, 1880–1951, and total value of gold, silver, copper, lead, and zinc, 1905–51

Silver.—Silver production in 1951 decreased 54 percent from 1950. Of the total, 96 percent was produced by three lode mines and two placer mines. These mines, in order of output, were the Buffalo mine (gold ore), Champion mine (gold and zinc-copper ore), Powder River Dredging Co. (bucket-line dredge), Porter & Co. (bucket-line dredge), and the Bourne Group (gold ore).

Copper.—The Champion mine, Lane County, and the Onion Falls mine, Josephine County, were the State's leading copper producers and together furnished 97 percent of the total output. Small quantities of copper were recovered from ores produced from the Bourne Group and from the Buffalo mine.

Lead and Zinc.—The Champion and Buffalo mines were the leading lead and zinc producers in 1951, although neither of these properties was worked continuously during the year.

TABLE 3.—Mine production of gold, silver, copper, lead, and zinc in Oregon, 1947–51, and total, 1852–1951, in terms of recoverable metal [1]

Year	Mines producing [2]		Material sold or treated [3] (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1947	20	49	3,277	18,979	$664,265	30,379	$27,493
1948	23	38	3,119	14,611	511,385	13,596	12,305
1949	28	29	6,215	16,226	567,910	12,195	11,037
1950	32	42	4,257	11,058	387,030	13,565	12,277
1951	14	21	1,495	7,927	277,445	6,218	5,628
1852–1951			(4)	5,760,353	129,575,398	5,301,265	4,863,175

Year	Copper		Lead		Zinc		Total value
	Short tons	Value	Short tons	Value	Short tons	Value	
1947	14	$5,880	12	$3,456	1	$242	$701,336
1948	2	868	7	2,506			527,064
1949	20	7,880	12	3,792	6	1,488	592,107
1950	19	7,904	17	4,590	21	5,964	417,765
1951	11	5,325	2	692	3	1,092	290,181
1852–1951	12,409	4,668,419	798	91,817	172	22,862	139,221,671

[1] Includes recoverable metal content of gravel washed (placer operations), ore milled, and ore shipped to smelters during calendar year indicated.
[2] Excludes itinerant prospectors, "snipers," "high-graders," and others who gave no evidence of legal right to property.
[3] Does not include gravel washed.
[4] Figure not available.

TABLE 4.—Gold produced at placer mines in Oregon, 1947–51, by class of mine and method of recovery

Class and method	Mines producing [1]	Material treated (cubic yards)	Gold recovered	
			Fine ounces	Value
Surface placers:				
Gravel mechanically handled:				
Bucket-line dredges:				
1947	2	[2] 3,976,500	[2] 12,164	[2] $425,740
1948	2	[2] 3,525,300	[2] 9,842	[2] 344,470
1949	3	3,468,900	10,744	376,040
1950	2	3,051,000	7,827	273,945
1951	2	2,719,900	6,775	237,125
Dragline dredges: [3]				
1947	12	1,093,000	4,984	174,440
1948	6	393,900	2,048	71,680
1949	3	594,750	3,224	112,840
1950	3	101,000	446	15,610
1951	1	6,500	47	1,645
Nonfloating washing plants: [4]				
1947	5	(2)	(2)	(2)
1948	3	(2)	(2)	(2)
1949	4	12,700	54	1,890
1950	5	8,300	40	1,400
1951				
Gravel hydraulically handled:				
1947	19	72,200	325	11,375
1948	21	84,300	412	14,420
1949	13	59,100	255	8,925
1950	21	83,300	472	16,520
1951	11	16,550	115	4,025
Small-scale hand methods: [5]				
1947	11	8,300	175	6,125
1948	5	8,900	210	7,350
1949	5	21,600	181	6,335
1950	10	3,200	229	8,015
1951	5	9,850	207	7,245
Underground placers (drift):				
1947				
1948	1	350	10	350
1949	1	250	7	245
1950	1	400	8	280
1951	2	800	20	700
Grand total placers:				
1947	49	5,150,000	17,648	617,680
1948	38	4,012,750	12,522	438,270
1949	29	4,157,300	14,465	506,275
1950	42	3,247,200	9,022	315,770
1951	21	2,753,600	7,164	250,740

[1] Excludes itinerant prospectors, "snipers," "high-graders," and others who gave no evidence of legal right to property.
[2] Data for nonfloating washing plants included with bucket-line dredges to avoid disclosure of individual output.
[3] Includes all placer operations using dragline excavator for delivering gravel to floating washing plant.
[4] Includes all placer operations using power excavator and washing plant, both on dry land; when washing plant is movable, outfit is termed "dry-land dredge."
[5] Includes all operations in which hand labor is principal factor in delivering gravel to sluices, long toms, dip boxes, pans, etc. "Wet" method used exclusively in Oregon.

TABLE 5.—Mine production of gold, silver, copper, lead, and zinc in Oregon in 1951, by counties, in terms of recoverable metal

County	Mines producing [1]		Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Fine ounces	Value	Fine ounces	Value
Baker	3	4	5,676	$198,660	1,717	$1,554
Curry	1	1	33	1,155	9	8
Douglas	2	1	40	1,400	7	7
Grant	2	1	1,534	53,690	3,079	2,786
Jackson	3	6	92	3,220	18	16
Josephine	2	7	272	9,520	66	60
Lane	1	----	272	9,520	1,320	1,195
Malheur	----	1	8	280	2	2
Total	14	21	7,927	277,445	6,218	5,628

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Baker	400	$97	----	----	----	----	$200,311
Curry	----	----	----	----	----	----	1,163
Douglas	----	----	----	----	----	----	1,407
Grant	300	73	1,600	$277	1,800	$328	57,154
Jackson	----	----	----	----	----	----	3,236
Josephine	8,700	2,105	----	----	----	----	11,685
Lane	12,600	3,049	2,400	415	4,200	764	14,943
Malheur	----	----	----	----	----	----	282
Total	22,000	5,324	4,000	692	6,000	1,092	290,181

[1] Excludes itinerant prospectors, "snipers," "high-graders," and others who gave no evidence of legal right to property.

MINING INDUSTRY

The number of producing lode mines in Oregon declined from 32 in 1950 to 14 in 1951. Most of the operating mines found it impossible to cope with the stabilized price of gold and increased costs of labor, supplies, and transportation. One of the State's larger placer operations was forced to close when its floating washing plant was lost in a flood.

The Bureau of Mines continued its project on investigation of the mineral resources of the Illinois Valley in southwestern Oregon. A number of mineral properties and prospects were examined during the year; several contained gold, silver, copper, lead, and zinc mineralization. Field work for a Bureau of Mines report of investigations on the Takilma-Waldo copper district, Josephine County, Oreg., was completed in April 1951. Results of exploration by trenching, drilling, and investigating mine dumps and accessible workings are set forth in the report which will be published in 1952.

Field teams of the Defense Minerals Administration, made up of Bureau of Mines engineers and geologists of the Geological Survey, examined several Oregon properties for eligibility under the Federal Government's program of assisting the development of domestic mineral resources. As a result of this work, an exploration contract for $30,000 on the Queen of Bronze copper mine, Josephine County, was made with Waite Minerals, Inc., operators of the property.

TABLE 6.—Mine production of gold, silver, copper, lead, and zinc in Oregon in 1951, by class of ore or other source material, in terms of recoverable metal

Source	Number of mines [1]	Material sold or treated (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Ore:							
Dry gold	12	818	549	3,380	5,300	1,800	1,800
Dry gold-silver	1	150	6	125			
Total	13	968	555	3,505	5,300	1,800	1,800
Copper	1	87	2	32	8,700		
Zinc-copper	1	440	206	918	8,000	2,200	4,200
Total	2	527	208	950	16,700	2,200	4,200
Gravel (placer operations)	21		7,164	1,763			
Total, all sources	35	1,495	7,927	6,218	22,000	4,000	6,000

[1] Detail will not necessarily add to totals because some mines produce more than 1 class of ore.

METALLURGICAL INDUSTRY

Of the 14 lode mines in Oregon in 1951, 7 treated ore by amalgamation, 3 operated concentration mills and shipped the product to smelters (2 also shipped smelting ore), and 4 shipped ore for direct smelting. Over 76 percent of the State total ore was treated in mills, and 24 percent was shipped crude to smelters. The 125-ton flotation mill at the Champion mine near Disston, Oreg., was closed down on June 1, 1951. All crude ore and material requiring smelting was shipped out of the State.

TABLE 7.—Mine production of gold, silver, copper, lead, and zinc in Oregon in 1951, by method of recovery, in terms of recoverable metal

Method of recovery	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Lode: [1]					
Amalgamation	54	10			
Concentration, and smelting of concentrates	471	3,498	8,300	3,800	6,000
Direct smelting	238	947	13,700	200	
Total lode	763	4,455	22,000	4,000	6,000
Placer	7,164	1,763			
Grand total	7,927	6,218	22,000	4,000	6,000

[1] Comprises ore only; no old tailings, etc., processed in Oregon in 1951.

TABLE 8.—Mine production of gold, silver, copper, lead, and zinc in Oregon in 1951, by method of recovery (except placer) and class of material processed, in terms of recoverable metal

A. For ore treated at mills

	Ore treated (short tons)	Recoverable in bullion		Concentrate shipped to smelters and recoverable metal					
		Gold (fine ounces)	Silver (fine ounces)	Concentrate (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
BY COUNTIES									
Baker	150			7	6	125			
Curry	5	8							
Douglas	20	2	1						
Grant	410	2		30	259	2,455	300	1,600	1,800
Jackson	106	16	6						
Josephine	12	26	3						
Lane	440			39	206	918	8,000	2,200	4,200
Total: 1951	1,143	54	10	76	471	3,498	8,300	3,800	6,000
1950	3,473	186	35	[1] 403	1,329	10,268	36,900	33,200	41,800
BY CLASS OF ORE TREATED									
Dry gold	553	54	10	30	259	2,455	300	1,600	1,800
Dry gold-silver	150			7	6	125			
Zinc-copper	440			39	206	918	8,000	2,200	4,200
Total 1951	1,143	54	10	76	471	3,498	8,300	3,800	6,000
BY CLASS OF CONCENTRATE SHIPPED TO SMELTERS									
Dry gold				30	259	2,455	300	1,600	1,800
Dry gold-silver				7	6	125			
Copper				6	83	121	927	320	
Zinc-copper				33	123	797	7,073	1,880	4,200
Total: 1951				76	471	3,498	8,300	3,800	6,000
1950				[1] 403	1,329	10,268	36,900	33,200	41,800

B. For ore shipped directly to smelters

	Ore shipped (short tons)	Recoverable metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
BY COUNTIES						
Baker	152	134	399	400		
Douglas	3	25	4			
Grant	12	11	110			
Josephine	87	2	32	8,700		
Lane	98	66	402	4,600	200	
Total: 1951	352	238	947	13,700	200	
1950	584	521	1,403	1,100	800	200
BY CLASS OF ORE						
Dry gold	265	236	915	5,000	200	
Copper	87	2	32	8,700		
Total, 1951	352	238	947	13,700	200	

[1] Includes 40 tons of concentrate from ore milled in 1949.

TABLE 9.—Mine production of gold, silver, copper, lead, and zinc in Oregon in 1951, by method of recovery (except placer) and class of material processed, in terms of gross metal content

Class of material	Quantity shipped or treated (short tons)	Gross metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
CONCENTRATE SHIPPED TO SMELTERS						
Dry gold	30	259	2,455	353	1,719	2,001
Dry gold-silver	7	6	125			
Copper	6	83	121	956	589	
Zinc-copper	33	123	797	7,852	1,927	4,496
Total: 1951	76	471	3,498	9,161	4,235	6,497
1950	[1] 403	1,329	10,268	41,988	39,405	68,715
ORE SHIPPED DIRECTLY TO SMELTERS						
Dry gold	265	236	915	5,151	351	
Copper	87	2	32	8,727		
Total: 1951	352	238	947	13,878	351	
1950	584	521	1,403	1,591	1,127	626

[1] Includes 40 tons of concentrate from ore milled in 1949.

REVIEW BY COUNTIES

BAKER

In Cracker Creek district, Curl Bourne Mines operated the Bourne Group, 7 miles north of Sumpter, from April through June 1951; 150 tons of crude ore containing 128 ounces of gold, 380 ounces of silver, and 431 pounds of copper was shipped to a smelter. In Sumpter district, the Powder River Dredging Co. worked the Sumpter Valley Placer on Powder River, 3 miles southeast of Sumpter, throughout 1951. The company's electric-powered bucket-line dredge, with 70 9-cubic-foot buckets, washed 2,520,729 cubic yards of gravel, which averaged nearly 8 cents a cubic yard in gold and silver values.

CURRY

A small quantity of gold concentrate was shipped to a mint from the Robert E. mine, in Chetco district, by W. D. Bowser.

DOUGLAS

The Forget-Me-Not mine, in Green Mountain district, was operated for about 3 months during 1951 by L. H. Brooks & Son. C. R. Cleveland operated the Warner mine from August 20 to October 20, 1951. Three tons of selected crude ore containing 25 ounces of gold and 4 ounces of silver was shipped to a smelter.

TABLE 10.—Mine production of gold, silver, copper, lead, and zinc in Oregon in 1951, by county and district, in terms of recoverable metal

County and district [1]	Mines producing [2]		Ore (short tons)	Gold (fine ounces)			Silver (lode and placer) [3] (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
	Lode	Placer		Lode	Placer	Total					
Baker County:											
Cornucopia	1	----	2	6	------	6	19	-------	-------	-------	$227
Cracker Creek	2	----	300	134	------	134	505	400	-------	-------	5,244
Greenhorn [4]	----	(5)	------	------	10	10	2	-------	-------	-------	352
Homestead	----	1	------	------	3	3	-------	-------	-------	-------	105
Lower Burnt River	----	1	------	------	2	2	-------	-------	-------	-------	70
Upper Burnt River	----	1	------	------	6	6	1	-------	-------	-------	211
Curry County:											
Agness	----	1	------	------	25	25	9	-------	-------	-------	883
Chetco	1	----	5	8	------	8	-------	-------	-------	-------	280
Douglas County:											
Green Mountain	2	----	23	27	------	27	5	-------	-------	-------	950
Riddle	----	1	------	------	13	13	2	-------	-------	-------	457
Grant County:											
Burnt River	----	(5)	------	------	1	1	-------	-------	-------	-------	35
Greenhorn [4]	1	----	50	2	------	2	-------	-------	-------	-------	70
Jackson County:											
Ashland	1	----	86	10	------	10	6	-------	-------	-------	355
Gold Hill	----	1	------	------	18	18	3	-------	-------	-------	633
Upper Applegate	2	5	20	6	58	64	9	-------	-------	-------	2,248
Josephine County:											
Galice	1	1	12	26	53	79	9	-------	-------	-------	2,773
Grants Pass	----	1	------	------	23	23	3	-------	-------	-------	808
Greenback	----	2	------	------	83	83	8	-------	-------	-------	2,912
Illinois River	1	2	87	2	40	42	38	8,700	-------	-------	3,609
Lower Applegate	----	(5)	------	------	17	17	3	-------	-------	-------	598
Waldo	----	1	------	------	28	28	5	-------	-------	-------	985
Lane County: Bohemia	1	----	538	272	------	272	1,320	12,600	2,400	4,200	14,943
Malheur County: Mormon Basin	----	1	------	------	8	8	2	-------	-------	-------	282
Other districts [6]	1	2	372	270	6,776	7,046	4,269	300	1,600	1,800	251,151
Total Oregon	14	21	1,495	763	7,164	7,927	6,218	22,000	4,000	6,000	290,181

[1] Only those districts shown separately for which Bureau of Mines is at liberty to publish figures; other producing districts listed in footnote 6 and their output included with "Other districts."
[2] Excludes itinerant prospectors, "snipers," "high-graders," and others who gave no evidence of legal right to property.
[3] Source of silver: 4,455 ounces from lode mines and 1,763 ounces from placers.
[4] Greenhorn district is in Baker and Grant Counties.
[5] From property not classed as a mine.
[6] Includes Sumpter district in Baker County and Granite district in Grant County.

GRANT

Porter & Co. operated a Yuba electric-powered dredge with 60 4½-cubic-foot buckets on the Crane Creek Placers, in Granite district for 3 months in 1951. The Buffalo mine near Granite was operated by R. G. Amidon & Co. during part of the year; 30 tons of concentrate containing 259 ounces of gold, 2,455 ounces of silver, 353 pounds of copper, 1,719 pounds of lead, and 2,001 pounds of zinc and 12 tons of crude ore containing 11 ounces of gold and 110 ounces of silver were shipped to smelters.

The Lucky Strike mine on Greenhorn Mountain, Greenhorn district, was operated during the summer of 1951 by Walter Ross. A small quantity of amalgam was sold to a bullion buyer.

JACKSON

The Ashland Mining Co. operated the Ashland mine, Ashland district, during the first part of the year. About 86 tons of ore was milled in the 75-ton amalgamation mill at the mine. Production totaled 10 fine ounces of gold and 6 fine ounces of silver. In Gold Hill district, R. E. Cook and Floyd G. Lance operated the Cook & Lance mine, on Foots Creek 12 miles southwest of Gold Hill, from January through April. About 3,000 cubic yards of bench gravel washed by hydraulic methods yielded 12 ounces of fine gold and 2 ounces of fine silver.

T. Ralph Pittock operated the Pittock mine on West Humbug Creek in Upper Applegate district by hydraulic methods for the first 2 months of the year. The 500 cubic yards of gravel washed yielded 11 fine ounces of gold and 2 of silver. The Apex mine was worked for a short time by J. C. McDonald and the Steamboat Group by Z. J. Collings. Small quantities of gold were produced from both properties.

JOSEPHINE

In Galice district, a dragline dredge, operated by Naron & Vandeventer, Oregon, Ltd., on the Lewis Bar placer during January and part of February, washed 6,500 cubic yards of gravel from which 47 fine ounces of gold and 4 fine ounces of silver were recovered. Operations were discontinued in February when the dredge was lost in a flood. A small quantity of gold was also recovered by small-scale hand methods. The Reno mine, situated one-half mile from the mouth of Whiskey Creek, was worked by Quentin Stone. From 12 tons of ore treated by amalgamation, 26 fine ounces of gold and 3 fine ounces of silver were recovered.

The Goff placer mine, in Greenback district, was worked by Cleo C. Clark during the first 6 months of 1951; 2,000 cubic yards of gravel washed hydraulically yielded 21 fine ounces of gold and 2 of silver. The Onion Falls mine, on Onion Mountain, 30 miles west of Grants Pass in the Illinois River district, was operated for a short time by C. E. Smith, who shipped 87 tons of crude ore to a smelter. Gross metal content of the ore shipped was 2 ounces of gold, 32 ounces of silver, and 8,727 pounds of copper.

LANE

In Bohemia district, the only producing area, Kenneth O. Watkins, lessee, operated the Champion mine, 14 miles southeast of Disston, until June 1, 1951. From about 440 tons of ore milled up to June 1, 39 tons of concentrate was produced and shipped to smelters. The gross metal content of this concentrate was 206 ounces of gold, 918 ounces of silver, 8,808 pounds of copper, 2,516 pounds of lead, and 4,496 pounds of zinc. After June 1 Harold E. L. Barton leased the mine and shipped to a smelter 98 tons of crude ore containing 66 ounces of gold, 402 ounces of silver, 4,720 pounds of copper, and 351 pounds of lead.

South Dakota
Gold, Silver, Copper, Lead, and Zinc

(MINE REPORT)

By Samuel A. Gustavson

GENERAL SUMMARY

SOUTH DAKOTA lode and placer mines in 1951 produced 458,101 fine ounces of gold, 139,590 fine ounces of silver, and 2 short tons of lead with a total value of $16,160,563. Output was reported from five lode mines and three small hand-operated placer mines. In 1950 production was from two lode mines only and totaled 567,996 ounces of gold, 142,065 ounces of silver, and no lead. No copper has been produced since 1944 and no zinc since 1948. Decreases of 19 percent in the output of gold and 2 percent in the output of silver from that of 1950 can be attributed chiefly to a shortage of men for underground mining. Most of the gold and silver was produced from the Homestake mine at Lead, Lawrence County, operated by the Homestake Mining Co. and the Portland, Dakota, and Clinton group of mines operated by the Bald Mountain Mining Co., at Trojan, also in Lawrence County.

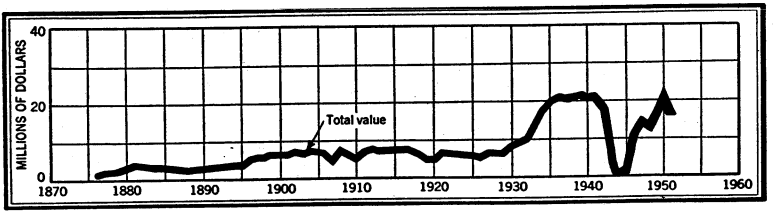

FIGURE 1.—Total value of mine production of gold and silver in South Dakota 1876–1951.

All tonnage figures herein are short tons and "dry weight"; that is, they do not include moisture. The value of production has been calculated at the prices shown in table 1.

TABLE 1.—Prices of gold, silver, copper, lead, and zinc, 1947–51

Year	Gold [1] (per fine ounce)	Silver [2] (per fine ounce)	Copper [3] (per pound)	Lead [3] (per pound)	Zinc [3] (per pound)
1947	$35.00	$0.905	$0.210	$0.144	$0.121
1948	35.00	.905+	.217	.179	.133
1949	35.00	.905+	.197	.158	.124
1950	35.00	.905+	.208	.135	.142
1951	35.00	.905+	.242	.173	.182

[1] Price under authority of Gold Reserve Act of Jan. 31, 1934.
[2] Treasury buying price for newly mined silver July 1, 1946, to date—$0.9050505 ($0.905 used in 1947 for calculating purposes).
[3] Yearly average weighted price of all grades of primary metal sold by producers. Price in 1947 includes bonus payments by Office of Metals Reserve for overquota production.

TABLE 2.—Mine production of gold, silver, and lead in South Dakota in 1951, by months, in terms of recoverable metal [1]

Month	Gold (fine ounces)	Silver (fine ounces)	Lead (short tons)
January	47,608	13,617	
February	43,320	12,242	
March	43,774	12,421	
April	44,126	13,470	
May	40,405	12,111	
June	42,093	12,358	
July	37,612	12,247	
August	35,613	11,846	
September	31,434	10,146	2
October	34,086	10,468	
November	29,453	9,301	
December	28,577	9,363	
Total	458,101	139,590	2

[1] Mine production comprises ore, gravel, or other mineral material sold or treated and metal recovered as natural gold or as bullion from cyanidation or amalgamation and the estimated recoverable metal (or gross metal as indicated) contained in concentrates, ores, tailings and other mineral materials shipped directly to smelters or sold to ore buyers within the year.

TABLE 3.—Mine production of gold, silver, copper, lead, and zinc in South Dakota, 1947–51, and total, 1876–1951, in terms of recoverable metal [1]

Year	Mines producing		Material sold or treated (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1947	4		939,384	407,194	$14,251,790	111,684	$101,074
1948	6		1,005,339	377,850	13,224,750	94,693	85,702
1949	5	1	1,230,172	464,650	16,262,750	109,383	98,997
1950	2		1,391,162	567,996	19,879,860	142,065	128,576
1951	5	3	1,166,380	458,101	16,033,535	139,590	126,336
1876–1951			[2]	23,322,092	597,870,429	10,285,424	7,440,743

Year	Copper		Lead		Zinc		Total value
	Short tons	Value	Short tons	Value	Short tons	Value	
1947			8	$2,304	19	$4,598	$14,359,766
1948			16	5,728	29	7,714	13,323,894
1949			4	1,264			16,363,011
1950							20,008,436
1951			2	692			16,160,563
1876–1951	106	$36,466	485	68,488	265	56,406	605,472,532

[1] Includes recoverable metal content of gravel washed (placer operations), ore milled, old tailings or slimes re-treated, and ore or old tailings shipped directly to smelters during the calendar year indicated. For production of gold and silver in South Dakota in earlier years, *see* Mineral Resources, 1913, pt. 1, p. 42; Mineral Resources, 1922, pt. 1, p. 194; and subsequent volumes of Mineral Resources and Minerals Yearbook.
[2] Figure not available.

MINING AND METALLURGICAL INDUSTRY

Details of mining and milling in South Dakota are given in the following Review by Counties. The tables that follow show the quantity of material treated and the gold and silver recovered by amalgamation and cyanidation. The Homestake Mining Co. treats its ore by both amalgamation and cyanidation, which explains the duplication of tonnage in tables 4 and 5.

TABLE 4.—Gold and silver bullion produced at mills in South Dakota by amalgamation, 1947–51

Year	Material sold or treated (short tons)	Gold in bullion (fine ounces)	Silver in bullion (fine ounces)
1947	849, 123	262, 257	52, 057
1948	896, 932	250, 782	72, 100
1949	1, 112, 193	312, 676	83, 538
1950	1, 265, 118	389, 473	111, 080
1951	1, 046, 305	317, 593	62, 685

TABLE 5.—Gold and silver bullion produced at mills in South Dakota by cyanidation, 1947–51

Year	Material treated (short tons)			Gold in bullion (fine ounces)	Silver in bullion (fine ounces)
	Crude ore	Sands and slimes	Total		
1947	86, 511	848, 875	935, 386	144, 888	59, 092
1948	106, 927	896, 567	1, 003, 494	126, 998	21, 669
1949	117, 979	1, 112, 183	1, 230, 162	151, 950	25, 632
1950	126, 044	1, 265, 118	1, 391, 162	178, 523	30, 985
1951	120, 051	1, 045, 384	1, 165, 435	140, 493	76, 436

REVIEW BY COUNTIES

LAWRENCE COUNTY

Homestake Mine.—The Homestake Mining Co. operated its mine in the Whitewood district through three shafts (the deepest being 4,245 feet) and an inside winze to the 5,000-foot level. Development in the mine during the year included 21,784 feet of drifts, 8,381 feet of raises, and 47,363 feet of diamond drilling. The following data are extracted from the annual report of the general manager of the Homestake Mining Co. for the year ended December 31, 1951:

Ore mined in 1951 was 1,046,203 tons, which compares with 1,265,118 tons in 1950. Bullion with value of $15,486,682.10 was produced. This is $3,777,366.10 less than in 1950. Average realization was $14.80 per ton and metallurgical recovery was 96.79 percent. This compares with $15.23 per ton and 97.03 percent in 1950.

Ore production was 218,915 tons less than in 1950. This reduction resulted entirely from the decrease in the number of men available for underground work. The average number of men employed in the mine department during 1951 was 267 less than in 1950. The shortage of men results primarily from the international situation and the defense production program.

Operating expense per ton of ore again increased because of reduced output, increased wage rates and higher supply costs. Such expense, exclusive of taxes and contributions to the Pension Trust was 11.06 per cent higher than in 1950. With inclusion of taxes (except Federal income) and the Pension Trust cost, the 1951 cost was 11.16 per cent higher than in 1950 and 76.47 per cent higher than in 1941.

Broken ore in shrinkage stopes increased from 430,000 tons on December 31, 1950 to 438,600 tons at the end of 1951. The reserve of developed ore, including broken ore, is 20,501,000 tons as compared with 20,804,000 at the end of 1950.

The mine and plant were well maintained and are in excellent condition. Remodelling of the Yates crusher plant with the addition of a third stage of crushing was completed. Operating results are excellent. Completion of similar remodelling of the Ross crusher plant is scheduled for March 1952. With changes in the grinding section of the South Mill, stamps will ultimately be eliminated with resultant economies in operation.

Changes in drilling equipment and practice, resulting from tests which have been carried on for several years, are now being made as rapidly as the material can be obtained. These will result in production economies.

Table 6 presents salient operating data for the Homestake mine for 1947–51.

TABLE 6.—Ore milled, receipts, and dividends, Homestake mine, 1947–51 [1]

Year	Ore milled (short tons)	Receipts for bullion product		Dividends
		Total	Per ton	
1947	849,023	$13,796,720.25	$16.2501	$4,018,560
1948	896,862	12,658,138.55	14.1138	4,018,560
1949	1,112,183	15,683,159.05	14.1012	4,520,880
1950	1,265,118	19,264,048.20	15.2271	5,525,520
1951	1,046,203	15,486,682.10	14.8028	4,319,952

[1] From 1876 to 1951, inclusive, this mine yielded bullion and concentrates that brought a net return of $528,863,881 and paid $175,022,266 in dividends.

