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Minerals Yearbook 1965

Volume III of Four Volumes

AREA REPORTS: DOMESTIC

Prepared by staff of the
BUREAU OF MINES

UNITED STATES DEPARTMENT OF THE INTERIOR • Stewart L. Udall, Secretary

BUREAU OF MINES • Walter R. Hibbard, Jr., Director

Created in 1849, the Department of the Interior—a Department of Conservation—is concerned with the management, conservation, and development of the Nation's water, fish, wildlife, mineral, forest, and park and recreational resources. It also has major responsibilities for Indian and Territorial affairs.

As the Nation's principal conservation agency, the Department works to assure that nonrenewable resources are developed and used wisely, that park and recreational resources are conserved for the future, and that renewable resources make their full contribution to the progress, prosperity, and security of the United States—now and in the future.

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Foreword

This issue marks the 100th year since the first publication by the Federal Government of a report on the U.S. mineral industries and the 84th year in which the Minerals Yearbook or its predecessors have been issued on an annual basis. The general content of the four-volume edition follows:

Volume I, Metals and Minerals (Except Fuels), contains chapters on metal and nonmetal mineral commodities except mineral fuels. In addition, it includes a chapter reviewing these mineral industries, a statistical summary, and chapters on mining and metallurgical technology, employment and injuries, and technologic trends.

Volume II, Mineral Fuels, contains a chapter on each mineral fuel and on such related products as helium, carbon black, peat, coke and coal chemicals, and natural gas liquids. Also included are data on employment and injuries in the fuel industries and a mineral-fuels review summarizing recent economic and technologic developments.

Volume III, Area Reports: Domestic, contains chapters covering each of the 50 States, the U.S. island possessions in the Pacific Ocean, the Commonwealth of Puerto Rico, the U.S. island possessions in the Caribbean Sea, and the Canal Zone. Volume III also has a statistical summary chapter, identical with that in Volume I, and a chapter on employment and injuries.

Volume IV, Area Reports: International, contains 105 chapters presenting the latest available mineral statistics for more than 130 foreign countries and areas. A separate chapter reviews minerals in the world economy.

The 1965 Minerals Yearbook has been redesigned to achieve a more compact volume and to maximize economy and efficiency in its publication. We believe that the short lines of the text improve readability despite use of the smaller type.

The Bureau of Mines' continuous effort to enhance the Yearbook's value to its wide readership can be aided by constructive comments and suggestions of its users. Such comment is particularly invited during the formative years of the new International review volume.

WALTER R. HIBBARD, Jr., *Director*

Acknowledgments

In preparing this volume of the Minerals Yearbook, the Bureau of Mines was assisted in collecting statistical data and mineral-industry information by State agencies, through cooperative agreements. Many State chapters were reviewed by staff members of these agencies, and in some instances the staff members collaborated in preparing the chapters and are shown as co-authors. For this assistance acknowledgment is made to the following cooperating organizations:

Alabama: Geological Survey of Alabama.
Alaska: Division of Mines and Minerals, Department of Natural Resources.
Arizona: Arizona Bureau of Mines and Oil and Gas Conservation Commission.
Arkansas: Geological Commission; Arkansas Oil and Gas Commission; Department of Revenue.
California: Division of Mines and Geology.
Colorado: The Oil and Gas Conservation Commission; Coal Mines Inspections Department; and the Colorado Bureau of Mines.
Connecticut: Geological and Natural History Survey.
Delaware: Delaware Geological Survey.
Florida: Florida Geological Survey, Board of Conservation.
Georgia: Division of Conservation, Department of Mines, Mining and Geology.
Hawaii: Department of Land and Natural Resources.
Idaho: Bureau of Mines and Geology.
Illinois: State Geological Survey Division.
Indiana: Geological Survey, Department of Natural Resources.
Iowa: Iowa Geological Survey.
Kansas: Conservation Division, State Cooperation Commission; and State Geological Survey.
Kentucky: Kentucky Geological Survey, University of Kentucky.
Louisiana: Louisiana Geological Survey; Louisiana Department of Conservation; Department of Labor, Division of Employment Security; and Department of Commerce and Industry.
Maine: Maine Geological Survey, Department of Economic Development.
Maryland: Maryland Geological Survey.
Michigan: Geological Survey Division, Department of Conservation.
Minnesota: Minnesota Geological Survey.
Mississippi: Mississippi Geological Survey; Mississippi State Oil and Gas Board; Oil and Gas Severance Tax Division, Mississippi State Tax Commission; and Mississippi Employment Security Commission.
Missouri: Division of Geological Survey and Water Resources, Department of Business and Administration.
Montana: Montana Bureau of Mines and Geology, The Oil and Gas Conservation Commission.
Nebraska: Conservation and Survey Division; and Oil and Gas Conservation Commission.

Nevada: Nevada Bureau of Mines.
New Hampshire: New Hampshire Division of Economic Development, Geologic Branch.
New Jersey: Bureau of Geology and Topography.
New Mexico: Oil and Gas Conservation Commission.
New York: Geological Survey—New York State Museum and Science Service.
North Carolina: Division of Mineral Resources, Department of Conservation and Development.
North Dakota: North Dakota Geological Survey.
Oklahoma: Oklahoma Geological Survey; Oil and Gas Conservation Department, Oklahoma Corporation Commission; and Gross Production Division, Oklahoma Tax Commission.
Oregon: State Department of Geology and Mineral Industries.
Pennsylvania: Bureau of Topographic and Geological Survey.
Puerto Rico: Mineralogy and Geology Section, Economic Development Administration, Commonwealth of Puerto Rico.
South Carolina: Division of Geology, State Development Board.
South Dakota: State Geological Survey.
Tennessee: Division of Geology, Department of Conservation.
Texas: Bureau of Economic Geology, The University of Texas; Oil and Gas Division, Railroad Commission of Texas; Oil and Gas Division, State Comptroller of Public Accounts.
Utah: Utah Geological and Mineralogical Survey; and Oil and Gas Conservation Commission.
Virginia: Division of Mineral Resources.
Washington: Division of Mines and Geology, Department of Conservation and Development.
West Virginia: West Virginia Geological and Economic Survey.
Wisconsin: Wisconsin Geological Survey.
Wyoming: The Geological Survey of Wyoming; and Oil and Gas Conservation Commission.

Except for the two review chapters, this volume was prepared by the staffs of the Mineral Resource Offices of the Bureau of Mines under the direction of the following Area Directors. Area I, G. W. Josephson; Area II, Donald O. Kennedy; Area III, Ottey Bishop; Area IV, Robert S. Sanford; Area V, Robert W. Geehan; Area VI, D. R. Irving; Area VII, Mark L. Wright; Area VIII, Jared A. Herdlick.

The preparation and the coordination of chapters with those in other volumes was under the general direction of Paul F. Yopes, Assistant to the Chief, Division of Minerals. The manuscripts upon which this volume was based were reviewed by a staff under the direction of Kathleen J. D'Amico to insure statistical consistency among the tables, figures, and text between this volume and other volumes, and between this volume and those for former years.

Minerals Yearbook compilations are based largely on facts provided by the mineral industries. Acknowledgment is made of the willing contribution by both companies and individuals of these essential data.

CHARLES W. MERRILL,
Chief, Division of Minerals.

Contents

Statistical Summary

By Kathleen J. D'Amico [1]

This summary appears in Minerals Yearbook volumes I and III, which cover mineral production in the United States, its island possessions, the Canal Zone, and the Commonwealth of Puerto Rico, as well as the principal minerals imported into and exported from the United States. The several commodity and area chapters contain further details on production. A summary table comparing world and U.S. mineral production also is included.

Mineral production may be measured at any of several stages of extraction and processing. The stage of measurement used in the chapter is normally what is termed "mine output." It 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.

Because of inadequacies in the statistics available, some series deviate from the foregoing definition. The quantities of gold, silver, copper, lead, zinc, and tin are recorded on a mine basis (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 as recovered metal and valued at the average New York price for metal.

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

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[1] Statistical officer, Division of Minerals.

Table 1.—Value of mineral production [1] in the United States [2] by mineral groups [3]
(Millions)

Year	Mineral fuels	Nonmetals (except fuels)	Metals	Total	Year	Mineral fuels	Nonmetals (except fuels)	Metals	Total
1925	$2,910	$1,187	$715	$4,812	1946	$5,090	$1,243	$729	$7,062
1926	3,371	1,219	721	5,311	1947	7,188	1,338	1,084	9,610
1927	2,875	1,201	622	4,698	1948	9,502	1,552	1,219	12,273
1928	2,666	1,163	655	4,484	1949	7,920	1,559	1,101	10,580
1929	2,940	1,166	802	4,908	1950	8,689	1,822	1,351	11,862
1930	2,500	973	507	3,980	1951	9,779	2,079	1,671	13,529
1931	1,620	671	287	2,578	1952	9,616	2,163	1,617	13,396
1932	1,460	412	128	2,000	1953	10,257	2,350	1,811	14,418
1933	1,413	432	205	2,050	1954	9,919	2,733	1,518	14,170
1934	1,947	520	277	2,744	1955	10,780	3,076	2,055	15,911
1935	2,013	564	365	2,942	1956	11,741	3,391	2,358	17,490
1936	2,405	685	516	3,606	1957	12,709	3,387	2,137	18,233
1937	2,798	711	756	4,265	1958	11,589	3,466	1,594	16,649
1938	2,436	622	460	3,518	1959	11,950	3,861	1,570	17,381
1939	2,423	754	631	3,808	1960	12,142	3,868	2,022	18,032
1940	2,662	784	752	4,198	1961	12,357	3,946	1,927	18,230
1941	3,228	989	890	5,107	1962	12,784	4,117	1,937	18,838
1942	3,568	1,056	999	5,623	1963	13,295	4,318	2,002	19,615
1943	4,028	916	987	5,931	1964 [r]	13,623	4,623	2,261	20,507
1944	4,574	836	900	6,310	1965	14,045	4,916	2,472	21,433
1945	4,569	888	774	6,231					

[r] Revised.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Excludes Alaska and Hawaii, 1925–53.
[3] Data for 1925–46 are not strictly comparable with those for subsequent years, since for earlier years value of heavy clay products has not been replaced by value of raw clays used for such products.

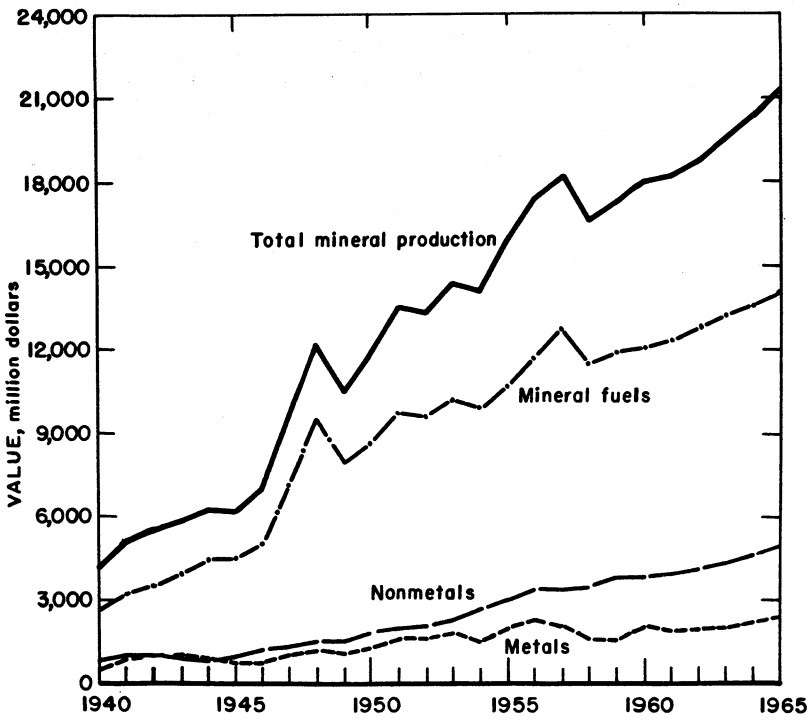

Figure 1.—Value of mineral production in the United States.

Table 2.—Mineral production [1] in the United States

Mineral	1962		1963		1964		1965	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Mineral fuels:								
Asphalt and related bitumens (native): Bituminous limestone and sandstone and gilsonite—short tons	1,647,063	$14,601	1,632,645	$8,383	1,935,344	$10,038	1,911,664	$9,461
Carbon dioxide, natural (estimate)—thousand cubic feet	1,144,107	146	1,295,545	178	1,232,816	166	1,173,676	152
Coal:								
Bituminous and lignite [2]—thousand short tons	422,149	1,891,553	458,928	2,013,309	486,998	2,165,582	512,088	2,276,022
Pennsylvania anthracite—do	16,894	134,094	18,267	153,503	17,184	148,648	14,866	122,021
Helium [3]—thousand cubic feet	599,519	20,905	627,344	21,957	r 4,027,497	r 61,245	4,365,068	66,687
Natural gas—million cubic feet	13,876,622	2,145,301	14,746,663	2,328,030	r 15,462,138	2,387,689	16,039,753	2,494,542
Natural gas liquids:								
Natural gasoline and cycle products—thousand gallons	6,244,522	444,817	6,534,967	439,173	7,000,181	463,600	7,288,070	494,354
LP gases—do	9,409,083	353,334	10,302,250	359,770	10,743,591	362,792	11,257,267	417,249
Peat—short tons	566,441	5,186	546,621	5,423	639,690	r 6,198	603,746	6,080
Petroleum (crude)—thousand 42-gallon barrels	2,676,189	7,774,051	2,752,723	7,965,743	2,786,822	8,017,078	r 2,848,462	r 8,158,150
Total mineral fuels	XX	12,784,000	XX	13,295,000	XX	r 13,623,000	XX	14,045,000
Nonmetals (except fuels):								
Abrasive stone [5]—short tons	2,653	260	2,693	255	3,186	292	3,603	432
Aplite—long tons	125,156	912	(6)	(6)	(6)	(6)	(6)	(6)
Asbestos—short tons	53,190	4,677	66,396	5,108	101,092	8,143	118,275	10,162
Barite—thousand short tons	860	9,820	824	9,402	830	9,796	852	10,192
Boron minerals—short tons	646,613	49,336	700,183	54,981	776,000	60,871	807,000	64,180
Bromine—thousand pounds	190,747	46,617	203,333	48,558	r 283,530	r 66,064	328,115	77,259
Calcite (optical grade)—pounds					4	2	(6)	(6)
Cement:								
Portland—thousand 376-pound barrels	325,476	1,070,371	342,036	1,095,884	358,378	1,145,108	366,802	1,154,448
Masonry—thousand 280-pound barrels	19,998	57,405	20,997	59,599	22,397	63,305	23,260	65,979
Natural and slag—thousand 376-pound barrels	402	1,611	352	1,407	283	1,057	279	1,027
Clays—thousand short tons	47,797	163,012	50,135	180,810	r 52,947	r 192,631	55,089	203,772
Emery—short tons	4,316	71	6,732	119	9,214	172	10,720	204
Feldspar—long tons	492,476	5,076	548,954	5,525	r 587,194	r 5,389	624,598	6,263
Fluorspar—short tons	206,026	9,166	199,948	9,001	217,137	9,723	240,932	10,889
Garnet (abrasive)—do	14,166	1,172	14,626	1,412	16,123	1,622	19,330	1,717
Gem stones (estimate)	NA	1,296	NA	1,421	NA	1,474	NA	2,218
Gypsum—thousand short tons	9,969	36,343	10,388	38,138	10,684	38,874	10,035	37,423
Lime—do	13,752	186,754	14,521	199,389	16,089	r 223,149	16,794	232,939
Magnesium compounds from sea water and brine (except for metals) short tons, MgO equivalent	408,129	28,742	520,699	39,323	599,698	42,177	644,021	47,555
Mica:								
Scrap—short tons	107,702	2,639	109,323	2,776	114,729	3,353	120,255	3,468
Sheet—pounds	363,016	1,299	102,961	13	242,662	58	716,086	185
Perlite—short tons	320,330	2,663	325,132	2,727	349,867	3,073	392,384	3,352
Phosphate rock—thousand long tons	19,382	134,304	19,855	139,861	22,960	161,067	26,440	194,552
Potassium salt—thousand short tons, K_2O equivalent	2,452	94,859	2,864	110,164	2,897	r 114,095	3,140	129,767
Pumice—thousand short tons	2,271	6,301	2,618	6,578	2,776	6,443	3,483	6,640
Pyrites—thousand long tons	916	6,809	825	5,698	847	5,471	875	5,333

Table 2.—Mineral production [1] in the United States—Continued

Mineral	1962		1963		1964		1965	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Nonmetals (except fuels)—Continued								
Salt thousand short tons	28,807	$174,841	30,641	$184,589	31,623	$200,706	34,687	$215,699
Sand and gravel do	776,701	794,725	821,850	847,272	r 868,208	r 893,375	[4] 908,049	[4] 957,416
Sodium carbonate (natural) short tons	977,584	24,330	1,119,081	27,616	1,274,745	30,451	1,494,105	34,717
Sodium sulfate (natural) do	457,881	9,092	435,257	8,392	575,033	10,989	619,752	11,024
Stone [7] thousand short tons	656,954	1,025,697	688,366	1,068,108	r 725,583	r 1,134,564	780,072	1,203,618
Sulfur:								
Frasch process mines thousand long tons	4,917	107,069	4,995	99,014	r 6,035	r 120,776	7,251	146,921
Other mines long tons	150,550	1,439	1,371	15	794	8	2,852	11
Talc, soapstone, and pyrophyllite short tons	771,728	5,278	804,358	5,505	889,949	6,218	862,875	6,343
Tripoli do	61,732	244	66,635	266	64,613	268	71,138	381
Vermiculite thousand short tons	205	3,293	226	3,572	226	3,613	249	4,460
Value of items that cannot be disclosed: Brucite calcium-magnesium chloride, diatomite, epsom salts from epsomite (1961–63), graphite, iodine, kyanite, lithium minerals, magnesite, greensand marl, olivine, staurolite, wollastonite, and values indicated by footnote 6	XX	49,436	XX	54,929	XX	r 58,771	XX	65,028
Total nonmetals	XX	4,117,000	XX	4,318,000	XX	r 4,623,000	XX	4,916,000
Metals:								
Antimony ore and concentrate short tons, antimony content	631	(8)	645	(8)	632	(8)	845	(8)
Bauxite long tons, dried equivalent	1,369,007	15,609	1,524,700	17,234	1,600,722	17,875	1,653,840	18,632
Beryllium concentrate short tons, gross weight	[9] 978	(8)	[9] 751	(8)	(8)	(8)	(8)	(8)
Copper (recoverable content of ores, etc.) short tons	1,228,421	756,707	1,213,166	747,310	1,246,780	812,901	1,351,734	957,028
Gold (recoverable content or ores, etc.) troy ounces	1,542,511	53,990	1,454,010	50,889	1,456,308	50,971	1,705,190	59,682
Iron ore, usable (excluding byproduct iron sinter) thousand long tons, gross weight	69,969	618,242	73,563	678,177	84,300	802,331	84,472	804,498
Lead (recoverable content of ores, etc.) short tons	236,956	43,602	253,369	54,727	286,010	74,935	301,147	93,959
Manganese ore (35 percent of more Mn) short tons, gross weight	24,758	(8)	10,622	(8)	26,058	(8)	29,258	(8)
Manganiferous ore (5 to 35 percent Mn) do	338,501	(8)	543,125	(8)	238,776	(8)	332,763	(8)
Mercury 76-pound flasks	26,277	5,024	19,117	3,623	14,142	4,452	19,582	11,176
Molybdenum (content of concentrate) thousand pounds	50,506	69,390	65,839	91,096	65,097	97,121	77,310	120,801
Nickel (content of ore and concentrate) short tons	13,110	(8)	13,394	(8)	15,420	(8)	16,188	(8)
Silver (recoverable content of ores, etc.) thousand troy ounces	36,798	39,929	35,243	45,076	36,334	46,980	39,808	51,469
Tin long tons	(8)	(8)	(8)	(8)	65	185	47	126
Titanium concentrate:								
Ilmenite short tons, gross weight	809,037	13,974	890,071	16,529	1,003,997	19,178	948,832	18,058
Rutile do	8,033	933	11,311	1,262	10,547	1,016	10,087	759
Tungsten ore and concentrate short tons, 60 percent WO_3 basis	8,429	11,639	5,657	7,202	9,244	11,251	7,949	13,028
Uranium ore short tons	7,052,870	138,294	5,645,921	115,821	r 5,674,631	[4] 111,707	4,362,614	83,915

Vanadium (recoverable in ore and concentrate)----do----	5,211	18,605	3,862	13,788	4,362	13,061	5,226	18,284
Zinc (recoverable content of ores, etc.)----------do----	505,491	116,413	529,254	122,533	574,858	156,308	611,153	178,284
Value of items that cannot be disclosed: Cobalt, magnesium chloride for magnesium metal, manganiferous residuum, platinum-group metals (crude), rare-earth metal concentrates, zirconium concentrate, and values indicated by footnote 8----------	XX	35,071	XX	36,827	XX	r 40,183	XX	42,641
Total metals----------	XX	1,937,000	XX	2,002,000	XX	r 2,261,000	XX	2,472,000
Grand total mineral production----------	XX	18,838,000	XX	19,615,000	XX	r 20,507,000	XX	21,433,000

r Revised. NA Not available. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

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

[3] Refined only, 1962–63; crude and refined, 1964–65.

[4] Final figure; superseded figure given in commodity chapter.

[5] Grindstones, pulpstones, millstones (weight not recorded), grinding pebbles, sharpening stones, and tube-mill liners.

[6] Figure withheld to avoid disclosing individual company confidential data; value included with "Value of items (nonmetal) that cannot be disclosed."

[7] Excludes abrasive stone, bituminous limestone, bituminous sandstone, and ground soapstone, all included elsewhere in table.

[8] Figure withheld to avoid disclosing individual company confidential data; value included with "Value of items (metal) that cannot be disclosed."

[9] Includes low-grade beryllium ore as follows: 760 tons in 1962, and 750 tons in 1963.

Table 3.—Minerals produced in the United States and principal producing States in 1965

Mineral	Principal producing States in order of quantity	Other producing States
Antimony	Idaho, Nev., Alaska	
Aplite	Va.	
Asbestos	Calif., Vt., Ariz., N.C.	
Asphalt	Tex., Utah, Ala., Mo.	
Barite	Mo., Ark., Ga., Nev.	Calif., Mont., N. Mex., S.C., Tenn., Tex., Wash.
Bauxite	Ark., Ala., Ga.	
Beryllium	S. Dak.	Colo., Wyo.
Boron	Calif.	
Bromine	Tex., Mich., Ark., Calif.	
Calcium-magnesium chloride	Mich., Calif., W. Va.	
Carbon dioxide	N. Mex., Colo., Utah, Calif.	Wash.
Cement	Calif., Pa., Tex., N. Y.	Ala., Ariz., Ark., Colo., Fla., Ga., Hawaii, Idaho, Ill., Ind., Iowa, Kans., Ky., La., Maine, Md., Mich., Minn., Miss., Mo., Mont., Nebr., Nev., N. Mex., N.C., Ohio, Okla., Oreg., S.C., S. Dak., Tenn., Utah, Va., Wash., W. Va., Wis., Wyo.
Clays	Ohio, Ga., Tex., Pa.	All other States except Alaska and R.I.
Coal	W. Va., Pa., Ky., Ill.	Ala., Alaska, Ark., Colo., Ind., Iowa, Kans., Md., Mo., Mont., N. Mex., N. Dak., Ohio, Okla., S. Dak., Tenn., Utah, Va., Wash., Wyo.
Cobalt	Pa.	
Copper	Ariz., Utah, Mont., N. Mex.	Alaska, Calif., Colo., Idaho, Mich., Mo., Nev., Okla., Oreg., Pa., Tenn., Wash., Wyo.
Diatomite	Calif., Nev., Wash., Ariz.	Oreg.
Emery	N.Y.	
Feldspar	N.C., Calif., Conn., S. Dak.	Ariz., Colo., Ga., Maine, N.H., S.C., Va., Wyo.
Fluorspar	Ill., Ky., Mont., Nev.	Colo., Utah.
Garnet, abrasive	N.Y., Idaho	
Gold	S. Dak., Utah, Nev., Ariz.	Alaska, Calif., Colo., Idaho, Mont., N. Mex., Oreg., Pa., Tenn., Wash., Wyo.
Graphite	Tex.	
Gypsum	Calif., Mich., Iowa, Tex.	Ariz., Ark., Colo., Ind., Kans., La., Mont., Nev., N. Mex., N.Y., Ohio, Okla., S. Dak., Utah, Va., Wyo.
Helium	Kans., Tex., Okla., Ariz.	N. Mex.
Iodine	Mich., Calif.	
Iron ore	Minn., Mich., Calif., N.Y.	Ala., Ariz., Ark., Colo., Ga., Idaho, Miss., Mo., Mont., Nev., N.J., N. Mex., Oreg., Pa., Tex., Utah, Wis., Wyo.
Kyanite	Va., S.C., Ga.	
Lead	Mo., Idaho, Utah, Colo.	Ariz., Ark., Calif., Ill., Kans., Ky., Mont., Nev., N. Mex., N.Y., Okla., Oreg., Va., Wash.
Lime	Ohio, Pa., Mo., Tex.	Ala., Ariz., Ark., Calif., Colo., Conn., Fla., Hawaii, Idaho, Ill., Iowa, La., Md., Mass., Mich., Minn., Miss., Mont., Nebr., Nev., N.J., N. Mex., N.Y., N. Dak., Okla., Oreg., S. Dak., Tenn., Utah, Vt., Va., Wash., W. Va., Wis., Wyo.
Lithium	N.C., Calif., S. Dak.	
Magnesite	Nev., Wash.	
Magnesium chloride	Tex.	
Magnesium compounds	Mich., Calif., Tex., N.J.	Fla., Miss.
Manganese ore	Mont., N. Mex.	
Manganiferous ore	Minn., N. Mex., Mont.	
Marl	N.J., Md.	
Mercury	Calif., Nev., Oreg., Idaho	Alaska, Ariz., Tex., Wash.
Mica:		
Scrap	N.C., Ala., Ga., S.C.	Ariz., Calif., Conn., N. Mex., Pa., S. Dak.
Sheet	N.C., Ga.	
Molybdenum	Colo., Utah, Ariz., N. Mex.	Calif., Nev., N. Dak., S. Dak.
Natural gas	Tex., La., Okla., N. Mex.	Ala., Alaska, Ariz., Ark., Calif., Colo., Fla., Ill., Ind., Kans., Ky., Md., Mich., Miss., Mo., Mont., Nebr., N.Y., N. Dak., Ohio, Pa., Tenn., Utah, Va., W. Va., Wyo.

Table 3.—Minerals produced in the United States and principal producing States in 1965—Continued

Mineral	Principal producing States in order of quantity	Other producing States
Natural gas liquids	Tex., La., Okla., N. Mex	Ark., Calif., Colo., Fla., Ill., Kans., Ky., Mich., Miss., Mont., Nebr., N. Dak., Pa., Utah, W. Va., Wyo.
Nickel	Oreg	
Olivine	Wash., N.C	
Peat	Mich., Ind., Pa., N.J	Alaska, Calif., Colo., Conn., Fla., Ga., Idaho, Ill., Iowa, Maine, Md., Mass., Minn., Mont., Nev., N.Y., N. Dak., Ohio, S.C., Vt., Wash., Wis.
Perlite	N. Mex., Ariz., Nev., Calif	Colo., Idaho, Tex., Utah.
Petroleum	Tex., La., Calif., Okla	Ala., Alaska, Ariz., Ark., Colo., Fla., Ill., Ind., Kans., Ky., Mich., Miss., Mo., Mont., Nebr., Nev., N. Mex., N.Y., N. Dak., Ohio, Pa., S. Dak., Tenn., Utah, Va., W. Va., Wyo.
Phosphate rock	Fla., Idaho, Tenn., Mont	Ark., Utah, Wyo.
Platinum-group metals	Alaska, Calif	
Potassium salts	N. Mex., Calif., Utah	Md., Mich.
Pumice	Ariz., Calif., Oreg., Hawaii	Colo., Idaho, Nebr., Nev., Okla., Tex., Utah, Wash.
Pyrites	Tenn., Pa., Ariz., Colo	S.C.
Rare-earth metals	Calif., Fla	
Salt	La., Tex., Ohio, N.Y	Calif., Colo., Hawaii, Kans., Mich., Nev., N. Mex., N. Dak., Okla., Utah, Va., W. Va.
Sand and gravel	Calif., Mich., Ohio, N.Y	All other States.
Silver	Idaho, Ariz., Utah, Mont	Alaska, Calif., Colo., La., Mich., Mo., Nev., N. Mex., N.Y., Okla., Oreg., Pa., S. Dak., Tenn., Wash., Wyo.
Sodium carbonate	Wyo., Calif	
Sodium sulfate	Calif., Tex., Wyo	
Staurolite	Fla	
Stone	Pa., Ill., Calif., Ohio	All other States.
Sulfur (Frasch)	Tex., La	
Sulfur, ore	Utah, Calif., Nev	
Talc	N.Y., Calif., N.C., Vt	Ala., Ark., Ga., Md., Mont., Nev., Pa., Tex., Va., Wash.
Tin	Colo., Alaska, Calif., N. Mex	
Titanium	N.Y., Fla., N.J., Va	Ga., Idaho.
Tripoli	Ill., Okla., Ark., Mo	Ala., Pa.
Tungsten	Calif., Colo., Wash	Ariz., Nev.
Uranium	N. Mex., Wyo., Colo., Utah	Alaska, Ariz., Calif., Nev., N. Dak., S. Dak., Tex., Wash.
Vanadium	Colo., Utah, Ariz., Idaho	N. Mex., N. Dak., S. Dak., Wyo.
Vermiculite	Mont., S.C	
Wollastonite	N.Y., Calif	
Zinc	Tenn., N.Y., Idaho, Colo	Ariz., Calif., Ill., Kans., Ky., Mo., Mont., Nev., N.J., N. Mex., Okla., Oreg., Pa., Utah, Va., Wash., Wis.
Zirconium	Fla., Ga	

Table 4.—Value of mineral production in the United States, and principal minerals produced in 1965

(Thousands)

State	Value	Rank	Percent of U.S. total	Principal minerals in order of value
Alabama	$246,264	21	1.15	Coal, cement, stone, petroleum.
Alaska	83,455	35	.39	Sand and gravel, petroleum, coal, stone.
Arizona	580,182	9	2.70	Copper, sand and gravel, molybdenum, cement.
Arkansas	179,110	27	.83	Petroleum, stone, bauxite, sand and gravel.
California	1,599,388	3	7.46	Petroleum, natural gas, cement, sand and gravel.
Colorado	331,216	17	1.54	Petroleum, molybdenum, coal, sand and gravel.
Connecticut	21,234	45	.10	Stone, sand and gravel, lime, feldspar.
Delaware	1,903	50	.01	Sand and gravel, stone, clays, gem stones.
Florida	249,320	20	1.16	Phosphate rock, stone, cement, clays.
Georgia	135,182	28	.63	Clays, stone, cement, sand and gravel.
Hawaii	20,835	46	.10	Stone, cement, sand and gravel, pumice.
Idaho	105,085	30	.49	Silver, lead, zinc, phosphate rock.
Illinois	593,025	8	2.77	Coal, petroleum, stone, sand and gravel.
Indiana	218,567	24	1.02	Coal, cement, stone, petroleum.
Iowa	112,783	29	.53	Cement, stone, sand and gravel, gypsum.
Kansas	553,491	11	2.58	Petroleum, natural gas, helium, natural gas liquids.
Kentucky	466,381	14	2.17	Coal, petroleum, stone, natural gas.
Louisiana	2,978,855	2	13.90	Petroleum, natural gas, natural gas liquids, sulfur.
Maine	17,741	47	.08	Sand and gravel, cement, stone, clays.
Maryland	77,995	38	.36	Stone, cement, sand and gravel, coal.
Massachusetts	36,198	43	.17	Stone, sand and gravel, lime, clays.
Michigan	565,560	10	2.69	Iron ore, cement, copper, sand and gravel.
Minnesota	507,760	12	2.37	Iron ore, sand and gravel, stone, cement.
Mississippi	208,972	25	.97	Petroleum, natural gas, sand and gravel, cement.
Missouri	225,568	23	1.05	Stone, cement, lead, iron ore.
Montana	229,392	22	1.07	Copper, petroleum, sand and gravel, phosphate rock.
Nebraska	83,791	34	.39	Petroleum, cement, sand and gravel, stone, natural gas.
Nevada	99,916	31	.47	Copper, sand and gravel, gold, iron ore.
New Hampshire	7,665	48	.03	Sand and gravel, stone, feldspar, clays.
New Jersey	80,158	37	.37	Sand and gravel, stone, zinc, magnesium compounds.
New Mexico	773,274	7	3.61	Petroleum, potassium salts, natural gas, copper.
New York	290,057	18	1.35	Cement, stone, sand and gravel, salt.
North Carolina	60,383	40	.28	Stone, sand and gravel, cement, feldspar.
North Dakota	92,878	32	.43	Petroleum, sand and gravel, coal, natural gas.
Ohio	464,252	15	2.17	Coal, stone, lime, cement.
Oklahoma	907,914	5	4.24	Petroleum, natural gas, natural gas liquids, cement.
Oregon	82,966	36	.39	Sand and gravel, stone, cement, nickel.
Pennsylvania	913,823	4	4.26	Coal, cement, stone, iron ore.
Rhode Island	2,931	49	.01	Sand and gravel, stone.
South Carolina	41,261	42	.19	Cement, stone, clays, sand and gravel.
South Dakota	50,175	41	.23	Gold, sand and gravel, stone, cement.
Tennessee	182,941	26	.85	Stone, zinc, cement, phosphate rock.
Texas	4,708,709	1	21.97	Petroleum, natural gas, natural gas liquids, cement.
Utah	431,378	16	2.01	Copper, petroleum, coal, molybdenum.
Vermont	27,392	44	.13	Stone, asbestos, sand and gravel, talc.
Virginia	267,977	19	1.25	Coal, stone, cement, sand and gravel.
Washington	86,172	33	.40	Sand and gravel, cement, stone, zinc.
West Virginia	859,604	6	4.01	Coal, natural gas, natural gas liquids, stone.
Wisconsin	72,999	39	.34	Sand and gravel, stone, cement, zinc.
Wyoming	498,552	13	2.33	Petroleum, natural gas, iron ore, sodium salts.
Total	21,433,000	--	100.00	Petroleum, natural gas, coal, cement.