Other Mines.—The Bald Mountain Mining Co. operated its Portland, Dakota, and Clinton group of mines (classed as one mine) and 370-ton all-sliming cyanide mill. Ore treated in 1951 totaled 120,051 tons compared with 126,044 in 1950. Gold output decreased 11 percent in 1951; however, silver output increased 38 percent owing chiefly to an increase in the silver content of the ore and to higher mill recovery. Ray Coppo shipped a small quantity of ore containing gold, silver, and lead from the Silver Queen dump.

CUSTER AND PENNINGTON COUNTIES

A small quantity of gold and silver was produced from the Juniper mine operated by the Southern Hills Mines, Inc., and from the Doctor Lode No. 1 and No. 2 by Robert E. Nelson in Pennington County. A few ounces of gold production was recorded from three hand placer operations, one in Custer County and two in Pennington County.

Utah

Gold, Silver, Copper, Lead, and Zinc

(MINE REPORT)

By Paul Luff

GENERAL SUMMARY

DESPITE a strong demand for copper and high prices throughout 1951, Utah's production of copper and gold was less than in 1950, mainly because of a decreased output of copper ore, from which these metals are mostly derived. On the other hand, production of silver, lead, and zinc rose because of increased output of zinc-lead ore, their major source.

Utah remained the second-largest copper-producing State (Arizona was the largest) and ranked second in gold and silver, third in lead, and tenth in zinc.

The value of the five metals in 1951 (exceeded only by that for Arizona) was $182,897,139, the highest in the State's history and 15 percent greater than the value of $159,415,431 in 1950. This increase was due to larger outputs of silver, lead, and zinc and to higher prices for copper, lead, and zinc. Of the total value in 1951, copper contributed 72 percent, lead over 9 percent, gold 8 percent, zinc 7 percent, and silver nearly 4 percent. The value of the metals recovered from copper ore was $146,877,590 in 1951 (80 percent of the State total from all ores), and that recovered from zinc-lead ore was $32,071,468 (18 percent of the State total).

In 1951, 94 percent of Utah's gold production, 65 percent of its silver, over 99 percent of its copper, 54 percent of its lead, and 53 percent of its zinc were recovered from copper ore (including precipitates) and zinc-lead ore from the West Mountain (Bingham) district, Salt Lake County. The remainder of the gold, silver, copper, lead, and zinc was recovered largely from zinc-lead ore and siliceous ores mined in the Park City region and the Tintic district.

All tonnage figures reported herein are short tons and "dry weight"; that is, they do not include moisture. The value of production has been calculated at the prices shown in table 1.

Gold.—Although Utah's 1951 output of recoverable gold (432,216 fine ounces) was 25,335 ounces (6 percent) less than in 1950, it was 23 percent above the annual average of the 10-year period ended with 1950. Most of the gold produced in Utah is a byproduct of copper ore, and since this class of ore declined in 1951 the State's production of gold declined also. In 1951 copper ore yielded 391,400 ounces of

TABLE 1.—Prices of gold, silver, copper, lead, and zinc, 1947–51

Year	Gold [1] (per fine ounce)	Silver [2] (per fine ounce)	Copper [3] (per pound)	Lead [3] (per pound)	Zinc [3] (per pound)
1947	$35.00	$0.905	$0.210	$0.144	$0.121
1948	35.00	.905+	.217	.179	.133
1949	35.00	.905+	.197	.158	.124
1950	35.00	.905+	.208	.135	.142
1951	35.00	.905+	.242	.173	.182

[1] Price under authority of Gold Reserve Act of Jan. 31, 1934.
[2] Treasury buying price for newly mined silver July 1, 1946, to date—$0.9050505 ($0.905 used in 1947 for calculating purposes).
[3] Yearly average weighted price of all grades of primary metal sold by producers. Price in 1947 includes bonus payments by Office of Metals Reserve for overquota production.

TABLE 2.—Mine production of gold, silver, copper, lead, and zinc in Utah in 1951, by months, in terms of recoverable metal [1]

Month	Gold (fine ounces)	Silver (fine ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
January	33,150	556,338	22,408	3,919	2,616
February	33,200	634,006	20,863	4,528	2,995
March	35,985	677,125	23,343	4,883	3,390
April	37,155	657,841	23,123	5,049	3,226
May	39,110	668,218	24,063	5,329	3,386
June	38,640	653,375	23,483	4,978	3,050
July	33,260	550,021	23,108	3,719	2,405
August	33,635	479,919	20,083	2,643	1,916
September	34,810	599,896	21,873	3,684	2,661
October	39,840	638,484	23,746	3,813	2,640
November	36,080	572,728	22,340	3,847	2,850
December	37,351	622,714	22,653	4,059	3,182
Total	432,216	7,310,665	271,086	50,451	34,317

[1] Mine production comprises ore, gravel, or other mineral material sold or treated and metal recovered as natural gold or as bullion from cyanidation or amalgamation and the estimated recoverable metal (or gross metal as indicated) contained in concentrates, ores, tailings, and other mineral materials shipped directly to smelters or sold to ore buyers during the year.

TABLE 3.—Mine production of gold, silver, copper, lead, and zinc in Utah, 1947–51, and total, 1864–1951, in terms of recoverable metal [1]

Year	Mines producing		Material sold or treated [2] (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1947	118	2	30,383,114	421,662	$14,758,170	7,780,032	$7,040,929
1948	118	2	25,741,911	368,422	12,894,770	8,045,329	7,281,429
1949	93	2	21,993,467	314,058	10,992,030	6,724,880	6,086,356
1950	84	2	31,855,601	457,551	16,014,285	7,083,808	6,411,204
1951	82		31,356,837	432,216	15,127,560	7,310,665	6,616,521
1864–1951 [3]			[1]710,933,618	12,636,887	342,516,085	756,117,233	557,522,201

Year	Copper		Lead		Zinc		Total value
	Short tons	Value	Short tons	Value	Short tons	Value	
1947	266,533	$111,943,860	49,698	$14,313,024	43,673	$10,568,866	$158,624,849
1948	227,007	98,521,038	55,950	20,030,100	41,490	11,036,340	149,763,677
1949	197,245	77,714,530	53,072	16,770,752	40,670	10,086,160	121,649,828
1950	278,630	115,910,080	44,753	12,083,310	31,678	8,996,552	159,415,431
1951	271,086	131,205,624	50,451	17,456,046	34,317	12,491,388	182,897,139
1864–1951 [3]	6,140,942	1,907,685,621	4,672,964	569,910,806	1,174,839	191,151,247	3,568,785,960

[1] Includes recoverable metal content of gravel washed (placer operations), ore milled, old tailings or slimes retreated, and ore, old tailings, or copper precipitates shipped to smelters during the calendar year indicated.
[2] Does not include gravel washed.
[3] Figures estimated for certain years before 1901.

gold—21,690 ounces (5 percent) less than in 1950. Zinc-lead ore supplied 33,489 ounces of gold in 1951, a decrease of 3,835 ounces (10 percent) from 1950. Over 94 percent of the gold recovered from zinc-lead ore came from the Park City region and West Mountain (Bingham) district.

Of the total gold in 1951, 91 percent came from copper ore, 8 from zinc-lead ore, and most of the remainder from silver ore, gold-silver ore, and lead ore; no placer gold was produced in 1951. The West Mountain (Bingham) district supplied 94 percent of the State total, the Park City region 4 percent, and the Tintic district 1 percent. Output of gold in the West Mountain (Bingham) district decreased 5 percent from 1950 and in the Park City region 23 percent, but in the Tintic district it increased 52 percent.

The leading gold producers in Utah in 1951—each with an output exceeding 1,000 ounces of recoverable metal—were as follows: Utah Copper mine and United States & Lark group in the West Mountain

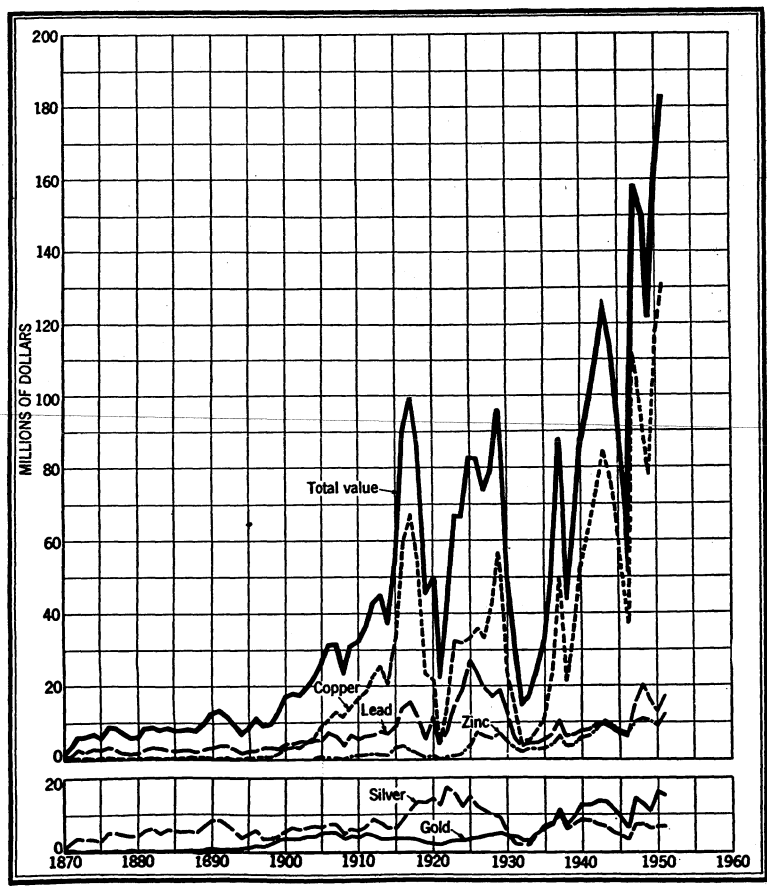

FIGURE 1.—Value of mine production of gold, silver, copper, lead, and zinc, in Utah, 1870–1951.

(Bingham) district; the property of the New Park Mining Co. in the Park City region; Chief Consolidated's Chief No. 1 mine in the Tintic district; and Park Utah Consolidated and Silver King Coalition properties in the Park City region. These 6 properties furnished 99 percent of the State gold.

Silver.—Even though Utah's output of recoverable silver increased to 7,310,665 fine ounces in 1951—a 3-percent gain over 1950—it was 7 percent less than the yearly average from 1941 to 1950. A substantial increase in output of silver from zinc-lead ore more than offset the loss in output from copper ore. Copper ore supplied 3,181,269 ounces—131,680 ounces (4 percent) less than in 1950—and zinc-lead ore 3,100,509 ounces—250,835 ounces (9 percent) more than in 1950. About 99 percent of the silver recovered from copper ore came from the West Mountain (Bingham) district, and 92 percent of the silver recovered from zinc-lead ore came from the Park City region, Tintic district, and West Mountain (Bingham) district. Copper ore furnished 44 percent of the State silver in 1951, zinc-lead ore 42 percent, and silver ore and gold-silver ore and old tailings 11 percent; the remainder came principally from lead ore. Output of silver increased 19 percent in the Park City region and 2 percent in the Tintic district but declined 1 percent in the West Mountain (Bingham) district.

Utah properties that produced over 170,000 ounces of recoverable silver each in 1951 were as follows: Utah Copper mine, United States & Lark group, Chief No. 1 mine, and the New Park, Silver King Coalition, Park Utah Consolidated, Butterfield, and Calumet properties. These 8 producers contributed 90 percent of the State silver.

Copper.—Despite a loss of 7,544 short tons (3 percent) in Utah's 1951 output of recoverable copper compared with 1950, the output was 9 percent above the yearly average from 1941 to 1950. The loss resulted from a 6-day shutdown—caused by a strike—at the Utah

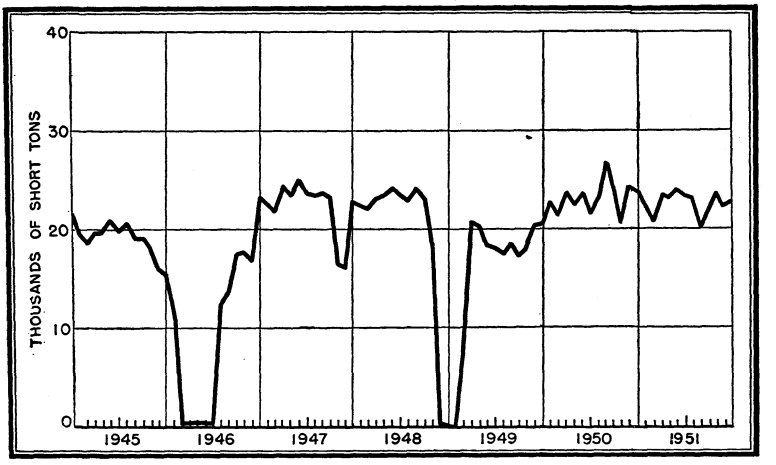

FIGURE 2.—Mine production of copper in Utah, 1945–51, by months, in terms of recoverable metal.

Copper property in Bingham Canyon, the State's only large producer. The United States & Lark group, also at Bingham, was the only other Utah property to produce over a million pounds of recoverable copper in 1951. These 2 producers contributed over 99 percent of the State copper.

Lead.—Utah's output of recoverable lead increased to 50,451 short tons in 1951—a gain of 5,698 tons (13 percent) over 1950. The gain resulted mainly from continuous operations, except for brief shutdowns, at the United States & Lark property at Bingham, the largest producer of zinc-lead ore in the State. In 1951 zinc-lead ore from the West Mountain (Bingham) district supplied 27,053 tons of lead (54 percent of the State total), the Park City region 11,297 tons (22 percent), and the Tintic district 2,510 tons (5 percent). The remainder came largely from zinc-lead ore from the Rush Valley (Stockton) and Ophir districts, silver ore and gold-silver ore from the Tintic and West Mountain (Bingham) districts, and lead ore from the West Mountain (Bingham) and Ophir districts. Output of lead in the Park City region was 55 percent more than in 1950 and in the West Mountain (Bingham) district 6 percent more, but in the Tintic district it dropped 15 percent.

The United States & Lark property remained by far the largest producer of lead in Utah, and its output in 1951 was about 10 percent more than in 1950; it was followed by the Chief No. 1, Park Utah Consolidated, Silver King Coalition, New Park, Calumet, Butterfield, Chief Consolidated tailings, Ophir unit of United States Smelting, Refining & Mining Co., and Hidden Treasure properties. These 10 producers supplied 96 percent of the State lead.

Zinc.—Utah's output of recoverable zinc increased to 34,317 short tons in 1951, an 8-percent gain over 1950. The gain resulted mainly from an increased output of zinc-lead ore from the United States & Lark group at Bingham and from the New Park, Park Utah Consolidated, and Silver King Coalition mines in the Park City region. In 1951 zinc-lead ore from the West Mountain (Bingham) district supplied 18,286 tons of zinc (53 percent of the State total); the Park City region contributed 10,209 tons (30 percent) and the Tintic district 3,410 tons (10 percent), nearly all from zinc-lead ore. The remainder came largely from zinc-lead ore from the Ophir and Rush Valley districts and from zinc slag and furnace cleanings from the Smelter (Tooele) district. Production of zinc in the West Mountain (Bingham) district was 13 percent more than in 1950, in the Park City region 37 percent more, and in the Smelter (Tooele) district 98 percent more. Zinc output in the Rush Valley district was about the same as in 1950, but output in the Tintic and Ophir districts dropped 43 and 9 percent, respectively.

The United States & Lark property remained by far the largest producer of zinc in Utah, and its output in 1951 was about 15 percent more than in 1950; it was followed by the Park Utah Consolidated, New Park, Chief No. 1, Silver King Coalition, Butterfield, and Calumet properties, and Tooele old slag and furnace cleanings. These 8 properties furnished 96 percent of the State total zinc.

TABLE 4.—Mine production of gold, silver, copper, lead, and zinc in Utah in 1951, by counties, in terms of recoverable metal

County	Mines producing, lode [1]	Gold		Silver	
		Fine ounces	Value	Fine ounces	Value
Beaver	5	41	$1,435	14,692	$13,297
Box Elder	1			52	47
Juab	15	3,541	123,935	846,144	765,803
Millard	3	1	35	42	38
Morgan	1			53	48
Salt Lake	9	407,534	14,263,690	4,960,448	4,489,456
San Juan and Wayne [2]	2	1	35	768	695
Summit	11	3,432	120,120	757,993	686,022
Tooele	19	1,159	40,565	253,767	229,672
Uintah	2			10	9
Utah	11	1,462	51,170	102,918	93,146
Wasatch	1	15,044	526,540	373,367	337,916
Washington	2	1	35	411	372
Total	82	432,216	15,127,560	7,310,665	6,616,521

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Beaver	32,500	$7,865	252,400	$43,665	253,200	$46,082	$112,344
Box Elder	35,700	8,639					8,686
Juab	224,900	54,426	10,643,000	1,841,239	6,812,300	1,239,839	4,025,242
Millard	700	169	3,000	519			761
Morgan			6,700	1,159			1,207
Salt Lake	540,463,400	130,792,143	58,835,300	10,178,507	36,818,800	6,701,022	166,424,818
San Juan and Wayne [2]	48,300	11,689					12,419
Summit	236,200	57,160	16,804,600	2,907,196	11,793,000	2,146,326	5,916,824
Tooele	190,700	46,149	7,184,600	1,242,936	4,296,000	781,872	2,341,194
Uintah	700	169	600	104			282
Utah	194,300	47,021	537,400	92,970	36,600	6,661	290,968
Wasatch	702,800	170,078	6,633,800	1,147,647	8,624,100	1,569,586	3,751,767
Washington	41,800	10,116	600	104			10,627
Total	542,172,000	131,205,624	100,902,000	17,456,046	68,634,000	12,491,388	182,897,139

[1] No placer production in Utah in 1951.
[2] Combined to avoid disclosure of individual company operations.

MINING AND METALLURGICAL INDUSTRY

Utah's mining operations in 1951 were interrupted by strikes for brief periods during the year—a 6-day strike in the copper-mining industry and an 8- to 13-day strike in the zinc-lead-silver-mining industry; in spite of the strike, the quantity of zinc-lead ore mined and treated increased 16 percent (from 579,946 tons in 1950 to 673,022 in 1951), but copper ore decreased 2 percent (from 31,049,641 tons to 30,454,456). Even though the output of copper ore declined in 1951 from 1950, it was well above the average for the 10 years from 1941 to 1950; on the other hand, the output of zinc-lead ore, in spite of an increase over 1950, was below the average for the preceding 10 years. Of the 30,454,456 tons of copper ore produced in Utah in 1951, 30,444,800 tons came from the West Mountain (Bingham) district. Of the 673,022 tons of zinc-lead ore mined in 1951, 373,747 tons (56 percent) came from the West Mountain (Bingham) district, 65,518 tons (10 percent) from the Tintic district, 190,178 tons (28 percent) from the Park City region, 34,871 tons (5 percent) from the Ophir and Rush Valley (Stockton) districts, and 8,708 tons (1 percent)

from other districts. Of the 25,593 tons of lead ore mined in 1951, 12,558 tons (49 percent) came from the West Mountain (Bingham) district, 7,890 tons (31 percent) from the Tintic district, 2,237 tons (9 percent) from the Park City region, and 2,908 tons (11 percent) from other districts. Lead slag, smelter cleanings, and old lead tailings treated totaled 3,788 tons. The siliceous material was largely silver ore and old tailings from the Park City region and the Tintic and West Mountain (Bingham) districts. The number of mines producing in the State declined from 86 in 1950 (including 2 placers) to 82 in 1951 (all lode mines).

The driving of a haulage tunnel 21,300 feet long from Bingham to Lark was completed during the year. This tunnel was driven to permit the Kennecott Copper Corp. to extend its open-pit operations toward the southwest. Driving of a new 7,000-foot haulage tunnel was begun during the year 200 feet below the present bottom outlet of the Utah Copper open pit. This tunnel was being driven to minimize haulage adverse to grade as mining operations are extended to lower levels.

During 1951 the Federal Government took steps to stimulate production by aiding in financing exploration projects in search of strategic and critical minerals. In 1951, 17 projects in Utah for copper, lead, zinc, tungsten, and uranium were approved, involving $1,002,752 to be spent by the Federal Government and $895,216 to be spent by private capital. The projects for copper, lead, and zinc were financed on a 50–50 basis, which meant that the Federal Government was to furnish 50 percent of the expense and private capital an equal amount. Repayment of the Government's contribution is to

TABLE 5.—Mine production of gold, silver, copper, lead, and zinc in Utah in 1951 by class of ore or other source material, in terms of recoverable metal

Source [1]	Number of mines [2]	Material sold or treated (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Ore:							
Dry gold	1	68	39	124		3,300	1,603
Dry gold-silver	8	36,520	2,632	108,403	227,991	1,014,068	11,207
Dry silver	15	94,863	2,215	465,390	207,237	3,165,455	
Total	21	131,451	4,886	573,917	435,228	4,182,823	12,810
Copper	15	30,454,456	391,400	3,181,269	527,443,279	3,800	
Lead	31	25,593	983	233,428	154,857	6,136,476	347,833
Lead-copper	1	36	1	326	2,188	3,000	
Zinc	3	509		197	208	15,807	200,344
Zinc-lead	30	673,022	33,489	3,100,509	2,991,197	88,322,164	66,351,094
Total	65	31,153,616	425,873	6,515,729	530,591,729	94,481,247	66,899,271
Other "lode" material:							
Old tailings	13	[3] 61,865	1,281	201,342	101,801	1,632,370	111,819
Copper precipitates	2				10,981,202		
Old slag and smelter cleanings	5	[4] 9,905	176	19,677	62,040	605,560	1,610,100
Total	20	71,770	1,457	221,019	11,145,043	2,237,930	1,721,919
Total, all sources	82	31,356,837	432,216	7,310,665	542,172,000	100,902,000	68,634,000

[1] All lode material; no placer recovery in Utah in 1951.
[2] Detail will not add to totals because some mines produce more than one class of ore.
[3] Gold 570 tons, gold-silver 7,168 tons, silver 43,518 tons, lead 571 tons, zinc 10,000 tons, zinc-lead 38 tons.
[4] Lead slag 2,025 tons, zinc slag 4,881 tons, zinc-lead slag 360 tons, lead smelter cleanings 1,192 tons, zinc smelter cleanings 1,447 tons.

be made, without interest, through a royalty on net returns from products sold if ore is discovered or delineated and the ore is mined within 10 years of the date of the contract.

The 31,356,837 tons of ore, old tailings, and other metal-bearing material produced in Utah in 1951 included the following: 31,134,299 tons (99 percent) treated at mills (31,628,415 tons in 1950); 216,210 tons (nearly 1 percent) shipped direct to smelters (223,343 tons in 1950); and 4,881 tons of old slag and 1,447 tons of furnace cleanings smelted and fumed (3,843 tons—all old slag—in 1950).

The 9 mills active in Utah in 1951 treated Utah crude ore as follows: Magna and Arthur concentrators (40,000 tons rated capacity each) of the Kennecott Copper Corp., 30,444,800 tons of copper ore; Midvale 1,700-ton concentrator of the United States Smelting, Refining & Mining Co., Tooele 1,500-ton concentrator of the International Smelting & Refining Co., Park City 800-ton concentrator of the Silver King Coalition Mines Co., Bauer 700-ton concentrator of the Combined Metals Reduction Co., and Horn Silver 500-ton concentrator of the Metal Producers, Inc., 672,432 tons of zinc-lead ore; 1 concentrator in San Juan County treated 6,992 tons of uranium-copper ore and 1 flotation mill in Summit County 10,000 tons of current zinc tailings. The Bauer mill also treated 50 tons of lead ore and 25 tons of zinc ore.

Smelting, milling, and refining operations in Utah were shut down during various periods in 1951, owing to strikes. The Garfield copper smelter of the American Smelting & Refining Co. was idle from July 2 to 29, inclusive; it operated principally on copper concentrates from the Magna and Arthur mills, siliceous crude ore and old tailings from mines and dumps in the Park City region and the Tintic and West Mountain (Bingham) districts, and iron concentrates from the Midvale and Tooele mills. The Midvale lead smelter of the United States Smelting, Refining & Mining Co. was idle for a brief period in August; it operated mainly on lead concentrates and lead ore from company-owned properties in Utah. The Tooele lead smelter of the International Smelting & Refining Co. was idle 6 weeks following a fire in

TABLE 6.—Mine production of gold, silver, copper, lead, and zinc in Utah in 1951, by method of recovery and type of material processed, in terms of recoverable metal

Method of recovery and type of material processed [1]	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Concentration, and smelting of concentrates:					
Ore	424,691	6,252,057	530,212,802	88,226,922	66,247,400
Old tailings	13	1,339	750	23,680	105,500
Total	424,704	6,253,396	530,213,552	88,250,602	66,352,900
Direct smelting:					
Ore	6,068	837,589	814,155	10,437,148	664,681
Old tailings	1,268	200,003	101,051	1,608,690	6,319
Copper precipitates [2]			10,981,202		
Old slag and smelter cleanings	176	19,677	62,040	605,560	1,610,100
Total	7,512	1,057,269	11,958,448	12,651,398	2,281,100
Grand total	432,216	7,310,665	542,172,000	100,902,000	68,634,000

[1] All lode material; no placer recovery in Utah in 1951.
[2] All from Salt Lake County.

the Cottrell plant August 27; the company zinc-fuming plant, operated in conjunction with the lead smelter, was likewise idle 6 weeks. The lead smelter treated zinc-lead ore, lead ore and concentrates, zinc ore, old zinc slag, and furnace cleanings (zinc) from both company and custom sources. The fuming plant treated 88,374 tons of current hot slag and crude ore in 1951 compared with 87,761 tons in 1950; output in 1951 was 18,084 tons of zinc fume, averaging 74.64 percent zinc and 2.41 percent lead, and 2,056 tons of lead fume averaging 52.61 percent lead and 17.00 percent zinc.

The copper refinery of the Kennecott Copper Corp. and the copper-anode plant of the American Smelting & Refining Co., both at Garfield, operated continuously, except for brief shutdowns caused by strikes. Wire bars are the principal output of the refinery.

ORE CLASSIFICATION

Definitions used in ore classification are given in the Gold and Silver chapter of this volume.

TABLE 7.—Mine production of gold, silver, copper, lead, and zinc in Utah in 1951, by method of recovery and class of material processed, in terms of recoverable metal [1]

A. For ore and old tailings treated at mills

	Material treated (short tons)	Concentrate shipped to smelters and recoverable metal					
		Concentrate (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
BY COUNTIES							
Beaver	5,221	546	31	12,452	9,400	194,970	237,847
Juab	65,490	10,834	825	250,454	53,330	5,019,623	6,457,267
Salt Lake	30,818,652	954,741	405,003	4,783,805	529,119,240	54,129,482	36,596,940
San Juan and Utah [2]	7,081	113	7	1,268	48,100	9,539	2,890
Summit	111,816	36,340	2,775	607,950	161,735	15,976,235	11,783,093
Tooele	37,743	8,917	1,019	224,100	118,947	6,286,953	[1] 2,650,763
Wasatch	88,296	17,057	15,044	373,367	702,800	6,633,800	8,624,100
Total:							
1951	31,134,299	1,028,548	424,704	6,253,396	530,213,552	88,250,602	66,352,900
1950	31,628,415	1,016,474	449,847	6,115,345	541,504,725	78,159,988	61,322,800
BY CLASS OF ORE AND OLD TAILINGS TREATED							
Copper	30,451,792	843,609	391,214	3,156,997	527,232,800	----------	----------
Lead	50	7	----------	130	----------	5,756	----------
Zinc:							
Crude ore	25	5	----------	22	----------	600	5,000
Old tailings	10,000	396	13	1,339	750	23,680	105,500
Zinc-lead	672,432	184,531	33,477	3,094,908	2,980,002	88,220,566	66,242,400
Total 1951	31,134,299	1,028,548	424,704	6,253,396	530,213,552	88,250,602	66,352,900
BY CLASS OF CONCENTRATE SHIPPED TO SMELTERS							
Copper		843,609	391,214	3,156,997	527,232,800	----------	----------
Lead		76,181	20,859	2,395,283	1,922,859	78,935,727	1,850,028
Zinc-lead		435	25	7,295	7,156	151,380	163,172
Iron (from zinc-lead ore)		44,280	6,532	136,791	196,099	1,517,668	635,076
Total to copper and lead plants		964,505	418,630	5,696,366	529,358,914	80,604,775	2,648,276
Zinc concentrates to zinc plants		64,043	6,074	557,030	854,638	7,645,827	63,704,624
Total:							
1951		1,028,548	424,704	6,253,396	530,213,552	88,250,602	66,352,900
1950		1,016,474	449,847	6,115,345	541,504,725	78,159,988	61,322,800

For footnotes, see end of table.

TABLE 7.—Mine production of gold, silver, copper, lead, and zinc in Utah in 1951, by method of recovery and class of material processed, in terms of recoverable metal [1]—Continued

B. For ore, old tailings, etc., shipped directly to smelters

	Material shipped (short tons)	Recoverable metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
BY COUNTIES						
Beaver	472	10	2,240	23,100	57,430	15,353
Box Elder	262		52	35,700		
Juab	102,192	2,716	595,690	171,570	5,623,377	355,033
Millard	27	1	42	700	3,000	
Morgan	17		53		6,700	
Salt Lake	53,212	2,531	176,643	[3]11,344,160	4,705,818	221,860
Summit	30,495	657	150,043	74,465	828,365	9,907
Tooele	9,658	140	29,667	71,753	897,647	1,645,237
Uintah	7		10	700	600	
Utah	26,030	1,456	102,418	194,000	527,861	33,710
Washington	163	1	411	41,800	600	
Wayne	3			500		
Total:						
1951	222,538	7,512	1,057,269	[3]11,958,448	12,651,398	2,281,100
1950	227,186	7,700	968,463	[3]15,755,275	11,346,012	2,033,200
BY CLASS OF ORE, OLD TAILINGS, ETC.						
Dry gold:						
Crude ore	68	39	124		3,300	1,603
Old tailings	570	56	690	1,240	23,317	
Dry gold-silver:						
Crude ore	36,520	2,632	108,403	227,991	1,014,068	11,207
Old tailings	7,168	220	25,282	16,835	295,000	
Dry silver:						
Crude ore	94,863	2,215	465,390	207,237	3,165,455	
Old tailings	43,518	960	171,228	80,801	1,219,160	
Copper:						
Crude ore	2,664	186	24,272	210,479	3,800	
Precipitates				10,981,202		
Lead:						
Crude ore	25,543	983	233,298	154,857	6,130,720	347,833
Old tailings	571	31	2,580	1,825	63,729	2,791
Old slag and smelter cleanings	3,217	128	13,300	25,600	277,300	
Lead-copper ore	36	1	326	2,188	3,000	
Zinc-lead:						
Crude ore	590	12	5,601	11,195	101,598	108,694
Old tailings	38	1	223	350	7,484	3,528
Old slag	360	14	942	1,940	33,860	20,900
Total to copper and lead plants	215,726	7,478	1,051,659	11,923,740	12,341,791	496,556
Zinc:						
Crude ore	484		175	208	15,207	195,344
Old slag and smelter cleanings	6,328	34	5,435	34,500	294,400	1,589,200
Total to zinc plants	6,812	34	5,610	34,708	309,607	1,784,544
Total 1951	222,538	7,512	1,057,269	11,958,448	12,651,398	2,281,100

[1] No bullion produced in 1951.
[2] Combined to avoid disclosure of production of San Juan County.
[3] Includes copper recovered from smelting of mine-water precipitates as follows: 1951—10,981,202 pounds; 1950—14,561,870 pounds.

TABLE 8.—Mine production of gold, silver, copper, lead, and zinc in Utah in 1951, by method of recovery and class of material processed, in terms of gross metal content

Class of material	Quantity shipped or treated (short tons)	Gross metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
ORE AND OLD TAILINGS TREATED AT MILLS						
Copper	30,451,792	541,989	3,586,909	582,727,380	----------	----------
Lead	50	----------	157	----------	6,894	352
Zinc:						
Crude ore	25	----------	37	----------	800	6,928
Oil tailings	10,000	100	10,000	5,000	100,000	400,000
Zinc-lead	672,432	45,696	3,548,463	4,392,666	101,107,475	86,347,178
Total: 1951	31,134,299	587,785	7,145,566	587,125,046	101,215,169	86,754,458
1950	31,628,415	622,660	7,162,447	598,080,005	90,371,057	78,938,157
CONCENTRATE SHIPPED TO SMELTERS						
Copper	843,609	391,214	3,156,997	537,990,726	----------	----------
Lead	76,181	20,859	2,395,283	2,477,314	81,692,395	10,350,895
Zinc-lead	435	25	7,295	8,358	154,000	206,754
Iron (from zinc-lead ore)	44,280	6,532	136,791	207,146	2,066,816	2,461,580
Total to copper and lead plants	964,505	418,630	5,696,366	540,683,544	83,913,211	13,019,229
Zinc concentrate to zinc plants	64,043	6,081	558,156	1,006,160	8,231,688	66,191,260
Total: 1951	1,028,548	424,711	6,254,522	541,689,704	92,144,899	79,210,489
1950	1,016,474	449,849	6,115,534	553,075,108	81,576,604	71,506,565
ORE, OLD TAILINGS, ETC., SHIPPED DIRECTLY TO SMELTERS						
Dry gold:						
Crude ore	68	39	124	----------	3,369	1,925
Old tailings	570	56	690	1,313	35,432	----------
Dry gold-silver:						
Crude ore	36,520	2,632	108,403	236,391	1,569,626	14,219
Old tailings	7,168	220	25,282	17,535	489,415	----------
Dry silver:						
Crude ore	94,863	2,215	465,390	216,004	4,926,403	6,911
Old tailings	43,518	960	171,228	83,961	1,896,926	200,000
Copper:						
Crude ore	2,664	186	24,272	217,718	6,348	----------
Precipitates	----------	----------	----------	11,146,992	----------	----------
Lead:						
Crude ore	25,543	983	233,298	216,325	6,406,459	764,402
Old tailings	571	31	2,580	2,192	72,879	7,055
Old slag and smelter cleanings	3,217	128	13,300	36,604	291,484	----------
Lead-copper ore	36	1	326	2,256	4,194	----------
Zinc-lead:						
Crude ore	590	12	5,601	13,631	103,716	138,473
Old tailings	38	1	223	420	7,637	4,467
Old slag	360	14	942	2,429	34,556	26,578
Total to copper and zinc plants	215,726	7,478	1,051,659	12,193,771	15,848,444	1,164,030
Zinc:						
Crude ore	484	----------	360	3,874	16,815	244,261
Old slag and smelter cleanings	6,328	34	5,435	40,695	302,850	2,029,297
Total to zinc plants	6,812	34	5,795	44,569	319,665	2,273,558
Total: 1951	222,538	7,512	1,057,454	12,238,340	16,168,109	3,437,588
1950	227,186	7,708	969,173	16,199,589	14,154,615	4,490,073

TABLE 9.—Mine production of gold, silver, copper, lead, and zinc in Utah in 1951, by county and district, in terms of recoverable metal

County and district	Mines producing, lode [1]	Ore, old tailings, etc. (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
Beaver County:								
Beaver Lake	1	50		43	8,600			$2,120
Rocky	1	53	1	169	7,900			2,100
San Francisco	2	4,797	28	7,761	12,000	163,400	166,700	69,515
Star and North Star	1	793	12	6,719	4,000	89,000	86,500	38,609
Box Elder County: Lucin	1	262		52	35,700			8,686
Juab County:								
Detroit (Drum Mountain) [2]	1	16	5	53	1,300			538
Fish Springs	2	19		1,895		15,400		4,379
Mount Nebo (Mona)	1	35		84		4,000	6,400	1,933
Spring Creek	1	31		221	200	1,600		525
Tintic [3]	9	167,571	3,536	843,880	223,300	10,619,900	6,805,100	4,017,324
West Tintic	1	10		11	100	2,100	800	543
Millard County:								
Detroit (Drum Mountain) [2]	1	10	1	11	700			214
Gordon (Dog Valley)	1	11		21		2,000		365
Mineral Mountain	1	6		10		1,000		182
Morgan County: Argenta	1	17		53		6,700		1,207
Salt Lake County:								
Big Cottonwood	3	728	6	3,929	7,000	77,000	212,800	57,511
Little Cottonwood	2	203	4	2,012	4,000	40,100	33,300	15,927
Smelter	[4]	7,542	328	31,258	86,600	477,300		143,300
West Mountain (Bingham)	4	30,863,391	407,196	4,923,249	540,365,800	58,240,900	36,572,700	166,208,080
San Juan County: White Canyon [5]	1	[5]	[5]	[5]	[5]			[5]
Summit County: Uintah	11	142,311	3,432	757,993	236,200	16,804,600	11,793,000	5,916,824
Tooele County:								
Blue Bell	1	50	1	610	200	22,100		4,458
Clifton	2	128	3	1,022	9,400	8,000		4,689
Columbia	1	25		22		600	5,000	1,034
Dugway	3	134		168	100	32,200	30,900	11,371
Erickson	4	2,994	8	2,433	3,600	350,100	361,400	129,695
Ophir	4	11,395	81	54,914	80,300	1,423,200	682,300	442,361
Rush Valley	3	26,343	1,032	189,110	62,500	5,053,400	1,627,200	1,392,787
Smelter	[4]	6,328	34	5,435	34,500	294,400	1,589,200	354,623
Willow Springs	1	4		53	100	600		176
Uintah County:								
Brush Creek	1	3				600		104
Uteland Knole	1	4		10	700			178
Utah County:								
American Fork	4	544	16	1,948	2,000	47,400	21,600	14,938
Santaquin	1	23		32		3,200		583
Tintic [3]	6	25,552	1,446	100,938	192,300	486,800	15,000	275,447
Wasatch County: Blue Ledge	1	88,296	15,044	373,367	702,800	6,633,800	8,624,100	3,751,767
Washington County:								
Harrisburg	1	52	1	369	2,000			853
Tutsagubet	1	111		42	39,800	600		9,774
Wayne County: Miners Mountain [5]	1	6,995	1	768	48,300			12,419
Total	82	31,356,837	432,216	7,310,665	542,172,000	100,902,000	68,634,000	182,897,139

[1] No placer production in 1951. [2] Detroit (Drum Mountain) district lies in both Juab and Millard Counties. [3] Tintic district lies in both Juab and Utah Counties.
[4] Production came from old smelter cleanings; not counted as mine.
[5] Production for White Canyon district included with that for Miners Mountain district to avoid disclosure of individual company operations.

REVIEW BY COUNTIES

BEAVER

The principal output in Beaver County in 1951 was zinc-lead ore from the old Horn Silver mine near Milford in the San Francisco district. Metal Producers, Inc., worked the mine most of the year and operated the 500-ton flotation mill 3 months. The mill treated 4,704 tons of zinc-lead ore, which yielded 435 tons of concentrate containing 25 ounces of gold, 7,295 ounces of silver, 8,358 pounds of copper, 154,000 pounds of lead, and 206,754 pounds of zinc. Development of the Harrington-Hickory group near Milford in the Star and North Star district by the Harrington Mines Co. resulted in shipment of 793 tons of ore containing 16 ounces of gold, 7,790 ounces of silver, 5,500 pounds of copper, 99,730 pounds of lead, and 116,469 pounds of zinc. Other county production was 126 tons of copper ore from the Cactus, O. K., and Old Hickory mines, all near Milford.

BOX ELDER

Output in Box Elder County in 1951 was 262 tons of ore containing 52 ounces of silver and 37,032 pounds of copper; the ore was produced by lessees from the Copper Mountain (Salt Lake Copper) group near Montello, Nev., in the Lucin district.

JUAB

Tintic District.—The Tintic district, which lies in both Juab and Utah Counties, is one of the most productive areas in the State. Table 10 gives metal production in each section of the district in 1951, as well as the district total for prior years.

TABLE 10.—Mine production of gold, silver, copper, lead, and zinc in Tintic district, Juab and Utah Counties, Utah, 1947–51, and total, 1869–1951, in terms of recoverable metal

	Mines producing	Ore and old tailings (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)	Total value
1947	27	167,384	15,385	1,076,726	550	6,166	3,969	$4,480,038
1948	21	175,897	11,007	1,123,460	501	5,970	3,680	4,735,701
1949	15	160,448	5,133	914,150	263	6,676	6,082	4,728,346
1950	18	189,870	3,277	924,722	149	6,520	5,985	4,474,031
1951:								
Juab County	9	167,571	3,536	843,880	112	5,310	3,403	4,017,324
Utah County	6	25,552	1,446	100,938	96	243	7	275,447
Total 1951	15	193,123	4,982	944,818	208	5,553	3,410	4,292,771
Total 1869–1951	--------	[1] 15,765,383	2,628,157	264,799,605	123,044	962,814	57,624	416,237,799

[1] Figures estimated for certain years before 1901.

Chief Consolidated Mining Co., in the Juab part of the district, was by far the most important producer in the entire district. The company operated its Chief No. 1 and Eureka Hill mines throughout the year, and the old tailings dump until October 31. According to the company annual report for 1951, the Chief No. 1 mine produced

64,136 tons of zinc-lead ore, 36,364 tons of siliceous silver ore, and 8,306 tons of lead-silver ore; and the Eureka Hill mine produced 5,971 tons of lead-silver ore. The ores contained 2,543 ounces of gold, 590,770 ounces of silver, 161,380 pounds of copper, 11,656,032 pounds of lead, and 8,421,975 pounds of zinc. In addition, the company shipped 34,160 tons of old tailings containing 762 ounces of gold, 129,392 ounces of silver, 50,000 pounds of copper, and 1,445,105 pounds of lead. On June 13 the Chief Consolidated Mining Co. signed an exploration contract with the Federal Government, which called for extensive exploration on the 2,700-foot level of the Chief No. 1 mine, sinking a winze 400 feet, and 3,300 feet of workings on the 3,100-foot level.

Lessees worked the American Star mine all year and shipped 10,011 tons of ore containing 456 ounces of gold, 132,380 ounces of silver, 19,000 pounds of copper, 522,614 pounds of lead, and 3,935 pounds of zinc. Lessees worked other properties in the Juab County part of the district; shipments in 1951 comprised 3,456 tons of lead-silver ore from the Centennial-Beck-Victoria group; 2,150 tons of silver ore and 328 tons of gold-silver ore from the Empire group; 1,894 tons of gold-silver ore, 184 tons of zinc-lead ore, and 61 tons of lead ore from the Godiva mine; 79 tons of silver ore from the Plutus mine; and 21 tons of lead ore from the Page and Bonnie Lee claims.

Lessees worked various properties in the Utah County part of the district; shipments in 1951 comprised 11,092 tons of gold-silver ore and 28 tons of zinc-lead ore from the Eureka Standard waste dump; 7,168 tons of old gold-silver tailings and 226 tons of lead tailings from the Harold dump; 2,013 tons of copper-silver ore and 1,814 tons of gold-silver ore from the Eureka Lilly mine; 1,559 tons of gold-silver ore and 68 tons of gold ore from the Mountain View group; 1,197 tons of silver ore from the Tintic Standard waste dump; and 387 tons of gold-silver ore from the Yankee mine.

Other Juab County production included 35 tons of zinc-lead ore from the Little Eva mine, 31 tons of silver ore from the Silver Prince mine, 18 tons of lead-silver ore from the Utah Mine group, and 16 tons of copper ore from the Ibex group.

MILLARD

A few small lots of ore were produced in 1951 from claims in Millard County—10 tons of copper ore from the R. J. Law claim (Detroit district), 11 tons of lead ore from the Blue Bell claim (Gordon district), and 6 tons of lead ore from the Keno claim (Mineral Mountain district).

MORGAN

After being idle for several years, the Carbonate Hill mine near Morgan in the Argenta district was operated in 1951 by lessees who shipped 17 tons of carbonate lead ore.

SALT LAKE

Big and Little Cottonwood Districts.—Output of ore in the Big Cottonwood district declined in 1951, owing largely to the fact that the smelters near Salt Lake City would not accept any carbonate

zinc ore from the Cardiff mine after April 13. During the remainder of the year all shipments from this mine were zinc-lead carbonate ore. The Cardiff Mining & Milling Co. reported that a total of 684 tons of zinc ore and zinc-lead ore was shipped from its mine in 1951; the ore contained 3 ounces of gold, 3,654 ounces of silver, 12,216 pounds of copper, 71,790 pounds of lead, and 271,238 pounds of zinc. Lessees worked the South Hecla and Drain Tunnel (Wasatch Mines) properties in the Little Cottonwood district a few months in 1951 and shipped 203 tons of ore containing 5 ounces of gold, 2,159 ounces of silver, 5,061 pounds of copper, 44,634 pounds of lead, and 44,017 pounds of zinc. Other production from the Big and Little Cottonwood districts was 44 tons of lead ore from the American Metal and Lake Blanche properties.

Smelter District.—Output in 1951 comprised 4,325 tons of dump ore and 1,192 tons of smelter cleanings from the Murray smelter site and 2,025 tons of old slag from the Midvale smelter dump.

West Mountain (Bingham) District.—In 1951 the West Mountain (Bingham) district produced 94 percent of the State gold, 67 percent of the silver, over 99 percent of the copper, 58 percent of the lead, and 53 percent of the zinc; the district total value of the 5 metals represented 91 percent of the State total. Output was 30,444,800 tons of copper ore, 373,747 tons of zinc-lead ore, 32,286 tons of siliceous silver ore and gold-silver ore, 12,558 tons of lead ore, and 6,919 tons of copper precipitates. Gold, silver, and copper production in 1951 was less than in 1950, owing mainly to a 6-day shutdown—caused by a strike—at the Utah Copper property. On the other hand, lead and zinc production was greater due to nearly continuous operations of the Lark and U. S. mines of the United States Smelting, Refining & Mining Co.

TABLE 11.—Mine production of gold, silver, copper, lead, and zinc in West Mountain (Bingham) district, Salt Lake County, Utah, 1947–51, and total, 1865–1951, in terms of recoverable metal

Year	Number of mines	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)	Total value
1947	5	29,306,718	384,414	4,816,611	264,315	26,163	20,446	$141,308,766
1948	6	24,889,134	332,588	4,694,674	225,225	30,672	22,077	130,490,268
1949	5	21,405,489	286,155	4,316,378	196,101	32,600	22,311	107,020,080
1950	6	31,405,801	428,313	4,963,586	277,655	27,472	16,120	146,983,284
1951	4	30,863,391	407,196	4,923,249	270,183	29,120	18,286	166,208,080
Total 1865–1951	-------	[1] 661,174,183	7,682,695	166,839,021	5,903,799	1,708,056	578,937	2,494,437,343

[1] Figures estimated for certain years before 1901.

In 1951 the Utah Copper Division of the Kennecott Copper Corp. moved about 45,000,000 tons of waste and treated 30,444,800 tons of ore, averaging 0.957 percent copper, in its two flotation mills at Arthur and Magna, compared with 41,342,160 tons of waste and 31,037,800 tons of copper ore in 1950; the cutoff point between waste and ore was 0.40 percent copper. The two milling plants, which have a combined rated capacity of 80,000 tons of ore a day, operated throughout the year, except for a 6-day shutdown in August. The

property is not only the largest producer of copper in the State but in 1951 was again the largest producer of gold and silver in the State and the second-largest producer of molybdenum in the United States.

In 1951 output of zinc-lead ore from the West Mountain (Bingham) district increased to 373,747 tons, a gain of 57,534 tons (18 percent) over that in 1950. This gain resulted from maximum operations nearly all year of the United States & Lark property of the United States Smelting, Refining & Mining Co., the largest producer of zinc-lead ore in the State. Output from both mines in 1951 comprised 355,242 tons of zinc-lead milling ore, 32,247 tons of siliceous silver ore and gold-silver smelting ore, and 12,558 tons of lead smelting ore. Labor supply, especially experienced miners, was short during the summer and fall months, but an aggressive training program and continued mechanization underground maintained operations at both mines at a satisfactory level.

Combined Metals Reduction Co. operated the Butterfield group at Lark nearly continuously and shipped 17,933 tons of zinc-lead ore to the Combined Metals custom flotation mill at Bauer and 39 tons of silver ore to a smelter. The milling ore contained 1,356 ounces of gold, 231,799 ounces of silver, 75,000 pounds of copper, 3,869,601 pounds of lead, and 1,797,793 pounds of zinc.

Other district production was 231 tons of zinc-lead ore from the National Tunnel property and 341 tons of material (zinc-lead) cleaned up from loading stations.

SAN JUAN

Vanadium Corporation of America operated its 20-ton pilot concentrator in White Canyon continuously during the year on uranium-copper ore purchased from various operators.

SUMMIT AND WASATCH

PARK CITY REGION

The Park City region, one of the most productive areas in the State, includes the Uintah district in Summit County and the Blue Ledge and Snake Creek districts in Wasatch County. Table 12 shows the production and total value of the five metals in 1951 compared with 1947-50 and the total from 1870 to 1951.

TABLE 12.—Mine production of gold, silver, copper, lead, and zinc in Park City region, Summit and Wasatch Counties, Utah, 1947–51, and total, 1870–1951, in terms of recoverable metal

Year	Number of mines	Ore and old tailings (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)	Total value
1947	10	657,496	17,052	1,352,748	570	10,987	10,956	$7,875,999
1948	10	506,671	19,087	1,703,864	597	12,670	10,320	9,749,907
1949	10	318,341	19,443	1,061,902	451	8,583	8,359	6,604,858
1950	12	209,640	24,125	952,632	417	7,538	7,425	6,023,922
1951	12	230,607	18,476	1,131,360	470	11,719	10,209	9,668,591
Total 1870–1951	--------	[1] 16,307,755	659,989	240,977,206	36,824	1,255,719	390,175	407,107,598

[1] Figures estimated for certain years before 1901.

Owing to nearly continuous operations throughout 1951 by all of the principal producers in the Park City region, output of ore and production of each metal (except gold) were greater than in 1950. Output of zinc-lead ore, the chief source of metal production, increased from 120,129 tons in 1950 to 190,178 in 1951, a 58-percent gain. The New Park Mining Co. was the leading producer in the Park City region. The company reported that 88,296 tons of zinc-lead ore was shipped in 1951 compared with 70,480 tons in 1950. The ore in 1951, containing 21,087 ounces of gold, 434,219 ounces of silver, 1,019,881 pounds of copper, 7,737,916 pounds of lead, and 10,985,330 pounds of zinc, was treated in the custom flotation mills of the United States Smelting, Refining & Mining Co. at Midvale and Combined Metals Reduction Co. at Bauer.

The Park Utah Consolidated Mines Co. operated its three units—Judge, Ontario, and Keetley—all year and shipped 55,185 tons (38,231 tons in 1950) of zinc-lead ore to the custom flotation mill of the International Smelting & Refining Co. near Tooele; all ore shipped in 1951 came from the Judge and Keetley units. The ore contained 2,118 ounces of gold, 315,608 ounces of silver, 22,605 pounds of copper, 9,249,384 pounds of lead, and 11,294,400 pounds of zinc. The company announced that results of development in the Ontario mine during 1951 exceeded expectations in the finding of new bodies of ore on all levels.

The 800-ton concentrator of the Silver King Coalition Mines Co. at Park City operated continuously on zinc-lead ore from the company-owned mine in the Uintah district of the Park City region. The company reported that 44,465 tons of ore was milled in 1951, which contained 1,260 ounces of gold, 328,000 ounces of silver, 200,000 pounds of copper, 8,340,000 pounds of lead, and 3,094,000 pounds of zinc. In addition, 1,507 tons of lead-silver ore was shipped direct to a lead smelter in Colorado. The mine produced only 11,418 tons of zinc-lead ore in 1950, as it was operated only 2½ months.

McFarland & Hullinger worked the Ontario waste dump the last 6 months of the year and shipped 18,481 tons of siliceous ore, which contained 362 ounces of gold, 81,366 ounces of silver, 34,458 pounds of copper, and 108,778 pounds of lead. About 10,000 tons of current zinc tailings from the Silver King Coalition mill was re-treated by Reuben Garbett; 2,232 tons of zinc-lead ore from the Silver King waste dump was shipped to custom flotation mills; and 730 tons of lead-silver ore from the Silver King Western mine was shipped direct to a lead smelter. Virtually all the rest of the district output (9,703 tons) was old tailings containing mostly silver and lead shipped from various locations along Silver Creek.

TOOELE

The most productive areas in Tooele County are the Ophir and Rush Valley districts. In 1951, 4 mines in the Ophir district produced 11,395 tons of ore compared with 7,900 in 1950. This gain was due to increased production of zinc-lead ore from the Ophir unit of the United States Smelting, Refining & Mining Co. (from 1,345 tons in 1950 to 8,167 in 1951). McFarland & Hullinger continued to operate the Hidden Treasure mine, but output of lead ore and zinc-lead ore de-

clined to 3,054 tons. Other district production was 90 tons of zinc-lead ore from the Mono-Kearsarge group and 45 tons of lead ore and 39 of zinc-lead ore from the Ophir Hill mine.

Output of ore in the Rush Valley district increased from 14,958 tons in 1950 to 26,343 in 1951. Zinc-lead ore produced from the West Calumet mine by the Combined Metals Reduction Co. increased from 6,054 tons in 1950 to 23,420 in 1951, while that from the Honorine mine declined from 8,030 tons to 2,320. The ore from both properties contained 1,632 ounces of gold, 227,644 ounces of silver, 87,500 pounds of copper, 6,060,404 pounds of lead, and 1,995,070 pounds of zinc. Other district production was 570 tons of old tailings, containing chiefly gold and lead shipped by the Combined Metals Reduction Co., and 33 tons of zinc-lead ore produced from the Silver Eagle mine.

The Bar X Mining Co. worked its Esther group in the Erickson district all year and shipped 2,876 tons of ore, which contained 10 ounces of gold, 464 ounces of silver, 4,866 pounds of copper, 380,554 pounds of lead, and 462,560 pounds of zinc. Other county production included 4,881 tons of old zinc slag from the International Smelting & Refining Co. dump near Tooele, 1,447 tons of furnace cleanings from its zinc fuming plant (also near Tooele), 115 tons of zinc-lead ore from the Ida-Desert View group in the Erickson district, 113 tons of copper ore from the Monocco mine in the Clifton (Gold Hill) district, 77 tons of zinc ore and zinc-lead ore from the Four Metals mine and 39 tons of lead ore from the Cannon property in the Dugway district, and 50 tons of lead ore from the Blackhawk claim in the Blue Bell district.

UTAH

American Fork District.—Jay Jacobson shipped 360 tons of old slag, containing principally lead and zinc, from the Yankee property and 113 tons of lead-silver ore from the Dutchman waste dump. Other district production was 60 tons of lead ore from the Blue Rock (Pacific) mine and 11 tons of zinc-lead ore from the Floral lode.

Tintic District.—Mines in the Utah County section of the Tintic district are reviewed under Juab County.

WASATCH

Park City Region.—Mines in the Wasatch County section of the Park City region are reviewed under Summit and Wasatch Counties.

WASHINGTON

The Requa mine in the Harrisburg (Leeds) district was operated a short time in 1951 and produced 52 tons of copper-silver ore. Kentucky-Utah Mining Co. worked the Dixie-Apex mine in the Tutsagubet district most of the year and shipped 111 tons of ore containing 42 ounces of silver, 40,726 pounds of copper, and 630 pounds of lead.

Washington

Gold, Silver, Copper, Lead, and Zinc

(MINE REPORT)

By Richard H. Mote

GENERAL SUMMARY

SUSTAINED high market prices and a brisk demand for metal to meet national defense requirements stimulated mining activity in Washington in 1951 and resulted in all-time high production of ore and recoverable zinc. The output of ore totaled 1,304,495 tons compared with 1,279,595 tons in 1950. Zinc output—over 70 percent of which came from mines in Pend Oreille County—totaled 18,189 tons, a 23-percent increase over the 1950 figure. The production of lead and gold, which had reached new peaks in 1950, declined 23 and 27 percent, respectively, in 1951; copper and silver production also declined.