Table 5.—Mineral production [1] in the United States, by States

Mineral	1962		1963		1964		1965	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
ALABAMA								
Cement: [2]								
Portland—thousand 376-pound barrels	12,482	$40,164	12,218	$38,417	12,870	$40,108	13,765	$42,604
Masonry—thousand 280-pound barrels	2,187	6,521	2,386	7,242	2,574	7,794	2,598	7,853
Clays [3]—thousand short tons	1,632	1,947	1,607	3,003	1,991	4,060	2,220	4,888
Coal (bituminous)—do	12,880	95,149	12,359	91,243	14,435	102,267	14,832	106,249
Gem stones			NA	2				
Iron ore (usable)—thousand long tons, gross weight	2,962	17,838	2,126	11,806	2,106	11,812	1,495	8,241
Lime—thousand short tons	522	6,298	596	6,974	599	7,118	653	7,905
Natural gas—million cubic feet	128	13	177	21	r 165	18	203	26
Petroleum (crude)—thousand 42-gallon barrels	7,473	19,355	9,175	23,763	8,498	22,095	8,064	21,047
Sand and gravel—thousand short tons	4,655	4,486	5,363	5,778	5,840	6,191	6,422	7,195
Stone [4]—do	12,680	19,667	13,684	22,206	15,852	24,976	17,987	30,810
Value of items that cannot be disclosed: Native asphalt, bauxite, slag cement, clays (kaolin, bentonite 1964–65), scrap mica, sheet mica (1962), salt, stone (dimension limestone, dimension marble 1964–65, shell 1963–65, crushed sandstone 1965), talc, and tripoli (1965)	XX	8,347	XX	5,415	XX	9,251	XX	9,446
Total	XX	219,785	XX	215,870	XX	235,690	XX	246,264
ALASKA								
Antimony ore and concentrate—short tons, antimony content					14	$18	1	$1
Coal (bituminous)—thousand short tons	871	$6,409	853	$5,910	745	5,008	893	6,095
Copper (recoverable content of ores, etc.)—short tons					11	7	32	23
Gold (recoverable content of ores, etc.)—troy ounces	165,259	5,784	99,573	3,485	58,416	2,045	42,249	1,479
Lead (recoverable content of ores, etc.)—short tons			5	1			9	3
Mercury—76-pound flasks	3,719	711	400	76	303	95	W	W
Natural gas—million cubic feet	2,184	467	4,498	1,111	r 6,238	1,719	7,255	1,799
Peat—short tons	64	W			2,350	19	1,967	16
Petroleum (crude)—thousand 42-gallon barrels	10,259	31,187	10,740	32,650	11,059	33,627	11,128	34,078
Sand and gravel—thousand short tons	5,731	5,355	16,926	22,005	26,089	18,488	30,266	34,467
Silver (recoverable content of ores, etc.) thousand troy ounces	22	24	14	18	7	9	8	10
Value of items that cannot be disclosed: Gem stones, platinum-group metals, stone, tin (1964-65), uranium ore, and values indicated by symbol W	XX	4,255	XX	2,584	XX	4,912	XX	5,489
Total	XX	54,192	XX	67,840	XX	65,947	XX	83,455

Table 5.—Mineral production [1] in the United States, by States—Continued

Mineral	1962		1963		1964		1965	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
ARIZONA								
Asbestos—short tons	W	W	W	W	W	W	3,469	$441
Beryllium concentrate—short tons, gross weight	1	(5)						
Clays [3]—thousand short tons	139	$184	163	$203	168	$213	129	164
Copper (recoverable content of ores, etc.)—short tons	644,242	396,853	660,977	407,162	690,988	450,524	703,377	497,991
Diatomite—do	W	W	W	W	450	16	295	8
Gem stones	NA	120	NA	120	NA	120	NA	120
Gold (recoverable content of ores, etc.)—troy ounces	137,207	4,802	140,030	4,901	153,676	5,379	150,431	5,265
Gypsum—thousand short tons	W	W	W	W	147	770	103	540
Helium, refined—thousand cubic feet	W	W	W	W	46,000	1,610	58,000	2,030
Iron ore (usable)—thousand long tons, gross weight	W	W	W	W	4	32	8	51
Lead (recoverable content of ores, etc.)—short tons	6,966	1,282	5,815	1,256	6,147	1,611	5,913	1,845
Lime—thousand short tons	174	2,914	181	3,048	177	2,920	204	3,543
Mercury—76-pound flasks	W	W	W	W	77	24	158	90
Molybdenum (content of concentrate)—thousand pounds	4,412	5,864	5,553	7,584	6,296	9,532	9,399	15,880
Natural gas—million cubic feet	230	27	1,334	161	r 2,014	241	3,106	376
Petroleum (crude)—thousand 42-gallon barrels	39	W	68	W	64	W	97	W
Pumice—thousand short tons	756	1,640	800	1,877	880	1,635	1,273	1,605
Sand and gravel—do	15,579	17,404	15,037	14,466	18,116	20,868	14,918	16,621
Silver (recoverable content of ores, etc.)—thousand troy ounces	5,454	5,917	5,373	6,873	5,811	7,513	6,095	7,881
Stone—thousand short tons	4,333	6,616	3,257	5,069	3,759	6,283	2,474	4,171
Tungsten ore and concentrate—short tons, 60-percent WO_3 basis	15	14			16	17	3	5
Uranium ore—short tons	143,196	3,047	150,584	4,844	102,258	3,253	117,898	3,918
Vanadium (recoverable in ore and concentrate)—do	632	W	222	W	W	575	W	381
Zinc (recoverable content of ores, etc.)—do	32,888	7,564	25,419	5,846	24,690	6,716	21,757	6,353
Value of items that cannot be disclosed: Cement, clays (bentonite, fire clay 1962–64), feldspar, scrap mica, perlite, pyrites, and values indicated by symbol W	XX	19,883	XX	17,705	XX	r 14,501	XX	10,903
Total	XX	474,131	XX	481,115	XX	r 534,353	XX	580,182
ARKANSAS								
Barite—thousand short tons	259	$2,232	236	$2,161	233	$2,202	249	$2,379
Bauxite—long tons, dried equivalent	1,270,124	14,606	1,478,047	16,701	1,561,984	17,431	1,593,085	17,974
Bromine and bromine in compounds—thousand pounds	W	W	W	W	W	W	32,254	7,171
Clays—thousand short tons	654	1,693	769	1,763	892	2,152	866	1,890
Coal (bituminous)—do	256	1,809	221	1,505	212	1,503	226	1,643
Gem stones	NA	15	NA	42	NA	33	NA	31
Gypsum—thousand short tons	83	261	W	W	W	W	W	W
Iron ore (usable)—thousand long tons, gross weight	43	296	W	W	W	W	W	W
Lime—thousand short tons	350	4,542	167	2,237	189	2,814	192	2,776
Natural gas—million cubic feet	66,213	9,866	76,101	11,796	r 75,753	11,806	82,831	12,922
Natural gas liquids: Natural gasoline and cycle products—thousand gallons	29,415	1,673	26,219	1,466	30,082	1,678	27,787	1,578

LP gases	do	69,452	2,432	66,377	2,497	61,616	2,460	69,752	3,139
Petroleum (crude)	thousand 42-gallon barrels	27,649	73,546	27,406	72,900	26,737	71,120	25,930	68,974
Sand and gravel	thousand short tons	10,847	10,006	12,099	13,589	11,794	14,836	12,806	15,836
Stone	do	20,611	19,866	18,913	22,727	20,241	26,172	21,241	26,778
Zinc (recoverable content of ores, etc.)	short tons	211	49						
Value of items that cannot be disclosed: Abrasive stones, cement, phosphate rock (1963–65), soapstone, tripoli (1965), and values indicated by symbol W		XX	11,063	XX	17,900	XX	r 20,611	XX	16,019
Total		XX	153,955	XX	167,284	XX	r 174,818	XX	179,110
CALIFORNIA									
Asbestos	short tons	W	W	19,591	$1,547	55,041	$4,419	74,587	$6,177
Barite	thousand short tons	7	$133	5	31	6	45	4	21
Boron minerals	short tons	646,613	49,336	700,183	54,981	776,000	60,871	807,000	64,180
Calcite (optical grade)	pounds					4	2	W	W
Cement	thousand 376-pound barrels	43,667	139,151	46,278	147,656	47,204	149,933	45,352	144,852
Clays	thousand short tons	3,137	7,349	3,395	8,031	r 3,685	r 8,433	3,207	7,226
Copper (recoverable content of ores, etc.)	short tons	1,162	716	916	564	1,035	675	1,165	825
Feldspar	long tons	W	W	75,516	W	102,264	W	95,975	W
Gem stones		NA	200	NA	200	NA	200	NA	200
Gold (recoverable content of ores, etc.)	troy ounces	106,272	3,720	86,867	3,040	71,028	2,486	62,885	2,201
Gypsum	thousand short tons	1,747	4,113	1,756	4,222	1,893	4,539	1,611	3,881
Lead (recoverable content of ores, etc.)	short tons	455	84	823	178	1,546	405	1,810	565
Lime	thousand short tons	470	8,454	487	8,932	577	r 10,294	602	11,073
Magnesium compounds from sea water and bitterns (partly estimated) short tons, MgO equivalent		76,445	6,077	82,397	6,135	94,739	7,143	101,563	8,302
Mercury	76-pound flasks	15,951	3,050	13,592	2,575	10,291	3,240	13,404	7,650
Mica, scrap	short tons	W	W	977	14	W	W	W	W
Natural gas	million cubic feet	564,220	163,624	646,486	189,420	r 660,444	198,551	660,384	204,059
Natural gas liquids:									
Natural gasoline and cycle products	thousand gallons	716,904	54,460	715,303	54,188	720,373	54,088	655,780	49,850
LP gases	do	407,378	19,294	393,503	17,329	352,614	15,893	339,082	15,467
Peat	short tons	33,901	331	39,873	450	35,391	443	30,905	434
Petroleum (crude)	thousand 42-gallon barrels	296,590	741,475	300,908	746,252	300,009	729,022	316,428	753,099
Pumice	thousand short tons	573	2,615	460	2,017	443	1,937	676	1,744
Salt	do	1,643	W	1,716	W	1,525	W	1,638	W
Sand and gravel	do	107,660	124,922	112,185	128,178	112,995	129,333	118,310	136,227
Silver (recoverable content of ores, etc.)	thousand troy ounces	133	144	157	200	172	222	197	254
Stone	thousand short tons	34,776	54,722	37,977	58,253	45,805	63,566	42,575	59,668
Sulfure ore	long tons	W	W	785	4	520	3	360	2
Talc, soapstone, and pyrophyllite	short tons	117,912	1,339	120,452	1,427	132,601	1,631	141,074	1,725
Wollastonite	do	W	W	3,000	28	3,625	36	W	W
Zinc (recoverable content of ores, etc.)	do	322	74	101	23	143	39	225	66
Value of items that cannot be disclosed: Bromine, calcium-magnesium chloride, carbon dioxide, coal (lignite), diatomite, iodine, iron ore, lithium minerals, manganiferous ore (1962), molybdenum, perlite, platinum-group metals (crude), potassium salts, pyrites (1962), rare-earth metal concentrates, sodium carbonates and sulfates, tin (1963–65), tungsten concentrate, uranium ore (1963–65), and values indicated by symbol W		XX	81,957	XX	90,366	XX	r 113,043	XX	119,640
Total		XX	1,467,340	XX	1,526,241	XX	r 1,560,492	XX	1,599,388

Table 5.—Mineral production [1] in the United States, by States—Continued

Mineral	1962		1963		1964		1965	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
COLORADO								
Beryllium concentrate—short tons, gross weight	[6] 782	W	[6] 751	W	W	W	W	W
Carbon dioxide, natural—thousand cubic feet	148,940	$15	224,856	$38	211,830	$36	155,668	$26
Clays—thousand short tons	802	1,573	686	1,334	558	1,275	631	1,446
Coal (bituminous)—do	3,379	19,999	3,690	21,888	4,355	23,427	4,790	24,431
Copper (recoverable content of ores, etc.)—short tons	4,534	2,793	4,169	2,568	4,653	3,034	3,828	2,710
Feldspar—long tons	W	W	W	W	W	W	521	3
Gem stones	NA	45	NA	63	NA	80	NA	80
Gold (recoverable content of ores, etc.)—troy ounces	48,882	1,711	33,605	1,176	42,122	1,474	37,228	1,303
Gypsum—thousand short tons	108	383	99	346	100	398	102	427
Iron ore (usable)—thousand long tons, gross weight	W	W	W	W	35	231	114	787
Lead (recoverable content of ores, etc.)—short tons	17,411	3,204	19,918	4,302	20,563	5,388	22,495	7,018
Lime—thousand short tons	93	1,518	128	2,104	138	2,193	118	2,074
Mica, scrap—short tons	142	2	440	7				
Molybdenum (content of concentrate)—thousand pounds	32,412	45,376	47,977	67,168	46,378	69,207	[7] 50,715	[7] 78,609
Natural gas—million cubic feet	101,826	11,812	105,705	12,367	[r] 113,691	13,489	126,381	16,303
Natural gas liquids:								
Natural gasoline—thousand gallons	60,558	3,826	56,869	3,191	52,400	2,845	54,180	3,034
LP gases—do	100,787	4,411	91,309	4,171	88,916	3,894	91,399	3,930
Peat—short tons	12,351	68	13,774	98	27,931	188	31,179	236
Petroleum (crude)—thousand 42-gallon barrels	42,477	122,334	38,283	110,255	34,755	100,094	33,511	96,512
Pumice—thousand short tons	76	82	60	87	61	114	56	134
Pyrites—thousand long tons	W	W	W	W	W	W	30	90
Sand and gravel—thousand short tons	19,313	18,926	20,385	20,929	20,746	22,227	20,810	22,041
Silver (recoverable content of ores, etc.) thousand troy ounces	2,088	2,265	2,307	2,951	2,626	3,396	2,051	2,652
Stone—thousand short tons	2,353	5,597	2,510	5,693	3,217	6,805	4,789	8,638
Tin—long tons	W	W	W	W	29	103	32	76
Tungsten—short tons	W	W	W	W	W	W	1,176	1,985
Uranium ore—do	1,135,440	18,044	1,014,206	15,864	833,282	13,389	574,795	10,651
Vanadium (recoverable in ore and concentrate)—do	3,742	W	3,047	W	3,312	9,916	4,017	14,056
Vermiculite—thousand short tons	W	W	(5)	1	(5)	1		
Zinc (recoverable content of ores, etc.)—short tons	43,351	9,971	48,109	11,065	53,682	14,602	53,870	15,730
Value of items that cannot be disclosed: Cement, fluorspar, molybdenum (1965), perlite, salt, and values indicated by symbol W	XX	34,209	XX	29,478	XX	[r] 18,205	XX	16,234
Total	XX	308,164	XX	317,144	XX	316,011	XX	331,216
CONNECTICUT								
Beryllium concentrate—short tons, gross weight	7	$4						
Clays—thousand short tons	[3] 179	[3] 287	189	$339	212	$262	237	$322
Gem stones	NA	8	NA	8	NA	8	NA	8
Lime—thousand short tons	35	635	35	666	39	689	W	W
Sand and gravel—do	10,208	9,244	10,503	9,343	10,088	9,437	9,940	9,106
Stone—do	5,090	8,816	5,318	9,612	5,864	10,764	5,871	10,444

Value of items that cannot be disclosed: Clays (kaolin 1962), feldspar, scrap mica, sheet mica (1962), peat, and values indicated by symbol W	XX	760	XX	646	XX	690	XX	1,354
Total	XX	19,754	XX	20,614	XX	21,850	XX	21,234
DELAWARE								
Clays—thousand short tons	W	W	13	$13	11	$11	11	$11
Gem stones	NA	W	NA	1	NA	1	NA	1
Sand and gravel—thousand short tons	1,755	$1,445	1,094	1,136	1,282	1,280	1,545	1,441
Stone—do	W	W	W	W	180	450	180	450
Value of items that cannot be disclosed: Other nonmetals and values indicated by symbol W	XX	86	XX	191	XX	----------	XX	----------
Total	XX	1,531	XX	1,341	XX	1,742	XX	1,903
FLORIDA								
Clays—thousand short tons	487	$6,741	538	$7,777	627	$8,405	651	$9,752
Lime—do	W	W	126	1,996	117	1,814	101	1,558
Natural gas—million cubic feet	29	6	35	7	40	5	107	14
Peat—short tons	20,595	139	21,049	129	19,813	102	19,258	109
Petroleum (crude)—thousand 42-gallon barrels	419	W	464	W	620	W	1,464	W
Phosphate rock—thousand long tons	13,949	94,595	14,592	101,050	17,108	119,667	19,253	141,258
Sand and gravel—thousand short tons	5,924	5,179	7,542	5,823	7,420	6,427	7,298	6,377
Stone—do	27,279	32,608	31,900	38,173	33,157	38,362	35,730	41,148
Value of items that cannot be disclosed: Cement, gem stones (1963), magnesium compounds, natural gas liquids, rare-earth metals concentrates, staurolite, titanium concentrate, zirconium concentrate, and values indicated by symbol W	XX	46,432	XX	46,665	XX	48,627	XX	49,104
Total	XX	185,700	XX	201,620	XX	223,409	XX	249,320
GEORGIA								
Barite—thousand short tons	109	$1,987	117	$2,013	109	$2,022	W	W
Clays—do	3,801	47,462	4,208	54,024	4,365	58,899	4,607	$63,158
Coal (bituminous)—do	8	28	5	16	4	15	----------	----------
Feldspar—long tons	35,692	795	W	W	W	W	W	W
Gem stones	NA	W	NA	1	----------	----------	----------	----------
Iron ore (usable)—thousand long tons, gross weight	215	1,118	260	1,304	354	1,752	424	2,170
Mica:								
Scrap—short tons	W	W	W	W	W	W	13,065	W
Sheet—pounds	60	1	----------	----------	----------	----------	2,793	(5)
Sand and gravel—thousand short tons	3,429	3,365	3,817	3,922	r 3,588	r 3,594	3,675	3,588
Stone—do	19,555	42,037	19,582	46,044	r 22,822	r 46,428	23,421	48,265
Talc—short tons	45,940	96	42,000	93	40,400	135	44,800	313
Value of items that cannot be disclosed: Bauxite, cement, kyanite (1963–65), manganiferous ore (1962), peat, titanium concentrate (1965), zirconium concentrate (1965), and values indicated by symbol W	XX	10,816	XX	12,059	XX	14,292	XX	17,688
Total	XX	107,705	XX	119,476	XX	r 127,137	XX	135,182

Table 5.—Mineral production [1] in the United States, by States—Continued

Mineral	1962		1963		1964		1965	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
HAWAII								
Cement—thousand 376-pound barrels	1,128	$6,055	1,483	$7,125	1,717	$8,877	1,564	$8,297
Clays—thousand short tons	W	W	W	W	3	W	W	W
Gem stones	NA	W	NA	36	NA	W	NA	W
Lime—thousand short tons	15	386	12	428	9	321	9	305
Pumice—do	232	380	274	469	365	603	380	624
Sand and gravel—do	700	1,122	304	764	407	979	751	2,237
Stone—do	4,071	6,883	3,844	6,480	5,282	8,765	5,172	9,353
Value of items that cannot be disclosed: Other nonmetals and values indicated by symbol W	XX	18	XX	5	XX	60	XX	19
Total	XX	14,844	XX	15,307	XX	19,605	XX	20,835
IDAHO								
Antimony ore and concentrate short tons, antimony content	631	W	645	W	585	W	818	W
Clays—thousand short tons	35	$70	[3] 31	[3] $15	[3] 29	[3] $25	[3] 47	[3] $33
Copper (recoverable content of ores, etc.)—short tons	3,861	2,378	4,172	2,570	4,666	3,042	5,140	3,639
Gold (recoverable content of ores, etc.)—troy ounces	5,845	205	5,477	192	5,677	199	5,078	178
Iron ore (usable)—thousand long tons, gross weight	5	35	6	40	4	33	9	84
Lead (recoverable content of ores, etc.)—short tons	84,058	15,467	75,759	16,364	71,312	18,684	66,606	20,781
Lime—thousand short tons	68	801	60	874	W	W	W	W
Mercury—76-pound flasks	----------	----------	W	W	83	26	1,119	639
Peat—short tons	W	W	W	W	900	8	W	W
Phosphate rock—thousand long tons	1,912	10,635	1,700	10,589	W	W	W	W
Pumice—thousand short tons	67	103	161	275	59	100	46	79
Sand and gravel—do	14,321	13,029	12,433	10,615	9,582	8,691	12,151	13,198
Silver (recoverable content of ores, etc.) thousand troy ounces	17,772	19,283	16,711	21,375	16,483	21,313	18,457	23,865
Stone—thousand short tons	1,381	2,698	1,168	2,217	1,144	2,773	1,831	3,440
Tungsten concentrate—short tons, 60-percent WO_3 basis	----------	----------	----------	----------	11	8	----------	----------
Vanadium (recoverable in ore and concentrate)—short tons	W	W	23	W	W	W	W	W
Zinc (recoverable content of ores, etc.)—do	62,865	14,459	63,267	14,551	59,298	16,129	58,034	16,946
Value of items that cannot be disclosed: Barite (1962–64), cement, clays (fire clay 1963–65, bentonite 1963–65, kaolin 1963–65), abrasive garnet, gem stones, scrap mica (1963–64), sheet mica (1962), perlite, titanium concentrate, uranium (1962), and values indicated by symbol W	XX	3,451	XX	3,110	XX	15,231	XX	22,203
Total	XX	82,614	XX	82,787	XX	86,262	XX	105,085
ILLINOIS								
Cement:								
Portland—thousand 376-pound barrels	9,145	$30,205	9,281	$30,577	9,790	$32,191	9,358	$30,622
Masonry—thousand 280-pound barrels	440	1,320	472	1,440	596	2,038	615	1,907

Clays—thousand short tons	1,929	4,151	1,949	4,368	[3] 2,007	[3] 4,358	[3] 2,169	[3] 4,601
Coal (bituminous)—do	48,487	186,986	51,736	196,518	55,023	208,448	58,483	218,972
Fluorspar—short tons	132,830	6,392	132,060	6,547	127,454	6,452	159,140	7,861
Lead (recoverable content of ores, etc.)—do	3,610	664	2,901	627	2,180	571	3,005	938
Natural gas—million cubic feet	10,650	1,523	9,459	1,220	r 7,824	905	7,396	865
Natural gas liquids:								
Natural gasoline and cycle products—thousand gallons	13,315	1,023	14,939	1,077	14,109	1,030	W	W
LP gases—do	327,616	13,812	337,278	14,714	312,173	13,758	W	W
Peat—short tons	W	W	W	W	W	W	36,774	453
Petroleum (crude)—thousand 42-gallon barrels	78,796	234,812	74,796	222,892	70,168	205,592	63,708	186,664
Sand and gravel—thousand short tons	34,122	38,981	31,746	36,431	34,880	39,966	36,228	40,480
Stone—do	41,293	54,411	40,293	52,217	42,987	56,553	47,066	61,294
Zinc (recoverable content of ores, etc.)—short tons	27,413	6,305	20,337	4,678	13,800	3,754	18,314	5,348
Value of items that cannot be disclosed: Clay (fuller's earth 1964–65), gem stones, lime, tripoli, and values indicated by symbol W	XX	12,133	XX	13,656	XX	15,520	XX	33,020
Total	XX	592,718	XX	586,962	XX	591,136	XX	593,025

INDIANA

Abrasive stones—short tons	5	$15	5	$16	5	$16	5	$15
Cement [2]—thousand 376-pound barrels	12,878	42,572	13,165	43,216	15,038	48,695	14,925	48,797
Clays—thousand short tons	1,450	2,255	1,546	2,347	1,545	2,264	1,459	2,160
Coal (bituminous)—do	15,709	60,079	15,100	57,120	15,075	57,246	15,565	59,927
Natural gas—million cubic feet	284	60	286	67	r 199	47	239	56
Peat—short tons	47,430	272	47,695	412	66,568	543	53,873	511
Petroleum (crude)—thousand 42-gallon barrels	12,077	35,989	11,902	35,230	11,283	32,157	[3] 11,429	[3] 32,458
Sand and gravel—thousand short tons	21,261	18,692	22,840	20,683	24,416	21,811	24,867	22,220
Stone—do	18,709	34,653	19,667	35,616	22,318	39,978	24,574	42,124
Value of items that cannot be disclosed: Cement (masonry 1963–64), gem stones (1962–63), and gypsum	XX	8,839	XX	9,259	XX	9,026	XX	10,299
Total	XX	203,426	XX	203,966	XX	211,783	XX	218,567

IOWA

Cement:								
Portland—thousand 376-pound barrels	12,261	$42,417	12,495	$42,891	13,607	$46,398	13,643	$46,273
Masonry—thousand 280-pound barrels	568	1,786	551	1,754	585	1,847	608	1,867
Clays—thousand short tons	1,039	1,427	1,064	1,405	1,008	1,254	1,085	1,347
Coal (bituminous)—do	1,130	4,026	1,213	4,244	973	3,447	1,043	3,694
Gypsum—do	1,256	5,318	1,282	5,667	1,287	5,821	1,254	5,554
Sand and gravel—do	13,797	12,474	14,168	12,845	13,890	13,546	18,205	17,152
Stone—do	21,618	28,244	20,904	27,788	23,935	33,038	25,891	35,468
Value of items that cannot be disclosed: Gem stones, lime, peat, and petroleum (1962–64)	XX	869	XX	1,076	XX	1,279	XX	1,428
Total	XX	96,561	XX	97,670	XX	106,630	XX	112,783

Table 5.—Mineral production[1] in the United States, by States—Continued

Mineral	1962		1963		1964		1965	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
KANSAS								
Cement:								
Portland—thousand 376-pound barrels	8,058	$25,134	8,201	$25,372	8,483	$25,959	8,801	$26,972
Masonry—thousand 280-pound barrels	392	1,156	387	1,183	384	1,173	404	1,178
Clays—thousand short tons	895	1,091	893	1,104	785	935	789	953
Coal (bituminous)—do	915	4,249	1,169	5,311	1,263	5,749	1,310	6,072
Helium[9]—thousand cubic feet	42,305	1,478	46,177	1,616	r2,215,338	r26,598	2,570,889	30,422
Lead (recoverable content of ores, etc.)—short tons	970	178	1,027	222	1,185	310	1,644	513
Lime—thousand short tons	5	59						
Natural gas—million cubic feet	694,352	86,100	732,946	97,482	r764,073	96,031	793,379	105,519
Natural gas liquids:								
Natural gasoline—thousand gallons	151,360	7,696	165,370	9,811	162,725	8,713	153,485	7,791
LP gases—do	166,769	6,295	395,877	15,481	512,747	18,121	587,416	22,322
Petroleum (crude)—thousand 42-gallon barrels	112,076	326,141	109,107	317,501	106,252	310,256	104,733	305,820
Salt[10]—thousand short tons	944	11,654	924	11,993	930	11,799	1,053	12,376
Sand and gravel—do	11,552	8,039	12,062	8,676	12,968	9,108	12,544	8,473
Stone—do	r13,527	r17,274	13,558	18,483	14,138	18,912	15,270	20,538
Zinc (recoverable content of ores, etc.)—short tons	3,943	907	3,508	807	4,665	1,269	6,508	1,900
Value of items that cannot be disclosed: Natural cement, gypsum, pumice, salt (brine), and stone (crushed sandstone 1962)	XX	3,625	XX	3,260	XX	3,277	XX	2,642
Total	XX	501,076	XX	518,302	XX	r538,210	XX	553,491
KENTUCKY								
Barite—thousand short tons	4	$36	6	$85	6	$96		
Clays[3]—do	936	2,158	984	2,397	920	1,801	1,059	$2,580
Coal (bituminous)—do	69,212	270,875	77,350	295,743	82,747	309,896	85,766	324,523
Fluorspar—short tons	33,830	1,492	35,072	1,537	38,214	1,693	31,992	1,485
Lead (recoverable content of ores, etc.)—do	743	137	831	179	858	225	756	236
Natural gas—million cubic feet	70,241	17,419	74,634	17,838	r76,940	18,257	78,976	18,638
Petroleum (crude)—thousand 42-gallon barrels	17,789	52,478	18,344	53,564	19,772	56,746	19,386	55,638
Sand and gravel—thousand short tons	6,137	5,378	6,480	6,071	6,560	6,297	6,742	6,332
Silver (recoverable content of ores, etc.)—thousand troy ounces	1	2	2	2	2	2	2	2
Stone—thousand short tons	19,472	27,682	24,689	34,571	r21,868	r29,594	26,029	34,533
Zinc (recoverable content of ores, etc.)—short tons	1,172	270	1,461	336	2,063	561	5,654	1,651
Value of items that cannot be disclosed: Cement, ball clay, gem stones (1962–63), natural gas liquids, and stone (dimension sandstone 1964)	XX	20,609	XX	20,370	XX	19,211	XX	20,763
Total	XX	398,536	XX	432,693	XX	444,379	XX	466,381
LOUISIANA								
Clays—thousand short tons	638	$641	655	$655	780	$797	909	$936
Lime—do	624	6,519	657	6,862	725	8,312	842	9,980

Natural gas—million cubic feet	3,525,456	694,515	3,928,427	777,829	r 4,152,731	793,328	4,466,786	812,955
Natural gas liquids:								
Natural gasoline and cycle products—thousand gallons	1,010,137	74,726	1,143,707	81,332	1,352,980	91,931	1,431,836	102,731
LP gases—do	862,772	29,037	1,113,670	41,043	1,247,484	45,935	1,300,038	46,101
Petroleum (crude)—thousand 42-gallon barrels	477,153	1,502,568	515,057	1,608,120	549,698	1,709,622	594,853	1,841,714
Salt—thousand short tons	5,248	27,407	6,199	30,450	6,401	36,056	8,126	41,812
Sand and gravel—do	12,040	14,817	12,500	14,701	13,594	15,253	14,298	16,405
Stone [4]—do	5,711	8,067	5,408	7,961	5,459	7,228	7,452	10,905
Sulfur (Frasch process)—thousand long tons	2,262	49,772	2,445	48,905	2,733	54,996	3,577	71,966
Value of items that cannot be disclosed: Cement, gypsum, and stone (crushed miscellaneous)	XX	18,554	XX	20,531	XX	21,549	XX	23,350
Total	XX	2,426,623	XX	2,638,389	XX	2,785,007	XX	2,978,855
MAINE								
Beryllium concentrate—short tons, gross weight	W	W						
Clays—thousand short tons	48	$63	42	$55	45	$58	49	$63
Gem stones	NA	25	NA	25	NA	35	NA	35
Mica:								
Scrap—short tons	15	(5)						
Sheet—pounds	2,017	16						
Peat—short tons	1,250	47	W	W	6,350	171	1,275	56
Sand and gravel—thousand short tons	10,014	4,013	11,195	4,673	13,552	6,463	17,294	7,831
Stone—do	1,127	4,249	947	3,581	1,414	4,506	1,100	3,409
Value of items that cannot be disclosed: Cement, feldspar, and values indicated by symbol W	XX	6,534	XX	5,770	XX	6,341	XX	6,347
Total	XX	14,947	XX	14,104	XX	17,574	XX	17,741
MARYLAND								
Clays—thousand short tons	593	$899	580	$897	[3] 635	[3] $798	[3] 914	[3] $1,088
Coal (bituminous)—do	821	3,168	1,162	4,330	1,136	4,511	1,210	4,389
Gem stones	NA	3	NA	3	NA	3	NA	3
Lime—thousand short tons	W	W	W	W	W	W	37	481
Natural gas—million cubic feet	2,472	667	1,633	439	r 1,373	366	408	103
Sand and gravel—thousand short tons	12,762	16,816	13,310	16,063	15,041	18,071	16,200	21,188
Stone—do	11,610	22,595	13,012	26,407	13,348	26,715	14,553	28,432
Value of items that cannot be disclosed: Cement, ball clay (1964–65), diatomite (1962–63), greensand marl, peat, potassium salts, talc and soapstone, and values indicated by symbol W	XX	22,481	XX	22,111	XX	23,429	XX	22,311
Total	XX	66,629	XX	70,250	XX	73,893	XX	77,995
MASSACHUSETTS								
Clays—thousand short tons	125	$96	157	$213	138	$174	181	$238
Gem stones	NA	2	NA	2	NA	2	NA	2
Lime—thousand short tons	148	2,337	145	2,426	171	2,703	170	2,779
Sand and gravel—do	17,566	15,026	19,905	15,592	21,341	16,794	22,141	16,172
Stone—do	4,985	12,541	5,570	14,396	6,519	16,663	6,168	16,980
Value of items that cannot be disclosed: Nonmetals	XX	33	XX	32	XX	31	XX	27
Total	XX	30,035	XX	32,661	XX	36,367	XX	36,198

Table 5.—Mineral production [1] in the United States, by States—Continued

Mineral	1962		1963		1964		1965	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
MICHIGAN								
Cement:								
Portland—thousand 376-pound barrels	22,682	$73,267	25,016	$76,944	26,745	$84,316	27,565	$86,996
Masonry—thousand 280-pound barrels	1,517	4,335	1,684	4,519	1,865	4,954	2,108	5,373
Clays—thousand short tons	1,751	1,917	1,958	2,149	2,385	2,592	2,402	2,580
Copper (recoverable content of ores, etc.)—short tons	74,099	45,645	75,262	46,361	69,040	45,014	71,749	50,798
Gypsum—thousand short tons	1,278	4,791	1,315	4,938	1,421	5,263	1,338	5,027
Iron ore (usable)—thousand long tons, gross weight	9,422	85,597	10,789	107,201	13,871	143,979	13,527	145,482
Lime—thousand short tons	1,153	15,371	1,371	18,431	1,430	19,246	1,095	13,057
Magnesium compounds from sea water and brine (except for metal)—short tons, MgO equivalent	W	W	266,740	23,062	306,494	23,385	319,389	26,143
Manganiferous ore (5 to 35 percent Mn) short tons, gross weight			152,957	W				
Natural gas—million cubic feet	28,987	6,174	32,850	8,902	r 31,388	7,984	34,558	8,674
Natural gas liquids:								
Natural gasoline—thousand gallons	W	W	W	W	W	W	9,054	607
LP gases—do	W	W	W	W	W	W	76,299	3,815
Peat—short tons	257,693	2,277	251,809	2,413	269,074	2,412	230,950	2,134
Petroleum (crude)—thousand 42-gallon barrels	17,114	48,775	15,972	45,520	15,601	43,839	14,728	41,091
Salt—thousand short tons	4,274	33,343	4,244	33,656	4,345	35,711	4,171	36,087
Sand and gravel—do	47,563	42,029	50,458	43,433	51,921	44,405	53,168	47,176
Silver (recoverable content of ores, etc.) thousand troy ounces	401	436	339	434	349	452	458	592
Stone—thousand short tons	28,440	29,055	30,316	32,065	34,650	37,002	34,713	36,438
Value of items that cannot be disclosed: Bromine, calcium-magnesium chloride, gem stones, iodine, potassium salts, and values indicated by symbol W	XX	53,500	XX	42,001	XX	r 54,278	XX	53,490
Total	XX	446,512	XX	492,029	XX	r 554,832	XX	565,560
MINNESOTA								
Clays—thousand short tons	203	$291	r 199	r $298	r 213	r $319	r 207	r $311
Iron ore (usable)—thousand long tons, gross weight	44,295	385,997	45,435	408,486	49,626	449,289	50,873	459,290
Manganiferous ore (5 to 35 percent Mn) short tons, gross weight	292,779	W	347,336	W	188,481	W	280,705	W
Peat—short tons	14,386	307	8,110	294	19,188	405	7,346	123
Sand and gravel—thousand short tons	29,399	22,656	30,462	23,318	35,817	25,907	37,545	27,296
Stone—do	3,803	10,360	3,898	11,027	3,588	12,297	4,371	11,680
Value of items that cannot be disclosed: Abrasive stones, cement, fire clay (1963–65), gem stones, lime, and values indicated by symbol W	XX	9,325	XX	10,120	XX	9,278	XX	9,060
Total	XX	428,936	XX	453,543	XX	497,495	XX	507,760

MISSISSIPPI								
Clays—thousand short tons	1,129	$5,742	1,235	$5,968	1,331	$6,130	1,502	$5,925
Natural gas—million cubic feet	170,271	32,351	176,807	31,825	r 180,428	31,385	166,825	28,861
Natural gas liquids:								
Natural gasoline and cycle products—thousand gallons	25,891	1,616	28,757	1,755	27,485	1,644	26,582	1,606
LP gases—do	20,401	732	24,541	956	23,277	780	22,150	975
Petroleum (crude)—thousand 42-gallon barrels	55,713	154,882	58,619	161,788	56,777	151,595	56,183	148,437
Sand and gravel—thousand short tons	7,001	7,262	6,825	7,056	7,825	8,569	8,447	8,717
Stone—do	1,199	1,266	1,267	1,267	1,553	1,557	r 2,357	r 2,358
Value of items that cannot be disclosed: Cement, iron ore (1965), lime magnesium compounds, and stone (dimension sandstone 1965)	XX	9,030	XX	9,579	XX	10,533	XX	12,093
Total	XX	212,881	XX	220,194	XX	212,193	XX	208,972
MISSOURI								
Asphalt, native—short tons	W	W	1,779	$15	1,522	$13	W	W
Barite—thousand short tons	304	$3,994	287	3,680	267	3,451	329	$4,219
Cement:								
Portland—thousand 376-pound barrels	12,739	44,004	12,402	41,640	12,378	42,618	13,334	46,034
Masonry—thousand 280-pound barrels	455	1,457	417	1,345	334	1,046	377	1,173
Clays—thousand short tons	2,053	5,033	1,746	4,467	1,966	4,874	2,226	5,439
Coal (bituminous)—do	2,896	12,057	3,174	13,196	3,254	13,285	3,564	14,779
Copper (recoverable content of ores, etc.)—short tons	2,752	1,695	1,816	1,119	2,059	1,343	2,331	1,650
Iron ore (usable)—thousand long tons, gross weight	346	3,188	345	3,085	1,116	14,907	1,784	24,607
Lead (recoverable content of ores, etc.)—short tons	60,982	11,221	79,844	17,246	120,148	31,479	133,521	41,659
Lime—thousand short tons	1,176	13,703	1,240	14,386	1,219	14,328	1,442	16,782
Natural gas—million cubic feet	92	23	100	27	r 107	26	84	21
Petroleum (crude)—thousand 42-gallon barrels	55	W	53	150	65	163	73	W
Sand and gravel—thousand short tons	10,304	11,572	10,653	12,260	11,483	13,380	12,068	13,735
Silver (recoverable content of ores, etc.) thousand troy ounces	491	533	132	168	----------	----------	300	387
Stone—thousand short tons	28,876	44,006	30,885	46,130	31,487	47,984	36,247	53,574
Zinc (recoverable content of ores, etc.)—short tons	2,792	642	321	74	1,501	408	4,312	1,259
Value of items that cannot be disclosed: Gem stones (1962), tripoli (1965), and values indicated by symbol W	XX	179	XX	----------	XX	----------	XX	250
Total	XX	153,307	XX	158,988	XX	189,305	XX	225,568
MONTANA								
Clays [3]—thousand short tons	56	$77	38	$45	49	$59	76	$98
Coal (bituminous and lignite)—do	382	1,140	343	967	346	925	364	1,050
Copper (recoverable content of ores, etc.)—short tons	94,021	57,917	79,762	49,133	103,806	67,682	115,489	81,766
Gold (recoverable content of ores, etc.)—troy ounces	24,387	854	18,520	648	29,115	1,019	22,772	797
Iron ore (usable)—thousand long tons, gross weight	9	62	13	89	15	99	9	71
Lead (recoverable content of ores, etc.)—short tons	6,121	1,126	5,000	1,080	4,538	1,189	6,981	2,178
Lime—thousand short tons	104	1,049	114	1,290	136	1,385	159	1,512
Manganese ore (35 percent or more Mn) short tons, gross weight	24,758	W	5,260	W	20,264	W	r 23,621	W
Manganiferous ore (5 to 35 percent Mn)—do	2,264	29	1,688	W	3,638	W	1,968	W

Table 5.—Mineral production [1] in the United States, by States—Continued

Mineral	1962		1963		1964		1965	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
MONTANA—Continued								
Natural gas—million cubic feet	29,955	$2,217	30,026	$2,253	r 25,051	$1,965	28,105	$2,305
Petroleum (crude)—thousand 42-gallon barrels	31,648	76,690	30,870	75,323	30,647	74,621	32,778	79,624
Sand and gravel—thousand short tons	18,473	17,642	14,319	13,756	16,017	17,840	12,048	13,587
Silver (recoverable content of ores, etc.)—thousand troy ounces	4,561	4,948	4,242	5,426	5,290	6,840	5,207	6,733
Stone—thousand short tons	996	1,708	6,109	7,081	7,345	8,477	5,512	5,971
Zinc (recoverable content of ores, etc.)—short tons	37,678	8,666	32,941	7,576	29,059	7,904	33,786	9,866
Value of items that cannot be disclosed: Barite, cement, clays (fire clay 1962–64, bentonite 1964–65), fluorspar, gem stones, gypsum, sheet mica (1962), natural gas liquids, peat, phosphate rock, pumice (1964), rare-earth metal concentrates (1962), talc, tungsten (1962), uranium ore (1962–64), vermiculite, and values indicated by symbol W	XX	16,531	XX	17,351	XX	r 21,447	XX	23,834
Total	XX	190,656	XX	182,018	XX	r 211,452	XX	229,392
NEBRASKA								
Clays—thousand short tons	142	$142	148	$148	143	$143	106	$106
Gem stones	NA	5	NA	5	NA	5	NA	5
Natural gas—million cubic feet	14,880	2,708	13,051	2,454	r 11,094	1,707	10,720	1,565
Natural gas liquids:								
Natural gasoline—thousand gallons	12,239	809	10,119	687	9,587	627	7,822	516
LP gases—do	28,718	1,329	25,931	1,207	24,556	1,092	16,946	847
Petroleum (crude)—thousand 42-gallon barrels	24,894	70,450	21,846	61,824	19,113	51,605	17,216	45,796
Sand and gravel—thousand short tons	12,853	9,797	11,166	10,680	14,641	15,748	11,993	13,697
Stone—do	3,670	6,626	3,700	6,192	3,779	6,417	4,198	6,637
Value of items that cannot be disclosed: Cement, lime, and pumice	XX	16,507	XX	15,710	XX	14,615	XX	14,622
Total	XX	108,373	XX	98,907	XX	91,959	XX	83,791
NEVADA								
Antimony ore and concentrate—short tons, antimony content	----------	----------	----------	----------	33	$20	26	$19
Barite—thousand short tons	138	$954	120	$760	149	1,261	91	583
Copper (recoverable content of ores, etc.)—short tons	82,602	50,883	81,738	50,351	67,272	43,861	71,332	50,503
Gem stones	NA	100	NA	100	NA	100	NA	100
Gold (recoverable content of ores, etc.)—troy ounces	62,863	2,200	98,879	3,461	90,469	3,166	229,050	8,017
Gypsum—thousand short tons	817	2,952	890	3,216	799	2,894	710	2,518
Iron ore (usable)—thousand long tons, gross weight	617	3,238	772	3,921	911	5,048	1,141	5,330
Lead (recoverable content of ores, etc.)—short tons	771	142	1,126	243	809	212	2,277	710
Mercury—76-pound flasks	6,573	1,257	4,944	937	3,262	1,027	3,333	1,902
Perlite—short tons	25,067	205	22,910	192	15,603	135	13,780	121
Petroleum (crude)—thousand 42-gallon barrels	141	W	118	W	255	W	209	W
Pumice—thousand short tons	W	W	W	W	W	W	68	187
Sand and gravel—do	7,850	9,655	9,688	10,513	14,142	14,427	9,455	11,796

Silver (recoverable content of ores, etc.) thousand troy ounces	245	266	215	275	172	223	507	656
Stone thousand short tons	722	1,220	639	1,101	788	1,396	1,248	2,247
Sulfur ore long tons	W	W	586	11	274	5	336	6
Talc and soapstone short tons	6,157	55	4,243	50	5,322	58	3,592	31
Tungsten ore and concentrate short tons, 60-percent WO_3 basis	156	234	W	W	W	W	W	W
Zinc (recoverable content of ores, etc.) short tons	281	65	571	131	582	158	3,858	1,127
Value of items that cannot be disclosed: Brucite (1965), cement (1965), clays, diatomite, fluorspar, lime, magnesite, molybdenum, peat (1964–65), salt, uranium ore (1963–65), and values indicated by symbol W	XX	9,648	XX	10,215	XX	11,146	XX	14,063
Total	XX	83,074	XX	85,477	XX	85,137	XX	99,916
NEW HAMPSHIRE								
Beryllium concentrate short tons, gross weight	7	$4						
Clays thousand short tons	37	37	47	$40	46	$40	53	$47
Mica:								
Sheet pounds	37,508	396						
Scrap short tons	411	11						
Sand and gravel thousand short tons	8,260	4,119	7,581	4,376	8,768	4,996	10,584	5,559
Stone do	154	1,368	137	1,566	202	2,138	153	1,932
Value of items that cannot be disclosed: Other nonmetals	XX	97	XX	109	XX	128	XX	127
Total	XX	6,032	XX	6,091	XX	7,302	XX	7,665
NEW JERSEY								
Clays thousand short tons	584	$1,476	498	$1,392	500	$1,441	506	$1,388
Gem stones	NA	9	NA	9	NA	10	NA	10
Peat short tons	29,099	247	23,685	241	W	W	40,480	431
Sand and gravel thousand short tons	13,728	21,230	16,672	25,245	17,661	27,079	17,389	28,646
Stone do	14,214	28,979	11,229	25,654	12,326	28,461	12,232	27,247
Zinc (recoverable content of ores, etc.) [11] short tons	15,309	3,559	32,738	7,855	32,926	8,935	38,297	11,106
Value of items that cannot be disclosed: Iron ore, lime, magnesium compounds, manganiferous residuum, greensand marl, titanium concentrate, and values indicated by symbol W	XX	10,186	XX	12,880	XX	12,246	XX	11,330
Total	XX	65,686	XX	73,276	XX	78,172	XX	80,158
NEW MEXICO								
Barite thousand short tons	(5)	$4	1	$6	W	W	(5)	$2
Beryllium concentrate short tons, gross weight	34	19						
Carbon dioxide, natural thousand cubic feet	826,810	74	854,339	63	816,168	$61	833,819	62
Clays thousand short tons	52	156	W	140	[3] 104	[3] 167	60	101
Coal (bituminous) do	677	2,595	1,945	5,629	2,969	9,763	3,212	10,710
Copper (recoverable content of ores, etc.) short tons	82,688	50,933	83,037	51,151	86,104	56,140	98,658	69,850
Fluorspar do					187	3		
Gem stones	NA	45	NA	45	NA	45	NA	45
Gold (recoverable content of ores, etc.) troy ounces	7,529	264	7,805	278	6,110	214	9,641	337
Gypsum thousand short tons	151	564	179	656	W	W	W	W

Table 5.—Mineral production [1] in the United States, by States—Continued

Mineral	1962		1963		1964		1965	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
NEW MEXICO—Continued								
Helium, refined—thousand cubic feet	27,377	$958	79,624	$2,787	r 82,105	$2,958	80,583	$2,975
Iron ore (usable)—thousand long tons, gross weight	9	121	W	W	W	W	W	W
Lead (recoverable content of ores, etc.)—short tons	1,134	209	1,014	219	1,626	426	3,387	1,057
Lime—thousand short tons	29	403	27	377	25	352	33	465
Manganese ore (35 percent or more Mn) short tons, gross weight	W	W	5,362	137	5,794	149	5,637	156
Manganiferous ore (5 to 35 percent Mn)—do	W	W	41,144	W	46,657	300	50,090	328
Mica: Scrap—short tons	5,731	140	W	W	6,922	105	4,263	45
Natural gas—million cubic feet	804,612	92,530	808,377	96,197	r 873,947	101,932	937,205	110,590
Natural gas liquids:								
Natural gasoline and cycle products—thousand gallons	273,969	16,775	291,388	17,555	356,047	21,570	358,487	20,824
LP gases—do	661,330	20,359	728,200	21,801	739,190	21,641	759,311	25,817
Perlite—short tons	258,164	2,143	259,113	2,212	286,329	2,568	331,011	2,905
Petroleum (crude)—thousand 42-gallon barrels	109,328	314,883	109,941	316,574	113,863	326,565	119,166	334,977
Potassium salts—thousand short tons, K_2O equivalent	2,208	85,124	2,643	101,458	2,675	r 104,861	2,848	117,771
Pumice—thousand short tons	308	741	322	850	260	760	264	915
Salt—do	43	334	54	472	62	559	64	572
Sand and gravel—do	6,889	8,021	8,402	12,843	8,781	10,160	11,763	12,130
Silver (recoverable content of ores, etc.) thousand troy ounces	302	327	256	328	242	313	288	372
Stone—thousand short tons	2,004	2,782	2,509	4,236	2,760	4,244	1,911	3,020
Uranium ore—short tons	3,478,238	63,504	2,304,577	41,372	2,093,350	38,203	2,013,861	38,311
Vanadium (recoverable in ore and concentrate)—do	W	W	23	W	W	154	W	221
Zinc (recoverable content of ores, etc.)—do	22,015	5,063	12,938	2,976	29,833	8,115	36,460	10,646
Value of items that cannot be disclosed: Cement, fire clay (1964), molybdenum, sheet mica (1962), tin (1964–65), and values indicated by symbol W	XX	6,743	XX	8,249	XX	r 7,802	XX	8,070
Total	XX	675,814	XX	688,606	XX	r 720,130	XX	773,274
NEW YORK								
Clays—thousand short tons	1,397	$1,618	1,598	$2,186	1,499	$1,993	1,354	$1,717
Emery—short tons	4,316	71	6,732	119	9,214	172	10,720	204
Gem stones	NA	10	NA	10	NA	10	NA	10
Gypsum—thousand short tons	601	3,122	647	3,339	653	3,321	662	3,511
Iron ore (usable)—thousand long tons, gross weight	2,099	24,953	W	W	W	W	W	W
Lead (recoverable content of ores, etc.)—short tons	1,063	196	1,009	218	732	192	601	188
Natural gas—million cubic feet	4,262	1,198	3,962	1,169	r 3,108	963	3,340	1,029
Peat—short tons	14,400	113	21,358	178	32,574	261	25,098	232
Petroleum (crude)—thousand 42-gallon barrels	1,589	7,309	1,679	7,707	1,874	8,321	1,632	7,246
Salt—thousand short tons	4,456	32,236	4,782	34,228	4,816	34,216	5,002	35,771
Sand and gravel—do	29,447	31,346	37,381	37,274	39,282	38,583	39,225	40,370
Silver (recoverable content of ores, etc.) thousand troy ounces	19	21	20	25	13	17	11	15
Stone—thousand short tons	27,589	47,256	26,611	44,549	29,141	46,669	30,801	48,675
Zinc (recoverable content of ores, etc.)—short tons	53,654	12,340	53,495	12,304	60,754	16,525	69,880	20,405

Value of items that cannot be disclosed: Cement, abrasive garnet, lime, talc, titanium concentrate, wollastonite, and values indicated by symbol W	XX	79,183	XX	115,768	XX	137,202	XX	130,684
Total	XX	240,972	XX	259,074	XX	288,445	XX	290,057
NORTH CAROLINA								
Abrasive stones (millstones)	NA	$2	NA	$2				
Clays [3] thousand short tons	2,731	1,782	2,735	1,761	3,199	$2,064	3,383	$2,162
Feldspar long tons	244,708	2,373	267,654	2,821	r 281,449	r 2,342	278,990	3,153
Gem stones	NA	2	NA	14	NA	15	NA	15
Gold (recoverable content of ores, etc.) troy ounces	460	16	33	1				
Iron ore (usable) thousand long tons	1	13	1	10				
Lead (recoverable content of ores, etc.) short tons	219	40	62	13				
Mica:								
Scrap do	61,983	1,384	61,598	1,497	64,010	2,027	72,199	1,987
Sheet pounds	320,305	867	92,961	13	242,662	58	713,293	185
Phosphate rock thousand long tons					6	41		
Sand and gravel thousand short tons	12,516	11,457	11,028	10,132	11,150	10,404	10,499	10,076
Silver (recoverable content of ores, etc.) thousand troy ounces	100	109	27	34				
Stone thousand short tons	19,308	29,533	15,701	25,683	r 17,943	r 30,378	r 18,835	r 30,920
Talc and pyrophyllite short tons	100,298	433	106,652	446	106,035	495	109,721	556
Zinc (recoverable content of ores, etc.) do			13	3				
Value of items that cannot be disclosed: Asbestos, cement (1963–65), clay (kaolin), copper (1962–63), lithium minerals, olivine, stone (crushed and dimension marble and dimension slate 1964–65), and tungsten concentrate (1962–64)	XX	6,586	XX	2,095	XX	7,903	XX	11,329
Total	XX	54,597	XX	44,525	XX	r 55,727	XX	60,383
NORTH DAKOTA								
Clays thousand short tons	98	$124	[3] 5	[3] $10	85	$119	81	$114
Coal (lignite) do	2,733	6,135	2,399	5,250	2,637	5,659	2,732	5,848
Gem stones	NA	1	NA	1	NA	1	NA	1
Natural gas million cubic feet	25,155	3,446	32,798	6,264	r 34,512	7,634	35,652	5,704
Natural gas liquids:								
Natural gasoline thousand gallons	16,872	1,085	20,511	1,339	21,368	1,338	21,059	1,263
LP gases do	68,881	2,665	79,653	3,166	84,338	2,960	85,174	3,066
Petroleum (crude) thousand 42-gallon barrels	25,181	69,248	25,030	68,332	25,731	63,813	26,350	65,875
Sand and gravel thousand short tons	9,615	7,122	9,529	9,193	10,520	10,142	7,574	7,895
Stone do	19	19	132	132	31	56	356	624
Uranium ore short tons	W	W	5,567	141	W	W	44,558	1,359
Value of items that cannot be disclosed: Clays (bentonite 1963, miscellaneous clay 1963), lime (1965), molybdenum (1964–65), peat (1963–65), salt, vanadium (1965), and values indicated by symbol W	XX	774	XX	875	XX	1,144	XX	1,129
Total	XX	90,619	XX	94,703	XX	92,866	XX	92,878

Table 5.—Mineral production [1] in the United States, by States—Continued

Mineral	1962		1963		1964		1965	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
OHIO								
Cement:								
Portland—thousand 376-pound barrels	15,353	$51,006	16,218	$53,244	15,553	$50,647	14,786	$47,499
Masonry—thousand 280-pound barrels	946	2,793	1,023	3,084	1,068	3,127	1,050	3,004
Clays—thousand short tons	4,751	12,979	4,841	13,959	5,005	14,426	5,070	14,816
Coal (bituminous)—do	34,125	127,051	36,790	136,113	37,310	137,776	39,390	146,028
Gem stones	NA	3	NA	3	NA	3	NA	3
Lime—thousand short tons	3,102	43,792	3,207	45,957	3,664	53,308	3,831	53,208
Natural gas—million cubic feet	36,747	9,407	36,817	8,909	r 37,106	8,880	35,684	8,421
Peat—short tons	7,383	106	6,910	109	6,363	83	5,352	80
Petroleum (crude)—thousand 42-gallon barrels	5,835	18,089	6,039	19,023	15,859	46,420	12,908	37,940
Salt—thousand short tons	4,187	28,706	4,245	29,682	4,537	31,092	5,026	34,816
Sand and gravel—do	35,204	43,333	37,790	44,368	37,771	45,567	40,852	49,305
Stone—do	34,470	57,202	37,537	62,787	r 37,715	r 61,814	42,263	66,969
Value of items that cannot be disclosed: Abrasive stone, gypsum, stone (calcareous marl 1964)	XX	1,588	XX	1,742	XX	1,794	XX	2,163
Total	XX	396,055	XX	418,980	XX	454,937	XX	464,252
OKLAHOMA								
Clays [3]—thousand short tons	737	$756	898	$911	835	$854	794	$806
Coal (bituminous)—do	1,048	6,978	1,008	5,667	1,028	5,474	974	5,520
Gypsum—do	509	1,668	531	1,462	694	1,899	761	2,343
Helium, refined—thousand cubic feet	284,214	9,917	237,201	8,302	r 298,803	r 8,591	300,992	9,532
Lead (recoverable content of ores, etc.)—short tons	2,710	499	3,192	689	2,781	729	2,813	878
Natural gas—million cubic feet	1,060,717	135,772	1,233,883	160,405	r 1,316,201	166,747	1,320,995	182,297
Natural gas liquids:								
Natural gasoline and cycle products—thousand gallons	552,795	35,764	555,467	35,131	554,053	34,011	570,129	34,561
LP gases—do	838,903	25,223	810,894	28,981	880,804	28,055	894,665	32,208
Petroleum (crude)—thousand 42-gallon barrels	202,732	591,977	201,962	587,709	202,524	587,320	203,441	587,944
Salt—thousand short tons	5	25	4	26	6	41	9	65
Sand and gravel—do	4,436	4,736	5,420	6,116	6,680	7,003	5,218	6,023
Stone—do	14,666	18,819	13,817	16,160	13,987	15,087	16,417	18,071
Zinc (recoverable content of ores, etc.)—short tons	10,013	2,303	13,245	3,046	12,159	3,307	12,715	3,713
Value of items that cannot be disclosed: Clay (bentonite), cement, copper (1965), gem stones (1962), lime, pumice, silver (1965) and tripoli	XX	20,853	XX	22,929	XX	22,670	XX	23,953
Total	XX	855,290	XX	877,534	XX	r 881,788	XX	907,914
OREGON								
Clays—thousand short tons	249	$305	279	$330	r 290	r $356	291	$359
Copper (recoverable content of ores, etc.)—short tons	W	W	W	W	15	10	W	W