The total value of the five metals rose to a new record high from $12,652,302 in 1950 to $14,030,884 in 1951, an advance of 11 percent. Expanded production from many of the mines, plus higher average prices for copper, lead, and zinc, were mainly responsible.

Chelan remained in first place among Washington counties in tonnage of ore treated, and Pend Oreille County continued to lead in value of metals produced.

All tonnage figures herein are short tons and "dry weight"; that is, they do not include moisture. The value of the metal production has been calculated at the prices shown in table 1.

Gold.—The decrease of 24,712 ounces in gold output in 1951, compared with 1950, reduced production of the metal in the State to the lowest amount since 1947. This sharp drop resulted mainly from declines in output from the following major producers, listed in order of output: Lovitt Mining Co. Gold King mine, Wenatchee River district, Chelan County; Howe Sound Co. Holden mine, Chelan

TABLE 1.—Prices of gold, silver, copper, lead, and zinc, 1947–51

Year	Gold [1] (per fine ounce)	Silver [2] (per fine ounce)	Copper [3] (per pound)	Lead [3] (per pound)	Zinc [3] (per pound)
1947	$35.00	$0.905	$0.210	$0.144	$0.121
1948	35.00	.905+	.217	.179	.133
1949	35.00	.905+	.197	.158	.124
1950	35.00	.905+	.208	.135	.142
1951	35.00	.905+	.242	.173	.182

[1] Price under authority of Gold Reserve Act of Jan. 31, 1934.
[2] Treasury buying price for newly mined silver July 1, 1946, to date—$0.9050505 ($0.905 used in 1947 for calculating purposes).
[3] Yearly average weighted price of all grades of primary metal sold by producers. Price in 1947 includes bonus payments by Office of Metals Reserve for overquota production.

Lake district, Chelan County; and Knob Hill Mines, Inc., Knob Hill mine, Ferry district, Republic County. These three properties produced nearly 98 percent of the State total gold in 1951.

Silver.—The Knob Hill mine (gold ore) continued to be the leading silver producer in Washington in 1951, followed by the Holden mine (zinc-copper ore). Other important silver producers in 1951, in order of decreasing output, were the Gold King mine (gold ore); the Anaconda Copper Mining Co. Bonanza mine (lead ore), Bossburg

TABLE 2.—Mine production of gold, silver, copper, lead, and zinc in Washington in 1951, by months, in terms of recoverable metal [1]

Month	Gold (fine ounces)	Silver (fine ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
January	6,749	33,964	366	735	1,674
February	5,541	25,198	311	781	1,449
March	6,625	28,830	394	814	1,663
April	3,290	17,903	98	607	1,376
May	5,469	26,292	260	627	1,428
June	7,635	30,123	346	560	1,515
July	5,710	25,096	345	500	1,477
August	4,444	28,573	320	674	1,548
September	4,369	23,591	213	563	1,384
October	5,378	28,763	413	749	1,603
November	7,069	40,402	516	715	1,463
December	5,126	26,213	507	677	1,609
Total	67,405	334,948	4,089	8,002	18,189

[1] Mine production comprises ore, gravel, or other mineral material sold or treated and metal recovered as natural gold or as bullion from cyanidation or amalgamation and the estimated recoverable metal (or gross metal as indicated) contained in concentrates, ores, tailings and other mineral materials shipped directly to smelters or sold to ore buyers within the year.

TABLE 3.—Mine production of gold, silver, copper, lead, and zinc in Washington, 1947–51, and total, 1860–1951, in terms of recoverable metal [1]

Year	Mines producing		Material sold or treated [2] (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1947	25	6	676,176	34,965	$1,223,775	293,736	$265,831
1948	30	1	974,257	70,075	2,452,625	375,831	340,146
1949	29	3	1,012,198	71,994	2,519,790	357,853	323,875
1950	27	6	1,279,595	92,117	3,224,905	363,656	329,127
1951	29	1	1,304,495	67,405	2,359,175	334,948	303,145
1860–1951			[3]	2,515,226	66,788,233	14,555,897	10,671,637

Year	Copper		Lead		Zinc		Total value
	Short tons	Value	Short tons	Value	Short tons	Value	
1947	2,240	$940,800	5,359	$1,543,392	13,800	$3,339,600	$7,313,398
1948	5,665	2,458,610	7,147	2,558,626	12,638	3,361,708	11,171,715
1949	5,275	2,078,350	6,417	2,027,772	10,740	2,663,520	9,613,307
1950	5,057	2,103,712	10,334	2,790,180	14,807	4,205,188	12,652,302
1951	4,089	1,979,076	8,002	2,768,692	18,189	6,620,796	14,030,884
1860–1951	101,252	30,261,057	113,022	21,835,686	207,989	42,569,460	172,126,073

[1] Includes recoverable metal content of gravel washed (placer operations), ore milled, and ore shipped to smelters during calendar year indicated.
[2] Does not include gravel washed. [3] 1860–1903: figures not available; 1904–51, 17,772,143 tons produced.

TABLE 4.—Gold produced at placer mines in Washington, 1947–51, by method of recovery

Method	Mines producing	Material treated (cubic yards)	Gold recovered	
			Fine ounces	Value
Dragline dredges:				
1947	1	3,500	14	$490
1948–51				
Nonfloating washing plants: [1]				
1947	3	4,700	56	1,960
1948	1	2,900	10	350
1949				
1950	1	8,000	31	1,085
1951	1	5,100	13	455
Small-scale hand methods:				
1947	2	400	7	245
1948				
1949	3	400	10	350
1950	5	1,033	8	280
1951				
Grand total placers:				
1947	6	8,600	77	2,695
1948	1	2,900	10	350
1949	3	400	10	350
1950	6	9,033	39	1,365
1951	1	5,100	13	455

[1] Includes all placer operations using a power excavator and washing plant, both on dry land; an outfit with a movable washing plant is termed a "dry-land dredge."

district, Stevens County; and the Pend Oreille Mines & Metals Co. Pend Oreille mine (zinc-lead ore), Metaline district, Pend Oreille County. These five mines supplied nearly 90 percent of the State total silver.

Copper.—A decline in the output of copper ore at the Holden mine was the principal factor in the 19-percent drop in Washington copper production in 1951. However, despite the smaller ore output, the Holden mine continued to rank first among the State's copper producers and was followed by the Alder Gold-Copper Co. Alder Group mine in Methow district, Okanogan County. These two properties produced over 99 percent of the State copper in 1951.

Lead.—Production of lead in Washington in 1951 decreased 2,332 tons or nearly 23 percent from the record high total of 10,334 tons produced in 1950. This decrease was due mainly to sharp drops in lead production at the Grandview and Bonanza mines. The following mines, ranked in order of decreasing output, were the leading lead producers in the State in 1951: Pend Oreille, Grandview, Bonanza, and Deep Creek. These four properties supplied 98 percent of the State total lead in 1951.

Zinc.—Recoverable zinc production in Washington in 1951 advanced nearly 23 percent over the 1950 output and attained the highest level in the State's mining history. A greatly increased output at the Deep Creek mine and a substantial gain at the property of the Pend Oreille Mines & Metals Co. were the principal factors in establishing the new record output. The leading zinc-producing mines, in order of rank, were: Grandview, Pend Oreille, Deep Creek, and Holden. These four properties produced over 98 percent of the State total zinc in 1951.

TABLE 5.—Mine production of gold, silver, copper, lead, and zinc in Washington in 1951, by counties, in terms of recoverable metal

County	Mines producing		Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Fine ounces	Value	Fine ounces	Value
Chelan	5		46,458	$1,626,030	113,155	$102,411
Garfield		1	13	455	2	2
King	1		2	70	57	52
Okanogan	5		1,360	47,600	15,007	13,582
Pend Oreille	4		30	1,050	22,896	20,722
Stevens	10		3	105	44,166	39,972
Other counties [1]	4		19,539	683,865	139,665	126,404
Total	29	1	67,405	2,359,175	334,948	303,145

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Chelan	7,864,700	$1,903,257	13,500	$2,336	3,758,800	$684,102	$4,318,136
Garfield							457
King	2,000	484					606
Okanogan	266,500	64,493	101,000	17,473	15,200	2,766	145,914
Pend Oreille	36,900	8,930	10,467,800	1,810,929	25,505,400	4,641,983	6,483,614
Stevens	2,700	653	5,421,600	937,937	7,098,500	1,291,927	2,270,594
Other counties [1]	5,200	1,259	100	17	100	18	811,563
Total	8,178,000	1,979,076	16,004,000	2,768,692	36,378,000	6,620,796	14,030,884

[1] Includes Ferry, Kittitas, and Whatcom Counties, for which Bureau of Mines is not at liberty to publish separate figures.

MINING INDUSTRY

Washington's mining industry in 1951 was highlighted by expanded activity in mining and development, stimulated largely by the sustained high level in the market prices of copper, lead, and zinc and a strong demand for metals to support the Nation's defense program. Although production was curtailed somewhat by labor shortages reported in several operating areas and the Nation-wide mine, mill, and smelter labor strike from August 27 to September 7, ore output advanced to a new record high level. As compared with 1950, zinc-lead ore production rose 47 percent, while the outputs of gold, lead, zinc, and zinc-copper ores decreased.

Field teams of the Defense Minerals Administration (Defense Minerals Exploration Administration after August 28, 1951, as a result of an Executive order), made up of Bureau of Mines engineers and geologists of the Geological Survey, examined a number of Washington mining properties for eligibility under the Federal Government program of assisting in the exploration of unknown or undeveloped sources of strategic and critical minerals and metals. As a result of this activity, nine exploration contracts totaling $307,646 were approved for properties producing copper, lead, and zinc.

Field work for a Bureau of Mines report of investigations on the Sunset copper deposit in the Index district, Snohomish County, was completed in February 1951. Results of exploration by diamond drilling are described in a report scheduled for publication in 1953.

TABLE 6.—Mine production of gold, silver, copper, lead, and zinc in Washington in 1951, by class of ore or other source material, in terms of recoverable metal

Source	Number of mines	Material sold or treated (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Ore:							
Dry gold	8	103,351	46,045	173,505	4,800	100	100
Dry silver	1	3		22			
Total	9	103,354	46,045	173,527	4,800	100	100
Copper	5	17,064	1,361	2,365	264,100		
Lead	4	14,684		44,462	6,930	3,611,400	58,520
Zinc	1	2,688		135		10,440	389,960
Zinc-copper	1	550,530	19,953	79,312	7,864,700	13,500	3,758,800
Zinc-lead	9	616,175	33	35,145	37,470	12,368,560	32,170,620
Total	20	1,201,141	21,347	161,419	8,173,200	16,003,900	36,377,900
Gravel (placer operations)	1		13	2			
Total all sources	30	1,304,495	67,405	334,948	8,178,000	16,004,000	36,378,000

METALLURGICAL INDUSTRY

Of the 1,304,495 tons of lode material sold or treated in 1951, 1,248,019 tons (96 percent) went to mills and 56,476 tons (4 percent) to smelters compared with 97 and 3 percent, respectively, in 1950.

The 12 flotation mills and 1 gravity-concentration mill that treated ores from Washington mines in 1951 had daily capacities ranging from 25 to 2,000 tons. The 2,000-ton mill was that of the Howe Sound Co., Chelan Division, in Chelan County. The name and location of all the mills and the source of the ore treated are given in the following review by counties and districts.

New milling plants were being constructed during the year at several mining properties in the State. Erection of a 1,000-ton zinc-lead concentrator was begun by the American Smelting & Re-

TABLE 7.—Mine production of gold, silver, copper, lead, and zinc in Washington in 1951, by method of recovery and type of material processed, in terms of recoverable metal

Method of recovery and type of material processed	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Lode: [1]					
Amalgamation	9	3			
Cyanidation	2,659	27,208			
Total recoverable in bullion	2,668	27,211			
Concentration and smelting of concentrates	38,208	272,117	8,174,865	15,987,900	36,373,140
Direct smelting [1]	26,516	35,618	3,135	16,100	4,860
Placer	13	2			
Grand total	67,405	334,948	8,178,000	16,004,000	36,378,000

[1] Comprises ore only. No old tailings, etc., processed in Washington in 1951.

TABLE 8.—Mine production of gold, silver, copper, lead, and zinc in Washington in 1951, by method of recovery (except placer) and class of material processed, in terms of recoverable metal

A. For ore treated at mills

	Ore treated (short tons)	Recoverable in bullion		Concentrate shipped to smelters [1] and recoverable metal					
		Gold (fine ounces)	Silver (fine ounces)	Concentrate (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
BY COUNTIES									
Chelan	550,641	3	2	21,204	19,959	79,314	7,864,700	13,500	3,758,800
Okanogan	18,000			1,646	1,359	14,894	266,400	100,600	15,050
Pend Oreille	510,207			31,016	30	22,896	36,900	10,467,800	25,505,400
Stevens	122,324			10,570	2	42,598	2,065	5,406,000	7,093,890
Other counties [2]	46,847	2,665	27,209	1,135	16,858	112,415	4,800		
Total: 1951	1,248,019	2,668	27,211	65,571	38,208	272,117	8,174,865	15,987,900	36,373,140
1950	1,235,765	5,860	37,235	65,351	54,455	294,291	10,113,908	20,661,746	29,612,446
BY CLASS OF ORE TREATED									
Dry gold	46,958	2,668	27,211	1,136	16,864	112,417	4,800		
Copper	17,020			1,548	1,359	2,215	261,065		
Lead	14,672			3,164		44,267	6,930	3,599,900	57,760
Zinc	2,688			336		135		10,440	389,960
Zinc-copper	550,530			21,203	19,953	79,312	7,864,700	13,500	3,758,800
Zinc-lead	616,151			38,184	32	33,771	37,370	12,364,060	32,166,620
Total 1951	1,248,019	2,668	27,211	65,571	38,208	272,117	8,174,865	15,987,900	36,373,140

BY CLASS OF CONCENTRATE SHIPPED TO SMELTERS [1]						
Dry gold	1,136	16,864	112,417	4,800		
Copper	18,906	21,128	78,813	8,057,635	550	
Lead	11,348	1	68,139	12,156	15,308,970	334,633
Zinc	34,174	214	10,690	100,274	670,920	36,037,549
Zinc-lead	7	1	2,058		7,460	958
Total: 1951	65,571	38,208	272,117	8,174,865	15,987,900	36,373,140
1950	65,351	54,455	294,291	10,113,908	20,661,746	29,612,446

B. For ore shipped directly to smelters

	Ore shipped (short tons)	Recoverable metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
BY COUNTIES						
Chelan	56,379	26,496	33,839			
King	31	2	57	2,000		
Stevens	44	1	1,568	635	15,600	4,610
Other counties [3]	22	17	154	500	500	250
Total: 1951	56,476	26,516	35,618	3,135	16,100	4,860
1950	43,830	31,763	32,120	92	6,254	1,554
BY CLASS OF ORE						
Dry gold	56,393	26,513	33,877		100	100
Dry silver	3		22			
Copper	44	2	150	3,035		
Lead	12		195		11,500	760
Zinc-lead	24	1	1,374	100	4,500	4,000
Total 1951	56,476	26,516	35,618	3,135	16,100	4,860

[1] Excludes concentrates treated only by amalgamation and/or cyanidation.
[2] Includes Ferry and Kittitas Counties, for which Bureau of Mines is not at liberty to publish separate figures.
[3] Includes Okanogan and Whatcom Counties, for which Bureau of Mines is not at liberty to publish separate figures.

TABLE 9.—Mine production of gold, silver, copper, lead, and zinc in Washington in 1951, by method of recovery (except placer) and class of material processed, in terms of gross metal content

Class of material	Quantity shipped or treated (short tons)	Gross metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
ORE TREATED AT MILLS						
Dry gold	46,958	22,514	174,338	5,500		
Copper	17,020	1,452	2,440	288,900		
Lead	14,672		49,520	11,500	3,880,964	83,577
Zinc	2,688		180		15,000	509,000
Zinc-copper	550,530	24,205	117,437	8,543,020	26,114	5,323,436
Zinc-lead	616,151	38	36,531	45,785	13,189,448	39,098,742
Total: 1951	1,248,019	48,209	380,446	8,894,705	17,111,526	45,005,755
1950	1,235,765	69,507	471,060	10,981,021	24,004,722	35,214,573
CONCENTRATE SHIPPED TO SMELTERS						
Dry gold	1,136	16,864	112,417	4,994		
Copper	18,906	21,128	78,813	8,306,615	996	
Lead	11,348	1	68,139	14,154	15,573,233	422,231
Zinc	34,174	214	10,690	105,416	700,796	38,906,447
Zinc-lead	7	1	2,058		7,540	1,212
Total: 1951	65,571	38,208	272,117	8,431,179	16,282,565	39,329,890
1950	65,351	54,455	294,291	10,441,468	21,036,958	30,618,228
ORE SHIPPED DIRECTLY TO SMELTERS						
Dry gold	56,393	26,513	33,877		105	126
Dry silver	3		22			
Copper	44	2	150	3,112		
Lead	12		195		11,668	962
Zinc-lead	24	1	1,374	115	4,540	5,067
Total: 1951	56,476	26,516	35,618	3,227	16,313	6,155
1950	43,830	31,763	32,120	126	6,498	1,888

fining Co. at its Van Stone property in Stevens County, and the Pend Oreille Mines & Metals Co. expected to complete a second 800-ton milling unit early in the second quarter of 1952 at its property in Pend Oreille County. Development of the Advance and Iroquois mines in the Northport district, Stevens County, by Mines Management, Inc., included construction of a 50-ton pilot concentrator.

Most of the ore and concentrates treated in 1951 at the Tacoma electrolytic copper smelter and refinery of the American Smelting & Refining Co. came from Washington mines. Other markets for Washington ores and concentrates during the year included the Bunker Hill & Sullivan Mining & Concentrating Co. lead smelter and refinery at Bradley, Idaho; the American Smelting & Refining Co. lead smelter at East Helena, Mont.; the Anaconda Copper Mining Co. electrolytic zinc plant at Anaconda, Mont.; the American Zinc Co. of Illinois zinc plants at Fairmont City and Monsanto, Ill.; the Sullivan Mining Co. electrolytic zinc plant at Kellogg, Idaho; and the Consolidated Smelting & Refining Co. lead and zinc plants at Trail, British Columbia.

TABLE 10.—Mine production of gold, silver, copper, lead, and zinc in Washington in 1951, by county and district, in terms of recoverable metal

County and district	Mines producing		Ore (short tons)	Gold (lode and placer) (fine ounces)	Silver (lode and placer)[1] (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
	Lode	Placer							
Chelan County:									
Chelan Lake	1		550,530	19,953	79,312	7,864,700	13,500	3,758,800	$3,359,831
Peshastin Creek	3		112	13	5				460
Wenatchee	1		56,378	26,492	33,838				957,845
Garfield County:									
Snake River		1		13	2				457
King County: Taylor River	1		31	2	57	2,000			606
Okanogan County:									
Concully	1		1		90	100	400	150	201
Loomis-Oroville	1		1,000		12,822	6,100	100,600	15,050	33,224
Methow	1		17,000	1,359	2,072	260,300			112,433
Myers Creek	1		4	1	1				36
Nespelem	1		3		22				20
Pend Oreille County:									
Metaline	4		510,207	30	22,896	36,900	10,467,800	25,505,400	6,483,614
Stevens County:									
Bossburg (Clugston Creek)	3		14,932	1	35,803	1,300	3,536,300	90,500	661,005
Northport (Aladdin)	5		107,208		4,551	1,200	1,873,100	6,992,300	1,601,054
Old Dominion	1		223	2	3,810		12,200	15,700	8,485
Springdale	1		5		2	200			50
Other counties[2]	4		46,861	19,539	139,665	5,200	100	100	811,563
Total	29	1	1,304,495	67,405	334,948	8,178,000	16,004,000	36,378,000	14,030,884

[1] Source of silver: 334,946 ounces from lode mines and 2 ounces from 1 placer mine.
[2] Includes production from Ferry, Kittitas and Whatcom Counties, for which Bureau of Mines is not at liberty to publish separate figures.

REVIEW BY COUNTIES

CHELAN

In Chelan Lake district, the Howe Sound Co. operated its Holden mine and 2,000-ton concentration mill throughout the year but at a reduced rate compared with 1950. Production was curtailed during April and May, when an underground bulkhead broke and lower levels of the mine were flooded. A strike in August and September also contributed to the decline in production. A total of 550,530 tons of zinc-copper ore was treated in 1951; its gross metal content was 24,205 ounces of gold, 117,437 ounces of silver, 8,543,020 pounds of copper, and 5,323,436 pounds of zinc.

Development of the Polepick mine, in Peshastin Creek (Blewett) district, by the Calton Mining Co., lessee, yielded 20 tons of gold ore, which was treated in the company 25-ton gravity-concentration mill. The Lovitt Mining Co., Inc., operated the Gold King mine, in Wenatchee district, throughout 1951 and shipped 56,378 tons of siliceous gold ore containing 26,492 ounces of gold and 33,838 ounces of silver to a smelter.

FERRY

Knob Hill Mines, Inc., operated its mine and 400-ton flotation-cyanidation mill, in Republic (Eureka) district, on gold ore during all of 1951; it treated about 16 percent less ore than in 1950.

GARFIELD

The only production was in Snake River district, where Sheldon Bowers operated a ¾-cubic yard dragline shovel and nonfloating washing plant on the WaWaWai placer property until March; activity was discontinued at that time owing to exhaustion of gold-bearing gravel. A total of 5,100 cubic yards of material was washed during the period of operation, which yielded 13 ounces of gold and 2 ounces of silver.

KING

The Northwestern Realty Co. operated the Rainy mine, in Taylor River district, during part of the year and shipped 31 tons of copper ore to a smelter. This was the only production in the county.

OKANOGAN

Kaaba Silver-Lead Mines, Inc., Loomis-Oroville district, operated its Kaaba mine and mill for 9 months in 1951; it shipped 100 tons of lead concentrate recovered from the treatment of a quantity of lead ore in the company 300-ton sink-float-flotation mill. The Alder Group, in Methow district, was worked by the Alder Gold-Copper Co. and 1,546 tons of copper concentrates containing 1,359 ounces of gold, 2,072 ounces of silver, and 268,202 pounds of copper recovered in the company 250-ton flotation mill were shipped to a smelter. A small quantity of gold ore was shipped to a smelter from the Grey Eagle mine, in Myers Creek district.

PEND OREILLE

All county production was in the Metaline district, where the American Zinc, Lead & Smelting Co. operated its Grandview mine and 750-ton flotation mill at capacity throughout 1951, except for a short period when the property was idle as a result of the industry-wide strike. During the year the company began to develop the Lead Hill property, approximately 15 miles from the Grandview mill, and a small tonnage of lead ore, mined by open-pit methods, was trucked to the mill for treatment in the latter part of 1951.

The Sullivan Mining Co., under an operating agreement with the Metaline Mining & Leasing Co., began to develop the Metaline Contact mine. From 3,556 tons of development ore, milled in the Josephine mill of Pend Oreille Mines & Metals Co. in October, 20 tons of lead concentrates and 72 tons of zinc concentrates were recovered and shipped to smelters.

The Pend Oreille Mines & Metals Co. operated its Pend Oreille mines throughout 1951. The scarcity of skilled miners in the area prevented the production of enough ore to keep both of the company mill units in continuous operation, however; as a result, the 600-ton Josephine mill was shut down for several weeks during the year. Construction of the second 800-ton flotation mill unit of the company projected 2,400-ton mill was in progress in 1951, and the unit was expected to begin operation in the second quarter of 1952. Ore treated in 1951 totaled 273,580 tons, an increase of 87,383 tons over the 186,197 tons milled in 1950. Lead concentrates produced totaled

3,999 tons and contained 11,877 ounces of silver, 5,799,144 pounds of lead, and 178,958 pounds of zinc; 11,166 tons of zinc concentrate produced contained 4,164 ounces of silver, 246,770 pounds of lead, and 12,771,626 pounds of zinc.

STEVENS

The Bonanza mine, northwest of Colville, Bossburg (Clugston Creek) district, was in operation throughout 1951. On February 9 the Anaconda Copper Mining Co. obtained a purchase option from the Bonanza Lead Co. and operated the property the rest of the year. About 13,700 tons of ore (20,000 tons in 1950) was milled in the 100-ton flotation mill at the mine, and 3,064 tons of lead concentrate was shipped to a smelter.

Lessees operating the Silver Trail mine of the Silver Trail Mining Co., in the same district, milled 600 tons of zinc-lead ore and recovered 7 tons of lead concentrates and 15 tons of zinc concentrates containing 1,614 ounces of silver, 282 pounds of copper, 8,882 pounds of lead, and 12,238 pounds of zinc. Zinc-lead milling ore was produced from the Young America mine. The property was operated during the middle of the year by Young America Mines, Inc., and by the Bonanza Lead Co. during the latter part of 1951. A total of 20 tons of lead concentrate and 35 tons of zinc concentrate was produced and shipped to smelters.

In Northport (Aladdin) district, the Admiral mine of the Admiral Consolidated Mining Co. was operated by lessees until September and then by the company throughout the remainder of the year. In all, 336 tons of zinc concentrates, containing 135 ounces of silver, 10,866 pounds of lead, and 406,166 pounds of zinc was recovered and shipped to a smelter. The Goldfield Consolidated Mines Co. operated its Deep Creek mine throughout 1951 and treated over four times as much ore in the company 300-ton flotation mill as was milled in 1950. The Gladstone Mountain Mining Co. worked its Gladstone Mountain mine during part of the year and shipped 5 tons of lead ore to a smelter.

The Pioneer Mining Co. began open-pit mining at its Long Shot property, in Old Dominion district. A total of 23 tons of ore, containing 1 ounce of gold, 1,284 ounces of silver, 4,130 pounds of lead, and 4,881 pounds of zinc, was shipped to a smelter. A small quantity of ore milled during the year yielded 18 tons of zinc-lead and zinc concentrates.

WHATCOM

In Glacier district, development on the Glacier mine by the Glacier Mining Co. during part of the year yielded 4 tons of copper ore, which was shipped to a smelter. Walter Gourlie operated the Golden Arrow Group, in Slate Creek district, for 4½ months in 1951 and shipped 10 tons of gold ore to a smelter.

Wyoming

Gold, Silver, Copper, and Lead

(MINE REPORT)

By A. J. Martin

WYOMING output of gold in 1951 was 9 fine ounces valued at $315 and that of silver 2 fine ounces valued at $2, all produced in Fremont County in July. No gold or silver was produced in the State in 1950. No copper has been recovered from Wyoming ores since 1946 and no lead since 1945. No Wyoming output of zinc has been recorded.

In 1951 the White Horse Mining Co. shipped 10 tons of ore from the Diana group of gold mines in the Atlantic City district, Fremont County. At the Copper King property in the Silver Crown or Hecla district in Laramie County 22 miles west of Cheyenne, Henry E. Ferguson and Patrick W. Dinneen, Sr., cleaned out 157 feet of shaft and reopened a 600-foot tunnel.

All tonnage figures reported herein are short tons and "dry weight"; that is, they do not include moisture. The value of production has been calculated at the prices shown in table 1.

TABLE 1.—Prices of gold, silver, copper, lead, and zinc, 1947–51

Year	Gold [1] (per fine ounce)	Silver [2] (per fine ounce)	Copper [3] (per pound)	Lead [3] (per pound)	Zinc [3] (per pound)
1947	$35.00	$0.905	$0.210	$0.144	$0.121
1948	35.00	.905+	.217	.179	.133
1949	35.00	.905+	.197	.158	.124
1950	35.00	.905+	.208	.135	.142
1951	35.00	.905+	.242	.173	.182

[1] Price under authority of Gold Reserve Act of Jan. 31, 1934.
[2] Treasury buying price for newly mined silver July 1, 1946, to date—$0.9050505 ($0.905 used in 1947 for calculating purposes).
[3] Yearly average weighted price of all grades of primary metal sold by producers. Price in 1947 includes bonus payments by Office of Metals Reserve for overquota production.