Diatomite	do	50	2	150	3	W	W	W	W
Gold (recoverable content of ores, etc.)	troy ounces	822	29	1,809	63	661	23	499	17
Lime	thousand short tons	78	1,514	87	1,835	95	1,918	98	1,853
Mercury	76-pound flasks	W	W	W	W	126	40	1,364	779
Nickel (content of ore and concentrate)	short tons	13,110	W	13,394	W	15,420	W	16,188	W
Perlite	do	3	(5)	----------	----------	5	(5)	----------	----------
Pumice	thousand short tons	W	W	422	664	566	909	657	1,181
Sand and gravel	do	14,869	14,556	15,715	18,850	18,253	25,158	21,800	32,849
Silver (recoverable content of ores, etc.)	thousand troy ounces	6	7	58	74	14	19	9	11
Stone	thousand short tons	18,258	20,977	19,692	24,197	16,120	19,296	21,212	27,301
Tungsten concentrate	short tons, 60-percent WO_3 basis	----------	----------	----------	----------	1	1	----------	----------
Uranium ore	short tons	2,722	112	1,763	45	27	2	----------	----------
Zinc (recoverable content of ores, etc.)	do	----------	----------	3	1	W	W	W	W
Value of items that cannot be disclosed: Cement, gem stones, iron ore (pigment material 1963, 1965), lead (1963–65), vanadium (1964), and values indicated by symbol W		XX	14,956	XX	16,630	XX	16,631	XX	18,616
Total		XX	52,458	XX	62,692	XX	r64,363	XX	82,966

PENNSYLVANIA

Cement:									
Portland	thousand 376-pound barrels	38,463	$127,969	38,316	$118,203	37,663	$113,409	40,153	$116,925
Masonry	thousand 280-pound barrels	2,565	7,105	2,510	6,611	2,818	7,594	3,006	7,991
Clays [3]	thousand short tons	2,893	12,815	3,191	14,717	3,187	15,814	3,394	17,697
Coal:									
Anthracite	do	16,894	134,094	18,267	153,503	17,184	148,648	14,866	122,021
Bituminous	do	65,315	331,298	71,501	350,085	76,531	388,218	80,308	407,267
Copper (recoverable content of ores, etc.)	short tons	W	W	4,434	2,731	3,614	2,356	4,354	3,083
Gem stones		NA	4	NA	4	NA	4	NA	4
Lime	thousand short tons	1,104	16,647	1,188	17,548	1,440	20,656	1,568	22,496
Natural gas	million cubic feet	90,053	24,494	92,657	24,091	r81,720	22,349	84,461	22,551
Natural gas liquids:									
Natural gasoline	thousand gallons	1,350	75	1,311	78	1,138	64	1,022	55
LP gases	do	1,521	112	1,721	118	1,481	100	1,683	109
Peat	short tons	32,936	369	33,952	339	39,500	397	45,600	527
Petroleum (crude)	thousand 42-gallon barrels	5,302	24,230	5,083	23,178	5,113	22,088	4,922	21,263
Sand and gravel	thousand short tons	14,419	23,587	14,066	23,539	16,199	26,414	18,502	29,606
Stone	do	48,144	82,087	49,536	83,450	52,829	91,075	56,806	99,627
Zinc (recoverable content of ores, etc.) [11]	short tons	24,308	5,652	27,389	6,572	30,754	8,345	27,635	8,014
Value of items that cannot be disclosed: Clay (kaolin), cobalt, gold, iron ore, scrap mica, pyrites, pyrophyllite, silver, tripoli, and values indicated by symbol W		XX	32,966	XX	32,644	XX	34,519	XX	34,587
Total		XX	823,504	XX	857,411	XX	902,050	XX	913,823

RHODE ISLAND

Gem stones		NA	W	NA	$1	NA	W	NA	W
Sand and gravel	thousand short tons	2,346	$1,890	1,750	1,838	1,647	$1,613	1,681	$1,811
Stone	do	r304	r483	442	968	450	935	437	1,119
Value of items that cannot be disclosed: Nonmetals and values indicated by symbol W		XX	621	XX	----------	XX	1	XX	1
Total		XX	2,994	XX	2,807	XX	2,549	XX	2,931

Table 5.—Mineral production[1] in the United States, by States—Continued

Mineral	1962		1963		1964		1965	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
SOUTH CAROLINA								
Clays—thousand short tons	1,518	$7,165	1,491	$7,589	1,743	$8,309	1,837	$8,539
Sand and gravel—do	3,318	3,670	4,051	4,750	4,622	5,262	5,248	6,688
Stone—do	6,382	10,066	7,262	10,926	[4] 6,109	[4] 9,176	[4] 5,948	[4] 8,447
Value of items that cannot be disclosed: Barite, cement, feldspar, gem stones (1962–63), kyanite, scrap mica, peat, pyrites, stone (crushed limestone 1964–65 and dimension granite 1965), and vermiculite	XX	13,000	XX	13,214	XX	15,966	XX	17,587
Total	XX	33,901	XX	36,479	XX	38,713	XX	41,261
SOUTH DAKOTA								
Beryllium concentrate—short tons, gross weight	144	$77	[5]	[5]	W	W	W	W
Cement:								
Portland—thousand 376-pound barrels	2,316	7,369	1,869	$5,909	2,001	$6,873	1,575	$5,127
Masonry—thousand 280-pound barrels	60	197	60	198	57	200	55	180
Clays—thousand short tons	249	690	240	960	245	1,076	223	1,220
Coal (lignite)—do	18	77	16	62	13	63	10	49
Copper (recoverable content of ores, etc.)—short tons	----------	----------	1	[5]	----------	----------	----------	----------
Feldspar—long tons	29,697	191	25,590	157	26,980	180	51,560	346
Gem stones	NA	20	NA	20	NA	20	NA	20
Gold (recoverable content of ores, etc.)—troy ounces	577,232	20,203	576,726	20,185	616,913	21,592	628,259	21,989
Gypsum—thousand short tons	23	93	24	97	19	76	7	27
Iron ore (usable)—thousand long tons	34	113	----------	----------	----------	----------	----------	----------
Lead (recoverable content of ores, etc.)—short tons	3	1	4	1	----------	----------	----------	----------
Lithium minerals—do	W	W	W	W	W	W	150	[6] 5
Mica:								
Scrap—do	210	6	W	W	996	32	W	W
Sheet—pounds	2,085	12	10,000	[5]	----------	----------	----------	----------
Petroleum (crude)—thousand 42-gallon barrels	169	W	215	428	247	495	219	438
Sand and gravel—thousand short tons	15,371	9,207	20,806	16,313	13,770	13,641	13,998	14,155
Silver (recoverable content of ores, etc.)—thousand troy ounces	113	123	117	150	133	172	129	167
Stone—thousand short tons	2,852	6,533	2,794	7,339	2,118	6,245	1,554	5,387
Uranium ore—short tons	29,452	370	72,088	1,931	110,147	1,551	44,738	303
Value of items that cannot be disclosed: Lime, molybdenum (1964–65), vanadium, and values indicated by symbol W	XX	505	XX	366	XX	608	XX	762
Total	XX	45,787	XX	54,116	XX	52,824	XX	50,175
TENNESSEE								
Barite—thousand short tons	14	$229	24	$404	39	$519	31	$442
Cement:								
Portland—thousand 376-pound barrels	8,509	27,741	8,283	26,760	8,343	26,791	8,724	27,535
Masonry—thousand 280-pound barrels	1,089	2,931	1,161	3,079	1,212	3,228	1,185	3,140

Clays	thousand short tons	[3] 1,037	[3] 4,597	[3] 1,238	[3] 5,248	[3] 1,310	[3] 5,576	1,495	6,103
Coal (bituminous)	do	6,214	22,555	6,121	22,689	5,990	22,674	5,865	20,930
Copper (recoverable content of ores, etc.)	short tons	14,298	8,808	13,717	8,450	13,889	9,056	14,823	10,495
Gem stones		NA	1	NA	[5]				
Gold (recoverable content of ores, etc.)	troy ounces	158	6	137	5	133	5	122	4
Lead (recoverable content of ores, etc.)	short tons	51	9						
Natural gas	million cubic feet	75	14	90	17	77	15	85	16
Petroleum (crude)	thousand 42-gallon barrels	14	W	16	W	10	W	11	W
Phosphate rock	thousand long tons	2,418	19,868	2,352	17,876	2,441	18,971	2,637	22,296
Sand and gravel	thousand short tons	6,075	8,018	7,613	9,443	7,972	10,245	8,193	10,690
Silver (recoverable content of ores, etc.)	thousand troy ounces	112	122	108	138	91	117	94	122
Stone	thousand short tons	24,398	35,614	26,825	38,113	[4] 26,497	[4] 38,239	[4] 28,888	[4] 38,859
Zinc (recoverable content of ores, etc.)	short tons	71,548	16,456	95,847	22,045	115,943	31,536	122,387	35,737
Value of items that cannot be disclosed: Clay (fuller's earth 1962–64), iron ore (1962–63), lime, pyrites, stone (crushed sandstone 1964–65), and values indicated by symbol W		XX	7,050	XX	6,458	XX	6,993	XX	6,572
Total		XX	154,019	XX	160,725	XX	173,965	XX	182,941

TEXAS

Cement:								
Portland	thousand 376-pound barrels	26,204	$83,162	29,104	$92,734	30,030	$94,492	30,820	$97,598
Masonry	thousand 280-pound barrels	926	2,774	930	2,858	930	2,805	968	3,011
Clays	thousand short tons	[3] 3,744	[3] 5,634	[3] 4,199	[3] 6,849	[3] 4,156	[3] 6,695	4,469	6,865
Gem stones		NA	150	NA	150	NA	140	NA	150
Gypsum	thousand short tons	1,120	3,956	1,099	3,999	1,131	4,049	1,045	3,794
Helium [9]	thousand cubic feet	245,623	8,552	264,342	9,252	[r] 1,385,251	[r] 21,488	1,354,704	21,728
Lime	thousand short tons	1,046	11,999	1,131	13,026	1,350	17,201	1,338	19,663
Natural gas	million cubic feet	6,080,210	747,866	6,205,034	775,629	[r] 6,490,202	809,180	6,636,555	858,396
Natural gas liquids:									
Natural gasoline and cycle products	thousand gallons	3,205,517	233,345	3,320,416	218,975	3,512,460	232,245	3,772,471	256,959
LP gases	do	5,012,291	189,382	5,366,831	169,695	5,521,236	167,492	5,847,601	204,666
Perlite	short tons					300	3	1,000	8
Petroleum (crude)	thousand 42-gallon barrels	943,328	2,818,709	977,835	2,908,380	989,525	2,928,994	1,000,749	2,962,119
Salt	thousand short tons	5,553	19,485	5,965	22,355	6,410	28,797	6,964	30,771
Sand and gravel	do	30,076	33,097	33,256	36,311	29,155	33,394	32,649	36,075
Stone	do	38,067	48,988	43,142	54,007	40,240	52,070	39,520	53,659
Sulfur (Frasch process)	thousand long tons	2,655	57,297	2,550	50,109	[r] 3,302	[r] 65,780	3,674	74,955
Talc and soapstone	short tons	73,635	387	72,658	368	89,334	395	64,211	204
Values of items that cannot be disclosed: Native asphalt, barite, bromine, clays (fuller's earth, kaolin 1964), coal (lignite), graphite, iron ore, magnesium chloride (for metal), magnesium compounds (except for metal), mercury (1965), pumice, sodium sulfate, and uranium ore		XX	58,774	XX	62,777	XX	[r] 83,604	XX	78,088
Total		XX	4,323,557	XX	4,427,474	XX	[r] 4,548,824	XX	4,708,709

UTAH

Carbon dioxide, natural	thousand cubic feet	81,920	$6	100,895	$7	96,432	$7	86,201	$6
Clays	thousand short tons	174	1,403	[3] 125	[3] 470	127	[3] 880	[3] 149	[3] 332
Coal (bituminous)	do	4,297	23,209	4,360	22,755	4,720	33,184	4,992	31,811
Copper (recoverable content of ores, etc.)	short tons	218,018	134,299	203,095	125,107	199,588	130,181	259,138	183,470

Table 5.—Mineral production[1] in the United States, by States—Continued

Mineral	1962		1963		1964		1965	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
UTAH—Continued								
Fluorspar—short tons	399	$12	247	$7	W	W	W	W
Gem stones	NA	75	NA	75	NA	$75	NA	$75
Gold (recoverable content of ores, etc.)—troy ounces	311,924	10,917	285,907	10,007	287,674	10,069	426,299	14,921
Iron ore (usable)—thousand long tons, gross weight	2,630	18,242	1,881	12,900	2,082	14,306	2,139	14,229
Lead (recoverable content of ores, etc.)—short tons	38,199	7,029	45,028	9,726	40,249	10,545	37,700	11,762
Lime—thousand short tons	163	2,759	156	2,668	163	2,917	189	3,470
Natural gas—million cubic feet	74,128	12,454	77,122	14,036	r 79,739	10,904	71,616	8,952
Perlite—short tons	929	3	1,313	7	2,003	12	W	W
Petroleum (crude)—thousand 42-gallon barrels	31,029	85,019	33,435	90,943	28,575	74,867	25,298	66,045
Pumice—thousand short tons	28	46	28	46	W	W	W	W
Salt—do	311	3,349	325	3,462	371	3,848	384	3,591
Sand and gravel—do	19,941	20,954	11,709	10,408	10,218	10,405	s 10,032	s 10,464
Silver (recoverable content of ores, etc.)—thousand troy ounces	4,628	5,022	4,791	6,128	4,552	5,886	5,636	7,287
Stone—thousand short tons	2,118	3,865	2,346	4,040	3,105	6,930	2,158	4,552
Sulfur ore—long tons, gross weight	----------	----------	----------	----------	----------	----------	2,156	3
Uranium ore—short tons	781,955	23,653	743,792	23,852	761,180	26,385	377,989	9,014
Vanadium (recoverable in ore and concentrate)—do	525	W	382	W	405	1,214	387	1,353
Zinc (recoverable content of ores, etc.)—do	34,313	7,892	36,179	8,321	31,428	8,548	27,747	8,102
Value of items that cannot be disclosed: Asphalt (gilsonite), barite (1962), beryllium (1963), cement, clays (fire clay 1963–65, kaolin 1965), gypsum, molybdenum, natural gas liquids, phosphate rock, potassium salts, and values indicated by symbol W	XX	50,382	XX	40,458	XX	40,867	XX	51,939
Total	XX	410,590	XX	385,423	XX	391,430	XX	431,378
VERMONT								
Gem stones	NA	$2	NA	W	NA	W	NA	W
Peat—short tons	----------	----------	----------	----------	286	$4	780	$3
Sand and gravel—thousand short tons	1,430	1,076	2,375	$1,410	1,764	$1,494	2,084	1,670
Stone—do	1,715	19,815	2,159	19,193	2,070	20,652	2,591	21,564
Value of items that cannot be disclosed: Asbestos, clays, lime, talc, and values indicated by symbol W	XX	4,237	XX	3,788	XX	3,977	XX	4,155
Total	XX	25,130	XX	24,391	XX	26,127	XX	27,392
VIRGINIA								
Aplite—long tons	125,156	$912	W	W	W	W	W	W
Clays—thousand short tons	1,464	1,444	1,410	$1,558	1,440	$1,614	1,415	$1,657
Coal (bituminous)—do	29,474	117,560	30,531	120,972	31,654	123,123	34,053	139,291
Gem stones	NA	6	NA	6	NA	6	NA	7
Lead (recoverable content of ores, etc.)—short tons	4,059	747	3,500	756	3,857	1,010	3,651	1,139
Lime—thousand short tons	615	7,668	639	8,058	780	9,781	847	10,584
Natural gas—million cubic feet	2,499	677	2,085	488	r 1,600	479	3,152	942

Petroleum (crude)—thousand 42-gallon barrels	3	W	3	W	6	W	4	W
Sand and gravel—thousand short tons	9,745	16,375	10,400	17,752	10,588	13,722	15,322	18,019
Soapstone—short tons	W	W	3,696	9	3,775	9	3,549	9
Stone—thousand short tons	25,766	43,121	27,653	45,529	30,407	52,153	36,350	59,397
Zinc (recoverable content of ores, etc.) [11]—short tons	26,479	6,141	23,988	5,725	21,004	5,700	20,491	5,942
Value of items that cannot be disclosed: Cement, feldspar, gypsum, iron ore (pigment materials), kyanite, pyrites (1962), salt, titanium concentrate, and values indicated by symbol W	XX	27,843	XX	28,211	XX	29,818	XX	30,990
Total	XX	222,494	XX	229,064	XX	237,415	XX	267,977
WASHINGTON								
Barite—thousand short tons	W	W					[6]	$1
Carbon dioxide—thousand cubic feet	W	W	W	W	W	W	11,848	3
Cement:								
Portland—thousand 376-pound barrels	W	W	W	W	W	W	6,258	22,351
Masonry—thousand 280-pound barrels	W	W	W	W	W	W	62	201
Clay [3]—thousand short tons	103	$100	134	$123	128	$119	162	211
Coal (bituminous)—do	235	1,630	190	1,380	68	575	55	497
Copper (recoverable content of ores, etc.)—short tons	41	25	W	W	35	23	30	21
Lead (recoverable content of ores, etc.)—do	6,033	1,110	5,374	1,161	5,731	1,502	6,328	1,974
Peat—do	41,962	288	37,248	188	35,609	170	29,729	131
Pumice—thousand short tons	10	130	W	W	W	W	W	W
Sand and gravel—do	19,580	18,145	22,760	20,490	31,920	25,971	31,301	27,234
Stone—do	12,749	18,180	12,934	16,346	r 10,498	r 15,204	12,461	17,446
Talc and soapstone—short tons	2,835	11	2,969	18	2,680	18	2,861	17
Uranium ore—do	110,948	2,050	117,286	2,545	147,005	3,601	73,495	1,871
Zinc (recoverable content of ores, etc.)—do	21,644	4,978	22,270	5,122	24,296	6,609	22,230	6,491
Value of items that cannot be disclosed: Abrasive stones (1962–63), clays (fire clay, bentonite 1965), diatomite, epsom salts (1962–63), gem stones, gold, gypsum (1962), lime (1963–65), magnesite, mercury (1965), olivine, silver, tungsten (1965), and values indicated by symbol W	XX	21,827	XX	24,057	XX	27,518	XX	7,723
Total	XX	68,474	XX	71,430	XX	r 81,310	XX	86,172
WEST VIRGINIA								
Clays—thousand short tons	447	$2,086	414	$2,044	[3] 261	[3] $309	[3] 289	[3] $328
Coal (bituminous)—do	118,499	578,293	132,568	634,794	141,409	693,572	149,191	726,096
Natural gas—million cubic feet	210,698	57,942	210,223	55,919	r 202,765	50,968	207,416	48,743
Natural gas liquids:								
Natural gasoline—thousand gallons	32,921	2,216	W	W	W	W	W	W
LP gases—do	344,969	17,475	W	W	W	W	W	W
Petroleum (crude)—thousand 42-gallon barrels	3,470	13,880	3,350	13,367	3,370	12,975	3,530	13,591
Salt—thousand short tons	1,042	4,635	W	W	1,033	3,666	1,153	5,539
Sand and gravel—do	5,202	10,942	4,808	10,578	5,472	11,555	5,253	11,480
Stone [4]—do	7,506	13,242	9,452	14,489	7,481	13,105	8,482	14,587
Value of items that cannot be disclosed: Calcium-magnesium chloride, cement, clay (fire clay 1964–65), gem stones, lime, stone (dimension sandstone) and values indicated by symbol W	XX	14,758	XX	37,051	XX	36,541	XX	39,240
Total	XX	715,464	XX	768,242	XX	822,691	XX	859,604

Table 5.—Mineral production[1] in the United States, by States—Continued

Mineral	1962		1963		1964		1965	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
WISCONSIN								
Abrasive stones—short tons	[12] 569	[12] $17	[13] 561	[13] $21	W	W	W	W
Clays—thousand short tons	137	156	111	140	119	$147	119	$147
Iron ore (usable)—thousand long tons, gross weight	1,045	W	938	W	524	W	141	W
Lead (recoverable content of ores, etc.)—short tons	1,394	256	1,116	241	1,742	456	1,645	513
Lime—thousand short tons	W	W	W	W	W	W	197	3,076
Peat—short tons	W	W	2,667	136	3,261	136	3,090	122
Sand and gravel—thousand short tons	33,649	24,408	35,363	24,863	34,348	24,695	38,751	27,707
Stone—do	13,392	19,709	13,583	18,744	13,901	20,232	15,344	21,924
Zinc (recoverable content of ores, etc.)—short tons	13,292	3,057	15,114	3,476	26,278	7,148	26,993	7,882
Value of items that cannot be disclosed: Abrasive stones (tube-mill liners, 1963), cement, gem stones, and values indicated by symbol W	XX	20,686	XX	19,220	XX	17,193	XX	11,628
Total	XX	68,289	XX	66,841	XX	70,007	XX	72,999
WYOMING								
Beryllium concentrate—short tons, gross weight	1	[5]	[5]	[5]	W	W	W	W
Clays—thousand short tons	1,141	$11,138	1,187	$12,385	1,271	$12,816	1,352	$13,633
Coal (bituminous)—do	2,569	8,198	3,124	9,922	3,101	9,774	3,260	10,150
Copper (recoverable content of ores, etc.)—short tons	----------	----------	----------	----------	5	3	6	4
Gem stones	NA	85	NA	110	NA	120	NA	120
Gold (recoverable content of ores, etc.)—troy ounces	----------	----------	4	[5]	6	[5]	3	[5]
Iron ore (usable)—thousand long tons, gross weight	739	6,441	1,604	17,504	2,056	24,543	2,087	25,198
Natural gas—million cubic feet	204,996	29,929	209,060	29,687	[r] 231,613	29,808	235,849	31,840
Natural gas liquids:								
Natural gasoline—thousand gallons	78,780	4,935	86,014	5,523	86,803	5,607	95,093	6,195
LP gases—do	149,438	5,762	150,437	6,203	152,982	6,433	143,331	6,020
Petroleum (crude)—thousand 42-gallon barrels	135,847	338,259	144,407	361,018	138,752	351,043	138,314	345,785
Pumice—thousand short tons	42	41	W	W	W	W	----------	----------
Sand and gravel—do	7,769	8,104	7,901	7,874	5,632	5,936	7,996	8,373
Stone—do	1,755	3,054	1,940	2,991	2,154	3,671	1,594	2,791
Uranium ore—short tons	1,301,784	25,715	1,173,420	23,849	[8] 1,183,754	[8] 23,321	1,048,176	17,758
Vanadium (recoverable in ore and concentrate)—do	W	442	W	435	W	359	W	444
Value of items that cannot be disclosed: Cement, feldspar (1965), gypsum, lime, phosphate rock, silver (1964–65), sodium carbonates and sulfates, vermiculite (1962–63), and values indicated by symbol W	XX	20,467	XX	24,736	XX	26,822	XX	30,241
Total	XX	462,570	XX	502,237	XX	[8] 500,256	XX	498,552

[c] Estimate. [r] Revised. NA Not available. W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed." XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Excludes certain cement, included with "Value of items that cannot be disclosed."
[3] Excludes certain clays, included with "Value of items that cannot be disclosed."
[4] Excludes certain stone, included with "Value of items that cannot be disclosed."
[5] Less than ½ unit.

[6] Includes 760 tons of low-grade beryllium ore in 1962, and 750 tons in 1963.
[7] Excludes shipments from Nye Metals, Inc., included with "Value of items that cannot be disclosed."
[8] Final figure, supersedes figure given in commodity chapter.
[9] Refined only, 1962–63; crude and refined, 1964–65.
[10] Excludes salt in brine, included with "Value of items that cannot be disclosed."
[11] Recoverable zinc valued at the yearly average price of Prime Western slab zinc, East St. Louis market. Represents value established after transportation, smelting and manufacturing charges have been added to the value of ore at mine.
[12] Grinding pebbles and tube-mill liners.
[13] Grinding pebbles; tube-mill liners included with "Value of items that cannot be disclosed."

Table 6.—Mineral production [1] in the Canal Zone and islands administered by the United States [2]

Mineral	1962		1963		1964		1965	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
American Samoa:								
Pumice—thousand short tons	50	$108	----------	----------	----------	----------	----------	----------
Sand and gravel—do	3	4	77	$193	22	$20	60	$55
Stone—do	1,103	1,788	944	2,351	157	234	60	60
Total	XX	1,900	XX	2,544	XX	254	XX	115
Canal Zone:								
Sand and gravel—thousand short tons	70	77	84	87	84	82	83	85
Stone (crushed)—do	207	359	162	281	153	349	153	366
Total	XX	436	XX	368	XX	431	XX	451
Canton: Stone (crushed)—thousand short tons	[3]	[3]	2	6	----------	----------	----------	----------
Guam: Stone—do	82	123	307	439	469	868	483	925
Virgin Islands: Stone (crushed)—do	21	82	66	329	69	342	68	302
Wake: Stone (crushed)—do	5	41	9	51	2	5	1	4

XX Not applicable.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Production data for Canton and Wake furnished by U.S. Department of Commerce, Civil Aeronautics Administration; Guam, by the Government of Guam; American Samoa, by the Government of American Samoa.
[3] Less than ½ unit.

Table 7.—Mineral production [1] in the Commonwealth of Puerto Rico

Mineral	1962		1963		1964		1965	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement---thousand 376-pound barrels	6,347	$20,018	7,217	$22,090	7,926	$23,879	7,284	$23,415
Clays---thousand short tons	219	131	200	158	341	271	357	288
Lime---do	1	14	4	103	18	574	27	867
Salt---do	----------	----------	8	131	5	74	8	138
Sand and gravel---do	7,378	9,793	7,616	10,407	7,816	11,492	8,147	12,405
Stone---do	5,589	8,551	5,334	8,237	5,504	8,586	5,344	9,111
Total	XX	38,507	XX	41,126	XX	44,876	XX	46,224

XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 8.—U.S. exports of principal minerals and products

Mineral	1964 Quantity	1964 Value (thousands)	1965 Quantity	1965 Value (thousands)
Metals:				
Aluminum:				
Ingots, slabs, crude—short tons	208,622	$92,227	203,642	$92,533
Scrap—do	68,615	21,476	38,547	12,452
Plates, sheets, bars, etc—do	69,761	50,982	65,172	51,323
Castings and forgings—do	1,832	4,671	2,256	6,669
Antimony: Metals and alloys, crude—do	401	223	14	18
Arsenic: Calcium arsenate—pounds	1,537,484	96	NA	NA
Bauxite, including bauxite concentrates—long tons	r 278,812	r 22,211	146,830	10,736
Aluminum sulfate—short tons	16,511	531	15,641	501
Other aluminum compounds—do	240,581	23,334	386,590	31,430
Beryllium—pounds	170,699	630	119,761	624
Bismuth: Metals and alloys—do	r 61,299	r 102	341,868	940
Cadmium—thousand pounds	1,439	4,033	r 73	r 195
Calcium chloride—short tons	39,893	1,513	NA	NA
Chrome:				
Ore and concentrate:				
Exports—do	6,366	241	7,047	285
Reexports—do	32,116	1,256	94,963	3,719
Chromic acid—do	891	523	999	574
Ferrochrome—do	10,032	2,504	12,002	3,021
Cobalt—pounds	1,453,107	2,002	1,441,187	2,097
Columbium metals, alloys, and other forms—do	348,107	610	4,217	177
Copper:				
Ore, concentrate, composition metal, and unrefined copper (copper content)—short tons	5,395	2,971	15,510	8,369
Refined copper and semimanufactures—do	381,432	262,741	379,498	317,338
Other copper manufactures—do	4,470	3,668	5,805	5,436
Copper sulfate or blue vitriol—do	1,087	275	2,135	1,288
Copper base alloys—do	80,613	56,705	80,049	70,116
Ferroalloys:				
Ferrosilicon—do	5,785	1,232	4,585	1,755
Ferrophosphorus—pounds	326,332,849	4,938	159,820,667	2,914
Gold:				
Ore and base bullion—troy ounces	21,566	755	49,836	1,744
Bullion, refined—do	12,056,841	421,989	36,667,207	1,283,352
Iron ore—thousand long tons	6,963	79,670	7,085	80,418
Iron and steel:				
Pig iron—short tons	176,056	10,275	28,225	1,665
Iron and steel products (major):				
Semimanufactures—do	r 2,800,935	r 440,485	1,935,571	351,212
Manufactured steel mill products—do	1,264,427	440,549	952,664	397,379
Advanced products—do	NA	206,378	NA	201,810
Iron and steel scrap: Ferrous scrap, including rerolling materials—short tons	r 7,898,473	r 243,333	6,248,728	199,744
Lead:				
Ore, matte, base bullion (lead content)—do	19	4	NA	NA
Pigs, bars, anodes—do	10,175	2,813	7,811	3,714
Scrap—do	13,148	2,384	3,793	757
Magnesium:				
Metal and alloys and semimanufactured forms, n.e.c—short tons	16,811	10,202	18,320	11,525
Powder—do	8	29	NA	NA
Manganese:				
Ore and concentrate—do	14,444	1,451	14,150	1,387
Ferromanganese—do	3,903	670	3,273	727
Mercury:				
Exports—76-pound flasks	188	52	7,543	5,031
Reexports—do	196	50	494	316
Molybdenum:				
Ore and concentrates (molybdenum content)—pounds	24,939,780	40,987	24,095,858	44,282
Metals and alloys, crude and scrap—do	1,404,502	3,630	110,709	414
Wire—do	30,903	500	23,414	631
Semifabricated forms, n.e.c—do	34,950	290	66,366	516
Powder—do	r 302,024	r 1,176	602,759	2,095
Ferromolybdenum—do	1,745,611	3,328	2,242,275	4,577
Nickel:				
Ore—short tons	8	3	NA	NA
Alloys and scrap (including Monel metal), ingots, bars, sheets, etc—short tons	66,108	35,412	16,552	26,437
Catalysts—do	1,002	2,013	2,547	6,063
Nickel-chrome electric resistance wire—do	445	1,929	380	1,914
Semifabricated forms, n.e.c—do	939	4,754	1,455	6,114
Platinum:				
Ore, concentrate, metal and alloys in ingots, bars, sheets, anodes, and other forms, including scrap—troy ounces	125,139	9,842	72,925	9,838

Table 8.—U.S. exports of principal minerals and products—Continued

Mineral	1964 Quantity	1964 Value (thousands)	1965 Quantity	1965 Value (thousands)
Metals—Continued				
Platinum—Continued				
Palladium, rhodium, iridium, osmiridium, ruthenium, and osmium (metal and alloys including scrap)—troy ounces	21,167	$1,363	30,172	$3,758
Platinum group manufactures, except jewelry	NA	5,083	NA	2,515
Radium metal (radium content)—milligrams	177	2	NA	NA
Rare earths:				
Cerium ore, metal, and alloys—pounds	1,637,142	400	54,151	221
Lighter flints—do	37,455	139		
Silver:				
Ore and base bullion—thousand troy ounces	r 649	r 840	537	697
Bullion, refined—do	r 108,746	r 140,557	39,128	50,727
Tantalum:				
Ore, metal, and other forms—pounds	232,282	1,211	304,409	1,656
Powder—do	32,217	574	24,662	757
Tin:				
Ingots, pigs, bars, etc:				
Exports—long tons	2,726	9,241	2,605	10,078
Reexports—do	1,315	6,225	224	880
Tin scrap and other tin-bearing material except tinplate scrap—long tons	4,844	2,151	1,354	1,220
Tin cans, finished or unfinished—do	23,963	14,244	NA	NA
Titanium:				
Ore and concentrate—short tons	2,161	386	1,201	203
Sponge (including iodide titanium) and scrap—short tons	1,817	1,781	2,132	2,070
Intermediate mill shapes—do	790	3,696	605	5,144
Mill products, n.e.c—do	75	1,302		
Ferrotitanium—do	541	392	NA	NA
Dioxide and pigments—do	29,359	8,287	26,896	7,249
Tungsten: Ore and concentrate:				
Exports—do	77	145	11	18
Reexports—do	150	122	261	181
Vanadium ore and concentrate, pentoxide, etc. (vanadium content)—pounds	2,461,193	3,620	1,856,096	3,540
Zinc:				
Ore and concentrate (zinc content)—short tons	39	12	NA	NA
Slabs, pigs, or blocks—do	26,515	7,240	5,939	1,765
Sheets, plates, strips, or other forms, n.e.c—short tons	6,569	3,978	5,120	3,051
Scrap (zinc content)—do	6,448	1,379	5,617	1,153
Dust—do	1,828	542	NA	NA
Semifabricated forms, n.e.c—do	5,666	2,451	2,764	1,931
Zirconium:				
Ore and concentrate—do	2,500	352	1,761	287
Metals and alloys and other forms—pounds	533,449	3,191	213,326	1,933
Nonmetals:				
Abrasives:				
Grindstones—short tons	179	48	NA	NA
Diamond dust and powder—carats	1,892,097	4,097	1,147,838	3,268
Diamond grinding wheels—do	405,328	2,709	382,605	3,053
Other natural and artificial metallic abrasives and products	NA	r 36,601	NA	42,754
Asbestos: Unmanufactured:				
Exports—short tons	26,819	3,162	42,995	5,270
Reexports—do	328	37	131	23
Boron: Boric acid, borates, crude and refined—pounds	766,200,586	31,289	348,033,874	16,922
Bromine, bromides, and bromates—do	17,036,442	3,437	NA	NA
Cement—376-pound barrels	712,678	3,290	748,440	4,288
Clays:				
Kaolin or china clay—short tons	151,725	4,671	192,875	6,244
Fire clay—do	246,796	5,596	182,446	3,667
Other clays—do	449,537	14,706	474,443	15,828
Cryolite—do	3,385	744	NA	NA
Fluorspar—do	3,702	158	9,429	395
Graphite:				
Amorphous—do	1,326	194	3,196	419
Crystalline flake, lump, or chip—do	229	62		
Natural, n.e.c—do	409	77		
Gypsum:				
Crude, crushed or calcined—thousand short tons	21	829	28	1,112
Manufactures, n.e.c	NA	979	NA	920
Iodine, iodide, iodates—thousand pounds	147	343	NA	NA
Kyanite and allied minerals—short tons	6,080	393	10,238	732
Lime—do	29,858	777	40,036	942

Table 8.—U.S. exports of principal minerals and products—Continued

Mineral		1964		1965	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Nonmetals—Continued					
Mica:					
Unmanufactured	pounds	542,516	$161	7,802,539	$589
Manufactured:					
Ground or pulverized	do	8,263,497	478		
Other	do	281,131	946	523,338	1,635
Mineral-earth pigments: Iron oxide, natural and manufactured	short tons	5,097	1,817	4,656	1,380
Nitrogen compounds (major)	do	1,182,425	67,636	1,637,752	88,421
Phosphate rock	long tons	5,652,573	52,630	6,653,602	65,632
Phosphatic fertilizers (superphosphates)	do	707,943	33,259	528,137	29,504
Pigments and compounds (lead and zinc):					
Lead pigments	short tons	1,680	608	2,286	890
Zinc pigments	do	3,619	899	3,269	1,005
Lead compounds	do	936	278	NA	NA
Potash:					
Fertilizer	do	1,026,446	32,563	1,052,305	33,809
Chemical	do	22,033	5,024	46,289	8,685
Quartz crystal (raw)		NA	558	NA	848
Radioactive isotopes, etc	curie	388,112	2,919	513,038	2,816
Salt:					
Crude and refined	short tons	594,318	3,373	688,418	4,285
Shipments to noncontiguous Territories	do	13,966	1,174	16,755	1,263
Sodium and sodium compounds:					
Sodium sulfate	do	43,545	1,320	12,808	415
Sodium carbonate	thousand short tons	r 276	r 8,535	277	9,030
Stone:					
Limestone, crushed, ground, broken	short tons	1,369,728	2,079	1,165,327	2,905
Marble and other building and monumental	cubic feet	441,312	2,027	517,843	3,290
Stone, crushed, ground, broken	short tons	105,504	2,013	73,096	1,955
Manufactures of stone		NA	677	NA	1,480
Sulfur:					
Crude	long tons	1,920,392	39,651	2,624,052	64,278
Crushed, ground, flowers of	do	7,700	1,287	27,683	1,271
Talc:					
Crude and ground	short tons	73,998	3,316	69,597	3,486
Manufactures, n.e.c	do	128	75	NA	4,045
Powders-talcum (face and compact)		NA	1,068		
Fuels:					
Carbon black	thousand pounds	333,907	31,929	274,608	26,658
Coal:					
Anthracite	short tons	1,575,097	22,060	850,630	11,483
Bituminous	do	47,969,423	441,216	50,181,361	465,314
Briquets	do	17,857	210	88,506	1,149
Coke	do	523,695	10,093	833,668	16,307
Petroleum:					
Crude	thousand barrels	1,361	3,806	1,004	2,841
Gasoline	do	5,295	31,877	3,820	24,371
Jet fuel	do	169	652	154	621
Naphtha	do	1,830	18,193	1,545	16,842
Kerosine	do	160	1,240	166	1,275
Distillate oil	do	6,507	20,498	5,042	17,576
Residual oil	do	19,135	41,853	14,997	33,509
Lubricating oil	do	r 16,177	r 197,420	14,191	165,135
Asphalt	do	614	4,909	450	2,827
Liquefied petroleum gases	do	5,365	14,836	7,511	27,231
Wax	do	1,736	32,849	1,646	30,072
Coke	do	13,618	45,491	13,263	42,027
Petrochemical feedstocks	do	716	8,501	1,944	11,700
Miscellaneous	do	r 1,363	r 22,121	1,333	20,086

r Revised. NA Not available.

[1] Not strictly comparable to preceding years.

[2] Excludes 10,275 pounds of spent catalysts, valued at $12,272 and 171,152 pounds of residues, valued at $17,980.

Table 9.—U.S. imports for consumption of principal minerals and products

Mineral		1964		1965	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Metals:					
Aluminum:					
Metal	short tons	394,563	$163,419	527,252	$218,217
Scrap	do	8,152	2,038	27,029	8,482
Plates, sheets, bars, etc	do	50,542	r30,376	66,484	38,993
Antimony:					
Ore (antimony content)	do	10,676	3,294	10,360	4,310
Needle or liquated	do	31	21	23	18
Metal	do	3,307	2,481	2,650	2,112
Oxide	do	3,131	3,022	2,173	1,798
Arsenic: White (As_2O_3 content)	do	18,185	1,383	15,525	1,271
Bauxite: Crude	thousand long tons	r10,180	128,787	11,400	142,989
Beryllium ore	short tons	5,425	1,372	7,791	2,056
Bismuth (general imports)	pounds	1,238,252	2,372	1,378,147	3,506
Boron carbide	do	4,845	19	13,801	48
Cadmium:					
Metal	thousand pounds	1,104	2,870	2,121	4,669
Flue dust (cadmium content)	do	1,272	1,545	1,531	1,521
Calcium:					
Metal	pounds	42,439	42	28,219	28
Chloride	short tons	2,718	92	3,658	100
Chromate:					
Ore and concentrate (Cr_2O_3 content)	do	645,693	22,713	685,497	25,239
Ferrochrome (chromium content)	do	17,696	5,783	36,961	13,236
Metal	do	732	1,109	1,010	1,522
Cobalt:					
Metal	thousand pounds	11,333	16,526	14,846	23,132
Oxide (gross weight)	do	1,514	1,422	947	1,011
Salts and compounds (gross weight)	do	94	43	108	149
Columbium ore	pounds	4,600,800	2,277	4,891,786	2,712
Copper (copper content):					
Ore and concentrate	short tons	r33,033	r17,235	1,441	777
Regulus, black, coarse	do	r88	r47	83	72
Unrefined, black, blister	do	121,365	73,300	75,122	45,262
Refined in ingots, etc	do	r113,018	r67,468	103,269	70,937
Old and scrap	do	r2,011	r1,372	7,646	6,410
Old and clippings	do	641	415	1,490	1,151
Ferroalloys: Ferrosilicon (silicon content)	do	3,044	908	4,558	1,606
Gold:					
Ore and base bullion	troy ounces	314,674	10,988	292,167	10,199
Bullion	do	854,211	29,900	2,613,161	91,469
Iron ore:					
Ore	thousand long tons	42,408	421,288	45,103	443,788
Pyrites cinder	long tons	8,635	49	1,563	19
Iron and steel:					
Pig iron	short tons	736,471	31,591	882,095	38,438
Iron and steel products (major):					
Iron products	do	46,055	11,242	45,038	15,013
Steel products	do	r6,583,651	r784,166	10,645,877	1,232,902
Scrap	do	r259,229	r7,795	193,482	6,999
Tinplate	do	22,561	472	18,988	451
Lead:					
Ore, flue dust, matte (lead content)	do	128,067	21,789	128,933	26,923
Base bullion (lead content)	do	7,043	2,058	566	380
Pigs and bars (lead content)	do	211,140	45,790	221,519	60,391
Reclaimed, scrap, etc. (lead content)	do	1,907	350	3,612	793
Sheets, pipe, and shot	do	1,523	369	880	273
Babbitt metal and solder (lead content)	do	r1,228	r5,077	986	8,129
Manufactures	do	2,276	713	512	329
Magnesium:					
Metallic and scrap	do	2,227	890	2,551	1,101
Alloys (magnesium content)	do	474	710	327	760
Sheets, tubing, ribbons, wire and other forms (magnesium content)	do	40	70	103	128
Manganese:					
Ore (35 percent or more manganese) (manganese content)	short tons	1,430,431	76,977	1,825,709	109,747
Ferromanganese (manganese content)	do	162,075	25,811	198,118	31,486
Mercury:					
Compounds	pounds	8,625	30	47,808	186
Metal	76-pound flasks	41,153	8,775	16,238	7,614
Minor metals: Selenium and salts	pounds	292,938	1,289	250,912	1,244
Nickel:					
Ore and matte	short tons	----------	----------	81	(1)
Pigs, ingots, shot, cathodes	do	r105,327	155,973	134,406	205,493
Scrap	do	1,343	1,256	1,188	898
Oxide	do	16,862	17,504	13,592	14,979

Table 9.—U.S. imports for consumption of principal minerals and products—Continued

Mineral	1964 Quantity	1964 Value (thousands)	1965 Quantity	1965 Value (thousands)
Metals—Continued				
Platinum group:				
Unrefined materials:				
Grains and nuggets, including crude, dust, and residues—troy ounces	35,916	$3,341	20,430	$2,275
Sponge and scrap—do	5,127	487	4	1
Osmiridium—do	r 2,548	r 85	3,988	228
Refined metal:				
Platinum—do	r 281,922	r 24,102	349,280	36,125
Palladium—do	r 483,018	r 13,475	734,881	22,381
Iridium—do	6,615	489	10,839	943
Osmium—do	1,399	113	269	88
Rhodium—do	55,804	7,955	39,768	6,762
Ruthenium—do	10,356	404	8,198	307
Radium: Radioactive substitutes	NA	1,869	NA	2,816
Rare earths: Ferrocerium and other cerium alloys—pounds	9,621	48	7,916	36
Silver:				
Ore and base bullion—thousand troy ounces	43,146	54,235	47,831	56,065
Bullion—do	8,528	10,159	6,878	6,838
Tantalum: Ore—pounds	980,702	1,606	1,196,487	2,150
Tin:				
Ore (tin content)—long tons	5,190	11,539	4,326	13,228
Blocks, pigs, grains, etc—do	r 32,132	r 101,049	40,816	159,506
Dross, skimmings, scrap, residues, and tin alloys, n.s.p.f.—long tons	1,210	714	502	883
Tinfoil, powder, flitters, etc	NA	300	NA	261
Titanium:				
Ilmenite—short tons	r 173,219	r 5,472	166,406	4,770
Rutile—do	110,981	7,724	151,957	10,116
Metal—pounds	4,111,285	3,711	6,497,792	6,118
Ferrotitanium—do	55,450	19	33,919	12
Compounds and mixtures—do	81,794,801	15,322	99,503,628	18,259
Tungsten: (tungsten content)				
Ore and concentrate—thousand pounds	3,148	2,008	3,618	3,886
Metal—pounds	65,418	131	60,213	187
Ferrotungsten—thousand pounds	195	136	386	404
Other alloys—pounds	29,048	27	43,890	117
Zinc:				
Ore (zinc content)—short tons	311,435	35,831	402,936	53,829
Blocks, pigs, and slabs—do	134,118	31,898	155,489	43,094
Sheets—do	1,774	527	1,381	453
Old, dross, and skimmings—do	3,775	652	4,701	1,004
Dust—do	3,269	797	244	57
Manufactures	NA	r 1,339	NA	962
Zirconium: Ore, including zirconium sand—short tons	44,413	1,184	58,873	1,690
Nonmetals:				
Abrasives: Diamond (industrial)—carats	r 14,297,911	r 60,042	12,839,314	55,318
Asbestos—short tons	739,361	72,973	719,559	70,457
Barite:				
Crude and ground—do	601,010	4,837	712,713	5,561
Witherite—do	2,407	98	2,570	112
Chemicals—do	5,190	529	4,204	565
Bromine—pounds	897	3	NA	NA
Cement—376-pound barrels	3,633,069	9,228	5,504,840	13,523
Clays:				
Raw—short tons	133,140	2,525	93,045	1,970
Manufactured—do	3,852	113	4,826	168
Cryolite—do	24,264	1,765	24,011	2,009
Feldspar: Crude—long tons	10	1	16	2
Fluorspar—short tons	687,933	16,882	816,546	19,958
Gem stones:				
Diamond—carats	2,644,750	258,534	3,159,681	307,285
Emerald—do	180,069	3,218	189,828	5,397
Other	NA	r 36,420	NA	40,749
Graphite—short tons	r 47,200	1,944	58,056	2,387
Gypsum:				
Crude, ground, calcined—do	6,259,066	13,358	5,912,624	11,913
Manufactures	NA	1,329	NA	1,415
Iodine, crude—thousand pounds	2,592	2,369	2,847	2,476
Kyanite—short tons	2,386	104	4,047	167
Lime:				
Hydrated—do	843	10	532	10
Other—do	93,420	1,112	215,816	2,590
Dead-burned dolomite—do	28,876	1,165	r 59,519	2,385
Magnesium:				
Magnesite—do	69,480	3,673	83,922	4,807
Compounds—do	12,591	556	12,008	546

Table 9.—U.S. imports for consumption of principal minerals and products—Continued

Mineral		1964		1965	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Nonmetal—Continued					
Mica:					
Uncut sheet and punch	pounds	2,267,681	$2,434	2,116,113	$2,142
Scrap	short tons	2,733	71	1,521	71
Manufactures	do	4,433	4,566	4,971	6,371
Mineral-earth pigments: Iron oxide pigments:					
Natural	do	2,902	136	2,978	155
Synthetic	do	8,829	1,426	10,071	1,748
Ocher, crude and refined	do	191	18	186	14
Siennas, crude and refined	do	726	97	1,025	105
Umber, crude and refined	do	3,412	118	3,195	118
Vandyke brown	do	259	21	296	25
Nitrogen compounds (major), including urea	do	1,536,631	65,838	1,511,563	71,743
Phosphate, crude	long tons	155,819	3,329	132,263	2,980
Phosphatic fertilizers	do	70,512	4,010	51,698	3,139
Pigments and salts:					
Lead pigments and compounds	short tons	24,250	5,174	24,571	6,183
Zinc pigments and compounds	do	12,430	2,389	17,731	3,482
Potash	do	r 1,254,026	r 35,797	1,866,750	52,675
Pumice:					
Crude or unmanufactured	do	5,499	65	9,457	99
Wholly or partly manufactured	do	104,444	356	180,768	509
Manufactures, n.s.p.f		NA	20	NA	27
Quartz crystal (Brazilian pebble)	pounds	r 834,062	r 645	1,181,753	1,083
Salt	short tons	2,261,318	5,677	2,410,409	6,505
Sand and gravel:					
Glass sand	do	40,308	128	10,830	39
Other sand and gravel	do	443,213	558	677,814	840
Sodium sulfate	thousand short tons	290	5,064	273	4,763
Stone and whiting		NA	23,753	NA	20,414
Strontium: Mineral	short tons	21,617	506	9,741	221
Sulfur and pyrites:					
Sulfur: Ores and other forms, n.e.s	long tons	1,462,211	26,100	1,465,093	26,759
Pyrites	do	10,202	49	13,959	76
Talc: Unmanufactured	short tons	22,714	917	21,022	833
Fuels:					
Carbon black:					
Acetylene	pounds	6,878,084	1,184	6,359,080	1,094
Gas black and carbon black	do	1,337,683	225	168,068	36
Coal:					
Bituminous, slack, culm, and lignite	short tons	293,059	2,289	184,399	1,564
Briquets	do	11,593	182	12,621	205
Coke	do	103,286	1,509	89,620	1,379
Peat:					
Fertilizer grade	do	265,585	11,997	271,466	11,748
Poultry and stable grade	do	4,834	256	3,996	220
Petroleum	thousand barrels	r 826,736	r 1,962,629	900,744	2,147,936

r Revised. NA Not available.
[1] Less than ½ unit.

Table 10.—Comparison of world and United States production of principal metals and minerals

Mineral	1964			1965 p		
	World	United States		World	United States	
	Thousand short tons (unless otherwise stated)		Percent of world	Thousand short tons (unless otherwise stated)		Percent of world
Fuels:						
Carbon black thousand pounds	NA	2,223,216	NA	NA	2,353,776	NA
Coal:						
Bituminous	2,008,575	484,048	24	2,064,381	509,045	25
Lignite	r 820,387	2,950	(1)	816,185	3,043	(1)
Pennsylvania anthracite	r 209,700	17,184	8	208,900	14,866	8
Coke (excluding breeze):						
Gashouse [2]	r 48,620	203	(1)	46,260	149	(1)
Oven and beehive	r 326,434	62,145	19	340,723	66,854	20
Fuel briquets and packaged fuel	r 133,300	368	(1)	128,400	369	(1)
Natural gas (marketable) million cubic feet	NA	r 15,462,667	NA	NA	16,039,753	NA
Peat	r 185,600	[3] 649	(1)	204,900	[3] 604	(1)
Petroleum (crude) thousand barrels	r 10,309,116	r 2,786,822	27	11,063,154	2,848,514	26
Nonmetals:						
Asbestos	3,540	101	3	3,570	118	3
Barite	r 3,400	817	24	3,790	846	22
Cement [4] thousand barrels	r 2,434,019	r 385,386	16	2,544,723	388,842	15
China clay	NA	3,331	NA	NA	3,604	NA
Corundum	9	----------	------	11	----------	-------
Diamond thousand carats	r 36,815	----------	------	35,513	----------	-------
Diatomite	r 1,890	r 580	31	1,750	580	33
Feldspar thousand long tons	r 1,815	r 587	32	1,900	625	33
Fluorspar	r 2,730	217	8	3,170	241	8
Graphite	r 700	W	W	675	W	W
Gypsum	r 51,370	10,684	21	51,610	10,035	19
Lime (sold or used by producers)	NA	16,089	NA	NA	16,794	NA
Magnesite	r 10,025	W	W	10,700	W	W
Mica (including scrap) thousand pounds	410,000	229,701	56	435,000	241,226	55
Nitrogen, agricultural [4] [5]	r 16,300	r 4,422	27	18,200	4,888	27
Phosphate rock thousand long tons	r 58,130	22,960	39	64,600	26,440	41
Potash (K_2O equivalent)	r 13,200	2,897	22	14,800	3,140	21
Pumice [6]	r 16,300	2,776	17	16,560	3,484	21
Pyrites thousand long tons	r 20,200	847	4	21,100	875	4
Salt [4]	r 109,720	31,628	29	118,590	34,695	29
Strontium [6]	r 25	----------	------	9	----------	-------
Sulfur, elemental thousand long tons	r 13,870	6,250	45	15,120	7,332	48
Talc, pyrophyllite, and soapstone	r 3,840	890	23	3,870	863	22
Vermiculite [6]	r 343	226	66	382	249	65
Metals, mine basis:						
Antimony (content of ore and concentrate) short tons	r 68,100	632	1	69,100	845	1
Arsenic, white [6]	r 65	W	W	68	W	W
Bauxite thousand long tons	r 33,230	1,601	5	36,530	1,654	5
Beryllium concentrate short tons	[7] r 5,200	W	W	[7] 5,700	W	W
Bismuth thousand pounds	r 8,200	W	W	9,400	W	W
Cadmium do	r 28,900	10,458	36	27,800	9,671	35
Chromite	r 4,705	----------	------	5,400	----------	-------
Cobalt (contained) [6] short tons	r 15,500	W	W	17,100	W	W
Columbium-tantalum concentrates [6] thousand pounds	r 11,745	----------	------	14,880	----------	-------
Copper (content of ore and concentrate)	r 5,340	1,247	23	5,600	1,352	24
Gold thousand troy ounces	46,100	r 1,456	3	47,700	1,705	4
Iron ore thousand long tons	r 569,336	84,836	15	605,637	87,842	15
Lead (content of ore and concentrate)	r 2,835	286	10	2,975	301	10
Manganese ore (35 percent or more Mn)	r 17,437	26	(1)	19,406	29	(1)
Mercury thousand 76-pound flasks	r 255	14	5	275	20	7
Molybdenum (content of ore and concentrate) thousand pounds	r 94,500	65,605	69	115,400	77,372	67
Nickel (content of ore and concentrate)	r 423	12	3	472	14	3

Table 10.—Comparison of world and United States production of principal metals and minerals—Continued

Mineral	1964			1965 [8]		
	World (unless otherwise stated)	United States Thousand short tons	Percent of world	World (unless otherwise stated)	United States Thousand short tons	Percent of world
Metals, mine basis—Continued						
Platinum groups (Pt, Pd, etc.) thousand troy ounces	r 2,550	40	2	2,960	35	1
Silver do	r 246,400	r 36,334	15	251,000	39,806	16
Tin (content of ore and concentrate) long tons	r 194,500	W	W	199,200	47	[1]
Titanium concentrates:						
Ilmenite [6]	r 2,588	1,001	39	2,728	969	36
Rutile [6]	212	8	4	243	W	W
Tungsten concentrate (60 percent WO_3) short tons	r 64,500	9,244	14	59,800	7,949	13
Vanadium (content of ore and concentrate) [6] short tons	r 7,841	4,362	56	9,150	5,226	57
Zinc (content of ore and concentrate)	r 4,425	575	13	4,750	611	13
Metals, smelter basis:						
Aluminum	r 6,720	2,553	38	7,415	2,754	37
Copper	r 5,730	1,338	23	6,020	1,434	24
Iron, pig (including ferroalloys)	r 351,034	87,922	25	370,065	91,016	25
Lead	r 2,825	449	16	2,905	418	14
Magnesium short tons	r 166,200	79,488	48	174,000	81,361	47
Selenium [6] thousand pounds	r 2,100	929	44	1,740	540	31
Steel ingots and castings	r 482,570	127,076	26	507,540	131,462	26
Tellurium [6] thousand pounds	r 277	145	52	337	195	58
Tin long tons	r 188,900	[8] 5,190	3	194,100	3,098	2
Uranium oxide (U_3O_8) [6] short tons	r 26,700	11,847	44	20,800	10,442	50
Zinc	r 4,110	954	23	4,240	994	23

[p] Preliminary. [r] Revised. NA Not avaiable. W Withheld to avoid disclosing individual company confidential data.

[1] Less than ½ unit.

[2] Includes low- and medium-temperature and gashouse coke.

[3] Agricultural use only.

[4] Including Puerto Rico.

[5] Year ended June 30 of year stated (United Nations).

[6] World total exclusive of U.S.S.R.

[7] Not including U.S. output which was very small, but withheld to avoid disclosing individual company confidential data.

[8] U.S. imports of tin concentrates (tin content).

Employment and Injuries in the Metal and Nonmetal Industries

By Forrest T. Moyer [1]

The safety record of the mineral and mineral-fuel mining and processing industries in 1965 was improved slightly, as indicated by the reduced injury-frequency and -severity rates. The overall operating activity was higher in 1965 as measured by the gains in the number of men working and in the total man-hours of worktime.

Injury Experience.—The rate of occurrence of all disabling work injuries in the mineral industries was 17.65 per million man-hours in 1965. This overall rate comprised frequencies of 0.28 for fatal and 17.37 for nonfatal work injuries, of which both were slightly better than the corresponding rates of 0.29 and 17.53 in 1964. Fatalities totaled 537; 5 less than in 1964. However, the total of 32,982 nonfatal injuries was 575 higher than in 1964. This larger number of nonfatal disabilities was offset by the increased worktime so that the nonfatal frequency rate decreased in 1965.

In general, the injury-frequency rates of the major industries changed only slightly from those of 1964. Decreases are seen in all except the coal, petroleum and natural gas, and coke industries. The most notable changes in frequency rates occurred in the smaller industries, native asphalt, peat, and slag, in each of which the changes were appreciably downward.

The overall injury-severity rate for the mineral industries in 1965 was 2,576 days lost per million man-hours, a 5-percent improvement over the corresponding rate of 2,712 in 1964. More favorable injury-severity rates in the oil and gas, metal, stone, peat, native asphalt, and slag industries more than compensated for the less favorable rates in the coal, nonmetal, sand and gravel, coke, and nonferrous smelting industries.

Employment and Worktime.—Of the mineral industries having an average of more than 10,000 men working daily, employment increased in the metal, nonmetal, stone, primary nonferrous smelting, petroleum and natural gas, and coke industries. These gains more than offset decreased employment in coal mining and in the sand and gravel industry. As a result, the total number of men working daily in the mineral industries in 1965 was nearly 17,000 higher than in 1964.

Total worktime of nearly 1.9 billion man-hours was 3 percent above 1964 data. Worktime in 1965 was increased in each of the mineral industries except in the coal, sand and gravel, and peat industries.

State Data.—The mineral industries in West Virginia and Kentucky, in each of which underground coal mining is the dominant mineral industry, had the least favorable injury experience. The injury-frequency rate for West Virginia in 1965 was 57.05 and for Kentucky 54.74 per million man-hours worked, as shown in table 1. The mineral industries in New Mexico and Idaho, where metal mining and milling predominate, had the next highest injury-frequency rates, 42.30 and 39.27, respectively.

The largest number of fatalities, 95, occurred in the mineral industries of West Virginia. The States that rank next in number of fatalities in the mineral industries are Pennsylvania with 51, Kentucky with 45, and Virginia with 27. The largest numbers of nonfatal injuries occurred in the mineral industries of West Virginia with 4,537, Pennsylvania with 2,493, Kentucky with 2,085, and Virginia with 1,232.

The magnitude of mining and milling activity in the ranking States, as measured by worktime (in thousands of man-hours), was as follows: Pennsylvania (89,185), West Virginia (81,188), Kentucky (38,911), California (37,080), and Ohio (36,401). The States having the largest number of man-hours worked within a particular mining and milling industry were as follows: Coal—West Virginia, metal—Arizona, nonmetal—California, sand and gravel—California, stone—Pennsylvania, peat—Michigan, and native asphalt—Utah.

Scope of Statistics.—Overall data for 1964 and 1965 injury experience, levels of employment, worktime, and operating activity of the mineral industries are shown by

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States in this chapter. More detailed breakdowns of these general industry groupings are presented in volumes I and II of the Minerals Yearbook. A corresponding chapter in volume I contains additional breakdowns of the data on metal, nonmetal, sand and gravel, slag, and stone mines and quarries, together with separate information on the related processing mills and plants including primary nonferrous smelters. The more specific information on the anthracite and bituminous coal, petroleum and natural gas, peat, and native asphalt industries is given in a similar chapter of volume II.

Injury and employment data were collected from coal producers as required by the Federal Coal Mine Safety Act (30 U.S.C., sec. 455). Producers of all other minerals (fuel and nonfuel) voluntarily reported the requested injury and employment data. The figures for 1965 are preliminary except for the anthracite, coke, petroleum and natural gas, native asphalt, and slag industries, which are final. All data for earlier years are final. The figures represent full coverage for all industries except the oil and gas industries for which coverage is not complete, particularly with respect to small companies.

Data by States are presented only for the mineral extractive and processing industries. Similar data for the oil and gas industries are not complete enough to be shown. The State breakdown is not presented for the purely processing industries, coke, primary nonferrous smelting, and blast furnace slag, but the totals for these industries are included in the summarization of the State table.