Table 2 shows the annual output of gold and silver in Wyoming from 1947 to 1951 and the total production of gold, silver, copper, and lead from 1867 to 1951.

The copper, which represents about three-fourths of the total value of four metals, was mined in the Copper Mountain district, Fremont County; Encampment district, Carbon County; Hartville district, originally in Laramie County, now in Platte County; and Laramie (Douglas Creek) district, Albany County. About 76 percent of the copper was mined in 1883 and 1899 to 1909.

The lead came from the Spring Creek district in Carbon County, the Hurricane district in Crook County, and the Douglas Creek district in Albany County; it was mined in 1932, 1934, 1935, 1942, and 1945.

Although gold was produced from many localities throughout the State, most of the output came from placer and lode mines in the Atlantic City (South Pass) district in Fremont County. Gold has been produced in Wyoming in nearly all the 85 years from 1867 to 1951, but cumulative output was only 80,040 ounces—over half of which was produced before 1890. The yearly production during the 43-year period from 1890 through 1932 averaged only 450 ounces, but with the rise in the world price of gold after the United States went off the gold standard in April 1933 that led to the fixing of the United States mint price (formerly $20.671835 an ounce) at $35 on February 1, 1934, the yearly output rose to an average of 2,905 ounces from 1933 through 1937. From 1938 through 1951 the only substantial production was 1,486 ounces in 1947, nearly all of which came from the Carissa mine in the South Pass district.

All the Wyoming silver output has been recovered as a byproduct from copper, gold, and lead ores and placer gravel.

TABLE 2.—Mine production of gold, silver, copper, and lead in Wyoming, 1947–51, and total, 1867–1951, in terms of recoverable metal [1]

Year	Material [2] (short tons)	Gold (lode and placer)		Silver (lode and placer)		Copper		Lead		Total value
		Fine ounces	Value	Fine ounces	Value	Short tons	Value	Short tons	Value	
1947	6,059	1,486	$52,010	95	$86	-------	-------	-------	-------	$52,096
1948	867	115	4,025	11	10	-------	-------	-------	-------	4,035
1949	[3] 1,800	389	13,615	21	19	-------	-------	-------	-------	13,634
1950	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
1951	10	9	315	2	2	-------	-------	-------	-------	317
1867–1951	([4])	80,040	1,909,728	74,821	51,914	16,326	$5,684,372	14	$1,486	7,647,500

[1] Includes recoverable metal content of gravel washed (placer operations), ore milled, and ore shipped directly to smelters during the calendar year indicated.
[2] Does not include gravel washed.
[3] Ore milled; recovery was 86 ounces of gold and 3 ounces of silver in amalgamation and cyanidation bullion and 300 ounces of gold and 18 ounces of silver in 35 tons of concentrates smelted.
[4] Figure not available.

PART IV. WORLD REVIEW

Mineral Production of the World, 1950-51

By Berenice B. Mitchell, Pauline Roberts, and Helen L. Hunt

INTRODUCTION

STATISTICAL tables in this chapter present, country by country, the mineral production of the world in 1950–51. The tables are essentially a retabulation, by countries, of the 55 commodity world tables appearing in the various chapters of this volume. The figures are on a mine basis, unless otherwise indicated, except for cement, coke, and steel, which are measured at the processing plant. Coke entries are for coke made at high temperatures (over 1,000° C.) in slot-type or beehive ovens and exclude gashouse or retort coke. Figures marked with an asterisk (*) are estimates.

The statistics in these tables were derived principally from questionnaires sent, in cooperation with the United States Department of State, to the government of each country. Supplementary sources were United States consular reports, the Imperial Institute's Statistical Summary of the Mineral Industry of the British Commonwealth and Foreign Countries, other official publications of various countries, the United Nations Statistical Yearbook, the Year Book of the American Bureau of Metal Statistics, Minerais et Métaux, business magazines, and company reports. Where official data were not available estimates were often supplied by Bureau of Mines commodity specialists.

For lack of comprehensive information, data for the following minerals are excluded: Andalusite, aplite, asphalt, boron, bromine, calcite (optical), calcium chloride (natural), carbon dioxide, clay, diatomite (kieselguhr), dumortierite, emery, garnet (abrasive), gem stones (other than diamonds), germanium, greensand, grindstones, helium, indium, iodine, kyanite, lithium, magnesium compounds (other than magnesite), meerschaum, mineral pigments, monazite, natural gas, natural gasoline, oil shale, olivine, perlite, pumice, quartz crystal, radium, sand and gravel, selenium, sillimanite, sodium salts (other than common salt), stone, strontium, sulfur (byproduct), tellurium, thallium, topaz (industrial), tripoli, uranium, vermiculite, wollastonite, and zirconium. In addition, a few minor geographic areas for which no statistics are available are also omitted from the tabulation; it is believed that no significant quantities of minerals are mined in any of these areas.

NORTH AMERICA

BRITISH WEST INDIES

TABLE 1.—Mineral production, 1950–51, in metric tons

Mineral [1]	1950	1951
Gypsum: Jamaica	23,369	(2)
Salt:		
Bahamas	60,960	51,000
Turks and Caicos Islands	60,960	(2)

[1] The following minerals have been produced in recent years, but no current data are available: Leeward Islands, barite and salt; Haiti, salt. Barbados has produced crude petroleum, but no output was recorded in 1950–51.
[2] Data not available.

CANADA

TABLE 2.—Mineral production, 1950–51, in metric tons

Mineral [1]	1950 [2]	1951	Mineral [1]	1950 [2]	1951
Aluminum	360,043	405,600	Mica (sales)	1,760	1,328
Antimony [3]	292	591	Molybdenum	28	95
Arsenic, white	360	1,091	Nickel	112,181	124,527
Asbestos (sales) [4]	794,095	882,866	Peat:		
Barite	70,013	76,674	Agricultural use	68,215	71,538
Beryllium concentrates	[5] 26	(6)	Fuel	53	18
Bismuth, smelter (kilograms) [7]	86,918	106,140	Petroleum, crude (sales, including natural gasoline) (thousand barrels)	29,044	48,097
Cadmium, smelter (kilograms)	384,828	601,878	Phosphate rock	117	----------
Cement, hydraulic (sold or used by producers) (thousand tons)	2,658	2,687	Platinum-group metals (troy ounces):		
Coal (thousand tons):			Platinum	124,571	154,956
Coal	15,364	14,845	Other platinum-group metals	148,741	162,480
Lignite	1,999	2,017	Pyrites, including cupreous pyrites	283,597	(6)
Cobalt [8]	265	430	Salt	779,132	876,542
Coke (thousand tons)	*3,100	3,086	Silver (troy ounces)	23,221,431	24,244,949
Copper:			Talc, pyrophyllite, and soapstone (shipments)	29,578	26,478
Mine	239,685	245,377	Tin (long tons):		
Smelter	216,094	223,227	Mine	356	155
Feldspar (shipments)	32,248	33,224	Smelter	356	155
Fluorspar	58,253	78,870	Titanium concentrates: Ilmenite [9]	3,177	19,235
Fuel briquets	410,219	359,200	Tungsten concentrates (60 percent WO_3 basis)	215	15
Gold (troy ounces)	4,441,227	4,328,931	Zinc:		
Graphite	3,253	1,467	Mine	284,153	309,450
Gypsum	3,429,332	3,563,745	Smelter	185,398	198,290
Iron ore (thousand tons)	3,271	4,297			
Iron and steel (thousand tons):					
Pig iron and ferroalloys	2,253	2,543			
Steel ingots and castings	3,070	3,236			
Lead:					
Mine	150,317	143,193			
Smelter	154,551	147,609			

[1] Magnesium metal and magnesite have been produced in recent years, but no current data are available. Chromite, corundum, manganese ore, and mercury are produced, but no output was recorded in 1950–51.
[2] Revised figures except for asbestos, beryllium concentrates, coke, fuel briquets, steel ingots and castings, lead (smelter), molybdenum, phosphate rock, pyrites, and smelter tin.
[3] Includes antimony content of antimonial lead.
[4] Exclusive of sand, gravel, and stone.
[5] United States imports.
[6] Data not available.
[7] Refined metal plus bismuth content of bullion exported.
[8] Figures comprise Canadian ore processed in Canada and exported (irrespective of year when mined), plus cobalt content of concentrates made at Port Colborne from copper-nickel ore. However, figures exclude the cobalt recovered at Clydach (Wales) from Canadian nickel-copper ores.
[9] Includes titanium slag containing approximately 70 percent TiO_2.

COSTA RICA

TABLE 3.—Mineral production, 1950–51, in metric tons

Mineral	1950	1951	Mineral	1950	1951
Gold (troy ounces) [1]	115	1	Silver (troy ounces) [1 2]	215	582
Salt	8,400	5,445			

[1] Imports into United States. [2] Including secondary.

CUBA

TABLE 4.—Mineral production, 1950–51, in metric tons

Mineral [1]	1950	1951	Mineral [1]	1950	1951
Cement, hydraulic (thousand tons)	316	*383	Iron ore (thousand tons)	12	17
Chromite	[2] 65,820	79,065	Manganese ore	[2] 79,209	154,091
Copper, mine	20,420	19,700	Petroleum, crude (thousand barrels) [4]	*156	*128
Gold (troy ounces) [3]	6,915	835	Salt	59,266	63,500
Gypsum	*15,500	*30,000	Silver (troy ounces) [3 5]	221,779	172,318

[1] Barite and lead (mine) have been produced in recent years, but no current data are available. Nickel is produced, but no output was recorded in 1950–51.
[2] Revised figure.
[3] Imports into United States.
[4] Natural naphtha and gas oil.
[5] Including secondary.

DOMINICAN REPUBLIC

TABLE 5.—Mineral production, 1950–51, in metric tons

Mineral	1950	1951	Mineral	1950	1951
Cement, hydraulic (thousand tons)	70	104	Salt:		
Gold (troy ounces) [1]	475	411	Rock salt	2,304	2,270
Gypsum	----------	21,238	Other salt	13,740	8,092

[1] Imports into United States.

EL SALVADOR

TABLE 6.—Mineral production, 1950–51, in metric tons

Mineral	1950	1951	Mineral	1950	1951
Gold (exports) (troy ounces)	29,053	27,097	Salt	*16,000	*27,200
Lead, mine	*530	*470	Silver (troy ounces)	462,973	352,102

GREENLAND

Production of bituminous coal in Greenland totaled 7,000 metric tons in 1950 and 8,000 in 1951. Cryolite has been produced in recent years, but no current data are available.

GUATEMALA

TABLE 7.—Mineral production, 1950–51, in metric tons

Mineral [1]	1950	1951	Mineral [1]	1950	1951
Cement, hydraulic (thousand tons)	42	57	Salt	[2] 11,502	12,061
Chromite	[2] 289	1,138	Silver (troy ounces)	339,360	309,857
Gold (troy ounces) [3]	397	7	Zinc, mine	332	6,457
Lead:					
Mine	3,000	3,300			
Smelter	271	60			

[1] Native sulfur has been produced in recent years, but no current data are available. Mica is produced, but no output was recorded in 1950–51.
[2] Revised figure.
[3] Imports into United States.

HAITI

Salt has been produced in recent years, but no current data are available. Bauxite is produced, but no output was recorded in 1950–51.

HONDURAS

TABLE 8.—Mineral production, 1950–51, in metric tons

Mineral	1950	1951	Mineral	1950	1951
Antimony	(1)	(1)	Mercury (flasks)		11
Gold (troy ounces)	36,545	31,216	Salt	4,397	4,650
Lead, mine	[2] 279	454	Silver (troy ounces)	[2] 3,514,556	3,182,254

[1] Less than 0.5 metric ton.
[2] Revised figure.

MEXICO

TABLE 9.—Mineral production, 1950–51, in metric tons

Mineral [1]	1950	1951	Mineral [1]	1950	1951
Antimony [2]	5,868	6,824	Lead:		
Arsenic, white	8,987	12,766	Mine	238,078	225,468
Bismuth, in impure bars (kilograms)	263,000	338,000	Smelter	230,831	219,107
Cadmium (kilograms) [3]	689,000	893,000	Manganese ore	32,400	66,100
Cement, hydraulic (thousand tons)	[4] 1,528	1,615	Mercury (flasks)	3,713	8,093
Coal, bituminous (thousand tons)	[4] 912	1,119	Petroleum, crude (thousand barrels)	72,443	77,312
Coke (thousand tons)	392	389	Silver (troy ounces)	49,141,445	43,797,734
Copper:			Tin (long tons):		
Mine	61,699	67,351	Mine	[4] 440	366
Smelter	48,477	59,241	Smelter	290	366
Fluorspar (exports)	65,667	66,761	Tungsten concentrates (60 percent WO_3 basis)	67	325
Gold (troy ounces)	408,122	394,007	Zinc:		
Graphite	24,626	32,286	Mine	223,530	180,064
Iron ore (thousand tons)	420	460	Smelter	53,492	58,750
Iron and steel (thousand tons):					
Pig iron [5]	249	211			
Steel ingots and castings	[4] 333	*430			

[1] Barite, gypsum, mica, salt, and native sulfur have been produced in recent years, but no current data are available. Molybdenum is produced, but no output was recorded in 1950–51.
[2] Includes antimony content of antimonial lead.
[3] Cadmium content of flue dust exported for treatment elsewhere; represent in part shipments from stocks on hand.
[4] Revised figure.
[5] Excluding ferroalloy production, for which data are not yet available.

NETHERLANDS ANTILLES (CURAÇAO)

TABLE 10.—Mineral production, 1950–51, in metric tons

Mineral	1950	1951
Phosphate rock	104,240	106,902
Salt	3,000	(1)

[1] Data not available.

NICARAGUA

TABLE 11.—Mineral production, 1950–51, in metric tons

Mineral	1950	1951	Mineral	1950	1951
Cement, hydraulic (thousand tons)	17	20	Salt	11,172	12,289
Gold (exports) (troy ounces)	229,206	251,160	Silver (troy ounces) [1]	133,282	141,764

[1] Imports into United States, including secondary.

PANAMA

TABLE 12.—Mineral production, 1950–51, in metric tons

Mineral	1950	1951	Mineral	1950	1951
Cement, hydraulic (thousand tons)	51	75	Salt	[1] 5,000	7,480
Gold (troy ounces)	1,118	2,897	Silver (troy ounces)	1,940	5,788

[1] Revised figure.

TRINIDAD

Production of crude petroleum in Trinidad totaled 20,632,000 barrels in 1950 and 20,843,000 in 1951.

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UNITED STATES (INCLUDING TERRITORIES)

TABLE 13.—Mineral production, 1950–51, in metric tons

Mineral [1]	1950	1951
Aluminum	651,920	759,202
Antimony	2,265	3,150
Arsenic, white	12,041	14,687
Asbestos (sold or used by producers)	38,495	46,851
Barite	629,060	767,092
Bauxite (dried equivalent)	[2] 1,355,946	1,878,347
Beryllium concentrates (mine shipments)	507	439
Cadmium, smelter:		
Metallic cadmium (kilograms)	4,021,254	3,680,537
Cadmium compounds (Cd content) (kilograms)	154,540	89,402
Cement, hydraulic (thousand tons)	39,273	42,548
Chromite	367	6,401
Coal (thousand tons):		
Anthracite (Pennsylvania)	[2] 39,986	38,709
Bituminous	[2] 465,330	481,144
Lignite	[2] 3,057	2,986
Cobalt (shipments)	299	343
Coke, metallurgical (thousand tons)	65,968	71,967
Copper:		
Mine	824,938	842,162
Smelter [3]	914,917	940,416
Feldspar (sold or used)	414,472	406,866
Fluorspar (shipments)	273,524	314,813
Fuel briquets:		
Briquets	2,512,907	2,165,637
Packaged fuel	123,088	108,440
Gold, refinery (troy ounces)	2,288,708	1,894,726
Graphite (amorphous and crystalline)	4,628	6,473
Gypsum	7,432,186	7,861,199
Iron ore (thousand tons)	99,619	118,375
Iron and steel (thousand tons):		
Pig iron and ferroalloys	[2] 60,210	65,805
Steel ingots and castings [4]	87,848	95,435
Lead:		
Mine	[2] 390,838	352,135
Refinery [5]	458,171	376,142
Magnesite	389,536	607,962
Magnesium metal	14,266	37,086
Manganese ore (shipments)	121,971	95,260
Mercury (flasks)	4,535	7,293
Mica (sold or used by producers):		
Block	262	270
Scrap	62,922	65,200
Molybdenum	12,918	17,625
Nickel, refinery [6]	828	686
Peat, agricultural use	118,589	176,370
Petroleum, crude (thousand barrels)	[2] 1,973,574	2,244,529
Phosphate rock (sold or used by producers)	10,418,122	11,273,282
Platinum, placer platinum and from domestic gold and copper refining (troy ounces)	37,855	36,951
Potassium salts (equivalent K_2O)	[2] 1,168,197	1,288,489
Pyrites, including cupreous pyrites	946,108	1,034,104
Salt:		
Rock salt	3,562,738	4,229,449
Other salt	11,523,492	14,102,056
Silver (troy ounces)	42,308,739	39,907,257
Sulfur, native (long tons)	5,192,184	5,278,249
Talc, pyrophyllite, and soapstone (sold by producers)	563,132	577,028
Tantalite-columbite (mine shipments) (pounds)	1,000	925
Tin (long tons):		
Mine	94	88
Smelter [7]	33,118	31,852
Titanium concentrates:		
Ilmenite	424,851	486,099
Rutile	([8])	([8])
Tungsten concentrates (60 percent WO_3 basis) (shipments)	[2] 4,373	5,693
Zinc:		
Mine	565,513	609,195
Smelter	765,176	799,800

[1] Excludes bismuth and vanadium, data for which Bureau of Mines is not at liberty to publish.
[2] Revised figure.
[3] Smelter output from domestic and foreign ores, exclusive of scrap. Production from domestic ores only was as follows: 1950, 826,760 tons; 1951, 844,379.
[4] Data from American Iron and Steel Institute. Excludes production of castings by companies that do not produce steel ingots.
[5] Figures cover lead refined from domestic and foreign ores; refined lead produced from foreign base bullion not included.
[6] Byproduct of electrolytic refining of copper.
[7] Includes production from imported scrap and residues refined on toll.
[8] Figure withheld in order to avoid disclosure of individual company operations.

SOUTH AMERICA

ARGENTINA

TABLE 14.—Mineral production, 1950–51, in metric tons

Mineral [1]	1950	1951	Mineral [1]	1950	1951
Cement, hydraulic (thousand tons)	[2] 1,572	1,543	Petroleum, crude (thousand barrels)	23,353	24,465
Coal, bituminous (thousand tons) [3]	[2] 26	*45	Silver (troy ounces)	1,150,000	1,253,879
Iron and steel (thousand tons):			Sulfur, native (long tons)	[2] 7,785	([5])
Pig iron and ferroalloys	20	28	Tin (long tons):		
Steel ingots and castings	*200	*250	Mine	[2] 267	242
Lead:			Smelter	[2] 253	206
Mine	*20,000	*20,000	Tungsten concentrates (60 percent WO_3 basis)	*20	*30
Smelter	[2] 18,960	24,000	Zinc:		
Mica	[4] 308	([5])	Mine	12,699	15,475
			Smelter	*7,530	*8,600

[1] Arsenic, asbestos, barite, beryl, bismuth, chromite, columbite, corundum, feldspar, fluorspar, gold, graphite, gypsum, iron ore, manganese ore, salt, talc, and vanadium have been produced in recent years, but no current data are available.
[2] Revised figure.
[3] In addition, asphaltite was produced and used as solid fuel, but data on production are not available.
[4] Exports.
[5] Not available.

BOLIVIA

TABLE 15.—Mineral production,[1] 1950–51, in metric tons

Mineral [2]	1950	1951	Mineral [2]	1950	1951
Antimony	8,781	11,816	Petroleum, crude (thousand barrels)	616	523
Asbestos	166	316	Silver (troy ounces)	6,566,950	7,172,220
Bismuth in ore and bullion (kilograms) [3]	24,443	69,081	Sulfur, native (long tons)	4,307	9,100
Cement, hydraulic (thousand tons)	*36	33	Tin (long tons):		
Copper, mine [4]	4,704	4,846	Mine	31,213	33,132
Fluorspar	61	38	Smelter	393	39
Gold (troy ounces)	*[5] 7,700	([6])	Tungsten concentrates (60 percent WO_3 basis)	2,461	2,718
Lead, mine	31,203	30,032	Zinc, mine	19,570	30,535
Mercury (flasks)		19			

[1] All data are exports, except that those for cement, lead, petroleum, and zinc are actual production.
[2] Cobalt and salt have been produced in recent years, but no current data are available.
[3] Excludes bismuth content of tin concentrates exported.
[4] Copper content of exports.
[5] Revised figure.
[6] Data not available.

BRAZIL

TABLE 16.—Mineral production, 1950–51, in metric tons

Mineral[1]	1950	1951	Mineral[1]	1950	1951
Aluminum		(2)	Iron and steel (thousand tons):		
Arsenic, white	1,067	1,321	Pig iron and ferroalloys	[3] 729	*750
Barite	6,860	50	Steel ingots and castings	[3] 779	*830
Bauxite	*17,000	(2)	Lead, smelter	[3] 4,200	*3,000
Beryllium concentrates (exports)	2,625	1,533	Manganese ore (exports)	[3] 148,339	(2)
Cement, hydraulic (thousand tons)	1,382	1,440	Mica (exports)	824	1,350
Coal, bituminous and lignite (thousand tons)	[3] 1,959	1,950	Petroleum, crude (thousand barrels)	[3] 339	691
Coke (thousand tons)	287	286	Salt	873,803	(2)
Columbite concentrates (exports) (pounds)	26,709	11,000	Silver (troy ounces)	[3] 21,155	20,315
Diamonds (metric carats)	*200,000	*200,000	Tantalite concentrates (exports) (pounds)	18,700	8,818
Feldspar	*12,000	(2)	Tin (long tons):		
Fluorspar	*600	(2)	Mine	[3] 180	*200
Gold (troy ounces)	*[3] 195,500	*200,000	Smelter	[3] 118	*180
Gypsum	*51,000	(2)	Titanium concentrates:		
Iron ore (thousand tons)	[3] 2,057	2,555	Ilemenite		(2)
			Rutile	(4)	(2)
			Tungsten concentrates (60 percent WO_3 basis) (exports)	[3] 759	*1,000

[1] Asbestos, bismuth, chromite, cobalt, corundum, graphite, lead (mine), magnesite, nickel, phosphate rock, pyrites, and talc have been produced in recent years, but no current data are available.
[2] Data not available.
[3] Revised figure.
[4] Figure withheld in order to avoid disclosure of United States production by differences. *See* footnote 8 on the United States table.

BRITISH GUIANA

TABLE 17.—Mineral production, 1950–51, in metric tons

Mineral	1950	1951
Bauxite	1,608,831	2,034,888
Diamonds (metric carats)	37,462	43,260
Gold (troy ounces)	11,800	13,485

CHILE

TABLE 18.—Mineral production, 1950–51, in metric tons

Mineral[1]	1950	1951	Mineral[1]	1950	1951
Asbestos	172	(2)	Lead, mine	3,318	*4,000
Barite	1,360	(2)	Manganese ore	[3] 33,530	*42,000
Cement, hydraulic (thousand tons)	513	698	Mercury (flasks)	319	(2)
Coal, bituminous (marketable) (thousand tons)	[3] 1,964	1,989	Molybdenum	965	*[5] 2,500
Cobalt		(2)	Petroleum, crude (thousand barrels)	629	759
Copper:			Phosphate rock (apatite)	13,437	(2)
Mine	[3] 362,757	379,726	Salt:		
Smelter	[3] 345,460	360,099	Rock salt	46,709	(2)
Feldspar	871	(2)	Other salt	942	(2)
Gold (troy ounces)	[3] 190,172	173,646	Silver (troy ounces)	[3] 746,765	983,491
Gypsum	65,509	(2)	Sulfur, native (long tons)	15,228	(2)
Iron ore (thousand tons)[4]	2,976	3,252	Talc and soapstone	142	(2)
Iron and steel (thousand tons):					
Pig iron and ferroalloys	[3] 109	240			
Steel ingots and castings	[3] 56	190			

[1] Beryl is produced, but no output was recorded in 1950–51.
[2] Data not available.
[3] Revised figure.
[4] Production of Tofo mines.
[5] Exports.

COLOMBIA

TABLE 19.—Mineral production, 1950–51, in metric tons

Mineral [1]	1950	1951	Mineral [1]	1950	1951
Cement, hydraulic (thousand tons)	580	641	Platinum, placer (troy ounces)	26,445	32,000
Coal, bituminous (thousand tons)	*1,200	*1,350	Salt	[3] 141,963	162,124
Gold (troy ounces)	379,412	430,723	Silver (troy ounces)	115,711	130,028
Gypsum	1,930	[2]	Steel ingots and castings (thousand tons)	*10	*10
Petroleum, crude (thousand barrels)	34,059	38,403	Sulfur, native (long tons)	1,461	2,273

[1] Barite and mica have been produced in recent years, but no current data are available.
[2] Data not available.
[3] Revised figure.

ECUADOR

TABLE 20.—Mineral production, 1950–51, in metric tons

Mineral [1]	1950	1951	Mineral [1]	1950	1951
Cement, hydraulic (thousand tons)	58	79	Petroleum, crude (thousand barrels)	2,632	2,708
Copper, mine	526	2	Salt	34,902	32,756
Gold (troy ounces)	91,946	*10,000	Silver (troy ounces)	[3] 273,200	33,600
Gypsum	*441	[2]	Sulfur, native (long tons)	*27	1
Lead, mine	[3] 229	30			

[1] Copper (smelter) is produced, but no output was recorded in 1950–51.
[2] Data not available.
[3] Revised figure.

FRENCH GUIANA

Production of gold in French Guiana totaled 12,249 troy ounces in 1950 and 12,056 (preliminary figure) in 1951.

PERU

TABLE 21.—Mineral production, 1950–51, in metric tons

Mineral [1]	1950	1951	Mineral [1]	1950	1951
Antimony	971	1,107	Mercury (flasks)	----------	[2]
Barite	3,031	23,015	Mica	----------	[2]
Bismuth (kilograms):			Molybdenum	1	3
Metal	226,851	262,655	Petroleum, crude (thousand barrels)	15,077	16,110
In lead-bismuth alloy	[2]	----------	Salt	66,501	[2]
Cadmium (kilograms)	1,365	----------	Silver (troy ounces)	[3] 13,367,807	14,856,536
Cement, hydraulic (thousand tons)	331	367	Steel ingots and castings (thousand tons)	*10	*10
Coal, bituminous and anthracite (thousand tons)	196	*235	Sulfur, native (long tons)	98	*1,000
Copper:			Tin (long tons):		
Mine	29,930	32,274	Mine [4]	[3] 38	86
Smelter	[3] 23,227	24,316	Smelter [5]	38	86
Feldspar	----------	[2]	Tungsten concentrates (60 percent WO_3 basis)	[3] 516	770
Gold (troy ounces)	[3] 147,958	141,711	Vanadium	436	*400
Gypsum	31,917	16,927	Zinc:		
Lead:			Mine	[3] 87,879	105,900
Mine	[3] 62,118	82,350	Smelter	1,262	870
Smelter	[3] 31,693	44,247			

[1] Arsenic and graphite have been produced in recent years, but no current data are available. Coke is produced, but no output was recorded in 1950–51.
[2] Data not available.
[3] Revised figure.
[4] Minor constituent of other base-metal ores.
[5] Tin content of dross.

SURINAM

TABLE 22.—Mineral production, 1950–51, in metric tons

Mineral	1950	1951
Bauxite	2,080,657	2,671,330
Gold (troy ounces)	4,546	6,494

URUGUAY

TABLE 23.—Mineral production, 1950–51, in metric tons

Mineral [1]	1950	1951	Mineral [1]	1950	1951
Cement, hydraulic (thousand tons)	305	301	Mica	1	1
Feldspar	710	675	Talc and soapstone	681	959

[1] Graphite is produced, but no output was recorded in 1950–51.