Table 1.—Employment and injury experience in the mineral industries (mines and mills) in the United States, by State [1]

State and industry group	Average men working daily		Man-shifts (thousands)		Man-hours worked (thousands)		Number of injuries				Injury rates per million man-hours			
							Fatal		Nonfatal		Frequency		Severity	
	1964	1965	1964	1965	1964	1965	1964	1965	1964	1965	1964	1965	1964	1965
Alabama:														
Coal	5,299	5,130	1,174	1,098	9,292	8,729	7	7	124	120	14.10	14.55	6,694	7,052
Metal	1,299	1,260	374	327	3,117	2,725	1	--	39	40	12.83	14.68	3,001	1,118
Nonmetal and native asphalt	1,093	929	309	255	2,490	2,066	--	--	37	30	14.86	14.52	288	3,105
Sand and gravel	445	475	122	131	1,067	1,142	2	2	18	19	18.74	18.39	11,555	14,011
Stone	2,339	2,490	691	728	5,661	5,971	1	3	65	65	11.66	11.39	1,614	4,100
Total	10,475	10,284	2,670	2,539	21,627	20,633	11	12	283	274	13.59	13.86	4,334	5,404
Alaska:														
Coal and peat	199	190	51	53	417	434	1	--	35	37	86.33	85.25	14,981	597
Metal	502	540	76	97	635	804	--	--	25	21	39.37	26.12	1,227	848
Sand and gravel	761	855	179	201	1,432	1,609	--	--	25	28	17.46	17.40	780	574
Stone	200	170	25	20	216	165	1	--	8	8	41.64	48.48	29,079	939
Total	1,662	1,755	331	371	2,700	3,012	2	--	93	94	35.19	31.21	5,344	671
Arizona:														
Coal	3	5	(2)	(2)	3	3	--	--	--	--	----	----	----	----
Metal	10,632	11,575	3,210	3,519	25,633	28,102	8	11	785	658	30.94	23.81	3,199	3,715
Nonmetal	378	285	85	63	676	508	--	1	10	19	14.80	39.37	536	12,232
Sand and gravel	1,115	1,150	261	234	2,102	1,883	--	--	53	27	25.21	14.34	562	660
Stone	681	655	165	155	1,309	1,223	--	2	13	18	9.93	16.35	199	10,277
Total	12,809	13,670	3,721	3,971	29,723	31,719	8	14	861	722	29.24	23.20	2,820	3,923
Arkansas:														
Coal	144	140	24	24	192	194	--	--	2	3	10.44	15.46	52	77
Metal	1,494	1,940	514	584	4,118	4,679	--	1	41	45	9.96	9.83	374	1,622
Nonmetal	642	740	155	187	1,240	1,536	--	--	78	49	62.90	31.90	1,946	761
Sand and gravel	1,104	1,000	269	284	2,256	2,385	--	--	45	47	19.94	19.71	901	591
Stone	1,861	2,055	483	513	3,981	4,446	--	1	94	120	23.61	27.22	1,426	3,135
Total	5,245	5,875	1,445	1,592	11,787	13,240	--	2	260	264	22.06	20.09	990	1,822

Table 1.—Employment and injury experience in the mineral industries (mines and mills) in the United States, by State[1]—Continued

State and industry group	Average men working daily		Man-shifts (thousands)		Man-hours worked (thousands)		Number of injuries				Injury rates per million man-hours			
							Fatal		Nonfatal		Frequency		Severity	
	1964	1965	1964	1965	1964	1965	1964	1965	1964	1965	1964	1965	1964	1965
California:														
Metal	1,981	2,540	448	555	3,594	4,439	--	1	92	101	25.60	22.98	1,204	2,441
Nonmetal	4,834	5,070	1,323	1,457	10,529	11,385	3	1	173	164	16.72	14.49	2,179	1,110
Sand and gravel	5,028	5,185	1,194	1,231	9,571	9,868	1	9	206	212	21.63	22.40	2,042	6,074
Stone	4,954	5,090	1,391	1,440	11,146	11,330	4	6	153	128	14.09	11.83	2,606	3,837
Peat and coal	38	35	7	7	51	58	--	--	4	2	78.43	34.48	294	86
Total	16,835	17,920	4,363	4,690	34,891	37,808	8	17	628	607	18.23	16.83	2,174	3,422
Colorado:														
Coal	1,569	1,500	325	337	2,559	2,691	4	11	113	119	45.72	48.31	13,449	28,595
Metal	4,361	4,355	1,115	1,142	8,918	9,136	9	3	353	352	40.59	38.86	8,425	3,599
Nonmetal	410	405	64	62	505	492	--	1	15	12	29.68	26.42	1,735	13,959
Sand and gravel	1,378	1,070	287	222	2,321	1,799	--	3	47	36	20.25	21.68	394	10,346
Stone	876	915	165	192	1,324	1,537	--	1	41	39	30.96	26.02	696	4,283
Peat	25	35	3	3	22	23	--	--	1	2	46.36	87.39	93	2,840
Total	8,619	8,280	1,959	1,958	15,649	15,678	13	19	570	560	37.25	36.93	7,173	9,054
Connecticut:														
Nonmetal and peat	112	141	31	38	235	289	--	--	4	2	17.00	6.92	191	104
Sand and gravel	657	655	152	150	1,233	1,223	1	--	21	25	17.84	20.44	8,938	266
Stone	367	435	92	110	794	957	1	1	16	12	21.41	13.58	8,075	6,672
Total	1,136	1,231	275	298	2,262	2,469	2	1	41	39	19.01	16.20	7,727	2,730
Delaware:														
Nonmetal and stone	11	25	2	6	21	53	--	--	--	--	----	----	----	----
Sand and gravel	54	55	11	13	89	102	--	--	1	1	11.27	9.80	338	39
Total	65	80	13	19	110	155	--	--	1	1	9.09	6.45	273	26
Florida:														
Metal	262	245	87	71	702	572	--	--	5	--	7.12	----	165	----
Nonmetal	3,109	3,480	988	1,175	7,931	9,432	1	4	73	52	9.33	5.94	2,152	2,770
Sand and gravel	470	430	122	112	1,069	984	1	--	20	15	19.64	15.24	6,580	945
Stone	2,420	2,615	687	751	5,909	6,473	8	2	80	102	14.89	16.07	9,943	3,323
Peat	21	22	4	5	34	42	--	--	--	--	----	----	----	----
Total	6,282	6,792	1,888	2,114	15,645	17,503	10	6	178	169	12.02	10.00	5,303	2,775

Georgia:														
Metal	97	255	16	37	127	301	--	--	1	--	7.89	----	134	----
Nonmetal, coal, and peat	3,591	3,110	1,103	977	8,860	7,856	3	2	221	183	25.28	23.55	2,811	3,042
Sand and gravel	425	370	104	72	875	678	--	1	21	8	23.99	13.27	7,219	9,074
Stone	2,613	2,910	663	756	5,514	6,297	1	2	122	125	22.31	20.17	3,092	2,973
Total	6,726	6,645	1,886	1,842	15,376	15,132	4	5	365	316	24.00	21.21	3,141	3,223
Hawaii:														
Nonmetal	90	115	9	9	76	72	--	1	1	--	13.18	13.89	119	83,333
Sand and gravel	64	60	7	6	55	51	--	--	1	--	18.24	----	766	----
Stone	445	510	120	128	991	1,061	--	--	29	35	29.27	32.99	665	621
Total	599	685	136	143	1,122	1,184	--	1	31	35	27.63	30.41	633	5,624
Idaho:														
Metal	2,738	2,715	658	690	5,258	5,525	7	9	214	250	42.03	46.88	11,640	11,366
Nonmetal and peat	460	467	121	138	977	1,165	--	1	27	15	27.64	13.73	835	5,560
Sand and gravel	275	330	64	69	514	554	--	--	8	14	15.57	25.27	397	361
Stone	175	240	28	28	223	218	--	1	1	3	4.49	18.35	54	27,904
Total	3,648	3,752	871	925	6,972	7,462	7	11	250	282	36.86	39.27	8,927	10,125
Illinois:														
Coal	8,386	8,600	2,032	2,101	15,811	16,590	10	14	675	725	43.33	44.54	5,682	6,986
Metal	51	30	13	8	104	65	--	--	5	--	48.07	----	1,634	----
Nonmetal	1,382	1,425	324	360	2,598	2,884	1	1	100	84	38.88	29.47	3,895	4,613
Sand and gravel	1,877	1,980	390	443	3,307	3,757	1	--	62	80	19.05	21.29	2,860	2,262
Stone	3,290	3,370	870	909	7,066	7,403	--	1	128	124	18.12	16.89	704	1,664
Peat	17	24	2	2	18	18	--	--	--	--	----	----	----	----
Total	15,003	15,429	3,631	3,823	28,904	30,717	12	16	970	1,013	33.97	33.50	3,963	4,884
Indiana:														
Coal	2,679	2,500	586	595	4,496	4,328	1	--	161	195	36.03	45.06	2,547	1,532
Nonmetal	818	840	202	218	1,611	1,743	1	--	20	32	13.03	18.36	4,146	962
Sand and gravel	1,188	1,200	283	315	2,421	2,692	--	1	32	26	13.22	10.03	4,095	4,272
Stone	3,372	2,935	886	813	7,297	6,718	3	3	144	137	20.15	20.84	3,450	3,624
Peat	36	41	7	7	58	62	--	--	--	2	----	32.52	----	3,740
Total	8,093	7,516	1,964	1,948	15,883	15,543	5	4	357	392	22.79	25.48	3,351	2,855
Iowa:														
Coal and peat	337	312	65	66	549	528	1	--	29	35	54.64	66.29	17,011	7,623
Nonmetal	724	1,095	178	316	1,433	2,538	--	--	60	33	41.86	13.00	4,833	1,339
Sand and gravel	1,186	1,330	205	264	1,780	2,286	2	--	31	50	18.54	21.87	8,954	1,619
Stone	2,523	2,530	674	712	5,736	6,056	2	1	100	81	17.78	13.54	3,716	1,524
Total	4,770	5,267	1,122	1,358	9,498	11,408	5	1	220	199	23.69	17.53	5,635	1,784

Table 1.—Employment and injury experience in the mineral industries (mines and mills) in the United States, by State [1]—Continued

State and industry group	Average men working daily		Man-shifts (thousands)		Man-hours worked (thousands)		Number of injuries				Injury rates per million man-hours			
							Fatal		Nonfatal		Frequency		Severity	
	1964	1965	1964	1965	1964	1965	1964	1965	1964	1965	1964	1965	1964	1965
Kansas:														
Coal	261	250	62	62	472	479	--	--	15	17	31.80	35.49	937	1,029
Metal	49	55	14	15	111	121	--	--	2	2	18.00	16.53	513	479
Nonmetal	1,087	1,185	306	336	2,451	2,682	--	1	48	53	19.59	20.13	2,733	2,563
Sand and gravel	957	960	203	195	1,742	1,674	--	--	28	20	16.07	11.95	552	478
Stone	2,069	2,190	448	477	3,677	3,912	4	--	38	37	11.42	9.46	6,826	609
Total	4,423	4,640	1,033	1,085	8,453	8,868	4	1	131	129	15.97	14.66	3,934	1,196
Kentucky:														
Coal	23,532	23,200	4,465	4,151	35,401	33,270	47	41	1,790	1,875	51.89	57.59	12,525	12,466
Metal and nonmetal	432	430	93	107	752	854	1	--	38	64	51.79	74.94	8,792	1,436
Sand and gravel	322	275	88	71	882	709	1	1	25	26	29.46	38.08	7,822	9,306
Stone	2,162	2,230	490	496	4,034	4,078	4	3	91	120	23.55	30.16	8,179	6,485
Total	26,448	26,135	5,136	4,825	41,069	38,911	53	45	1,944	2,085	48.63	54.74	11,929	11,540
Louisiana:														
Metal	906	1,090	318	397	2,546	3,182	--	--	11	15	4.32	4.71	203	203
Nonmetal	1,942	2,145	564	620	4,833	5,469	--	2	121	100	25.04	18.65	1,183	4,246
Sand and gravel	1,077	1,210	286	318	2,498	2,783	--	--	30	28	12.01	10.06	2,288	392
Stone	417	400	138	135	1,213	1,174	--	--	31	28	25.55	23.85	1,228	931
Total	4,342	4,845	1,306	1,470	11,090	12,608	--	2	193	171	17.40	13.72	1,212	2,066
Maine:														
Metal and nonmetal	162	175	27	36	214	286	--	1	9	22	41.70	80.42	653	21,734
Sand and gravel	1,264	320	312	79	2,510	638	--	--	48	12	19.12	18.81	549	113
Stone	517	490	120	116	982	984	--	--	31	15	31.56	15.24	244	208
Peat	37	20	9	2	70	17	--	--	--	--	-----	-----	-----	-----
Total	1,980	1,005	468	233	3,776	1,925	--	1	88	49	23.31	25.97	466	3,373
Maryland and District of Columbia:														
Coal and peat	437	457	87	90	679	715	1	--	14	15	22.09	20.98	9,411	587
Nonmetal	265	245	65	67	529	548	--	--	22	36	41.55	65.69	844	1,226
Sand and gravel	1,089	1,155	275	292	2,342	2,476	--	1	66	73	28.18	29.89	1,162	4,120
Stone	1,347	1,100	369	287	3,206	2,473	1	--	69	53	21.83	21.43	3,431	310
Total	3,138	2,957	796	736	6,756	6,212	2	1	171	177	25.61	28.65	3,043	1,941

Massachusetts:														
Nonmetal and peat	78	80	20	20	151	153	--	--	1	--	6.62	----	159	----
Sand and gravel	1,318	1,465	283	314	2.322	2.577	--	1	39	43	16.80	17.07	390	2,645
Stone	1,073	1,030	267	256	2,156	2,065	--	--	64	46	29.68	22.28	1,972	925
Total	2,469	2,575	570	590	4,629	4,795	--	1	104	89	22.47	18.77	1,119	1,820
Michigan:														
Metal	5,470	5,605	1,514	1,593	12,125	12,739	1	4	321	341	26.56	27.08	1,893	2,739
Nonmetal	2,303	2,120	688	589	5,500	4,718	--	--	54	43	9.82	9.11	459	269
Sand and gravel	2,717	2,715	577	577	4,765	4,765	2	2	90	90	19.31	19.31	3,010	3,897
Stone	3,175	3,315	958	968	7,683	7,767	--	--	42	54	5.47	6.95	333	453
Peat	291	189	54	30	495	270	--	--	12	3	24.26	11.11	267	148
Total	13,956	13,944	3,791	3,757	30,568	30,259	3	6	519	531	17.08	17.75	1,391	1,926
Minnesota:														
Metal	9,219	9,505	2,493	2,741	19,869	21,944	3	--	45	80	2.42	3.65	1,183	237
Nonmetal	249	225	62	61	493	486	1	1	28	33	58.80	69.96	13,093	13,840
Sand and gravel	2,213	2,180	364	358	3,098	3,054	2	--	53	52	17.76	17.03	5,081	494
Stone	1,701	1,590	436	383	3,657	3,209	--	--	89	60	24.34	18.70	548	414
Peat	88	38	6	2	47	16	--	--	--	--	----	----	----	----
Total	13,470	13,538	3,361	3,545	27,164	28,709	6	1	215	225	8.14	7.87	1,756	514
Mississippi:														
Nonmetal	972	1,015	248	264	1,986	2,108	--	--	36	46	18.13	21.82	1,225	1,129
Sand and gravel	564	585	145	151	1,261	1,313	1	--	23	24	19.03	18.28	6,982	585
Stone	522	215	142	64	1,143	521	--	--	12	2	10.50	3.84	202	58
Total	2,058	1,815	535	479	4,390	3,942	1	--	71	72	16.40	18.26	2,613	806
Missouri:														
Coal	458	440	109	109	823	836	--	--	23	26	27.93	31.10	889	995
Metal	2,364	2,415	616	647	4,936	5,189	5	2	250	254	51.66	49.34	8,026	3,821
Nonmetal and native asphalt	993	1,138	230	264	1,854	2,120	1	--	55	67	30.20	31.60	3,972	539
Sand and gravel	806	860	188	208	1,532	1,695	1	--	29	24	19.58	14.16	4,423	3,894
Stone	4,196	4,790	1,124	1,251	9,137	10,143	3	1	153	199	17.07	19.72	2,347	1,181
Total	8,817	9,643	2,267	2,479	18,282	19,983	10	3	510	570	28.44	28.67	4,153	2,021
Montana:														
Coal and peat	105	102	14	16	110	122	1	--	16	17	154.55	139.34	57,591	2,926
Metal	3,748	3,810	1,068	1,106	8,547	8,772	5	7	207	221	24.81	25.99	4,810	5,750
Nonmetal	863	870	241	231	1,919	1,837	1	2	40	32	21.37	18.51	6,020	7,183
Sand and gravel	974	820	198	167	1,593	1,341	--	--	31	26	19.47	19.39	683	136
Stone	715	570	159	118	1,273	948	--	--	20	24	15.71	25.32	352	439
Total	6,405	6,172	1,680	1,638	13,442	13,020	7	9	314	320	23.88	25.27	4,503	4,960

Table 1.—Employment and injury experience in the mineral industries (mines and mills) in the United States, by State [1]—Continued

State and industry group	Average men working daily		Man-shifts (thousands)		Man-hours worked (thousands)		Number of injuries				Injury rates per million man-hours			
							Fatal		Nonfatal		Frequency		Severity	
	1964	1965	1964	1965	1964	1965	1964	1965	1964	1965	1964	1965	1964	1965
Nebraska:														
Nonmetal	13	15	3	3	23	25	--	--	--	--	----	----	----	----
Sand and gravel	1,156	1,025	254	225	2,228	1,978	5	4	29	26	15.26	15.17	14,287	12,646
Stone	603	615	177	165	1,469	1,370	1	1	12	19	8.85	14.60	4,313	5,543
Total	1,772	1,655	434	393	3,720	3,373	6	5	41	45	12.63	14.82	10,260	9,667
Nevada:														
Metal	1,936	2,155	517	616	4,154	4,925	3	1	99	133	24.56	27.21	4,939	2,068
Nonmetal and peat	874	897	231	246	1,857	1,975	--	--	40	44	21.54	22.28	1,380	685
Sand and gravel	999	810	215	174	1,720	1,395	--	--	36	16	20.92	11.47	722	344
Stone	128	180	27	50	213	401	--	--	2	7	9.37	17.46	642	426
Total	3,937	4,042	990	1,086	7,944	8,696	3	1	177	200	22.66	23.11	3,079	1,402
New Hampshire:														
Nonmetal	46	45	7	8	55	63	--	--	1	1	18.17	15.87	1,272	143
Sand and gravel	411	370	81	73	672	607	--	--	9	8	13.40	13.18	289	329
Stone	274	275	57	51	457	419	--	--	13	8	28.48	19.09	887	105
Total	731	690	145	132	1,184	1,089	--	--	23	17	19.43	15.61	565	232
New Jersey:														
Metal	592	460	141	117	1,131	942	2	--	40	55	37.14	58.39	12,119	5,700
Nonmetal	374	395	106	111	849	888	1	--	19	27	23.57	30.41	7,916	1,170
Sand and gravel	1,201	1,055	281	274	2,310	2,252	--	--	52	47	22.51	20.87	935	417
Stone	962	1,220	239	304	1,920	2,465	1	--	39	62	20.83	25.15	3,536	602
Peat	8	16	2	4	14	33	--	--	--	--	----	----	----	----
Total	3,137	3,146	769	810	6,224	6,580	4	--	150	191	24.74	29.03	4,719	1,342
New Mexico:														
Coal	305	290	67	70	525	552	--	1	19	20	36.18	38.04	516	11,377
Metal	3,754	3,335	947	899	7,580	7,189	2	5	367	422	48.68	59.40	3,705	5,574
Nonmetal	3,087	2,945	1,019	1,007	8,148	8,058	5	--	223	263	27.98	32.64	4,931	2,341
Sand and gravel	887	1,030	171	198	1,362	1,578	3	--	28	32	22.77	20.28	13,769	385
Stone	272	270	61	96	485	780	--	1	20	24	41.24	32.05	916	8,210
Total	8,305	7,870	2,265	2,270	18,100	18,157	10	7	657	761	36.85	42.30	4,847	3,978

New York:														
Metal	1,709	1,730	464	457	3,709	3,660	--	1	46	59	12.40	16.39	1,190	4,127
Nonmetal	2,464	2,455	636	614	5,217	5,036	1	--	141	157	27.22	31.18	2,146	1,340
Sand and gravel	2,553	1,995	497	388	4,021	3,141	2	3	78	61	19.89	20.38	3,593	6,666
Stone	4,073	3,710	977	937	7,938	7,630	2	--	88	91	11.34	11.93	1,858	1,262
Peat	28	19	5	3	36	23	--	--	2	--	55.78	----	84	----
Total	10,827	9,909	2,579	2,399	20,921	19,490	5	4	355	368	17.21	19.09	2,142	2,690
North Carolina:														
Metal and nonmetal	1,679	1,840	389	465	3,051	3,649	1	3	80	91	26.55	25.76	4,217	6,232
Sand and gravel	1,043	895	219	206	1,836	1,731	--	--	43	34	23.42	19.64	908	412
Stone	1,834	1,865	417	440	3,376	3,562	1	--	63	52	18.96	14.60	3,967	1,001
Total	4,556	4,600	1,025	1,111	8,263	8,942	2	3	186	177	22.75	20.13	3,379	3,021
North Dakota:														
Coal and peat	279	268	59	62	457	481	1	1	12	13	28.43	29.11	14,416	13,786
Metal	69	70	12	15	99	122	--	--	3	2	30.35	16.39	830	311
Nonmetal	38	40	10	9	79	73	--	--	1	--	12.69	----	1,218	----
Sand and gravel	617	625	116	118	963	978	--	--	19	19	19.73	19.43	646	330
Stone	20	20	1	2	11	12	--	--	--	--	----	----	----	----
Total	1,023	1,023	198	206	1,609	1,666	1	1	35	34	22.37	21.01	4,594	4,197
Ohio:														
Coal	7,733	7,900	1,763	1,758	14,205	13,470	6	8	291	300	20.91	22.87	4,013	5,167
Metal and nonmetal	2,633	2,620	664	695	5,318	5,560	--	2	113	137	21.25	25.00	736	3,352
Sand and gravel	2,328	2,310	515	563	4,240	4,634	2	4	70	59	16.98	13.60	4,973	5,701
Stone	5,514	5,725	1,531	1,567	12,429	12,723	6	4	169	141	14.08	11.40	3,658	2,235
Peat	19	18	2	2	14	14	--	--	1	--	69.85	----	4,889	----
Total	18,227	18,573	4,475	4,585	36,206	36,401	14	18	644	637	18.17	17.99	3,523	3,931
Oklahoma:														
Coal	278	265	58	58	457	463	--	--	11	12	24.09	25.92	655	700
Metal	149	155	35	35	283	276	--	1	7	3	24.71	14.49	3,721	22,703
Nonmetal	353	375	80	88	643	710	--	1	14	12	21.78	18.31	252	9,325
Sand and gravel	407	350	103	89	878	755	--	1	18	15	20.50	21.19	846	8,364
Stone	952	955	250	252	2,056	2,072	--	--	34	72	16.54	34.75	304	1,870
Total	2,139	2,100	526	522	4,317	4,276	--	3	84	114	19.46	27.36	668	5,473
Oregon:														
Metal	160	160	28	33	220	266	--	1	11	12	49.93	48.87	980	24,632
Nonmetal and coal	145	140	28	29	224	223	--	--	7	15	31.14	67.26	734	1,422
Sand and gravel	1,929	2,060	427	455	3,418	3,647	--	--	61	66	17.84	18.10	529	362
Stone	1,610	1,665	295	322	2,367	2,583	--	--	73	53	30.84	20.52	585	506
Total	3,844	4,025	778	839	6,229	6,719	--	1	152	146	24.40	21.88	574	1,413

Table 1.—Employment and injury experience in the mineral industries (mines and mills) in the United States, by State [1]—Continued

State and industry group	Average men working daily		Man-shifts (thousands)		Man-hours worked (thousands)		Number of injuries				Injury rates per million man-hours			
							Fatal		Nonfatal		Frequency		Severity	
	1964	1965	1964	1965	1964	1965	1964	1965	1964	1965	1964	1965	1964	1965
Pennsylvania:														
Bituminous coal	24,959	24,400	5,529	5,514	44,523	44,630	18	35	896	910	20.53	21.17	4,068	6,377
Anthracite	13,144	11,132	2,812	2,271	20,368	16,375	24	8	1,342	1,067	67.07	65.65	9,650	4,936
Metal	1,451	1,475	422	420	3,467	3,467	1	--	38	27	11.25	7.77	2,114	421
Nonmetal	1,780	1,735	434	433	3,504	3,497	1	2	125	137	35.96	39.75	3,379	4,137
Sand and gravel	1,179	1,210	273	282	2,297	2,368	--	--	48	48	20.90	20.27	499	324
Stone	7,984	8,435	2,164	2,265	17,948	18,758	3	6	303	303	17.05	16.47	1,544	2,721
Peat	52	59	12	11	95	90	--	--	2	1	21.01	11.05	19,431	309
Total	50,549	48,446	11,646	11,196	92,202	89,185	47	51	2,754	2,493	30.38	28.52	4,637	4,857
Rhode Island:														
Sand and gravel	131	140	26	27	209	214	--	--	5	5	23.87	23.36	1,456	70
Stone	46	45	11	12	88	97	1	--	1	1	22.73	10.31	68,219	155
Total	177	185	37	39	297	311	1	--	6	6	23.57	19.29	21,239	96
South Carolina:														
Nonmetal and peat	960	1,202	251	319	2,091	2,650	--	--	41	35	19.60	13.21	732	2,182
Sand and gravel	289	435	73	105	590	845	1	1	13	27	23.75	33.14	10,543	11,989
Stone	819	740	207	201	1,687	1,636	--	--	25	28	14.82	17.11	564	527
Total	2,068	2,377	531	625	4,368	5,131	1	1	79	90	18.32	17.74	1,991	3,269
South Dakota:														
Coal	3	5	1	1	6	4	--	--	--	--	----	----	----	----
Metal	2,037	1,865	616	558	4,928	4,465	1	3	70	82	14.41	19.04	2,020	6,621
Nonmetal	225	210	58	61	471	501	--	--	9	9	19.12	17.96	894	437
Sand and gravel	935	1,130	156	184	1,278	1,512	1	--	28	21	22.70	13.89	5,591	389
Stone	500	470	115	103	954	850	--	1	30	20	31.43	24.71	898	7,911
Total	3,700	3,680	946	907	7,637	7,332	2	4	137	132	18.20	18.55	2,406	5,059
Tennessee:														
Coal	2,340	2,265	445	416	3,606	3,388	3	11	107	105	30.51	34.24	6,123	20,658
Metal	1,538	1,640	418	444	3,368	3,544	3	3	93	107	28.50	31.04	7,712	8,611
Nonmetal	821	660	213	174	1,743	1,425	--	--	32	31	18.36	21.75	607	2,356
Sand and gravel	615	630	161	155	1,371	1,319	1	1	34	26	25.53	20.47	8,519	7,430
Stone	2,773	2,925	723	777	6,027	6,487	3	--	99	114	16.92	17.57	3,366	3,476
Total	8,087	8,120	1,960	1,966	16,115	16,163	10	15	365	383	23.27	24.62	5,031	8,427

Texas:														
Coal	107	105	29	30	234	238	--	--	6	7	25.59	29.41	1,425	1,647
Metal	736	675	158	135	1,261	1,087	1	--	19	6	15.86	5.52	6,271	178
Nonmetal and native asphalt	2,808	2,846	816	840	6,693	6,870	3	--	167	159	25.40	23.14	5,008	898
Sand and gravel	2,740	2,875	602	599	5,277	5,251	--	4	111	130	21.03	25.52	909	5,610
Stone	4,121	4,095	1,292	1,240	10,866	10,466	4	2	220	228	20.61	21.98	2,720	1,857
Total	10,512	10,596	2,897	2,844	24,331	23,912	8	6	523	530	21.82	22.42	3,128	2,327
Utah:														
Coal	1,636	1,565	326	339	2,580	2,713	6	2	78	82	32.56	30.96	17,243	7,718
Metal	5,322	5,060	1,396	1,540	11,090	12,232	3	6	256	255	23.35	21.34	2,769	3,903
Nonmetal	661	945	155	246	1,236	1,882	1	3	84	111	68.75	60.57	6,191	13,747
Sand and gravel	549	495	111	100	909	818	--	1	22	20	24.21	25.67	779	7,922
Stone	527	515	129	133	1,036	1,065	--	--	22	17	21.23	15.96	389	244
Native asphalt	195	239	47	59	374	470	--	1	15	19	40.15	42.53	1,151	14,954
Total	8,890	8,819	2,164	2,417	17,225	19,180	10	13	477	504	28.27	26.96	4,900	5,647
Vermont:														
Nonmetal and peat	308	303	84	85	678	684	--	--	17	17	25.06	24.85	228	9,273
Sand and gravel	205	175	38	33	312	268	1	--	3	3	12.81	11.19	19,475	933
Stone	1,962	2,210	510	544	4,127	4,391	1	1	154	137	37.56	31.43	2,411	2,687
Total	2,475	2,688	632	662	5,117	5,343	2	1	174	157	34.40	29.57	3,164	3,442
Virginia:														
Coal	11,437	11,650	2,407	2,465	19,189	20,196	23	25	1,009	905	53.78	46.05	9,834	9,668
Metal	301	300	78	79	622	629	--	--	28	35	45.04	55.64	1,108	1,448
Nonmetal	701	705	183	198	1,454	1,564	--	--	45	45	30.95	28.77	1,077	850
Sand and gravel	806	615	199	133	1,768	1,181	--	--	34	30	19.23	25.40	2,418	508
Stone	3,837	3,955	1,014	1,047	8,418	8,715	3	2	201	217	24.23	25.13	3,548	2,144
Total	17,082	17,225	3,881	3,922	31,451	32,285	26	27	1,317	1,232	42.70	39.00	7,158	6,714
Washington:														
Coal	85	80	21	22	169	178	--	--	4	4	23.64	22.47	402	382
Metal	447	425	110	120	884	958	1	1	46	76	53.19	80.38	7,984	8,160
Nonmetal	147	140	19	22	150	176	--	--	1	2	6.67	11.36	7	318
Sand and gravel	1,879	2,085	343	402	2,825	3,311	2	--	48	62	17.70	18.73	4,676	337
Stone	1,207	1,270	238	256	1,912	2,053	--	--	37	31	19.35	15.10	655	128
Peat	45	35	7	4	58	32	--	--	--	1	----	30.79	----	123
Total	3,810	4,035	738	826	5,998	6,708	3	1	136	176	23.17	26.39	3,599	1,890
West Virginia:														
Coal	44,644	45,000	9,422	9,685	74,679	75,840	88	94	4,280	4,475	58.49	60.25	10,119	10,564
Nonmetal	957	985	284	302	2,268	2,410	--	--	36	17	15.87	7.05	208	433
Sand and gravel	411	450	92	95	780	806	1	--	12	16	16.68	19.85	8,150	953
Stone	888	975	233	265	1,865	2,132	1	1	21	29	11.80	14.07	3,739	3,058
Total	46,900	47,410	10,031	10,297	79,592	81,188	90	95	4,349	4,537	55.77	57.05	9,668	9,971

Table 1.—Employment and injury experience in the mineral industries (mines and mills) in the United States, by State [1]—Continued

State and industry group	Average men working daily		Man-shifts (thousands)		Man-hours worked (thousands)		Number of injuries				Injury rates per million man-hours			
							Fatal		Nonfatal		Frequency		Severity	
	1964	1965	1964	1965	1964	1965	1964	1965	1964	1965	1964	1965	1964	1965
Wisconsin:														
Metal	347	330	93	66	745	527	3	--	36	35	52.36	66.41	26,475	2,683
Nonmetal	104	15	13	1	107	5	--	--	2	--	18.70	--	103	--
Sand and gravel	2,323	2,435	432	469	3,597	3,899	--	--	73	65	20.30	16.67	688	1,199
Stone	2,567	2,720	518	547	4,254	4,484	1	2	93	154	22.10	34.79	1,817	3,995
Peat	15	14	3	1	23	9	--	--	2	1	86.08	113.37	215	5,668
Total	5,356	5,514	1,059	1,084	8,726	8,924	4	2	206	255	24.07	28.80	3,431	2,695
Wyoming:														
Coal	415	395	81	84	635	667	--	--	18	19	28.36	28.49	2,034	2,051
Metal	1,715	1,675	429	416	3,614	3,384	1	1	102	85	28.50	25.41	3,027	3,725
Nonmetal	1,152	1,025	273	322	2,204	2,587	--	1	37	42	16.79	16.62	470	3,882
Sand and gravel	965	845	175	153	1,394	1,221	--	--	30	26	21.52	21.29	3,768	614
Stone	644	475	163	144	1,317	1,172	--	--	18	24	13.67	20.48	255	166
Total	4,891	4,415	1,121	1,119	9,164	9,031	1	2	205	196	22.48	21.92	2,058	2,764
United States totals: [2]														
Coal	150,761	148,132	32,012	31,424	252,405	248,085	242	258	11,070	11,102	44.82	45.79	8,420	8,947
Metal	67,480	69,500	18,401	19,503	147,521	156,165	60	61	3,662	3,815	25.23	24.82	3,734	3,520
Nonmetal	49,054	50,000	13,334	14,050	107,438	113,140	24	31	2,486	2,475	23.36	22.15	2,501	2,892
Sand and gravel	55,886	54,700	12,129	11,979	100,891	99,745	34	40	1,957	1,870	19.73	19.15	3,237	3,322
Stone	88,137	90,200	22,944	23,526	188,569	193,465	61	49	3,371	3,465	18.20	18.16	2,752	2,426
Peat	781	623	133	94	1,121	784	--	--	24	13	21.39	16.57	1,851	593
Native asphalt	369	427	94	108	762	874	2	1	30	26	41.97	30.89	16,701	8,335
Primary nonferrous reduction and refining	36,956	42,300	12,158	14,126	97,807	110,900	8	11	999	975	10.30	8.89	1,005	1,107
Slag (iron blast-furnace)	1,472	1,537	389	425	3,107	3,415	1	1	53	50	17.38	14.93	3,895	3,173
Petroleum and natural gas [3]	427,697	436,935	NA	NA	910,525	931,645	109	78	8,551	8,963	9.51	9.70	1,172	934
Coke	13,447	14,521	4,807	5,113	38,418	40,869	1	7	204	228	5.34	5.75	795	1,805
Grand total	892,040	908,875	116,401	120,348	1,848,564	1,899,087	542	537	32,407	32,982	17.83	17.65	2,712	2,576

NA Not available.
[1] All data for 1964 are final. All data for 1965 are preliminary except anthracite, peat, native asphalt, petroleum and natural gas, coke, and slag.
[2] Data may not add to totals shown because of rounding.
[3] Includes data on officeworkers.

Table 2.—Employment and injury experience in the mineral industries

Year	Men working	Man-hours worked (thousands)	Number of injuries		Injury rate per million man-hours	
			Fatal	Nonfatal	Fatal	Nonfatal
1931	784,347	1,288,136	1,707	94,021	1.33	72.99
1932	671,343	962,925	1,368	66,028	1.42	68.57
1933	677,722	1,058,246	1,242	70,158	1.17	66.30
1934	739,817	1,167,724	1,429	79,211	1.22	67.83
1935	783,139	1,215,317	1,495	80,070	1.23	65.88
1936	824,514	1,426,234	1,686	90,608	1.18	63.53
1937	859,951	1,482,242	1,759	94,466	1.19	63.73
1938	774,894	1,144,137	1,369	69,940	1.20	61.13
1939	788,925	1,251,169	1,334	73,253	1.07	58.55
1940	801,926	1,385,128	1,716	80,856	1.24	58.37
1941	835,095	1,541,335	1,621	87,911	1.05	57.04
1942 [1]	1,120,450	2,319,214	1,970	100,861	.85	43.49
1943	1,144,831	2,555,620	1,953	101,164	.76	39.58
1944	1,086,103	2,573,453	1,751	98,066	.68	38.11
1945	1,033,035	2,363,783	1,414	87,578	.60	37.05
1946	1,108,517	2,275,961	1,336	86,291	.59	37.91
1947	1,179,835	2,469,257	1,556	91,311	.63	36.98
1948	1,242,241	2,530,418	1,383	86,295	.55	34.10
1949	1,240,330	2,256,418	898	65,909	.40	29.21
1950	1,237,649	2,340,955	952	66,729	.41	28.51
1951	1,223,639	2,418,090	1,122	67,285	.46	27.83
1952	1,230,692	2,383,608	927	61,296	.39	25.72
1953	1,193,182	2,357,971	817	53,992	.35	22.90
1954	1,096,423	2,138,687	671	43,130	.31	20.17
1955 [2]	1,122,393	2,290,058	729	46,197	.32	20.17
1956 [3]	1,113,471	2,294,678	788	45,454	.34	19.81
1957 [4]	1,187,052	2,409,970	810	45,898	.34	19.05
1958 [5]	1,129,638	2,208,298	656	39,925	.30	18.08
1959	1,106,534	2,194,902	597	37,750	.27	17.20
1960	1,045,111	2,082,521	603	36,044	.29	17.31
1961	951,378	1,913,481	542	34,173	.28	17.86
1962	950,876	1,917,475	647	33,067	.34	17.25
1963	926,700	1,898,476	568	32,659	.30	17.20
1964	892,040	1,848,564	542	32,407	.29	17.53
1965 [p]	908,875	1,899,087	537	32,982	.28	17.37

[p] Preliminary.
[1] Includes oil and gas (for which officeworker data are included) beginning with 1942.
[2] Clay mines and nonmetal mills included beginning with 1955.
[3] Clay mills included beginning with 1956.
[4] Peat and sand and gravel included beginning with 1957.
[5] Slag included beginning with 1958.

Work Stoppages.—A total of 205 work stoppages in certain mineral industry groups during 1965 resulted in a time loss of approximately 493,000 man-days of work, according to the U.S. Department of Labor, Bureau of Labor Statistics. Comparable data for 1964 were 170 work stoppages with an aggregate time loss of approximately 975,000 man-days. Work stoppages of relatively greater significance during 1965 in the mineral industries occurred in bituminous coal mining with 145 work stoppages and 258,000 man-days lost, in copper mining with 3 stoppages and 60,500 man-days lost, in lead-zinc mining with 6 stoppages and 43,300 man-days lost, and in crushed and broken stone production with 9 stoppages and 38,000 man-days lost.

Table 3. Work stoppages in certain mineral industries in the United States

Industry and year	Work stoppages: Number	Work stoppages: Man-days lost (thousands)
Coal mining:		
Anthracite:		
1961	5	4.2
1962	8	14.6
1963	4	3.0
1964	5	(1)
1965	3	1.7
Bituminous:		
1961	117	90.7
1962	121	191.0
1963	131	2 234.0
1964	111	340.0
1965	145	258.0
Coke and byproducts, coke only:		
1961	NA	NA
1962	NA	NA
1963	NA	NA
1964	NA	NA
1965	NA	NA
Petroleum refining:		
1961	9	310.0
1962	5	516.0
1963	1	2 314.0
1964	14	162.0
1965	7	2 31.4
Metal mining:		
Iron:		
1961	2	4.2
1962	3	17.4
1963	1	2 2.4
1964	3	5.5
1965	3	21.9
Copper:		
1961	4	106.0
1962	5	129.0
1963	5	27.6
1964	11	385.0
1965	3	60.5
Lead-zinc:		
1961	4	18.0
1962	4	160.0
1963	--	2 91.7
1964	9	14.9
1965	6	43.3
Gold-silver:		
1961	1	2.1
1962	1	8.8
1963	1	16.0
1964	--	2 21.6
1965	--	--
Bauxite and other aluminum ores:		
1961	--	--
1962	--	--
1963	--	--
1964	--	--
1965	--	--
Ferroalloy metal ores:		
1961	1	5.5
1962	1	211.0
1963	1	2 9.6
1964	--	--
1965	--	--
Metal mining services:		
1961	--	--
1962	--	--
1963	--	--
1964	--	--
1965	--	--
Miscellaneous metal ores:		
1961	2	44.4
1962	--	--
1963	--	--
1964	--	--
1965	--	--
Mining and quarrying of nonmetallic minerals (except fuels):		
Dimension stone:		
1961	1	2.6
1962	3	74.5
1963	1	(1)
1964	1	2.2
1965	3	2 2.1
Crushed and broken stone:		
1961	7	2.8
1962	4	6.3
1963	5	3.8
1964	8	24.7
1965	9	38.0
Sand and gravel:		
1961	4	4.3
1962	3	2.0
1963	2	(1)
1964	2	(1)
1965	10	3.5
Clays, ceramic and refractory minerals:		
1961	2	1.9
1962	1	(1)
1963	--	--
1964	1	(1)
1965	--	--
Chemical and fertilizer mineral mining:		
1961	3	17.6
1962	5	169.0
1963	1	2 88.6
1964	4	12.5
1965	1	(1)
Nonmetallic minerals (except fuels) services:		
1961	--	--
1962	--	--
1963	--	--
1964	--	--
1965	--	--
Miscellaneous nonmetallic minerals (except fuels):		
1961	--	--
1962	--	--
1963	--	--
1964	--	--
1965	1	(1)
Cement, hydraulic:		
1961	5	4.9
1962	1	(1)
1963	1	(1)
1964	1	7.4
1965	14	32.3

NA Not available.
[1] Less than 1,000 man-days.
[2] Includes idleness from stoppages which began in the previous year.

Source: U. S. Department of Labor, Bureau of Labor Statistics.

SAFETY COMPETITIONS

The Bureau of Mines annually conducts safety competitions among the mineral industries of the Nation. These contests have been recognized as effective tools to promote accident prevention work among employees in mines, quarries, and related operations. A total of 1,203 operations participated in the contests during 1965.

During 1965 a total of 846 operations competed in the 41st National Safety Competition cosponsored by the Bureau and the American Mining Congress. A total of 379 or 45 percent of the participants worked 26.7 million man-hours without a disabling work injury, 16 percent of the total man-hours of exposure at all enrolled plants.

The National Safety Competition is divided into six groups to assure equality of competition among operations with similar working conditions. The winning operation in each group is awarded the Sentinels of Safety trophy and plant flag. In addition each employee at the winning plant receives the Bureau's Certificate of Accomplishment in Safety as a personal memento.

The following operations won the 1965 Sentinels of Safety trophies by working the greatest number of injury-free man-hours in each of the six competing groups:

Stone Quarries.—Calcite Quarry, Michigan Limestone Operations of the United States Steel Corp., Rogers City, Mich.

Underground Nonmetal Mines.—Barberton mine, Pittsburgh Plate Glass Co., Barberton, Ohio.

Underground Metal Mines.—No. 4 mine, Bethlehem Mines Corp., Cornwall, Pa.

Open-Pit Mines (Metal and Nonmetal).—Pierce Group mine, The Hanna Ore Mining Co., Hibbing, Minn.

Underground Coal Mines.—Robena No. 4 mine, United States Steel Corp., Frick District, Waynesburg, Pa.

Surface Coal Mines.—No. 2 mine, Truax-Traer Coal Division, Consolidation Coal Co., Pinckneyville, Ill.

A total of 253 operations participated in the National Sand and Gravel Safety Competition sponsored by the Bureau. More than 65 percent of these operations were injury-free during 1965 and worked over 4.6 million man-hours, or 46 percent of the total man-hours of exposure of all participants.

Two other competitions, one cosponsored by the National Lime Association and the other cosponsored by the National Slag Association, were conducted during 1965. A total of 104 plants were entered in these contests.

The Mineral Industry of Alabama

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U. S. Department of the Interior, and the Geological Survey of Alabama for collecting information on all minerals except fuels.

By Ronald P. Hollenbeck [1] and Thomas A. Simpson [2]

The value of mineral production in Alabama reached a new high of more than $246 million, 4 percent above the previous record established in 1964. New high values were reported for bentonite, portland cement, fire clay, kaolin, miscellaneous clay, lime, crushed limestone, crushed marble, mica, salt, and sand and gravel. Among the States, Alabama ranked second in the production of bauxite and scrap mica and third in the production of native asphalt.

The mineral industry of Alabama was dominated by the mining and processing of coal and stone, the manufacturing of cement, and the production of crude petroleum, which together comprised 85 percent of the total value of mineral output, compared with 84 percent in 1964. The iron ore industry continued to decline. Coal production continued to increase, resulting in the State's coal-mining best year since 1948.

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[2] Assistant State geologist, Geological Survey of Alabama, Tuscaloosa, Ala.

Table 1.—Mineral production in Alabama[1]

Mineral	1964 Quantity	1964 Value (thousands)	1965 Quantity	1965 Value (thousands)
Cement:				
Portland—thousand 376-pound barrels	12,870	$40,108	13,765	$42,604
Masonry—thousand 280-pound barrels	2,574	7,794	2,598	7,853
Clays [2]—thousand short tons	1,991	4,060	2,220	4,888
Coal (bituminous)—do	14,435	102,267	14,832	106,249
Iron ore (usable)—thousand long tons, gross weight	2,106	11,812	1,495	8,241
Lime—thousand short tons	599	7,118	653	7,905
Natural gas—million cubic feet	165	18	203	26
Petroleum (crude)—thousand 42-gallon barrels	8,498	22,095	8,064	21,047
Sand and gravel—thousand short tons	5,840	6,191	6,422	7,195
Stone [3]—do	15,852	24,976	17,987	30,810
Value of items that cannot be disclosed: Asphalt (native), bauxite, slag cement, bentonite, kaolin, scrap mica, salt, stone (dimension limestone, dimension marble, oystershell, and crushed sandstone 1965), and talc	XX	9,251	XX	9,446
Total	XX	235,690	XX	246,264

XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes bentonite and kaolin.

[3] Excludes certain stone; included with "Value of items that cannot be disclosed."

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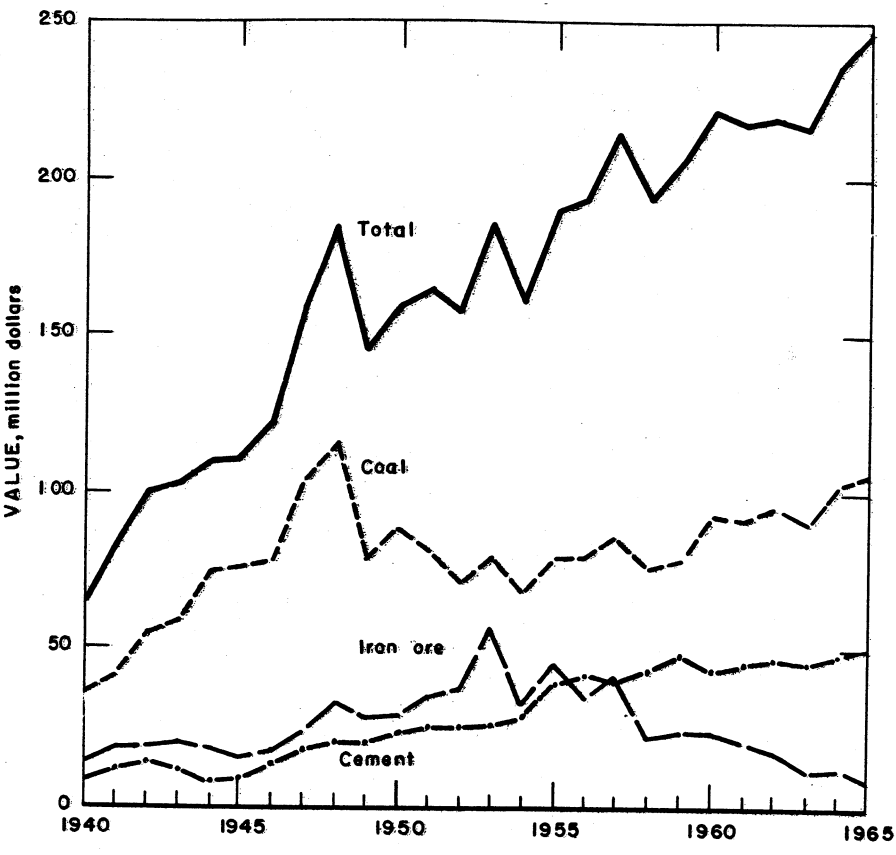

Figure 1.—Value of coal, cement, and iron ore, and total value of mineral production in Alabama.

Table 2.—Value of mineral production in constant 1957–59 dollars

(Thousands)

Year	Value
1956	$198,712
1957	213,605
1958	194,053
1959	205,416
1960	225,882
1961	224,815
1962	228,652
1963	226,802
1964	r 242,146
1965	p 257,796

p Preliminary.
r Revised.

Trends and Developments.—Republic Steel Corp. was constructing a $40 million plate mill complex. The complex will include a reheating furnace, a breakdown mill, followed by a 134-inch rolling stand, more powerful mill drives, and related shearing and finishing facilities. The mill complex was scheduled to go into operation in December 1966.

Alabama By-Products Corp. was developing a highly mechanized coal mine at Ghepopa, near Graysville. Steps were being taken to comply with the Alabama Water Pollution Control Law. Production was scheduled for late 1966.

Birmingham Slag Division, Vulcan Materials Co. completed construction and started operating a new expanded shale lightweight aggregates plant at Bessemer with an announced capacity of 400,000 tons per year.

Jenkins Brick Co. completed construction of a second plant with a capacity of 70,000 bricks a day just north of Montgomery.

Table 3.—Employment and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hour worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1964:								
Coal	5,299	222	1,174	9,292	7	124	14.10	6,694
Metal	1,299	288	374	3,117	1	39	12.83	3,001
Nonmetal and native asphalt	1,093	283	309	2,490	---	37	14.86	288
Sand and gravel	445	274	122	1,067	2	18	18.74	11,555
Stone	2,339	295	691	5,661	1	65	11.66	1,614
Total	10,475	255	2,670	21,627	11	283	13.59	4,334
1965: p								
Coal	5,130	214	1,098	8,729	7	120	14.55	7,052
Metal	1,260	260	327	2,725	---	40	14.68	1,118
Nonmetal and native asphalt	929	274	255	2,066	---	30	14.52	3,105
Sand and gravel	475	275	131	1,142	2	19	18.39	14,011
Stone	2,490	292	728	5,971	3	65	11.39	4,100
Ttotal	10,284	274	2,539	20,633	12	274	13.86	5,404

p Preliminary.

Legislation and Government Programs.—The Bureau of Mines operated the Tuscaloosa Metallurgy Research Center at Tuscaloosa, which has been conducting research on many problems connected with the mineral industries. During the year the Area II Mineral Resource Field Office (Tuscaloosa) was specifically engaged in projects concerning resources of scrap iron, aluminum, coal, talc, and anthophyllite in the Southeastern States. At yearend, 346 miles of Alabama's total Interstate highway system mileage was open to traffic. Work was in progress on 415 miles, and work had not started on the remaining 113 miles of Interstate highway designated for the State.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Production of mineral fuels accounted for 52 percent of the total value of mineral production compared with 53 percent in 1964.

Asphalt (Native).—Alabama Asphaltic Limestone Co. (Margerum quarry) crushed bituminous limestone in Colbert County; production declined 11 percent.

Coal (Bituminous).—Bituminous coal was mined at 206 mines in 12 counties, compared with 175 mines in 12 counties in 1964. The leading producing counties were Jefferson, Tuscaloosa, and Walker. The leading companies were Southeastern Electric Generating Co., United States Steel Corp., Alabama By-Products Corp., and Peabody Coal Co., which together supplied 47 percent of the total production of the State. Production increased 3 percent but was 29 percent less than the record established in 1926. The average output per mine decreased from 82,000 tons in 1964 to 72,000 tons in 1965. Captive tonnage was 49 percent of the total output compared with 45 percent in 1964.

Underground mines produced 67 percent of the total production; strip mines, 32 percent, and auger mines, 1 percent. Eighty-three percent of the coal was shipped by rail or water, and 17 percent by truck.

Ninety-two percent of the coal mined underground was mechanically loaded; 87 mobile loading machines loaded 89 percent, 4 self-loading conveyors, and 25 face conveyors loaded 2 percent, and 1 continuous miner loaded 1 percent.

Equipment, used at 143 underground mines, included 143 cutting machines, which cut 97 percent of the tonnage; 195 power drills, which drilled 98 percent; 135 locomotives; 28 tractors; 182 shuttle cars; and 67 mother conveyors.

Table 4.—Coal (bituminous) production, by counties

County	1964		1965	
	Short tons	Value (thousands)	Short tons	Value (thousands)
Bibb	230,073	$954	203,040	$946
Blount	2,596	14	53,384	270
Cullman	8,452	64	4,393	32
Etowah	126,560	672	134,227	712
Jackson	163,809	775	272,419	1,002
Jefferson	7,455,816	59,774	7,330,030	58,733
Marion	319,888	1,419	477,365	1,848
St. Clair	4,000	10	35,000	148
Shelby	686,879	5,723	674,751	6,091
Tuscaloosa	1,101,488	4,797	1,187,750	5,154
Walker	4,182,893	27,306	4,305,506	30,544
Winston	153,500	759	153,727	769
Total	14,435,454	102,267	14,831,592	106,249
Earliest record to date	1,012,234,000	NA	1,027,066,000	NA

NA Not available.

Equipment used at 58 strip mines included 81 power shovels, 29 draglines, 4 carryall scrapers, 92 bulldozers, 43 power drills, and 108 trucks. An estimated 82 million cubic yards of overburden was removed.

Six coal-recovery augers, two bulldozers, and eight trucks were used at five auger mines.

Of the total production of coal, 77 percent was cleaned at 28 cleaning plants.

Coke.—Six companies produced byproduct metallurgical coke at seven plants in Jefferson, Etowah, and Tuscaloosa Counties. Leading coke producers were United States Steel Corp. and U.S. Pipe & Foundry Co.

Natural Gas.—Marketed production of natural gas from Marion County increased 23 percent.

Petroleum.—Production of crude petroleum decreased 5 percent and was 12 percent below the 1963 record. Leading counties were Mobile and Escambia. During 1965, 17 new producing wells were drilled. The 513 producing wells were located in the following counties: Baldwin, 7; Choctaw, 57; Clarke, 13; Escambia, 29; and Mobile, 407. During the year 38 wells, totaling 201,602 feet, were drilled.

Table 5.—Crude petroleum production, by counties
(42-gallon barrels)

County	1964	1965
Baldwin	43,350	36,797
Choctaw	265,707	310,468
Clarke	133,931	126,701
Escambia	487,528	509,174
Mobile	7,567,484	7,080,860
Total	8,498,000	8,064,000
Earliest record to date	65,876,000	73,940,000

Source: State Oil and Gas Board.

NONMETALS

Production of nonmetals accounted for 45 percent of the total value of mineral production, compared with 42 percent in 1964.

Asbestos.—An asbestos (anthophyllite) occurrence was being investigated by the Bureau of Mines in Tallapoosa County.

Cement.—Eight companies produced masonry cement at nine plants in five counties. Leading producers were Southern Cement Co. and Ideal Cement Co. Shipments increased 1 percent and tied the 1955 record. Consumption of masonry cement in Alabama was 25 percent of the total shipments. Other shipments were made to Georgia (35 percent), Florida (11 percent), South Carolina (8 percent), Mississippi (6 percent), Louisiana (6 percent), North Carolina (4 percent), Tennessee (4 percent), and other States (1 percent).

Seven companies produced portland cement at eight plants in five counties. Leading producers were Ideal Cement Co. (Mobile plant) and Southern Cement Co. (Calera plant). Shipments increased 7 percent and set a new record for the State. Consumption of portland cement in Alabama was 39 percent of shipments. Other shipments were made to Georgia (21 per-

cent), Mississippi (13 percent), Florida (12 percent), South Carolina (5 percent), and other States (10 percent).

Raw materials used in manufacturing portland cement included limestone and oystershell (47 percent), cement rock (34 percent), clay and shale (11 percent), and other materials (8 percent).

Fifty-one percent of the portland cement was used for ready-mixed concrete; highway contractors used 16 percent; concrete-products manufacturers, 15 percent; building materials dealers, 6 percent; and other users consumed 12 percent. The annual capacity of portland cement plants was 16.1 million barrels.

Southern Cement Co. and Cheney Lime & Cement Co. produced slag cement at Jefferson and Blount County plants. Shipments decreased 5 percent and were 80 percent below the record established in 1952.

Clays.—Thirteen companies mined fire clay for refractories at 17 mines in 6 counties. Leading producers were Donoho Clay Co. and Russell Coal & Clay Co. with mines in Calhoun and Walker Counties. Production increased 19 percent to 460,000 tons to set a new record. Twenty-three companies mined 1,759,000 tons of miscellaneous clay at 27 mines in 12 counties for heavy clay products, portland cement, and lightweight aggregate. Leading producers were Bickerstaff Brick Co., Inc., in Russell County, Jenkins Brick Co., with plants in Montgomery and Elmore Counties, and Dixie Brick Co. in Russell County. Production increased 12 percent, setting a new record. Harbison-Walker Refractories Co. and Thomas Alabama Kaolin Co. mined kaolin in Henry and Marion Counties for a variety of uses. Production increased 9 percent to set a new record. American Colloid Co. produced bentonite in Lowndes County; production increased 200 percent in their second year of operation.

Lime.—Six companies produced quicklime and hydrated lime at seven plants in Shelby and Dallas Counties for building, agricultural, chemical, and industrial uses. Leading producers were Southern Cement Co. (Roberta and Keystone limekilns) and Longview Lime Corp. Production increased 9 percent, setting a new record. Consumption of lime in Alabama was 58 percent of total shipments. Other shipments were made to Florida (17 percent), Georgia (13 percent), Tennessee (5 percent), and other States (7 percent).

Six companies recovered quicklime at by-product plants at seven papermills in six counties. Leading producers of regenerated lime were Scott Paper Co. and International Paper Co., operating plants in Mobile County.

Mica.—U.S. Gypsum Co. mined scrap mica at the Micaville mine. Production increased 8 percent over the 1964 record. Among the States, Alabama ranked second in the production of scrap mica. Most of the mica was shipped to St. Louis, Mo. for further grinding, although some was ground in Alabama and shipped to various consumers.

Salt.—Olin Mathieson Chemical Corp. produced salt in brine in Washington County. Production increased 3 percent above the 1964 record.

Sand and Gravel.—Thirty-four companies mined sand and gravel at 37 mines in 25 counties. Leading counties were Montgomery, Macon, Mobile, and Escambia. Leading producers were Birmingham Slag (Montgomery and Macon Counties), Alabama Gravel Co. (Elmore and Montgomery Counties), and Dallas Sand & Gravel

Table 6.—Fire clay sold or used by producers, by uses

Use	1964			1965		
		Value			Value	
	Short tons	Total	Average per ton	Short tons	Total	Average per ton
Firebrick and block	175,204	$709,050	$4.05	233,996	$947,244	$4.05
Foundries and steelworks	201,593	1,795,674	8.91	221,457	2,237,567	10.10
Other uses [1]	10,410	76,200	7.32	4,997	34,790	6.96
Total	387,207	2,580,924	6.67	460,450	3,219,601	6.99

[1] Includes high-alumina brick (1964), mortar, and exports (1965).

Table 7.—Lime sold or used by producers, by uses

Use	1964			1965		
		Value			Value	
	Short tons	Total	Average per ton	Short tons	Total	Average per ton
Paper	150,202	$1,737,856	$11.57	179,541	$2,251,069	$12.54
Steel electric furnaces	33,164	386,477	11.65	49,032	620,155	12.65
Water purification	40,867	553,188	13.54	46,842	599,852	12.81
Aluminum	22,553	259,871	11.52	W	W	W
Tanning	W	W	W	1,125	14,319	12.73
Metallurgy	7,230	87,149	12.05	W	W	W
Sugar refining	4,672	60,096	12.86	W	W	W
Other uses [1]	340,459	4,033,732	12.63	376,697	4,419,860	11.73
Total	599,147	7,118,369	11.88	653,237	7,905,255	12.10

W Withheld to avoid disclosing individual company confidential data.

[1] Includes lime used for construction, agriculture, alkalies, copper (1964), brick sand-lime slag, brick silica, calcium carbide, coke, food, insecticides, ore concentration, paint, petroleum, refining, well drilling (1964), sewage, wire drawing (1964), steel basic-oxygen, steel open-hearth, magnesium, other uses, and uses indicated by symbol W.

Table 8.—Sand and gravel sold or used by producers, by counties

(Thousand short tons and thousand dollars)

County	1964		1965	
	Quantity	Value	Quantity	Value
Autauga	504	$409	W	W
Barbour	19	33	26	$38
Cherokee	36	45	2	5
Cleburne	9	11	----	----
Conecuh	40	46	W	W
Dallas	239	239	281	281
Escambia	W	W	424	467
Etowah	140	202	W	W
Jefferson	----	----	20	18
Macon	626	849	601	796
Marion	----	----	25	38
Mobile	W	W	499	500
Monroe	45	39	69	62
Montgomery	1,315	1,202	1,327	1,321
Russell	188	189	W	W
Other Counties [1]	2,679	2,927	3,148	3,669
Total	5,840	6,191	6,422	7,195

W Withheld to avoid disclosing individual company confidential data.

[1] Includes Chilton, Clarke, Crenshaw (1965), Elmore, Fayette (1965), Franklin, Geneva, Houston, Morgan, Tuscaloosa, and Washington Counties, and counties indicated by symbol W.

Co., Inc. Production increased 10 percent above the 1964 record. Virtually the entire production was processed by washing. Of the total production, 57 percent was shipped by truck, 36 percent by rail, and 7 percent by water. Of the total production, 16 percent was produced at portable plants. The size of the plants producing sand and gravel is illustrated by the fact that 49 percent of the plants, with a total production of less than 100,000 tons, accounted for only 14 percent of the total.

Stone.—Thirty-three companies crushed limestone at 41 quarries in 18 counties. Leading counties were Shelby, Jefferson, Madison, and Morgan. Leading producers were Birmingham Slag, Madison Limestone Co., Lone Star Cement Corp., and Southern Cement Co. Production increased 13 percent above the 1964 record. Of the total commercial production, 59 percent was shipped by truck, 27 percent by rail, and 14 percent by conveyor belt.

Georgia Marble Co. and Sisson Bros. Stone Co. quarried dimension limestone in Franklin and Blount Counties for rough architectural, rough construction, and dressed building stone. Production increased 11 percent but was 24 percent below the 1956 record. Thompson-Weinman & Co., Moretti-Harrah Marble Co., and Georgia Marble Co. crushed marble at Sylacauga for paint, putty, plastics, rubber, roofing granules, and other uses. Production increased 20 percent above the 1964 record.