VENEZUELA

TABLE 24.—Mineral production, 1950–51, in metric tons

Mineral	1950	1951	Mineral	1950	1951
Asbestos	190	260	Gypsum [1]	2,050	(2)
Cement, hydraulic (thousand tons)	501	621	Iron ore (thousand tons)	190	1,270
Coal, bituminous (thousand tons)	25	28	Magnesite	1,400	(2)
Diamonds (metric carats)	60,389	63,226	Petroleum, crude (thousand barrels)	546,783	622,216
Gold (troy ounces)	34,462	2,861	Salt	56,439	38,920

[1] Production in Government quarries only.
[2] Data not available.

EUROPE

ALBANIA

Production of crude petroleum in Albania totaled 2,800,000 barrels in 1950 and 1,200,000 in 1951. Production of lignite in Albania was estimated at 16,000 metric tons in 1950; data for 1951 are not available. Cement, chromite, and salt have been produced in recent years, but no current data are available.

AUSTRIA

TABLE 25.—Mineral production, 1950–51, in metric tons

Mineral [1]	1950	1951	Mineral [1]	1950	1951
Aluminum	17,988	26,389	Lead:		
Antimony [2]	409	498	Mine	4,440	4,522
Barite	10,800	9,645	Smelter	10,910	11,147
Bauxite	616	7,795	Magnesite	543,817	664,296
Cement, hydraulic (thousand tons)	[3] 1,289	1,475	Mercury (flasks)	44	26
Coal (thousand tons):			Mica	368	307
Bituminous	[3] 183	196	Molybdenum	18	19
Lignite	[3] 4,308	4,989	Peat	*50,000	*50,000
Coke (thousand tons)	[3] 987	1,083	Petroleum, crude (thousand barrels)	[3] *10,200	*14,600
Copper:			Pyrites, including cupreous pyrites	12,489	9,756
Mine	1,635	1,838	Salt:		
Smelter	[3] 5,369	6,450	Rock salt	1,085	692
Feldspar	3,802	3,751	Other salt	[3] 327,426	362,294
Fuel briquets	45,897	79,594	Silver (troy ounces)	18,901	[4]
Graphite	14,685	18,227	Talc and soapstone	53,625	66,574
Iron ore (thousand tons)	1,859	2,370	Zinc, mine	2,970	3,355
Iron and steel (thousand tons):					
Pig iron and ferroalloys	[3] 886	1,051			
Steel ingots and castings	947	1,028			

[1] Arsenic, gold, gypsum, and phosphate rock have been produced in recent years, but no current data are available.
[2] Excludes Soviet Zone, production data for which are not available.
[3] Revised figure.
[4] Data not available.

BELGIUM

TABLE 26.—Mineral production, 1950–51, in metric tons

Mineral [1]	1950	1951	Mineral [1]	1950	1951
Arsenic, white (exports)	1,909	325	Iron ore (thousand tons)	46	79
Cadmium, smelter (kilograms)	*365,000	*450,000	Iron and steel (thousand tons):		
Cement, hydraulic (thousand tons)	3,557	4,395	Pig iron and ferroalloys	[2] 3,695	4,847
Coal, bituminous and anthracite (thousand tons)	[2] 27,304	29,675	Steel ingots and castings	[2] 3,777	5,069
Coke (thousand tons)	[2] 4,585	6,106	Lead, smelter [4]	62,094	70,646
Copper, smelter	[3]	[3]	Phosphate rock	50,846	[3]
Fuel briquets	1,014,290	1,801,810	Tin, smelter (long tons)	9,512	8,360
			Zinc, smelter [4]	177,326	200,886

[1] Barite has been produced in recent years, but no current data are available.
[2] Revised figure.
[3] Data not available.
[4] Includes secondary.

BULGARIA

TABLE 27.—Mineral production, 1950–51, in metric tons

Mineral [1]	1950	1951	Mineral [1]	1950	1951
Coal (thousand tons):			Coke (thousand tons)	*10	*10
Anthracite	*30	*35	Fuel briquets	*200,000	*200,000
Bituminous and lignite	5,682	6,134	Gypsum	*5,000	[2]

[1] Asbestos, cement, chromite, gold, iron ore, manganese ore, salt, and silver have been produced in recent years, but no current data are available.
[2] Data not available.

CZECHOSLOVAKIA

TABLE 28.—Mineral production, 1950–51, in metric tons

Mineral [1]	1950	1951	Mineral [1]	1950	1951
Antimony	*2,000	(2)	Iron ore (thousand tons)	*1,600	(2)
Coal (thousand tons):			Iron and steel (thousand tons):		
Bituminous	18,456	17,900	Pig iron and ferroalloys	1,883	*2,000
Lignite	27,506	31,000	Steel ingots and castings	[3] *3,011	*3,312
Coke (thousand tons)	*4,876	*5,150	Magnesite	*173,000	(2)
Fuel briquets:			Petroleum, crude (thousand barrels)	*292	*650
Bituminous coal	387,500	395,000			
Lignite	*303,300	*400,000			

[1] Arsenic, asbestos, barite, cement, feldspar, gold, graphite, lead, mercury, pyrites, salt, silver, and zinc have been produced in recent years, but no current data are available. Manganese ore has been produced in recent years, but it is too low-grade to be classified as such.
[2] Data not available.
[3] Revised figure.

DENMARK

TABLE 29.—Mineral production, 1950–51, in metric tons

Mineral [1]	1950	1951	Mineral [1]	1950	1951
Cement, hydraulic (thousand tons)	873	985	Iron and steel (thousand tons):		
Coal, lignite (thousand tons)	[1] 770	1,582	Pig iron and ferroalloys	51	33
Fuel briquets	*40,000	*40,000	Steel ingots and castings	123	164
			Peat	901,802	2,013,932

[1] Revised figure.

FAROE ISLANDS

Coal has been produced in Faroe Islands in recent years, but no current data are available.

FINLAND

TABLE 30.—Mineral production, 1950–51, in metric tons

Mineral [1]	1950	1951	Mineral [1]	1950	1951
Asbestos, including flour	10,949	(2)	Lead, mine	142	136
Cement, hydraulic (thousand tons)	743	829	Molybdenum		(2)
Cobalt		(2)	Nickel		(2)
Copper:			Peat:		
Mine	15,600	[3] 27,000	Agricultural use	7,000	224,000
Smelter	13,572	17,851	Fuel	197,000	
Feldspar	8,000	(2)	Pyrites, including cupreous pyrites	[4] 162,050	232,546
Fuel briquets	80,000	80,000	Silver (troy ounces)	115,939	157,275
Gold (troy ounces)	9,465	18,721	Talc and soapstone	4,000	(2)
Iron and steel (thousand tons):			Tungsten concentrates (60 percent WO_3 basis)	20	8
Pig iron and ferroalloys	63	102	Zinc, mine	[4] *2,100	*2,400
Steel ingots and castings	105	138			

[1] Beryl and gypsum have been produced in recent years, but no current data are available. Graphite is produced, but no output was recorded in 1950–51.
[2] Data not available.
[3] Approximate production.
[4] Revised figure.

FRANCE

TABLE 31.—Mineral production, 1950–51, in metric tons

Mineral [1]	1950	1951
Aluminum	[2] 60, 715	91, 080
Antimony	[2] 355	650
Arsenic, white	2, 454	[3]
Asbestos	6, 080	[3]
Barite	25, 027	[3]
Bauxite	[2] 805, 228	1, 124, 400
Bismuth, in ore (kilograms)	----------	[3]
Cadmium, smelter (kilograms)	71, 591	84, 997
Cement, hydraulic (thousand tons):		
France	7, 208	8, 125
Saar	208	234
Coal (thousand tons):		
Bituminous and anthracite:		
France	[2] 50, 843	52, 968
Saar	[2] 15, 091	16, 128
Lignite (France)	[2] 1, 686	2, 004
Coke (thousand tons):		
France	7, 012	8, 079
Saar	3, 227	3, 766
Feldspar	42, 000	66, 000
Fluorspar	35, 400	50, 000
Fuel briquets	6, 307, 000	8, 049, 000
Gold (troy ounces)	63, 015	45, 976
Gypsum	2, 100, 000	*2, 000, 000
Iron ore (thousand tons) [4]	[2] 29, 983	35, 264
Iron and steel (thousand tons):		
Pig iron and ferroalloys:		
France	[2] 7, 838	8, 839
Saar	[2] 1, 684	2, 364
Iron and Steel—Continued		
Steel ingots and castings:		
France	8, 652	9, 828
Saar	[2] 1, 898	2, 603
Lead:		
Mine	[2] 11, 459	10, 605
Smelter	61, 236	47, 970
Magnesium metal	[2] 446	875
Molybdenum	----------	[3]
Peat	*60, 000	*60, 000
Petroleum, crude (thousand barrels)	909	2, 036
Phosphate rock	73, 752	110, 000
Potassium salts (equivalent K_2O)	1, 017, 800	987, 600
Pyrites, including cupreous pyrites	247, 642	280, 600
Salt:		
Rock salt and salt from springs	2, 049, 373	[3]
Other salt	604, 550	430, 608
Silver (troy ounces)	549, 669	546, 550
Sulfur, native (content of ore) (long tons)	14, 500	26, 600
Talc and soapstone	95, 500	120, 000
Tin, mine (long tons)	[2] 117	*170
Tungsten concentrates (60 percent WO_3 basis)	[2] 442	765
Zinc:		
Mine	12, 419	13, 283
Smelter	71, 531	74, 600

[1] Beryl and copper have been produced in recent years, but no current data are available.
[2] Revised figure.
[3] Data not available.
[4] Including Moselle (Lorraine).

GERMANY

TABLE 32.—Mineral production, 1950–51, in metric tons

Mineral	1950	1951	Mineral	1950	1951
EAST GERMANY[1]					
Barite	(2)	(2)	Iron and steel (thousand tons):		
Coal (thousand tons):			Pig iron and ferroalloys	[5] 283	*350
Bituminous and anthracite	[4] 3,000	*3,100	Steel ingots and castings	1,155	1,552
Lignite	*123,000	*147,000	Peat	*500,000	*500,000
Coke (thousand tons)	*300	*300	Tin (long tons):		
Fuel briquets, lignite	[5]*38,000,000	*39,500,000	Mine	*120	*120
Iron ore (thousand tons)[6]	328	(2)	Smelter	(3)	*316
WEST GERMANY[7]					
Aluminum	[5] 27,840	74,136	Iron ore (thousand tons)[6]	10,882	12,923
Arsenic, white (exports)	1,124	(2)	Iron and steel (thousand tons):		
Barite	230,269	[5] 331,324	Pig iron and ferroalloys	9,480	10,880
Cadmium, smelter (kilograms)	----------	70,000	Steel ingots and castings	12,121	13,506
Cement, hydraulic (thousand tons)	10,877	12,204	Lead:		
Coal (thousand tons):			Mine	44,830	50,368
Bituminous and anthracite	110,756	118,920	Smelter	118,140	121,524
Lignite	75,840	83,124	Peat	*1,200,000	[12] 423,400
Coke (thousand tons)	27,333	33,626	Petroleum, crude (thousand barrels)	[5] 8,107	9,681
Copper:[9]			Potassium salts (equivalent K_2O)	911,600	1,280,000
Mine	1,360	1,679	Pyrites, including cupreous pyrites	525,400	533,530
Smelter[10]	[5] 202,500	212,868	Salt	2,470,000	2,757,785
Feldspar	57,899	46,095	Silver (troy ounces)	1,637,116	4,138,990
Fluorspar	92,520	143,741	Talc and soapstone	13,314	19,500
Fuel briquets:			Tin, smelter (long tons)	[5] *375	*600
Bituminous coal	[5] 3,721,600	4,104,100	Zinc:		
Lignite	[5] 14,912,400	15,924,400	Mine	69,298	72,935
Graphite	[5] 6,563	(2)	Smelter	[5] 122,796	140,640
Gypsum[11]	[5] 756,842	814,945			

[1] Aluminum, arsenic, bauxite, bismuth, cement, cobalt, copper, fluorspar, gold, lead, magnesium metal, manganese ore, mercury, potassium salts, pyrites, and zinc have been produced in recent years, but no current data are available. Nickel is produced, but no output was recorded in 1950–51.
[2] Data not available.
[3] Included with West Germany.
[4] Planned production.
[5] Revised figure.
[6] Exclusive of manganiferous iron ore carrying 12 to 30 percent manganese.
[7] Bauxite, bismuth, cobalt, gold, magnesite, magnesium, and mercury have been produced in recent years, but no current data are available. Nickel and phosphate rock are produced, but no output was recorded in 1950–51. Manganese ore has been produced in recent years, but it is too low-grade to be classified as such.
[8] Includes East Germany.
[9] Approximate production.
[10] Includes scrap.
[11] Crude production estimates based on the following calcined figures: 1950, 630,702; 1951, 679,121.
[12] Including 280,959 tons for agricultural use.

GREECE

TABLE 33.—Mineral production, 1950–51, in metric tons

Mineral [1]	1950	1951	Mineral [1]	1950	1951
Antimony	[2] 350	810	Lead:		
Arsenic, white	33	56	Mine	[3] 2,307	4,852
Asbestos	30	(3)	Smelter	2,125	3,890
Barite	20,799	29,399	Magnesite	26,256	63,859
Bauxite	77,448	197,060	Manganese ore	320	2,290
Cement, hydraulic (thousand tons)	352	432	Pyrites, including cupreous pyrites	87,678	181,263
Chromite	12,631	25,333	Salt	102,329	82,434
Coal: Lignite (thousand tons)	[2] 152	191	Silver (troy ounces)		64,300
Gypsum	820	950	Steel ingots and castings (thousand tons)	*26	(3)
Iron ore (exports) (thousand tons)	41	56	Sulfur, native (long tons)		(3)
			Talc and soapstone	2,500	2,623
			Zinc, mine	3,184	6,300

[1] Molybdenum has been produced in recent years, but no current data are available.
[2] Revised figure.
[3] Data not available.

HUNGARY

TABLE 34.—Mineral production, 1950–51, in metric tons

Mineral [1]	1950	1951	Mineral [1]	1950	1951
Bauxite	350,000	(2)	Iron and steel (thousand tons):		
Coal (thousand tons):			Pig iron and ferroalloys	*500	*410
Bituminous	1,400	1,600	Steel ingots and castings	1,022	*1,234
Lignite	11,850	14,000	Lead, mine	300	(2)
Fuel briquets	*125,000	*150,000	Peat	*8,000	*8,000
Iron ore (thousand tons)	368	(2)	Petroleum, crude (thousand barrels)	[3] *3,700	*3,500

[1] Aluminum, antimony, arsenic, cement, copper (mine), gold, lead (smelter), manganese ore, salt, and silver have been produced in recent years, but no current data are available.
[2] Date not available.
[3] Revised figure.

ICELAND

Production of peat in Iceland was estimated to be 3,000 metric tons in 1950 and 2,000 in 1951.

IRELAND

TABLE 35.—Mineral production, 1950–51, in metric tons

Mineral [1]	1950	1951	Mineral [1]	1950	1951
Barite	4,821	*7,500	Fuel briquets [3]	27,637	*40,000
Cement, hydraulic (thousand tons)	444	(2)	Gypsum	82,668	*100,000
Coal, bituminous and anthracite (thousand tons)	181	184	Peat	*2,680,300	*4,000,000
			Steel ingots and castings (thousand tons)	*16	*16

[1] Phosphate rock has been produced in recent years, but no current data are available.
[2] Data not available.
[3] Including peat briquets.

ITALY

TABLE 36.—Mineral production, 1950–51, in metric tons

Mineral [1]	1950	1951	Mineral [1]	1950	1951
Aluminum	37,070	49,750	Lead:		
Antimony	[2] 679	822	Mine	[2] 38,300	38,738
Arsenic, white	[2] 670	(3)	Smelter	37,469	36,000
Asbestos	21,433	22,651	Magnesite	200	246
Barite	48,142	75,106	Magnesium metal		(3)
Bauxite	153,433	174,274	Manganese ore	16,208	27,743
Cadmium, smelter (kilograms)	[2] 75,000	204,000	Mercury (flasks)	53,346	53,839
Cement, hydraulic (thousand tons)	5,004	5,578	Peat	*150,000	*150,000
Coal (thousand tons):			Petroleum, crude (thousand barrels)	63	136
Bituminous and anthracite	1,030	1,167	Pyrites, including cupreous pyrites	895,459	898,023
Lignite	780	854	Salt:		
Cobalt		(3)	Rock salt	717,158	746,321
Coke (thousand tons)	1,502	2,173	Other salt	651,935	965,652
Copper:			Silver (troy ounces)	[2] 850,998	821,529
Mine	34	172	Sulfur, native, crude (long tons) [4]	209,767	197,382
Smelter	[2] 18	60	Talc and soapstone	[2] 67,616	75,827
Feldspar	14,254	22,630	Tungsten concentrates (60 percent WO_3 basis)	2	6
Fluorspar	31,611	40,838	Zinc:		
Fuel briquets	*10,000	*25,000	Mine	[2] 87,026	100,733
Gold (troy ounces)	10,674	12,089	Smelter	38,119	47,227
Graphite	3,855	4,486			
Iron ore (thousand tons)	442	515			
Iron and steel (thousand tons):					
Pig iron and ferroalloys	[2] 573	1,048			
Steel ingots and castings	2,323	2,992			

[1] Beryl, gypsum, mica, and potassium salts have been produced in recent years, but no current data are available. Molybdenum, nickel, platinum, and tin are produced, but no output was recorded in 1950–51.
[2] Revised figure.
[3] Data not available.
[4] In addition, the following tonnages of ground sulfur rock (30 percent "S") were produced and used as an insecticide: 1950, 15,778 tons; 1951, 22,120 tons.

LUXEMBOURG

TABLE 37.—Mineral production, 1950–51, in metric tons

Mineral	1950	1951	Mineral	1950	1951
Cement, hydraulic (thousand tons)	125	132	Iron and steel (thousand tons):		
Iron ore (thousand tons)	3,845	5,625	Pig iron and ferroalloys	2,499	3,157
			Steel ingots and castings	[1] 2,451	3,077

[1] Revised figure.

MALTA

Production of salt in Malta totaled 1,827 metric tons in 1950 and 3,841 in 1951.

NETHERLANDS

TABLE 38.—Mineral production, 1950–51, in metric tons

Mineral	1950	1951	Mineral	1950	1951
Cement, hydraulic (thousand tons)	593	702	Iron and steel (thousand tons):		
Coal (thousand tons):			Pig iron and ferroalloys	454	525
Bituminous	12,247	12,424	Steel ingots and castings	490	552
Lignite	194	249	Peat	[1] 527,600	641,900
Coke (thousand tons)	2,804	2,973	Petroleum, crude (thousand barrels)	4,897	4,942
Fuel briquets:			Salt	412,570	*473,000
Bituminous coal	[1] 1,049,200	1,062,400	Tin, smelter (long tons)	21,027	20,977
Lignite	[1] 56,500	72,700	Zinc, smelter	19,752	22,605

[1] Revised figure.

NORWAY

TABLE 39.—Mineral production, 1950–51, in metric tons

Mineral [1]	1950	1951	Mineral [1]	1950	1951
Aluminum	[2] 46,560	51,240	Magnesium metal	(3)	120
Beryllium concentrates	----------	(3)	Mica (exports)	571	547
Cadmium, smelter (kilograms)	78,747	100,000	Molybdenum	62	119
Cement, hydraulic (thousand tons)	[2] 582	720	Peat:		
Copper:			Agricultural use	24,500	25,300
Mine	[2] 15,458	[4] 14,400	Fuel	[2] 360,743	329,616
Smelter	[2] 9,035	8,651	Phosphate rock (guano)	2,538	(3)
Feldspar	[2] 23,695	24,000	Pyrites, including cupreous pyrites	749,363	696,217
Fluorspar	838	*700	Silver (troy ounces)	[2] 167,184	160,754
Graphite	[2] 2,465	2,500	Talc and soapstone	[2] 64,099	60,000
Iron ore (thousand tons)	[2] 304	353	Titanium concentrates:		
Iron and steel (thousand tons):			Ilmenite	105,000	105,000
Pig iron and ferroalloys	[2] 227	241	Rutile	(5)	(5)
Steel ingots and castings	[2] 81	86	Zinc:		
Lead, mine	*360	*360	Mine	[2] 5,702	5,500
Magnesite	1,800	(3)	Smelter	[2] 43,173	40,233

[1] Bismuth has been produced in recent years, but no current data are available. Coke and nickel are produced, but no output was recorded in 1950–51.
[2] Revised figure.
[3] Data not available.
[4] Approximate production.
[5] Figure withheld in order to avoid disclosure of United States production by differences. *See* note 8 on United States table.

POLAND

TABLE 40.—Mineral production, 1950–51, in metric tons

Mineral [1]	1950	1951	Mineral [1]	1950	1951
Cadmium, smelter (kilograms)	*240,000	*240,000	Gypsum	32,824	(3)
Cement, hydraulic (thousand tons)	[2] 2,512	2,688	Iron ore (thousand tons)	790	*850
Coal (thousand tons):			Iron and steel (thousand tons):		
Bituminous	[2] 78,001	81,900	Pig iron and ferroalloys	[2] 1,488	*1,479
Lignite	[2] 4,837	5,000	Steel ingots and castings	2,515	*2,800
Coke (thousand tons)	5,924	*6,300	Lead, smelter	18,000	18,000
Fuel briquets:			Magnesite	----------	(3)
Bituminous coal	*631,300	*622,000	Petroleum, crude (thousand barrels)	*1,205	*1,502
Lignite	[2] 169,300	*159,000	Zinc, smelter	86,200	86,200

[1] Lead (mine), phosphate rock, pyrites, salt, silver, and zinc (mine) have been produced in recent years, but no current data are available.
[2] Revised figure.
[3] Data not available.

PORTUGAL

TABLE 41.—Mineral production, 1950–51, in metric tons

Mineral [1]	1950	1951	Mineral [1]	1950	1951
Antimony	15	(2)	Manganese ore	798	7,615
Arsenic, white	801	940	Mica		(2)
Asbestos	271	(2)	Peat	402	
Barite	128		Pyrites, including cupreous pyrites	613,522	729,611
Beryllium concentrates	*49	112	Salt:		
Cement, hydraulic (thousand tons)	573	644	Rock salt	42	(2)
Chromite	45	(2)	Other salt (exports)	30,765	29,374
Coal (thousand tons):			Silver (troy ounces)	60,709	55,798
Bituminous and anthracite	426	418	Tin (long tons):		
Lignite	95	83	Mine [4]	690	902
Fuel briquets	[3] 79,585	87,600	Smelter	[3] 209	*240
Gold (troy ounces)	15,465	*14,000	Titanium concentrates: Ilmenite	47	34
Lead:			Tungsten concentrates (60 percent WO_3 basis)	2,500	4,680
Mine	845	*900			
Smelter	591	(2)			

[1] Feldspar, gypsum, iron ore, and talc have been produced in recent years, but no current data are available.
[2] Data not available.
[3] Revised figure.
[4] Excluding mixed concentrates.

RUMANIA

TABLE 42.—Mineral production, 1950–51, in metric tons

Mineral [1]	1950	1951	Mineral [1]	1950	1951
Cement, hydraulic (thousand tons)	650	(2)	Iron ore (thousand tons)	*395	*510
Coal (thousand tons):			Iron and steel (thousand tons):		
Bituminous and anthracite	[*3] 300	*300	Pig iron and ferroalloys	[3*] 335	(2)
Lignite	[*3] 2,900	*3,500	Steel ingots and castings	*558	646
Coke (thousand tons)	*120	*125	Petroleum, crude (thousand barrels)	*32,000	*31,000
Copper, smelter	200	(2)	Zinc, smelter	3,000	(2)
Fuel briquets	*250,000	*250,000			

[1] Bauxite, beryl, bismuth, feldspar, gold, gypsum, lead, manganese ore, mercury, mica, molybdenum, phosphate rock, pyrites, salt, silver, talc, and zinc (mine) have been produced in recent years, but no current data are available.
[2] Data not available.
[3] Revised figure.

SPAIN

TABLE 43.—Mineral production, 1950–51, in metric tons

Mineral [1]	1950	1951	Mineral [1]	1950	1951
Aluminum	[2] 2.338	3,847	Lead:		
Antimony	[2] 200	[3] 380	Mine	[2] 32,257	55,745
Arsenic, white	159	375	Smelter	[2] 40,568	41,240
Asbestos	41	(4)	Magnesite	7,632	13,733
Barite	7,147	12,449	Manganese ore	[2] 19,002	21,912
Bauxite	[2] 13,219	12,667	Mercury (flasks)	[2] 51,808	44,840
Bismuth, metal (kilograms)	11,344	15,180	Mica	14	11
Cadmium, smelter (kilograms)	4,348	3,900	Peat	4,952	4,410
Cement, hydraulic (thousand tons)	[2] 2,522	2,741	Phosphate rock	24,080	22,830
Coal (thousand tons):			Potassium salts (salable) (equivalent K_2O)	152,000	190,000
Bituminous and anthracite	[2] 11,118	11,553	Pyrites, including cupreous pyrites	[2] 1,453,032	1,630,711
Lignite	[2] 1,318	1,497	Salt:		
Coke (thousand tons)	946	995	Rock salt	[2] 308,228	367,809
Copper:			Other salt	901,575	893,297
Mine [5]	[2] 6,171	[6] 6,804	Silver (troy ounces)	[2] 823,831	735,911
Smelter	[2] 5,211	5,836	Sulfur, native (long tons)	[2] 6,800	(4)
Feldspar (quarry) [7]	1,650	800	Talc and soapstone [8]	25,131	36,034
Fluorspar	32,669	54,789	Tin (long tons):		
Fuel briquets	[2] 1,130,362	1,160,542	Mine	*575	*716
Gold (troy ounces)	13,217	12,777	Smelter	[2] 1,597	945
Graphite	[2] 310	284	Titanium concentrates:		
Gypsum	2,251,831	1,821,676	Ilmenite	637	700
Iron ore (thousand tons)	[2] 2,088	2,316	Tungsten concentrates (60 percent WO_3 basis)	[2] 850	2,300
Iron and steel (thousand tons):			Zinc:		
Pig iron and ferroalloys	680	679	Mine	*64,000	*74,000
Steel ingots and castings	[2] 807	831	Smelter	21,264	21,345

[1] Beryl, cobalt, molybdenum, and vanadium have been produced in recent years, but no current data are available.
[2] Revised figure.
[3] Including Spanish Morocco.
[4] Data not available.
[5] According to Year Book of American Bureau of Metal Statistics.
[6] Approximate production.
[7] There is some additional production of feldspar, but comparable figures are not available.
[8] Includes steatite as follows: 1950, 13,702; 1951, 22,628.

SVALBARD (SPITZBERGEN)

Production of coal in Svalbard (Spitzbergen) totaled 379,000 metric tons in 1950 and 470,000 in 1951, exclusive of U. S. S. R.-controlled mines.

SWEDEN

TABLE 44.—Mineral production, 1950–51, in metric tons

Mineral [1]	1950	1951	Mineral [1]	1950	1951
Aluminum (includes alloys)	[2] 4,038	6,600	Lead:		
Barite	50	(3)	Mine	22,673	15,059
Bismuth (kilograms)	----------	(3)	Smelter	[2] 16,681	9,435
Cement, hydraulic (thousand tons)	[2] 1,936	2,012	Manganese ore	11,847	(3)
Coal, bituminous (thousand tons)	[2] 309	272	Mercury (flasks)	----------	(3)
Cobalt	----------	(3)	Molybdenum	6	(3)
Coke (thousand tons)	72	----------	Peat:		
Copper:			Agricultural use	*100,000	*100,000
Mine	[2] 16,100	14,424	Fuel	*100,000	*250,000
Smelter	16,708	14,968	Phosphate rock (apatite)	2,044	(3)
Gold (troy ounces)	78,866	80,000	Pyrites, including cupreous pyrites	406,800	420,000
Iron ore (thousand tons)	13,927	16,111	Silver (troy ounces)	1,291,656	(3)
Iron and steel (thousand tons):			Talc and soapstone	13,843	(3)
Pig iron and ferroalloys	[2] 837	838	Tungsten concentrates (60 percent WO_3 basis)	362	*500
Steel ingots and castings	[2] 1,437	1,503	Zinc, mine	[2] 37,121	38,000

[1] Arsenic, chromite, feldspar, fluorspar, fuel briquets, graphite, mica, and salt have been produced in recent years, but no current data are available. Nickel is produced, but no output was recorded in 1950–51.
[2] Revised figure.
[3] Data not available.

SWITZERLAND

TABLE 45.—Mineral production, 1950–51, in metric tons

Mineral[1]	1950	1951	Mineral[1]	1950	1951
Aluminum	[2] 19, 200	*24, 000	Iron ore (thousand tons)	55	86
Cement, hydraulic (thousand tons)	1, 078	1, 315	Iron and steel (thousand tons):		
Coal, bituminous and anthracite (thousand tons)	*10	*10	Pig iron and ferroalloys	34	35
Fuel briquets	*100, 000	*100, 000	Steel ingots and castings	130	144
Gypsum	*80, 000	120, 000	Magnesium metal		[3]
			Salt	94, 000	114, 000

[1] Feldspar, fluorspar, and peat have been produced in recent years, but no current data are available. Asbestos and coal (lignite) are produced, but no output was recorded in 1950–51.
[2] Revised figure.
[3] Data not available.

TRIESTE

TABLE 46.—Mineral production, 1950–51, in metric tons

Mineral	1950	1951
Coke (thousand tons)	99	99
Iron and steel (thousand tons):		
Pig iron and ferroalloys	65	40
Steel ingots and castings	39	56

TURKEY (IN EUROPE)

Data on output of Turkey in Europe are included with those of Turkey in Asia.

U. S. S. R. (IN EUROPE AND ASIA)

TABLE 47.—Mineral production, 1950–51, in metric tons (all data estimated)

Mineral[1]	1950	1951	Mineral[1]	1950	1951
Aluminum	190, 000	200, 000	Lead, smelter	[2] 111, 600	128, 400
Cadmium, smelter (kilograms)	70, 000	80, 000	Manganese ore	2, 000, 000	2, 000, 000
Cement, hydraulic (thousand tons)	10, 500	12, 400	Nickel	25, 000	25, 000
Chromite	500, 000	600, 000	Peat	44, 000, 000	44, 000, 000
Coal (thousand tons)	264, 000	281, 000	Petroleum, crude (thousand barrels)[3]	273, 200	292, 000
Coke (thousand tons)	27, 000	30, 000	Phosphate rock	2, 540, 125	[4]
Copper, smelter	218, 000	254, 000	Platinum, placer and refining copper ores (troy ounces)	100, 000	100, 000
Gold (troy ounces)	[2] 8, 000, 000	9, 500, 000	Salt	[5]	[5]
Iron and steel (thousand tons):			Tungsten concentrates (60 percent WO_3 basis)	[2] 7, 500	7, 500
Pig iron and ferroalloys	19. 500	22, 500	Zinc, smelter	128, 700	148, 000
Steel ingots and castings	27, 000	31, 500			

[1] Antimony, arsenic, asbestos, barite, bauxite, beryl, bismuth, corundum, diamonds, feldspar, fluorspar, graphite, gypsum, iron ore, lead (mine), magnesite, magnesium metal, mercury, mica, molybdenum, potassium salts, pyrites, silver, native sulfur, talc, tin, vanadium, and zinc (mine) have been produced in recent years, but no current data are available.
[2] Revised figure.
[3] Includes Sakhalin.
[4] Data not available.
[5] Exceeds 4,000,000 tons.

UNITED KINGDOM

TABLE 48.—Mineral production, 1950–51, metric tons

Mineral [1]	1950	1951
Aluminum	29,941	28,200
Barite	[2] 98,557	([3])
Cadmium, smelter (kilograms)	[4] 118,899	148,343
Cement, hydraulic (thousand tons)	9,913	10,388
Coal (thousand tons):		
Great Britain: Bituminous and anthracite	[4] 219,792	225,815
Northern Ireland: Bituminous	1	1
Coke (thousand tons)	[4] 15,690	16,354
Fluorspar	50,294	([3])
Fuel briquets	[4] 1,419,422	1,775,039
Gypsum:		
Great Britain	2,241,711	*2,200,000
Northern Ireland	([3])	173
Iron ore (Great Britain) (thousand tons) [5]	[4] 13,143	14,882
Iron and steel (thousand tons):		
Pig iron and ferroalloys	[4] 9,818	9,859
Steel ingots and castings	16,555	15,889
Lead:		
Mine	[4] 3,338	4,158
Smelter	[4] * 3,048	*4,158
Magnesium metal [6]	4,900	[7] * 7,700
Petroleum, crude (thousand barrels)	340	335
Pyrites, including cupreous pyrites	13,501	([3])
Salt:		
Great Britain:		
Rock salt	41,658	([3])
Other salt	4,223,814	([3])
Northern Ireland	13,000	13,251
Silver (troy ounces)	18,153	([3])
Tin (long tons):		
Mine [8]	[4] * 1,230	*1,210
Smelter [9]	[4] * 28,750	*27,900
Tungsten concentrates (60 percent WO_3 basis)	[4] 74	54
Zinc:		
Mine	37	----------
Smelter	71,418	70,851

[1] Arsenic, bismuth, chromite, and talc have been produced in recent years, but no current data are available. Bauxite (Northern Ireland) and coal (lignite) (Northern Ireland) are produced, but no output was recorded in 1950–51.
[2] Includes witherite.
[3] Data not available.
[4] Revised figure.
[5] Exclusive of bog ore, which is used mainly for purification of gas.
[6] Includes secondary metal.
[7] Includes magnesium alloy.
[8] Intake by smelters.
[9] Includes production from imported scrap.

YUGOSLAVIA

TABLE 49.—Mineral production, 1950–51, metric tons

Mineral [1]	1950	1951
Aluminum	*2,500	([2])
Antimony	3,205	([2])
Barite	29,730	24,822
Bauxite	*201,000	453,000
Bismuth, metal (kilograms)	60,531	87,760
Cement, hydraulic (thousand tons)	1,219	1,145
Chromite	[3] * 115,200	*107,000
Coal (thousand tons):		
Bituminous	[3] 1,154	992
Lignite	[3] 11,712	10,827
Copper, smelter	[3] 40,080	32,011
Fuel briquets	*200,000	200,000
Iron ore (thousand tons)	[3] 826	581
Iron and steel (thousand tons):		
Pig iron and ferroalloys	[3] 212	250
Steel ingots and castings	[3] 428	434
Lead:		
Mine	[3] 86,039	78,750
Smelter	[3] 57,200	60,100
Magnesite	58,971	89,915
Manganese ore	13,338	12,743
Mercury (flasks)	14,368	14,649
Molybdenum	174	([3])
Petroleum, crude (thousand barrels)	780	1,092
Pyrites, including cupreous pyrites	117,187	143,779
Salt	131,000	95,646
Silver (troy ounces)	2,200,000	3,000,000
Zinc:		
Mine	[3] 38,092	39,420
Smelter	10,844	13,223

[1] Copper (mine), gold, and gypsum have been produced in recent years, but no current data are available.
[2] Data not available.
[3] Revised figure.

ASIA

ADEN

Production of salt in Aden totaled 259,972 metric tons in 1950 and 309,186 in 1951.

AFGHANISTAN

Production of coal in Afghanistan totaled 9,000 metric tons in 1950 and 13,000 in 1951. Production of beryllium totaled 7 metric tons in 1950; data for 1951 are not available. Salt and talc have been produced in recent years, but no current data are available.

BAHRAIN ISLAND

Bahrain Island produced 11,016,000 barrels of crude petroleum in 1950 and 10,994,000 in 1951.

BRITISH BORNEO

TABLE 50.—Mineral production, 1950–51, in metric tons

Mineral [1]	1950	1951	Mineral [1]	1950	1951
Antimony [2]	2		Petroleum, crude (thousand barrels)	30,958	37,506
Gold (troy ounces) [2]	1,440	931	Phosphate rock (guano)	653	659

[1] Coal, diamonds, and silver have been produced in recent years, but no current data are available.
[2] Sarawak only.

BURMA

TABLE 51.—Mineral production, 1950–51, in metric tons

Mineral [1]	1950	1951	Mineral [1]	1950	1951
Antimony	*6	(2)	Petroleum, crude (thousand barrels)	*450	*645
Gold (troy ounces)	150	(2)	Salt	21,457	(2)
Lead:			Tin, mine (long tons)	[3] 1,520	1,624
Mine	78	*2,000	Tungsten concentrates (60 percent WO_3 basis)	[3] *750	1,647
Smelter	[3] 11	4,966			

[1] Bismuth has been produced in recent years, but no current data are available. Silver is produced, but no output was recorded in 1950–51.
[2] Data not available.
[3] Revised figure.

CEYLON

TABLE 52.—Mineral production, 1950–51, in metric tons

Mineral	1950	1951	Mineral	1950	1951
Cement, hydraulic (thousand tons)		63	Gypsum		309
Graphite (exports)	13,030	12,824	Mica		(1)
			Salt	66,093	36,990

[1] Less than 0.5 ton.

CHINA (EXCEPT FORMOSA)

TABLE 53.—Mineral production, 1950–51, in metric tons

Mineral [1]	1950	1951	Mineral [1]	1950	1951
Antimony	*6,000	*8,000	Lead, smelter	*4,000	*5,000
Bauxite		*10,000	Mercury (flasks)	*1,450	*4,000
Cement, hydraulic (thousand tons)	[2] 430	([3])	Mica (exports)	[4] 16,579	11,112
Coal, bituminous, anthracite, and lignite (thousand tons)	[4] 37,000	43,250	Petroleum, crude (thousand barrels)	*730	*730
Coke (thousand tons)	[4] *1,000	*1,300	Phosphate rock	*20,000	*20,000
Copper, smelter [5]	4,000	6,000	Salt	*2,500,000	*3,000,000
Gold (troy ounces)	[4] 108,000	*100,000	Silver (troy ounces)	320,000	320,000
Gypsum	*60,000	([3])	Tin (long tons):		
Iron ore (thousand tons)	*2,000	*3,000	Mine	[4] *6,890	*6,890
Iron and steel (thousand tons):			Smelter	[4] *6,890	*6,890
Pig iron and ferroalloys	*1,022	*1,300	Tungsten concentrates (60 percent WO_3 basis)	[4] *12,000	*15,800
Steel ingots and castings	[4] *680	*1,000	Zinc, smelter	*180	*180

[1] Aluminum (Manchuria only), arsenic, asbestos, barite, beryl (Manchuria only), bismuth, cobalt, feldspar, fluorspar, graphite, lead (mine), magnesite, magnesium metal, manganese ore, mica, molybdenum, potassium salts, pyrites, native sulfur, and talc, have been produced in recent years, but no current data are available.
[2] Manchuria only.
[3] Data not available.
[4] Revised figure.
[5] Approximate production.

CHRISTMAS ISLAND

Exports of phosphate rock from Christmas Island totaled 320,423 metric tons in 1950 and 337,677 in 1951. This is the Christmas Island south of Java, not the one south of Hawaii.

CYPRUS

TABLE 54.—Mineral production, 1950–51, in metric tons

Mineral [1]	1950	1951	Mineral [1]	1950	1951
Asbestos	14,989	[2] 15,330	Magnesite (exports)	20	20
Chromite (exports)	18,441	12,653	Pyrites, including cupreous pyrites	[4] 829,889	959,838
Copper, mine [3]	23,301	22,811	Salt	4,133	11,198
Gypsum (exports)	65,485	23,171			

[1] Gold and silver have been produced in recent years, but no current data are available.
[2] Exports.
[3] Copper content of exports.
[4] Revised figure.

HONG KONG

Production of hydraulic cement in Hong Kong totaled 68,000 metric tons in 1950 and 72,000 in 1951. Production of iron ore totaled 169,000 metric tons in 1950 and 161,000 in 1951. Silver has been produced in recent years, but no current data are available.

INDIA

TABLE 55.—Mineral production, 1950–51, in metric tons

Mineral[1]	1950	1951	Mineral[1]	1950	1951
Aluminum	3,650	3,960	Iron and steel (thousand tons):		
Asbestos	211	(2)	Pig iron and ferroalloys	[3] 1,706	1,853
Barite	8,211	(2)	Steel ingots and castings	[3] 1,461	1,524
Bauxite	65,433	*65,000	Lead, smelter	[3] 639	878
Beryllium concentrates	(2)	215	Magnesite	55,829	118,650
Cement, hydraulic (thousand tons)	2,652	3,252	Manganese ore	[3] 897,100	1,179,680
Chromite	16,998	*11,000	Mica	[4] 16,579	11,112
Coal, bituminous (thousand tons)	[3] 32,815	34,983	Petroleum, crude (thousand barrels)	1,867	1,949
Coke (thousand tons)	[3] 2,251	2,183	Phosphate rock (apatite)	3,025	(2)
Copper:			Salt:		
Mine	7,000	7,388	Rock salt	5,130	5,519
Smelter	6,720	7,197	Other salt	[3] 2,609,029	2,889,377
Corundum	304	557	Silver (troy ounces)	15,676	17,180
Feldspar	1,800	(2)	Talc and soapstone	25,894	32,314
Gold (troy ounces)	196,848	226,475	Titanium concentrates:		
Graphite	1,611	1,066	Ilmenite	216,076	143,174
Gypsum	205,362	193,276	Rutile	(5)	(2)
Iron ore (thousand tons)	[3] 3,005	3,714	Tungsten concentrates (60 percent WO_3 basis)	2	----------

[1] Columbite, diamonds, lead (mine), and potassium salts have been produced in recent years, but no current data are available. Fluorspar is produced, but no output was recorded in 1950–51.
[2] Data not available.
[3] Revised figure.
[4] Exports.
[5] Figure withheld in order to avoid disclosure of United States production by differences. *See* footnote 8 on United States table.

INDOCHINA

TABLE 56.—Mineral production, 1950–51, in metric tons

Mineral[1]	1950	1951	Mineral[1]	1950	1951
Cement, hydraulic (thousand tons)	144	212	Fuel briquets	*12,000	*12,000
Coal, bituminous and anthracite (thousand tons)	[2] 502	645	Salt	[2] 75,722	93,908
			Tin, mine (long tons)	62	92

[1] Asbestos, chromite, gold, and graphite have been produced in recent years, but no current data are available. Coke, molybdenum, and tin (smelter) are produced, but no output was recorded in 1950–51.
[2] Revised figure.

INDONESIA

TABLE 57.—Mineral production, 1950–51, in metric tons

Mineral[1]	1950	1951	Mineral[1]	1950	1951
Bauxite	[2] 531,143	642,316	Gold (troy ounces)	*42,000	(3)
Cement, hydraulic (thousand tons)	(3)	*100	Petroleum, crude (thousand barrels)[4]	50,148	57,199
Coal, bituminous (thousand tons)	[2] 804	865	Salt	375,000	*300,000
Fuel briquets	25,278	26,705	Tin, mine (long tons)	[2] 32,102	30,986

[1] Pig iron, silver, and native sulfur have been produced in recent years, but no current data are available. Nickel, phosphate rock, and tin (smelter) are produced, but no output was recorded in 1950–51.
[2] Revised figure.
[3] Data not available.
[4] Includes Western New Guinea, whose production amounted to 1,748,000 barrels in 1950 and 1,745,790 in 1951

IRAN

TABLE 58.—Mineral production, 1950–51, in metric tons

Mineral [1]	1950	1951	Mineral [1]	1950	1951
Antimony [2]	230	*230	Gypsum [2]	*378,000	(3)
Arsenic, white [2]	*25	(3)	Manganese ore	[4] *9,360	(3)
Cement, hydraulic (thousand tons) [2]	64	65	Petroleum, crude (thousand barrels)	242,475	*127,600
Coal, bituminous (thousand tons) [2]	*200	*200	Salt	*100,000	76,252

[1] Chromite has been produced in recent years, but no current data are available.
[2] Fiscal year ended March 20 of year following that stated.
[3] Data not available.
[4] Exports.

IRAQ

TABLE 59.—Mineral production, 1950–51, in metric tons

Mineral	1950	1951	Mineral	1950	1951
Cement, hydraulic (thousand tons)	66	[1] 75	Petroleum, crude (thousand barrels)	[3] 49,726	65,122
Gypsum	250,000	(2)	Salt	[3] 11,861	16,503

[1] Fiscal year ended March 31 of the year following that stated.
[2] Data not available.
[3] Revised figure.

ISRAEL AND JORDAN

TABLE 60.—Mineral production, 1950–51, in metric tons

Mineral [1]	1950	1951	Mineral [1]	1950	1951
Cement, hydraulic (thousand tons) [2]	380	439	Potassium salts (equivalent K_2O)		(3)
Gypsum	23,623	[2] 1,700	Salt [4]	18,000	12,212
Phosphate rock (exports)	(3)	6,888			

[1] Barite, feldspar, salt (rock), and native sulfur have been produced in recent years, but no current data are available.
[2] Israel only.
[3] Data not available.
[4] Other than rock salt.

JAPAN

TABLE 61.—Mineral production, 1950–51, in metric tons

Mineral [1]	1950	1951	Mineral [1]	1950	1951
Aluminum	24,764	36,780	Lead:		
Antimony	161	221	Mine	[2] 10,896	12,672
Arsenic, white	1,627	1,300	Smelter	9,984	10,740
Asbestos	[2] 4,848	6,139	Manganese ore	134,066	198,000
Barite	14,239	16,704	Mercury (flasks)	1,312	1,847
Bismuth, smelter (kilograms)	33,049	42,010	Molybdenum	13	43
Cadmium, smelter (kilograms)	90,348	117,687	Petroleum, crude (thousand barrels)	2,048	2,337
Cement, hydraulic (thousand tons)	[2] 4,463	6,548	Phosphate rock	258	143
Chromite	31,953	40,407	Platinum, refinery (troy ounces)	1,938	245
Coal (thousand tons):			Potassium salts, alunite (equivalent K_2O)	203	([5])
Bituminous and anthracite	38,461	43,320	Pyrites, including cupreous pyrites	[2] 1,928,750	2,250,784
Lignite	[2] 1,284	1,403	Salt	418,144	430,405
Coke (thousand tons)	[2] 2,712	3,864	Silver (troy ounces)	[2] 3,964,572	4,607,713
Copper:			Sulfur, native (long tons)	90,940	139,364
Mine	39,322	42,298	Talc, pyrophyllite, and soapstone	283,566	400,626
Smelter	84,749	90,948	Tin (long tons):		
Feldspar [3]	13,187	26,528	Mine	326	426
Fluorspar	2,425	3,996	Smelter	[2] 389	579
Fuel briquets	[2] *1,500,000	*1,800,000	Tungsten concentrates (60 percent WO_3 basis)	64	86
Gold (troy ounces)	[2] 135,033	177,086	Zinc:		
Graphite	3,804	4,716	Mine	52,032	64,416
Gypsum	114,505	200,640	Smelter	49,008	56,340
Iron ore (thousand tons) [4]	[2] 927	1,099			
Iron and steel (thousand tons):					
Pig iron and ferroalloys	[2] 2,299	3,228			
Steel ingots and castings	[2] 4,838	6,502			

[1] Cobalt, magnesium metal, and nickel are produced, but no output was recorded in 1950–51.
[2] Revised figure.
[3] In addition the following quantities of aplite and other feldspathic rock were produced: 1950, 45,679 metric tons; 1951, 59,919 tons.
[4] Includes iron sand production as follows: 1950, 101,544 metric tons; 1951, 213,924 tons.
[5] Data not available.

KOREA

TABLE 62.—Mineral production, 1950–51, in metric tons

Mineral	1950	1951	Mineral	1950	1951
REPUBLIC OF KOREA [1]					
Beryllium concentrates	----------	([2])	Copper, mine	27	6
Bismuth (kilograms)	([2])	12,500	Fuel briquets	*75,000	*100,000
Cement, hydraulic (thousand tons)	10	([2])	Gold (troy ounces)	5,144	1,000
Coal (thousand tons):			Lead, mine	136	136
Anthracite	[3] 586	*600	Pig iron and ferroalloys (thousand tons)	----------	([2])
Lignite	[3] 27	([2])	Tungsten concentrates (60 percent WO_3 basis)	[3] *2,000	*900
Cobalt	----------	([2])			
Coke (thousand tons)	*10	*10			
NORTH KOREA [4]					
Coal, anthracite (thousand tons)	*1,500	*1,000	Pig iron and ferroalloys (thousand tons)	*23	([2])
Coke (thousand tons)	*500	*250	Tungsten concentrates (60 percent WO_3 basis)	*1,000	*1,200

[1] Aluminum, arsenic, asbestos, copper (smelter), fluorspar, graphite, lead (smelter), magnesite, manganese ore, mica, molybdenum, phosphate rock, potassium salts, pyrites, salt, silver, steel, talc, and zinc (mine) have been produced in recent years, but no current data are available. Magnesium metal is produced, but no output was recorded in 1950–51.
[2] Data not available.
[3] Revised figure.
[4] Barite, cement, coal (lignite), copper (smelter), fluorspar, gold, iron ore, lead, mica, molybdenum, potassium salts, silver, and zinc (mine) have been produced in recent years, but no current data are available. Magnesium metal is produced, but no output was recorded in 1950–51.

KUWAIT

Production of crude petroleum in Kuwait totaled 125,722,000 barrels in 1950 and 204,910,000 in 1951.

LEBANON

TABLE 63.—Mineral production, 1950–51, in metric tons

Mineral	1950	1951
Cement, hydraulic (thousand tons)	263	303
Salt	6,604	(1)

[1] Data not available.

MALAYA

TABLE 64.—Mineral production, 1950–51, in metric tons

Mineral [1]	1950	1951	Mineral [1]	1950	1951
Coal, bituminous (thousand tons)	422	389	Tin (long tons):		
Corundum	*10	(2)	Mine	57,537	57,167
Gold (troy ounces)	18,436	17,018	Smelter	68,747	65,914
Iron ore (thousand tons)	507	851	Titanium concentrates: Ilmenite	25,315	[3] 42,341
			Tungsten concentrates (60 percent WO_3 basis)	27	54

[1] Silver has been produced in recent years, but no current data are available. Graphite is produced, but no output was recorded in 1950–51.
[2] Data not available.
[3] Exports.

PAKISTAN

TABLE 65.—Mineral production, 1950–51, in metric tons

Mineral	1950	1951	Mineral	1950	1951
Cement, hydraulic (thousand tons)	421	507	Gypsum	[1] 16,927	22,791
Chromite	[1] 18,416	18,006	Petroleum, crude (thousand barrels)	[1] 1,281	1,348
Coal, bituminous (thousand tons)	[1] 444	513	Salt	142,522	147,109
Fuel briquets	[1] *7,300	*7,500	Steel ingots and castings (thousand tons)	5	6

[1] Revised figure.

PHILIPPINES

TABLE 66.—Mineral production, 1950–51, in metric tons

Mineral [1]	1950	1951	Mineral [1]	1950	1951
Cement, hydraulic (thousand tons)	292	309	Gypsum	2,883	399
Chromite	250,511	334,571	Iron ore (thousand tons)	599	903
Coal, bituminous (thousand tons)	159	151	Lead, mine	879	571
Copper, mine	[2] 10,384	12,712	Manganese ore	29,867	22,343
Gold (troy ounces)	333,991	393,602	Phosphate rock (guano)	32,606	(3)
			Salt	56,283	52,960
			Silver (troy ounces)	216,034	274,602

[1] Pig iron has been produced in recent years, but no current data are available.
[2] Revised figure.
[3] Data not available.

PORTUGUESE INDIA

TABLE 67.—Mineral production, 1950–51, in metric tons

Mineral	1950	1951
Iron ore (thousand tons)	131	436
Manganese ore	[1] 38,220	86,789
Salt	17,608	31,577

[1] Revised figure.

QATAR

Production of crude petroleum in Qatar totaled 12,268,000 barrels in 1950 and 18,009,000 in 1951.

SAUDI ARABIA

TABLE 68.—Mineral production, 1950–51, in metric tons

Mineral	1950	1951	Mineral	1950	1951
Copper, mine	41	(1)	Petroleum, crude (thousand barrels)	199,547	277,963
Gold (troy ounces)	66,202	73,104	Silver (troy ounces)	124,287	109,912

[1] Data not available.

SYRIA

TABLE 69.—Mineral production, 1950–51, in metric tons

Mineral	1950	1951
Cement, hydraulic (thousand tons)	68	64
Gypsum [1]	2,000	8,170
Salt	[2] 12,000	7,000

[1] Some pure, some 80 percent gypsum and 20 percent limestone.
[2] Revised figure.

TAIWAN (FORMOSA)

TABLE 70.—Mineral production, 1950–51, in metric tons

Mineral [1]	1950	1951	Mineral [1]	1950	1951
Aluminum	1,761	2,598	Gold (troy ounces)	18,232	30,500
Cement, hydraulic (thousand tons)	*332	*389	Petroleum, crude (thousand barrels)	23	21
Coal, bituminous (thousand tons)	1,402	1,450	Salt	[3] 175,063	274,766
Coke (thousand tons)	*50	125	Silver (troy ounces)	[3] *3,200	*3,200
Copper, smelter	360	[2] 629	Sulfur, native (long tons)	72	2,608

[1] Copper (mine) and magnesium metal have been produced in recent years, but no current data are available.
[2] Approximate production.
[3] Revised figure.

THAILAND (SIAM)

TABLE 71.—Mineral production, 1950–51, in metric tons

Mineral [1]	1950	1951	Mineral [1]	1950	1951
Antimony	[2] 87	65	Salt	*200,000	250,000
Cement, hydraulic (thousand tons)	166	312	Tin (long tons):		
Gypsum	336	79	Mine	10,364	9,502
Iron ore (thousand tons)	3	7	Smelter	2	----------
Iron and steel (thousand tons):			Tungsten concentrates (60 percent WO_3 basis)	[2] 1,200	1,200
Pig iron and ferroalloys	8	9			
Steel ingots and castings	5	6			

[1] Gold has been produced in recent years, but no current data are available.
[2] Revised figure.

TURKEY (IN ASIA AND EUROPE)

TABLE 72.—Mineral production, 1950–51, in metric tons

Mineral [1]	1950	1951	Mineral [1]	1950	1951
Antimony (Asia Minor)	[2] 1,288	3,360	Iron ore (thousand tons)	234	226
Asbestos	245	(3)	Iron and steel (thousand tons):		
Cement, hydraulic (thousand tons)	[2] 396	396	Pig iron and ferroalloys	116	155
Chromite	[2] 420,792	602,220	Steel ingots and castings	90	135
Coal (marketable) (thousand tons):			Lead, mine	260	600
Bituminous	2,824	2,988	Magnesite	450	505
Lignite	*907	*1,000	Manganese ore	[2] 32,178	50,517
Coke (thousand tons)	[2] 304	*300	Mercury (flasks)	----------	(3)
Copper:			Petroleum, crude (thousand barrels)	[2] 108	129
Mine	13,300	11,850	Salt:		
Smelter	11,700	16,445	Rock salt	[2] 20,330	21,584
Fuel briquets	29,100	*30,000	Other salt	[2] 284,912	249,970
			Sulfur, native (long tons) [4]	5,708	7,101

[1] Molybdenum, silver, and zinc have been produced in recent years, but no current data are available. Pyrites is produced, but no output was recorded in 1950–51.
[2] Revised figure.
[3] Data not available.
[4] Refined.

U. S. S. R. (IN ASIA)

Data on output of U. S. S. R. in Asia are included with those of U. S. S. R. in Europe.

AFRICA

ALGERIA

TABLE 73.—Mineral production, 1950–51, in metric tons

Mineral	1950	1951	Mineral	1950	1951
Antimony	[1] 1,250	1,462	Lead, mine	1,408	2,838
Barite	[1] 22,890	21,021	Mercury (flasks)	----------	(2)
Cement, hydraulic (thousand tons)	[1] 324	448	Petroleum, crude (thousand barrels)	24	49
Coal, bituminous and anthracite (thousand tons)	258	257	Phosphate rock	684,657	776,575
Copper, mine	81	120	Pyrites, including cupreous pyrites	25,075	31,450
Fuel briquets	65,589	65,100	Salt	75,656	(2)
Gypsum	46,097	82,000	Silver (troy ounces)	32,000	(2)
Iron ore (thousand tons)	2,573	2,815	Zinc, mine	[1] 7,177	9,466

[1] Revised figure.
[2] Data not available.

ANGLO-EGYPTIAN SUDAN

TABLE 74.—Mineral production, 1950–51, in metric tons

Mineral [1]	1950	1951
Gold (troy ounces)	3,503	1,495
Gypsum		183
Salt	40,754	46,215

[1] Beryl is produced, but no output was recorded in 1950–51.

ANGOLA

TABLE 75.—Mineral production, 1950–51, in metric tons

Mineral [1]	1950	1951	Mineral [1]	1950	1951
Copper, mine	[2] 1,279	1,100	Mica	24	136
Diamonds (metric carats)	538,867	751,447	Phosphate rock	1,033	943
Gold (troy ounces)	201	61	Salt	40,473	49,764
Manganese ore	9,308	46,192			

[1] Gypsum has been produced in recent years, but no current data are available.
[2] Revised figure.

BECHUANALAND

TABLE 76.—Mineral production, 1950–51, in metric tons

Mineral	1950	1951
Gold (troy ounces)	261	(1)
Silver (troy ounces)	24	(1)

[1] Data not available.

BELGIAN CONGO

TABLE 77.—Mineral production, 1950–51, in metric tons

Mineral [1]	1950	1951	Mineral [1]	1950	1951
Bismuth, in ore (kilograms)	668	225	Gold (troy ounces) [4]	339,415	352,308
Cadmium, smelter (kilograms)	[2] 29,668	24,316	Gypsum	[2] 7,190	[2] 7,973
Cement, hydraulic (thousand tons)	[2] 174	205	Manganese ore	16,990	70,945
Coal, bituminous and anthracite (thousand tons)	160	219	Salt	550	583
Cobalt	[2] 5,148	5,875	Silver (troy ounces)	4,459,951	3,795,266
Columbite concentrates (pounds) [3]	297,675	209,437	Tin (long tons): Mine [4]	[2] 13,464	13,669
Copper, smelter	175,920	191,959	Smelter	3,238	3,011
Diamonds (metric carats)	10,147,471	10,564,667	Tungsten, concentrates (60 percent WO_3 basis)	164	285
			Zinc, mine	[2] 74,805	88,704

[1] Copper (mine) and pig iron have been produced in recent years, but no current data are available. Lead (mine) and palladium (refinery) are produced, but no output was recorded in 1950–51.
[2] Revised figure.
[3] In addition, tin-columbite-tantalite concentrates were produced as follows: 1950, 2,431,674 pounds; 1951, 2,597,019 pounds, columbite-tantalite content averaging about 10 percent.
[4] Including Ruanda-Urundi.

BRITISH SOMALILAND

Salt and beryllium concentrates have been produced in British Somaliland in recent years, but no current data are available.

CANARY ISLANDS

Production of salt in the Canary Islands totaled 6,072 metric tons in 1950, but no data are available for 1951.

CAPE VERDE ISLANDS

Salt has been produced in the Cape Verde Islands in recent years, but no current data are available.

EGYPT

TABLE 78.—Mineral production, 1950–51, in metric tons

Mineral [1]	1950	1951	Mineral [1]	1950	1951
Asbestos	260	1,247	Phosphate rock	397,207	499,976
Barite		41	Salt	[2] 539,016	687,038
Cement, hydraulic (thousand tons)	[2] 900	1,145	Steel ingots and castings (thousand tons)	*10	*10
Chromite	36		Talc and soapstone	3,731	3,754
Gold (troy ounces)	[2] 10,724	16,232	Titanium concentrates: Ilmenite	260	317
Gypsum	([3])	112,056	Tungsten concentrates (60 percent WO_3 basis)		7
Manganese ore	152,169	155,364			
Petroleum, crude (thousand barrels)	16,373	16,311			

[1] Iron ore and native sulfur have been produced in recent years, but no current data are available. Graphite is produced, but no output was recorded in 1950–51.
[2] Revised figure.
[3] Data not available.

ERITREA

TABLE 79.—Mineral production, 1950–51, in metric tons

Mineral [1]	1950	1951	Mineral [1]	1950	1951
Gold (troy ounces)	1,042	([2])	Potassium salts, chloride (equivalent K_2O)	264	
Mica	1		Salt	53,922	*60,000

[1] Cement and coal have been produced in recent years, but no current data are available. Feldspar is produced, but no output was recorded in 1950–51.
[2] Data not available.

ETHIOPIA

TABLE 80.—Mineral production, 1950–51, in metric tons

Mineral [1]	1950	1951
Gold (troy ounces)	*43,200	*33,000
Platinum, placer (troy ounces)	([2])	[3] 60
Salt: Rock salt	*10,000	*10,000

[1] Cement, gypsum, mica, and potassium salts have been produced in recent years, but no current data are available.
[2] Data not available.
[3] Exports for year ended September 10 of year stated.

FRENCH CAMEROON

TABLE 81.—Mineral production, 1950–51, in metric tons

Mineral	1950	1951
Gold (troy ounces)	7,170	5,422
Tin, mine (long tons)	67	72
Titanium concentrates: Rutile	25	([1])

[1] Data not available.

FRENCH EQUATORIAL AFRICA

TABLE 82.—Mineral production, 1950–51, in metric tons

Mineral [1]	1950	1951	Mineral [1]	1950	1951
Columbite concentrates (pounds)	3,655	----------	Lead, mine	1,814	2,504
Corundum	----------	(2)	Titanium concentrates: Rutile	6	(2)
Diamonds (metric carats)	111,460	*136,000	Zinc, mine	621	518
Gold (troy ounces)	54,996	52,849			

[1] Graphite and salt have been produced in recent years, but no current data are available.
[2] Data not available.

FRENCH GUINEA

Gold has been produced in French Guinea in recent years, but no current data are available.

FRENCH MOROCCO

TABLE 83.—Mineral production, 1950–51, in metric tons

Mineral [1]	1950	1951	Mineral [1]	1950	1951
Antimony	[2] 706	960	Lead:		
Asbestos	511	604	Mine	[2] 48,759	68,134
Barite	[2] 4,912	3,256	Smelter	12,097	22,322
Beryllium concentrates	56	84	Manganese ore	287,265	372,233
Cement, hydraulic (thousand tons)	321	377	Mica	[2] 74	37
Coal, anthracite (thousand tons)	368	394	Petroleum, crude (thousand barrels)	305	587
Cobalt	[2] 420	680	Phosphate rock	[2] 3,872,241	4,716,800
Copper, mine	18	28	Pyrites, including cupreous pyrites	[2] 1,473	1,949
Fluorspar	40	1,968	Salt	60,000	45,971
Fuel briquets	34,573	24,755	Silver (troy ounces)	482,261	(3)
Gold (troy ounces)	119	2,069	Tin, mine (long tons)	----------	13
Graphite	[2] 74	131	Tungsten concentrates (60 percent WO_3 basis)	[2] 12	30
Iron ore (thousand tons)	319	533	Zinc, mine	12,521	19,450

[1] Gypsum and vanadium have been produced in recent years, but no current data are available. Molybdenum and nickel are produced, but no output was recorded in 1950–51.
[2] Revised figure.
[3] Data not available.

FRENCH SOMALILAND

Production of salt in French Somaliland was estimated at 80,000 metric tons in 1950 and 40,000 in 1951.

FRENCH WEST AFRICA

TABLE 84.—Mineral production, 1950–51, in metric tons

Mineral	1950	1951	Mineral	1950	1951
Bauxite	10,125	----------	Salt	66,000	*66,000
Diamonds (metric carats)	126,346	*101,000	Tin, mine (long tons)	51	65
Gold (troy ounces)	96,452	(1)	Titanium concentrates:[2]		
Phosphate rock (aluminum phosphate)	11,035	23,580	Ilmenite	[3] 540	2,500
			Rutile	----------	(4)

[1] Data not available.
[2] From Senegal.
[3] Revised figure.
[4] Figure withheld in order to avoid disclosure of United States production by differences. *See* footnote 8 on United States table.

GOLD COAST

TABLE 85.—Mineral production, 1950–51, in metric tons

Mineral [1]	1950	1951	Mineral [1]	1950	1951
Bauxite (exports)	116,793	*140,000	Manganese ore (exports)[3]	[2] 722,784	819,018
Diamonds (metric carats)	*950,000	*1,600,000	Silver (exports) (troy ounces)	43,317	52,542
Gold (troy ounces)	[2] 689,441	699,000			

[1] Salt has been produced in recent years, but no current data are available.
[2] Revised figure.
[3] Dry weight.

ITALIAN SOMALILAND

The production of salt in Italian Somaliland totaled 1,500 metric tons in 1950 and 2,000 in 1951.

KENYA

TABLE 86.—Mineral production, 1950–51, in metric tons

Mineral [1]	1950	1951	Mineral [1]	1950	1951
Asbestos	229	396	Mica	6	1
Corundum	2	(2)	Salt	18,722	19,084
Gold (troy ounces)	22,945	19,765	Silver (troy ounces)	2,586	2,150
Gypsum	610	83	Talc and soapstone	334	337
Magnesite	181	----------			

[1] Beryl and pyrites have been produced in recent years, but no current data are available. Feldspar and graphite are produced, but no output was recorded in 1950–51.
[2] Data not available.

LIBERIA

Production of gold in Liberia totaled 11,025 troy ounces in 1950 and 9,822 in 1951. Production of iron ore was nil in 1950 and 171,000 metric tons in 1951.

LIBYA

Production of salt in Tripolitania was estimated to be 9,000 metric tons in 1950, but no data for 1951 are available. In Cyrenaica no data for salt production in 1950 are available, but it was estimated to be 2,500 metric tons in 1951.

MADAGASCAR

TABLE 87.—Mineral production, 1950–51, in metric tons

Mineral [1]	1950	1951	Mineral [1]	1950	1951
Asbestos	1	(2)	Coal, bituminous (thousand tons)	2	5
Beryllium concentrates	486	530	Gold (troy ounces)	1,935	1,951
Cement, hydraulic (thousand tons)	5	5	Graphite	[3] 14,013	18,340
			Mica	[3] 819	958

[1] Iron ore and salt have been produced in recent years, but no current data are available. Corundum is produced, but no output was recorded in 1950–51.
[2] Data not available.
[3] Revised figure.

MAURITIUS

The production of salt in Mauritius totaled 2,606 metric tons in 1950, but no data for 1951 are available.

MOZAMBIQUE

TABLE 88.—Mineral production, 1950–51, in metric tons

Mineral [1]	1950	1951	Mineral [1]	1950	1951
Bauxite	4,336	(2)	Columbite concentrates (pounds)	7,700	[4] 11,133
Beryllium concentrates	[3] 264	230	Corundum	16	(2)
Cement, hydraulic (thousand tons)	50	77	Gold (troy ounces)	997	861
Coal, bituminous (thousand tons)	56	78	Graphite		240
			Mica	[3] 41	11
			Silver (troy ounces)	71	(3)
			Tin, mine (long tons)	[3] 1	8

[1] Salt has been produced in recent years, but no current data are available.
[2] Data not available.
[3] Revised figure.
[4] In addition to figure shown, 204,036 pounds of samarskite was produced.

NIGERIA

TABLE 89.—Mineral production, 1950–51, in metric tons

Mineral [1]	1950	1951	Mineral [1]	1950	1951
Coal, bituminous (thousand tons)	[2] 593	559	Silver (troy ounces)	325	200
Columbite concentrates (pounds)	1,935,360	2,419,200	Tantalite concentrates (pounds)	2,240	6,720
Gold (troy ounces)	2,238	1,566	Tin, mine (long tons)	8,258	8,555
Lead, mine	[2] 12	[3] 56	Tungsten concentrates (60 percent WO_3 basis)	5	23

[1] Salt has been produced in recent years, but no current data are available. Beryl and zinc (mine) are produced, but no output was recorded in 1950–51.
[2] Revised figure.
[3] Exports.

NORTHERN RHODESIA

TABLE 90.—Mineral production, 1950–51, in metric tons

Mineral [1]	1950	1951	Mineral [1]	1950	1951
Beryllium concentrates	5		Lead, smelter	13,905	14,194
Cobalt [2]	670	678	Mica	2	6
Copper:			Silver (troy ounces)	[4] 173,304	
Mine	297,487	319,373	Tin, mine (long tons)	4	2
Smelter	279,987	314,103	Vanadium		87
Gold (troy ounces)	[3] 1,432	101	Zinc, smelter	23,080	22,953

[1] Manganese ore has been produced in recent years, but it is too low-grade to be classified as such. Iron ore is produced, but no output was recorded in 1950–51; lead (mine) and zinc (mine) production are not available.
[2] Fiscal year ended June 30 of year stated.
[3] Included is yield from Nkana-mine slimes accumulated during the war: 1,296 tons in 1950.
[4] Recovered from an accumulation of refinery slimes.

NYASALAND

Production of corundum in Nyasaland totaled 187 metric tons in 1950 and 101 in 1951.

SEYCHELLES ISLANDS

Exports of phosphate rock from the Seychelles Islands totaled 10,005 metric tons in 1950 and 4,547 in 1951.

SIERRA LEONE

TABLE 91.—Mineral production, 1950–51, in metric tons

Mineral [1]	1950	1951	Mineral [1]	1950	1951
Chromite	7,518	[2]	Iron ore (thousand tons)	1,185	[2]
Diamonds (metric carats)	655,474	475,579	Platinum, placer (troy ounces)		[2]
Gold (troy ounces)	[3] 3,778	[2]			

[1] Silver has been produced in recent years, but no current data are available.
[2] Data not available.
[3] Revised figure.

SOUTHERN RHODESIA

TABLE 92.—Mineral production, 1950–51, in metric tons

Mineral [1]	1950	1951	Mineral [1]	1950	1951
Antimony	[2] 24	62	Iron and steel (thousand tons):		
Arsenic, white	114	76	Pig iron and ferroalloys	[2] 34	10
Asbestos	64,888	70,454	Steel ingots and castings	22	28
Barite	261	85	Magnesite	8,615	14,814
Beryllium concentrates	[2] 846	1,007	Mica	407	348
Cement, hydraulic (thousand tons)	156	163	Phosphate rock	36	
Chromite	291,525	300,267	Pyrites, including cupreous pyrites	13,810	28,269
Coal, bituminous (thousand tons)	2,128	2,300	Silver (troy ounces)	85,549	79,731
Coke (thousand tons)	*80	102	Tantalite concentrates (pounds)	1,700	
Copper, mine	117	95	Tin (long tons):		
Feldspar	3,520	1,148	Mine	65	40
Fluorspar	447	111	Smelter	80	63
Gold (troy ounces)	511,163	486,907	Tungsten concentrates (60 percent WO_3 basis)	64	231
Iron ore (thousand tons)	57	58			

[1] Corundum, graphite, lead (mine), manganese ore, and mercury are produced, but no output was recorded in 1950–51.
[2] Revised figure.

SOUTH-WEST AFRICA

TABLE 93.—Mineral production, 1950–51, in metric tons

Mineral [1]	1950	1951	Mineral [1]	1950	1951
Beryllium concentrates	659	753	Salt:		
Bismuth, in ore (kilograms)	*7,200	*100	Rock salt	[4] 3,915	4,706
Cadmium (kilograms) [2]	*240,000	*240,000	Other salt	[4] 12,903	39,880
Copper, mine	10,961	12,355	Silver (troy ounces)	843,737	1,030,066
Corundum	10		Tantalite concentrates (pounds)	12,570	3,974
Diamonds (metric carats)	488,422	478,075	Tin, mine (long tons)	100	76
Fluorspar	73	779	Tungsten concentrates (60 percent WO_3 basis)	4	*5
Gold (troy ounces)	32	[3]	Vanadium	295	*300
Graphite	1,380	2,626	Zinc, mine [5]	[4] 11,300	14,817
Lead, mine	[4] 33,680	39,230			
Manganese ore	993	6,560			
Phosphate rock (guano)	581	785			

[1] Iron ore has been produced in recent years, but no current data are available. Barite and lead (smelter) are produced, but no output was recorded in 1950–51.
[2] Cadmium content of ore and flue dust exported for treatment elsewhere.
[3] Data not available.
[4] Revised figure.
[5] Zinc content of lead-copper ore sorted from dumps plus jig concentrates derived from same source.

SPANISH MOROCCO

TABLE 94.—Mineral production, 1950–51, in metric tons

Mineral	1950	1951	Mineral	1950	1951
Antimony	353	(1)	Lead, mine	[2] 178	*300
Graphite	3		Manganese ore	[2] 36	*900
Iron ore (thousand tons)	[2] 951	948	Salt	*254	(3)

[1] Included in Spain.
[2] Revised figure.
[3] Data not available.

SWAZILAND

TABLE 95.—Mineral production, 1950–51, in metric tons

Mineral	1950	1951	Mineral	1950	1951
Asbestos	29,635	31,719	Silver (troy ounces)	60	18
Barite	441	477	Tin, mine (long tons)	37	32
Gold (troy ounces)	1,794	322			

TANGANYIKA

TABLE 96.—Mineral production, 1950–51, in metric tons

Mineral [1]	1950	1951	Mineral [1]	1950	1951
Diamonds (metric carats)	195,274	108,625	Silver (exports) (troy ounces)	31,014	35,697
Gold (exports) (troy ounces)	65,127	65,224	Tin, mine (exports) (long tons)	[2] 97	67
Magnesite (exports)	83	2,716	Tungsten concentrates (exports) (60 percent WO_3 basis)	15	15
Mica (exports)	136	71			
Phosphate rock	468	345			
Salt	14,152	16,107			

[1] Beryl is produced, but no output is recorded in 1950–51.
[2] Revised figure.

TUNISIA

TABLE 97.—Mineral production, 1950–51, in metric tons

Mineral [1]	1950	1951	Mineral [1]	1950	1951
Barite	25	10	Lead:		
Cement, hydraulic (thousand tons)	169	187	Mine	[3] 19,260	21,250
Coal; Lignite (thousand tons)	41	8	Smelter	23,536	22,906
Fluorspar		(2)	Phosphate rock	1,524,800	1,678,905
Fuel briquets	41,800	37,593	Pyrites, including cupreous pyrites	1,150	
Iron ore (thousand tons)	758	923	Salt	98,771	160,000
			Silver (troy ounces)	73,947	61,119
			Zinc, mine	2,932	3,548

[1] Gypsum has been produced in recent years, but no current data are available. Manganese ore and mercury are produced, but no output was recorded in 1950–51.
[2] Data not available.
[3] Revised figure.

UGANDA

TABLE 98.—Mineral production, 1950–51, in metric tons

Mineral [1]	1950	1951	Mineral [1]	1950	1951
Beryllium concentrates	44	2	Salt	7,413	(2)
Bismuth (kilograms)	3,658	(2)	Tantalite concentrates (pounds)	(6)	(6)
Columbite concentrates (exports) (pounds) [3]	11,413	45,560	Tin, mine (exports) (long tons)	[4] 192	118
Gold (exports) (troy ounces)	[4] 509	223	Tungsten concentrates (60 percent WO_3 basis)	217	220
Mica	(5)	(5)			
Phosphate rock	467	(2)			

[1] Silver has been exported, but no exports were recorded in 1950–51.
[2] Data not available.
[3] Columbite-tantalite concentrates.
[4] Revised figure.
[5] Less than 0.5 ton.
[6] Included in columbite figure.

UNION OF SOUTH AFRICA

TABLE 99.—Mineral production, 1950–51, in metric tons

Mineral [1]	1950	1951	Mineral [1]	1950	1951
Antimony	[2] 8,311	15,858	Lead, mine	[2] 600	900
Asbestos	[2] 79,300	97,402	Magnesite	11,782	18,773
Barite	2,268	2,038	Manganese ore	790,937	758,870
Beryllium concentrates	844	593	Mica	1,371	1,779
Bismuth (in ore) (kilograms)	7,649	3,184	Nickel	843	1,138
Cement, hydraulic (thousand tons)	1,847	1,953	Phosphate rock	51,844	81,840
Chromite	496,324	545,306	Platinum-group metals (troy ounces):		
Coal, bituminous (marketable) (thousand tons)	26,473	26,632	Platinum-group metals from platinum ore	144,217	190,898
Coke (thousand tons) [3]	1,036	[4] 1,200	Osmiridium from gold ores	6,449	6,359
Copper:			Pyrites, including cupreous pyrites	36,026	33,378
Mine	33,982	33,731	Salt	[2] 106,396	149,795
Smelter	33,342	32,922	Silver (troy ounces)	1,119,135	1,162,588
Corundum	3,201	4,563	Talc, pyrophyllite, and soapstone	3,978	5,663
Diamonds (metric carats):			Tantalite concentrates (sales and exports) (pounds)	4,000	6,000
Lode	1,516,194	1,967,272	Tin (long tons):		
Alluvial [4]	231,674	289,063	Mine	[2] 643	746
Feldspar	[2] 6,001	3,343	Smelter	[2] 718	829
Fluorspar	[2] 6,948	12,313	Tungsten concentrates (60 percent WO_3 basis)	96	160
Gold (troy ounces)	11,663,713	11,516,450			
Graphite	244	328			
Gypsum (sales and exports)	103,707	124,979			
Iron ore (thousand tons)	1,189	1,421			
Iron and steel (thousand tons):					
Pig iron and ferroalloys	733	805			
Steel ingots and castings	755	948			

[1] Arsenic, columbite, and mercury are produced, but no output was recorded in 1950–51.
[2] Revised figure.
[3] Revised to include coke production of South African Iron and Steel Corp., Limited (ISCOR).
[4] Includes an estimated 100,000 carats in each year for State mines of Namaqualand.

AUSTRALIA AND OCEANIA

AUSTRALIA

TABLE 100.—Mineral production, 1950–51, in metric tons

Mineral [1]	1950	1951	Mineral [1]	1950	1951
Antimony	[2] 227	310	Magnesite	[2] 35, 960	38, 856
Arsenic, white	163	([3])	Manganese ore	[2] 15, 108	*8, 600
Asbestos	[2] 1, 643	*1, 710	Mica	[2] 738	573
Barite	[2] 6, 028	*6, 500	Molybdenum	3	1
Bauxite	[2] 3, 523	*3, 700	Petroleum, crude (thousand barrels) (Victoria)	[2] 1	2
Beryllium concentrates	[4] 23	94	Phosphate rock	1, 653	8, 027
Bismuth, in ore (kilograms) [5]	[2] 914	1, 188	Platinum-group metals:		
Cadmium, smelter (kilograms) (Tasmania)	[2] 299, 125	234, 708	Placer osmiridium (Tasmania) (troy ounces)	46	33
Cement, hydraulic (thousand tons)	[2 6] 1, 278	1, 236	Potassium salts (equivalent K_2O):		
Chromite	905	([3])	Alunite	30	*25
Coal (thousand tons):			Alunitic mud	84	([3])
Bituminous	[2] 16, 795	17, 891	Pyrites, including cupreous pyrites	113, 973	154, 182
Lignite	[2] 7, 445	7, 962	Salt	279, 414	222, 424
Cobalt	10	8	Silver (troy ounces)	10, 677, 456	10, 436, 324
Coke (thousand tons) [6]	[2] 1, 183	*1, 400	Talc and soapstone	[2] 9, 851	11, 987
Copper:			Tantalite concentrates (pounds)	16, 536	5, 129
Mine	[2] 15, 144	16, 874	Tin (long tons):		
Smelter	[2] 13, 726	12, 683	Mine	[2] 1, 855	1, 577
Feldspar [7]	[2] 13, 276	14, 328	Smelter	2, 013	1, 459
Fluorspar	585	*250	Titanium concentrates:		
Fuel briquets [6]	598. 010	*590, 000	Ilmenite	[8] 12, 417	([3])
Gold (troy ounces)	[2] 868, 567	886, 170	Rutile	[9] 18, 379	33, 718
Graphite	[2] 147	129	Tungsten concentrates (60 percent WO_3 basis)	[2] 1, 235	1, 864
Gypsum	[2] 340, 151	370, 195	Zinc:		
Iron ore (thousand tons)	2, 403	2, 468	Mine	[2] 205, 632	197, 843
Iron and steel (thousand tons):			Smelter	[2] 84, 995	78, 246
Pig iron and ferroalloys	[2] 1, 336	1, 357			
Steel ingots and castings	[2] 1, 448	1, 457			
Lead:					
Mine	[2] 222, 694	228, 407			
Smelter	[2] 163, 102	173, 767			

[1] Asbestos (Tasmania), corundum (New South Wales), diamonds, and magnesium metal have been produced, but no current data are available. Mercury and placer platinum (New South Wales) are produced, but no output was recorded in 1950–51.
[2] Revised figure.
[3] Data not available.
[4] Preliminary figure.
[5] Partly estimated; excludes content of some bismuth-tungsten concentrates.
[6] Fiscal year ended June 30 of year stated.
[7] Includes some china stone.
[8] Estimated ilmenite content of all ilmenite-bearing concentrates.
[9] Estimated rutile content of all rutile-bearing concentrates.

FIJI ISLANDS

TABLE 101.—Mineral production, 1950–51, in metric tons

Mineral	1950	1951
Gold (troy ounces)	103, 421	93, 635
Manganese ore	203	[1] 641
Silver (troy ounces)	37, 736	24, 869

[1] Exports.

FRENCH OCEANIA

Exports of phosphate rock from French Oceania (Makatea Island, Tuamotu Archipelago) totaled 245,804 metric tons in 1950 and 277,858 in 1951.

NAURU AND OCEAN ISLANDS

Exports of phosphate rock from Nauru Island were 1,070,358 metric tons in 1950 and 942,945 in 1951. Exports of phosphate rock from Ocean Island were 251,218 metric tons in 1950 and 256,451 in 1951.

NEW CALEDONIA

TABLE 102.—Mineral production, 1950–51, in metric tons

Mineral	1950	1951	Mineral	1950	1951
Chromite	84,801	88,386	Iron ore (thousand tons)	15	----------
Coke (thousand tons)	*80	*80	Manganese ore	[1] 5,392	20,135
Gypsum	15,200	15,777	Nickel	6,300	9,200

[1] Revised figure.

NEW GUINEA TERRITORY [1]

TABLE 103.—Mineral production, 1950–51, in metric tons

Mineral	1950	1951
Gold (troy ounces)	[1] 80,099	94,085
Platinum-group metals (troy ounces)	----------	5
Silver (troy ounces)	[2] 30,399	[3]

[1] Revised figure.
[2] Fiscal year ended May 31 of year following that stated.
[3] Data not available.

NEW ZEALAND

TABLE 104.—Mineral production, 1950–51, in metric tons

Mineral [1]	1950	1951	Mineral [1]	1950	1951
Arsenic, white	10	----------	Iron ore (thousand tons)	[3] 4	3
Asbestos	42	[2]	Magnesite	346	589
Cement, hydraulic (thousand tons)	256	163	Manganese ore	358	408
Coal (thousand tons):			Petroleum, crude (thousand barrels)	7	5
Bituminous and anthracite	[3] 936	689	Platinum placer (troy ounces)	----------	8
Lignite	[3] 1,777	1,786	Silver (troy ounces)	199,701	133,291
Coke (thousand tons)	6	6	Tungsten concentrates (60 percent WO_3 basis)	24	*35
Fuel briquets	11,311	*11,500			
Gold (troy ounces)	76,527	75,115			

[1] Pig iron was produced in recent years, but no current data are available. Antimony, mercury, mica, and phosphate rock are produced, but no output was recorded in 1950–51.
[2] Data not available.
[3] Revised figure.

[1] Does not include western New Guinea, which is part of Indonesia, or southwestern New Guinea, which is the same as Papua.

PALAU ISLANDS

Exports of phosphate rock from Angaur Island were estimated to be 119,000 metric tons in 1950 and 144,843 in 1951.

PAPUA

The production of gold in Papua totaled 788 troy ounces in 1950 and 248 in 1951. The production of manganese ore totaled 60 metric tons in the year ended June 30, 1950, and 21 in the year ended June 30, 1951. The production of placer platinum was less than 0.5 troy ounce in the year ended June 30, 1950, and 2 ounces in the year ended June 30, 1951.

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