Table 9.—Sand and gravel sold or used by producers, by uses
(Thousand short tons and thousand dollars)

Use	1964			1965		
		Value			Value	
	Quantity	Total	Average per ton	Quantity	Total	Average per ton
Sand:						
Structural	1,820	$1,703	$0.94	2,348	$2,266	$0.97
Paving	1,005	920	.92	717	656	.91
Filtration	W	W	W	56	56	1.00
Fill	100	85	.85	17	14	.82
Railroad ballast	11	5	.45	----	----	----
Other uses [1]	252	425	1.69	297	486	1.64
Total sand	3,188	3,138	.98	3,435	3,478	1.01
Gravel:						
Structural	1,169	1,403	1.20	2,098	2,590	1.23
Paving	1,276	1,442	1.13	559	669	1.20
Other uses [2]	207	208	1.00	330	458	1.39
Total gravel	2,652	3,053	1.15	2,987	3,717	1.24
Total sand and gravel	5,840	6,191	1.06	6,422	7,195	1.12

W Withheld to avoid disclosing individual company confidential data.
[1] Includes engine, molding, and other sands, and uses indicated by symbol W.
[2] Includes fill and other gravel.

Table 10.—Crushed limestone sold or used by producers, by counties

County	1964		1965	
	Short tons	Value	Short tons	Value
Calhoun	400,000	$511,800	453,051	$730,882
Colbert	W	W	1,120,379	1,328,341
Cullman	52,987	78,580	----	----
Henry	7,533	12,800	10,447	31,341
Jackson	109,946	211,427	----	----
Jefferson	3,054,194	3,384,224	4,042,196	4,700,295
Limestone	69,658	104,487	51,027	76,540
Marshall	W	W	258,773	387,720
Shelby	4,608,955	6,203,278	4,872,315	6,741,595
Other Counties [1]	7,105,151	7,766,065	6,677,979	6,596,182
Total	15,408,424	18,272,661	17,486,167	20,592,896

W Withheld to avoid disclosing individual company confidential data.
[1] Includes Bibb, Covington, DeKalb, Etowah, Franklin, Lee, (1965), Madison, Marengo, Morgan, St. Clair, Talladega, Tuscaloosa (1964), and Washington Counties, and counties indicated by symbol W.

Moretti-Harrah Marble Co. and Georgia Marble Co. quarried dimension marble at Sylacauga for rough and dressed building stone and for dressed monumental stone. Production decreased 16 percent and was 29 percent below the 1962 record.

Radcliff Materials, Inc., and Southern Oystershell Milling Corp. crushed oystershell from Mobile Bay for concrete, roads, cement, and poultry grit. Production decreased 1 percent and was 37 percent below the 1957 record.

United States Steel Corp., Enos Vann, and Sam P. Acton crushed sandstone for cement, foundries, and refractories. Production decreased 28 percent and was 91 percent below the 1956 record. Brookshire & Kirkland quarried a small quantity of dimension sandstone for building stone in Marshall County.

Talc.—American Talc Co. mined and ground talc at Winterboro for paint, paper, toilet preparations, and other uses. Production declined 52 percent below the 1964 record. The Bureau of Mines was investigating a talc and asbestos deposit at Dadeville, in cooperation with the Alabama Geological Survey.

Tripoli.—Alasil Corp. mined tripoli near Waterloo for foundry facing.

Vermiculite.—Zonolite Co. exfoliated vermiculite at its plant near Birmingham, using crude materials from other States.

Table 11.—Crushed limestone sold or used by producers, by uses

Use	1964			1965		
		Value			Value	
	Short tons	Total	Average per ton	Short tons	Total	Average per ton
Concrete and roads	8,538,779	$10,771,183	$1.26	10,185,299	$12,208,595	$1.20
Cement manufacture	3,924,981	2,712,369	.69	3,969,157	2,757,899	.69
Lime manufacture	1,127,469	1,684,809	1.49	1,115,403	1,758,515	1.58
Fluxing stone	961,491	1,564,160	1.63	867,124	1,394,739	1.61
Agstone	410,458	681,164	1.66	546,291	892,282	1.63
Riprap	W	W	W	77,383	101,608	1.31
Asphalt filler	13,127	66,269	5.05	W	W	W
Other uses [1]	432,119	792,707	1.83	725,510	1,479,258	2.04
Total	15,408,424	18,272,661	1.19	17,486,167	20,592,896	1.18

W Withheld to avoid disclosing individual company confidential data.
[1] Includes refractory stone, rock dust for coal mines, railroad ballast, paper, alkali, stone sand, mineral food, other uses, and uses indicated by symbol W.

Table 12.—Usable iron ore shipments, by counties

County	1964		1965	
	Long tons	Value	Long tons	Value
Barbour	W	W	97,929	$479,230
Butler	328,858	$1,634,687	152,842	799,150
Crenshaw	W	W	24,265	140,000
Jefferson	1,050,565	W	539,051	W
Pike	192,397	938,000	228,318	1,169,200
Tuscaloosa	49,798	W	34,378	W
Other Counties [1]	484,677	9,238,843	417,889	5,653,677
Total	2,106,295	11,811,530	1,494,672	8,241,257

W Withheld to avoid disclosing individual company confidential data.
[1] Includes Blount, Calhoun (1964), Cherokee (1964), Franklin, Shelby (1965), and Talladega (1964) Counties, and counties indicated by symbol W.

Table 13.—Usable iron ore production and shipments

	1964		1965	
	Long tons	Iron content, natural (percent)	Long tons	Iron content, natural (percent)
Production:				
Hematite	1,165,795	34	634,342	34
Limonite	1,026,050	46	906,092	44
Shipments:				
Direct-shipping ore	275,330	32	121,766	34
Concentrates and sinter	1,830,965	41	1,372,906	43

Table 14.—Mine production and shipments of crude iron ore

	1964		1965	
	Number of mines	Long tons	Number of mines	Long tons
Mine production:				
By varieties:				
Hematite	2	1,403,311	2	759,143
Limonite	20	4,103,900	22	3,343,800
By mining methods:				
Open pit	21	4,236,523	23	3,443,800
Underground	1	1,270,688	1	659,143
Shipments from mines:				
Direct to consumers	2	275,330	1	121,766
To beneficiation plants	22	5,166,449	23	3,936,754

METALS

Aluminum.—Reynolds Metals Co. operated the Listerhill aluminum reduction plant at Sheffield.

Bauxite.—Harbison-Walker Refractories Co., Wilson-Sneed Bauxite Co., and R. E. Wilson Mining Co. mined crude bauxite in Barbour and Henry Counties for refractories and chemicals. Production increased 30 percent. Among the States, Alabama ranked second in the production of bauxite.

Iron Ore.—Total shipments of iron ore decreased 29 percent and were 83 percent below the 1942 record. Of the total shipments, 8 percent was direct-shipping ore, compared with 13 percent in 1964, 15 percent in 1963, and 31 percent in 1962. The number of operating mines increased from 22 to 24, but the average usable production per mine decreased from 100,000 tons to 62,000. Among the States, Alabama ranked ninth in production of iron ore.

Woodward Iron Co. mined red iron ore (hematite) at the Pyne mine in Jefferson County and the Vance mine in Tuscaloosa County. Total production decreased 46 percent and was 92 percent below the 1942 record.

Nineteen operators mined brown iron ore (limonite) at 22 mines in 7 counties. Leading counties were Franklin, Pike, and Butler. Leading producers were Shook & Fletcher Supply Co. (Blount and Franklin Counties), Glenwood Mining Co., Inc. (Butler and Pike Counties), and U.S. Pipe & Foundry Co. (Franklin County). Production decreased 12 percent and was 54 percent below the 1942 record.

Magnesium.—Alabama Metallurgical Corp. produced magnesium metal from dolomite at Selma.

Pig Iron and Steel.—United States Steel Corp., Republic Steel Corp., U.S. Pipe & Foundry Co., and Woodward Iron Co. produced 4,296,000 tons of basic, foundry, and malleable pig iron compared with 4,321,000 tons in 1964. Value of shipments was $235 million compared with $234 million in 1964. Imports of iron ore, chiefly from Venezuela and Brazil, increased 22 percent.

Consumption of iron ore in agglomerating plants, blast furnaces, and steel furnaces was 35 percent domestic ore and 65 percent imported ore. This was the second year in which use of imported ore exceeded that of domestic ore. In 1962, imports had been 38 percent of total ore consumed, in 1963, 50 percent, and in 1964, 59 percent.

REVIEW BY COUNTIES

Mineral production was reported from 51 of the 67 counties compared with 49 in 1964. The major producing counties were Jefferson, Walker, Mobile, and Shelby, which together furnished 75 percent of the total State value.

Baldwin.—Production of crude petroleum from seven wells decreased 2 percent. Three dry wildcat oil wells were drilled, totaling 28,922 feet. Fairhope Clay Products Co. mined miscellaneous clay for heavy clay products.

Barbour.—H. D. Loflin and Phillips-Holmes Co., Inc., (new operation) mined brown iron ore. R. E. Wilson Mining Co. and Wilson-Sneed Mining Co. mined bauxite for chemicals and refractories. McKenzie Construction Co. mined building and paving sand and building gravel at Eufaula.

Bibb.—Nine coal mines were active; leading producers were C & C Coal Co., Inc., Bibb Mining Co., and E. & P. Mining Co. Alamet Corp. crushed limestone for lime which was used in the manufacture of metallic magnesium.

Blount.—Shook & Fletcher Supply Co. mined brown iron ore at the Champion mine. Four coal mines were active; leading producers were Youngblood Coal Co. (Lehigh strip mine) and BTU Corp. (Trafford strip mine). Cheney Lime & Cement Co. produced masonry and slag cements at the Graystone mill. Harbison-Walker Refractories Co. mined fire clay at its Thermal mine for refractories. Sisson Bros. Stone Co. produced dimension limestone for rough architectural and dressed building stone, curbing, and flagging. One dry wildcat oil well was drilled to a depth of 430 feet.

Bullock.—A dry wildcat oil well was drilled to a depth of 1,500 feet.

Butler.—Eight companies mined brown iron ore. Leading producers were Pigeon Creek Mining Co., B & C Construction Co.,

Table 15.—Value of mineral production in Alabama, by counties [1]

County	1964	1965	Minerals produced in 1965 in order of value
Autauga	$409,000	W	Sand and gravel.
Baldwin	W	$100,640	Petroleum, miscellaneous clay.
Barbour	W	W	Iron ore, bauxite, sand and gravel.
Bibb	W	W	Coal, limestone.
Blount	W	W	Iron ore, coal, cement, fire clay, limestone.
Butler	1,634,687	799,150	Iron ore.
Calhoun	W	W	Fire clay, limestone, miscellaneous clay.
Cherokee	W	5,000	Sand and gravel.
Chilton	W	W	Do.
Choctaw	W	810,321	Petroleum.
Clarke	W	W	Petroleum, sand and gravel.
Cleburne	11,000	----	
Colbert	W	W	Limestone, native asphalt.
Conecuh	46,000	W	Sand and gravel.
Covington	W	W	Limestone.
Crenshaw	W	W	Iron ore, sand and gravel.
Cullman	142,477	31,673	Coal.
Dallas	W	W	Sand and gravel, lime.
DeKalb	W	W	Limestone.
Elmore	W	W	Sand and gravel, miscellaneous clay.
Escambia	W	W	Petroleum, sand and gravel, miscellaneous clay.
Etowah	W	W	Coal, limestone, sand and gravel, fire clay.
Fayette	----	W	Sand and gravel.
Franklin	3,252,514	3,641,954	Iron ore, limestone, sand and gravel, fire clay.
Geneva	W	W	Sand and gravel.
Henry	W	W	Bauxite, kaolin, limestone.
Houston	W	W	Sand and gravel.
Jackson	986,325	1,002,671	Coal.
Jefferson	94,916,276	94,316,913	Coal, cement, limestone, iron ore, miscellaneous clay, sandstone, sand and gravel.
Lauderdale	----	W	Tripoli.
Lee	----	W	Limestone.
Limestone	104,487	76,540	Do.
Lowndes	W	W	Bentonite.
Macon	849,000	796,000	Sand and gravel.
Madison	W	W	Limestone, miscellaneous clay.
Marengo	W	W	Cement, limestone.
Marion	W	W	Coal, kaolin, sand and gravel.
Marshall	W	390,290	Limestone, sandstone.
Mobile	W	W	Petroleum, cement, oystershell, sand and gravel, miscellaneous clay.
Monroe	38,000	62,000	Sand and gravel.
Montgomery	W	1,442,350	Sand and gravel, miscellaneous clay.
Morgan	W	W	Limestone, sand and gravel.
Pike	938,000	1,169,200	Iron ore.
Randolph	W	W	Mica.
Russell	727,500	W	Miscellaneous clay, sand and gravel.
St. Clair	W	W	Cement, limestone, fire clay, coal, miscellaneous clay.
Shelby	25,819,543	27,828,773	Lime, cement, limestone, coal, miscellaneous clay, iron ore.
Talladega	W	W	Marble, limestone, talc.
Tuscaloosa	W	W	Coal, sand and gravel, iron ore.
Walker	W	W	Coal, fire clay, miscellaneous clay.
Washington	W	W	Salt, limestone, sand and gravel.
Winston	759,125	768,635	Coal.
Undistributed [2]	105,056,066	113,021,890	
Total	235,690,000	246,264,000	

W Withheld to avoid disclosing individual company confidential data.

[1] The following counties are not listed because no production was reported: Bullock, Chambers, Clay, Coffee, Coosa, Dale, Greene, Hale, Lamar, Lawrence, Perry, Pickens, Sumter, Tallapoosa, and Wilcox.

[2] Includes value of natural gas, and counties indicated by symbol W.

and KMC Mining Co. Shipments declined 54 percent.

Calhoun.—Three companies mined fire clay for refractories; producers were Donoho Clay Co., Dixie Clay Co., and Leroy Lackey. Hodges & Co. crushed limestone near Anniston for concrete aggregate, roads, and fluxing stone. Frame Brick & Tile Co. mined miscellaneous clay for heavy clay products at three separate mines.

Choctaw.—Production of crude petroleum from 57 wells increased 17 percent. One dry wildcat and 10 development (7 oil, 1 dry, 2 service) wells were drilled, totaling 43,244 feet. Marathon Southern Corp. produced regenerated lime for use in paper manufacture.

Clark.—Production of crude petroleum from 13 wells decreased 5 percent. Two dry wildcat wells were drilled, totaling 16,587 feet. Jackson Sand & Gravel Co. mined building sand and gravel.

Colbert.—Birmingham Slag, Alabama Asphaltic Limestone Co., and Ralph Rogers & Co., Inc., crushed limestone for concrete aggregate and roadstone. Alabama Asphaltic Limestone Co. produced native asphalt for roadstone.

Crenshaw.—McGhee & Merrill Co. mined brown iron ore at its Searcy mine. Southern Sand Co. opened a new operation near Brantley and produced molding sand.

Dallas.—C. Pierson Cosby mined building, engine, and filtration sands. Alabama Metallurgical Corp. produced lime at the Selma plant, which was used by the company in the manufacture of magnesium metal.

Escambia.—Production of crude petroleum from 29 wells increased 4 percent. One dry wildcat well was drilled to a depth of 6,310 feet. Dixie Sand & Gravel Co., Flomaton Gravel Co., Inc., and Ward Gravel Co. mined building and paving sand and gravel. Keego Clay Products Co. mined miscellaneous clay near Brewton for heavy clay products. Container Corp. of America recovered regenerated lime for use in paper manufacture.

Etowah.—Republic Steel Corp. produced pig iron and steel at its Gadsden plant. Robbins Coal Co. Inc., mined bituminous coal at its Southview strip mine. Birmingham Slag and Herbert Construction Co. crushed limestone for riprap, concrete aggregate, and roadstone. Southside Sand Co. mined building and paving sand and building gravel. R & F Sand Co. mined fire clay near Gadsden.

Fayette.—Fayco, Inc., opened a new operation and produced building sand and gravel. Three dry wildcat oil wells were drilled, totaling 2,601 feet.

Franklin.—Shook & Fletcher Supply Co., U.S. Pipe & Foundry Co., and Walston Hester & T. E. Farned mined brown iron ore. Birmingham Slag, Clarke & Ford, and Georgia Marble Co. crushed limestone for asphalt filler, riprap, concrete, and roads. Tennessee Valley Sand & Gravel Co. and North Alabama Sand Co. Inc. mined building and paving sand and gravel. Georgia Marble Co. produced dimension limestone for rough construction, rough architectural, and dressed building stone. Tennessee Valley Sand & Gravel Co. mined fire clay for refractories.

Henry.—Harbison-Walker Refractories Co., operating one mine, and Wilson-Sneed Mining Co., operating two mines, mined bauxite for refractories and chemicals. Harbison-Walker Co. also mined kaolin. Abbeville Lime Co. crushed limestone for agstone.

Jackson.—Four coal mines were active; the leading producer was Farco Co., Inc. (Fies No. 1 strip mine). Coal shipments increased 66 percent.

Jefferson.—Seventy-six coal mines were active; the leading producers were United States Steel Corp. (Concord No. 1 mine), Alabama By-Products Corp. (Maxine mine), and Woodward Iron Co. (Mulga mine).

Universal Atlas Cement, Lehigh Portland Cement Co., Lone Star Cement Corp., and Alpha Portland Cement Co. produced masonry and portland cements. Southern Cement Co. produced masonry and slag cements.

Dolcito Quarry Co., United States Steel Corp., Wade Sand & Gravel Co., Inc., (new operation), Lehigh Portland Cement Co., Alpha Portland Cement Co., Lone Star Cement Corp., and U.S. Pipe & Foundry Co. crushed limestone for cement, fluxing stone, concrete, roads, agstone, asphalt filler, metallurgical uses, and rock dust for coal mines. The Alabama State Highway Department crushed limestone for concrete and roads.

United States Steel Corp., U.S. Pipe & Foundry Co., Woodward Iron Co., and Republic Steel Corp. produced pig iron. United States Steel Corp. also produced steel. Woodward Iron Co. operated the Pyne mine and mined red iron ore.

Birmingham Slag Division, Vulcan Materials Co. operated the Parkwood mine to obtain shale for production of lightweight aggregates at a new 400,000 tons-per-year rotary kiln plant at Bessemer.

Lehigh Portland Cement Co., Natco Corp., Birmingham Slag, United States Steel Corp., Lone Star Cement Corp., Stephenson Brick & Tile Co., Birmingham Clay Products Co., Watkins Brick Co., and W. S. Dickey Clay Manufacturing Co. mined miscellaneous clay for use in cement and heavy clay products.

Universal Atlas Cement, Enos Vann, and Sam P. Acton crushed sandstone for cement, foundries, and refractory uses.

Wade Sand & Gravel Co. mined paving sand.

Zonolite Co. exfoliated vermiculite at its Birmingham plant.

Lauderdale.—Alasil Corp. opened a new mine near Waterloo and mined a small quantity of tripoli.

Macon.—Birmingham Slag, Sharpe Sand & Gravel Co., and Tri-State Sand Co. mined building, paving, fill, and molding sand and building and paving gravel.

Madison.—Madison Limestone Co. operated three quarries and crushed limestone for concrete and roads. Huntsville Brick & Tile Co. and Alabama Brick & Tile Co. mined miscellaneous clay for heavy clay products. One dry wildcat oil well was drilled to a depth of 1,310 feet.

Marengo.—Lone Star Cement Corp. produced portland cement and crushed limestone, used in the manufacture of cement. Gulf States Paper Corp. produced regenerated lime for use in the manufacture of paper.

Marion.—Coal production increased 49 percent; 35 coal mines were active; leading producers were Coalite, Inc. (Brilliant strip mine), Brookside-Pratt Mining Co. (New River strip mine), and H & F Coal Co. (No. 4 mine). Thomas Alabama Kaolin Co. mined kaolin near Hackelburg. Thompson Sand & Gravel Co. opened a new operation and mined building sand and gravel. One dry wildcat oil well was drilled to a depth of 658 feet.

Marshall.—C. A. Langford & Co. crushed limestone for concrete, roads, and agstone. Brookshire & Kirkland Sandstone Co. produced dimension sandstone for rough architectural stone.

Mobile.—Production of crude petroleum from 407 wells decreased 6 percent; six development wells, totaling 53,016 feet, were drilled. Ideal Cement Co. produced masonry and portland cements from oystershells. Radcliff Materials, Inc., and Southern Oystershell Mining Corp. dredged oystershells from Mobile Bay for cement, concrete and roads, and poultry grit. Radcliff Materials, Inc., and Hicks Sand Co. mined building, paving, and fill sand and building and paving gravel. Ideal Cement Co. mined miscellaneous clay for cement. Scott Paper Co. and International Paper Co. produced regenerated lime for use in their paper plants.

Monroe.—Manning's Sand & Gravel Co. mined building sand and building and paving gravel. Two dry wildcat oil wells were drilled, totaling 20,400 feet.

Montgomery.—Birmingham Slag, Alabama Gravel Co., Deep South Construction Co., Inc., and a new producer, C. T. Halstead, mined building, paving, molding, and engine sand, and paving and building gravel. Jenkins Brick Co. mined miscellaneous clay for heavy clay products.

Morgan.—Waters Quarries, Inc., Trinity Stone Co., Inc., and Alabama State Highway Department crushed limestone for roadstone, riprap, and agstone; production more than doubled. Decatur Sand & Gravel Co. mined building sand and gravel near Decatur.

Pike.—Glenwood Mining Co., Inc., Dunbar Mining Co., Inc., Armco Mining Co., Gibson Mining Co. (new operation), Pigeon Creek Co., and Loflin Mining Co. mined brown iron ore. One dry wildcat oil well was drilled to a depth of 1,226 feet.

Russell.—Dixie Brick Co., Bickerstaff Brick Co., Inc., and Bickerstaff Co., Inc., mined miscellaneous clay for heavy clay products. Consolidated Gravel Co., Inc., mined building sand and gravel.

St. Clair.—National Cement Co. produced portland and masonry cements at the Ragland mill and crushed limestone for use in the manufacture of cement. Riverside Clay Co. mined fire clay at two mines, Pell City and McAffee. Fulgham Coal Co. mined coal. Ragland Brick Co.

and National Cement Co. mined miscellaneous clay for heavy clay products and cement.

Shelby.—Southern Cement Co., Longview Lime Corp., Alabaster Lime Co., United Cement Co. Inc., and Cheney Lime & Cement Co. produced quicklime and hydrated lime for building, agriculture, chemical, and industrial uses. Southern Cement Co. produced masonry and portland cements at the Calera mill. Birmingham Slag, Southern Cement Co., Longview Lime Corp., Southern Rock Products Co. Inc., Alabaster Lime Co., Montevallo Limestone Co., Cheney Lime & Cement Co., and U.S. Gypsum Co. crushed limestone for riprap, fluxing stone, paper, coal dust, lime, asphalt filler, mineral food, cement, agstone, concrete aggregate, roadstone, alkali, and other chemicals.

Nine coal mines were active; leading producers were Southern Electric Generating Co. (Segco No. 2 mine), River Valley Coal Co. (River Valley No. 8 mine), and Alabama Red Ash Coal Co. (No. 2 mine).

Southern Cement Co. mined miscellaneous clay for cement. Shook & Fletcher Co. opened a new operation and mined brown iron ore.

Talladega.—Thompson-Weinman & Co., Moretti-Harrah Marble Co., and Georgia Marble Co. crushed marble for whiting and roofing granules; production increased 20 percent. Moretti-Harrah Marble Co. and Georgia Marble Co. produced dimension marble for rough interior building stone, for sawed, dressed interior and exterior building stone, and for sawed and dressed monumental stone. Talladega Materials Co. Inc., and a new operation, Birmingham Slag Co., crushed limestone for concrete and roads; production increased 81 percent. American Talc Co. mined and ground talc at Winterboro for paint, paper, and toilet preparations. Kimberly-Clark Corp. produced regenerated lime for use in its paper plant.

Tuscaloosa.—Eleven coal mines were active; leading producers were Peabody Coal Co. (Seminole strip mine), Abston Construction Co. (Lima strip mine), and Mitchell Bros. Construction Co. (Mitchell No. 2 and No. 3 strip mines). Yazoo Gravel Co. Inc. and Tuscaloosa Sand & Gravel Co. mined building sand and gravel. Woodward Iron Co. mined red iron ore at the Vance mine. Gulf States Paper Corp. produced regenerated lime.

Walker.—Coal production increased 3 percent from 53 active mines; leading producers were Southern Electric Generating Co. (Segco No. 1 mine), Bankhead Mining Co., Inc., (Cobb strip mine), and Alabama Power Co. (Gorgas mine). Nine companies mined fire clay; leading producers were Russell Coal & Clay Co., Natco Corp., and Taft Coal & Clay Co.; production increased 32 percent. K & S Coal & Clay Corp. and Beaird Coal & Clay Co. (new operation) mined miscellaneous clay for heavy clay products.

Washington.—Olin Mathieson Alabama Chemical Corp. produced salt brine for use in the McIntosh plant. Lone Star Cement Corp. crushed limestone at the St. Stephens quarry and transported it to New Orleans for use in the manufacture of cement. Faith & Hayes Sand & Gravel Co. and Mid-South Materials, Inc., mined building and paving sand and gravel. One dry wildcat and one dry development oil wells were drilled, totalling 21,759 feet.

The Mineral Industry of Alaska

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the Division of Mines and Minerals of the Alaska Department of Natural Resources, for collecting information on all minerals.

By Kevin Malone,[1] Donald P. Blasko,[2] and Phil R. Holdsworth[3]

Discovery of new offshore oilfields in Cook Inlet at Granite Point, McArthur River, and Trading Bay, and extension of the Middle Ground Shoal field (discovered in 1964) 6 miles southward, featured the news of the mineral industry in 1965. New gas discoveries at Birch Hill, North Fork, and the Moquawkie Indian Reservation and extension of the Cook Inlet gasfield 2 miles to the southwest were of major significance in the industry's efforts to define Alaska gas resources for possible exportation either as liquefied natural gas or as chemical-fertilizer products.

Value of mineral production was $83.5 million compared with $65.9 million in 1964. Most of the increase was attributable to sand and gravel where more realistic pricing by Federal and State agencies resulted in an increase to $1.14 per short ton from $0.71 per ton in 1964; an increase in physical volume of sand and gravel was also an appreciable factor. Out-

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Table 1.—Mineral production in Alaska [1]

Mineral	1964		1965	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Antimony ore and concentrate, short tons, antimony content	14	$18	1	$1
Coal (bituminous), thousand short tons	745	5,008	893	6,095
Copper (recoverable content of ores, etc.), short tons	11	7	32	23
Gold (recoverable content of ores, etc.), troy ounces	58,416	2,045	42,249	1,479
Lead (recoverable content of ores, etc.), short tons	----	----	9	3
Mercury, 76 pound flasks	303	95	W	W
Natural gas, million cubic feet	r 6,238	1,719	7,255	1,799
Peat, short tons	2,350	19	1,967	16
Petroleum (crude), thousand 42-gallon barrels	11,059	33,627	11,128	34,073
Sand and gravel, thousand short tons	26,089	18,488	30,266	34,467
Silver (recoverable content of ores, etc.), thousand troy ounces	7	9	8	10
Value of items that cannot be disclosed: Gem mercury, platinum-group metals, stone, tin, uranium ore and values indicated by symbol W	XX	4,912	XX	5,489
Total	XX	65,947	XX	83,455

r Revised.
W Withheld to avoid disclosing individual company confidential data. XX Not applicable.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

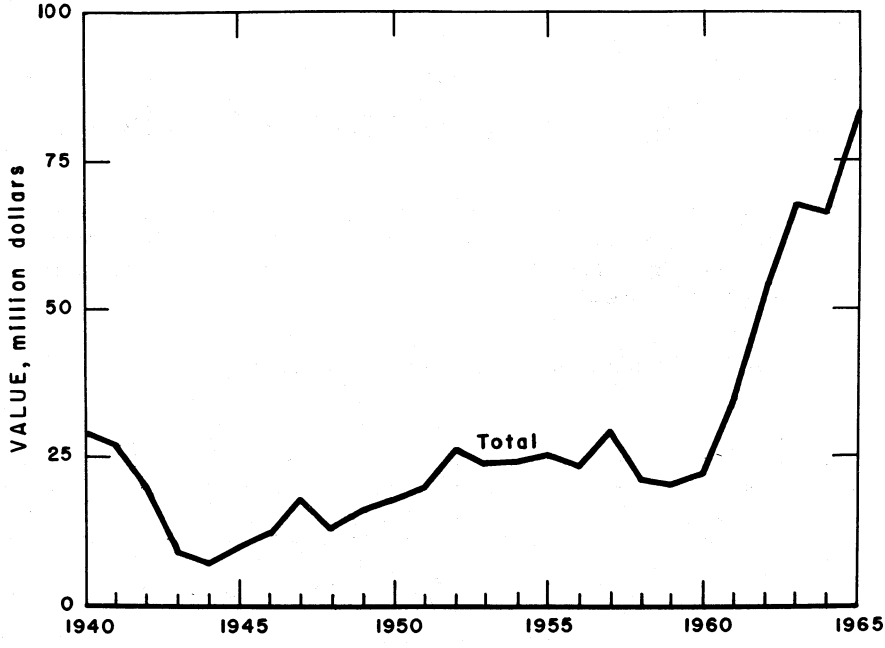

Figure 1.—Total value of mineral production in Alaska.

Table 2.—Value of mineral production in constant 1957–59 dollars

(Thousands)

Year	Value
1956	$23,487
1957	28,596
1958	21,642
1959	20,644
1960	22,198
1961	34,978
1962	53,564
1963	r 67,365
1964	r 65,168
1965	p 83,335

p Preliminary. r Revised.

put of gold, following the trend of recent years, was again down, with a value of only $1.5 million.

Legislation and Government Programs.—The Federal Field Committee for Development Planning in Alaska, created by Executive order in October 1964 for long-range planning in Alaska, was organized into functional units and became operational in 1965. Task forces, each with Federal and State members, were set up in minerals, power, transportation, commercial and industrial matters, forestry, fisheries, agriculture, parks and recreation, and human resources.

Preliminary studies on the Snettisham hydroelectric project, 30 miles south of Juneau, proceeded on schedule. Geological studies, core drilling, and camp construction were accomplished. Study of the Rampart Dam Project also continued.

A 2-year Federal Power Commission (FPC) study was started to project Alaska's electric power needs for 20 years. Commission personnel were assisted in the study by an advisory committee of civilians associated with power production, distribution, and marketing in the State.

Bureau of Land Management (BLM) held an informal public hearing at Fairbanks in December on the proposal to withdraw 9,000 acres in the Kantishna area for inclusion in Mount McKinley National Park. As a result of objections by potential mineral producers the Bureau announced that it was recommending reduction in the withdrawal to some 4,000 acres, eliminating Kantishna proper as well as lands to the north and the Eureka Creek mining area from the proposed withdrawal. The Kantishna district, an old

Table 3.—Expenditures by major companies for exploration and prospecting
(Thousand dollars)

Type and region	1964	1965
Metals exploration:		
Southeastern Alaska	$30	$222
Copper River and Prince William Sound	320	232
Kuskokwim River and Yukon River	110	88
Northwestern Alaska	810	1,220
Other	[1] 330	[1] 1,425
Total metals	1,600	3,187
Oil and gas:		
Exploration	61,000	66,020
Development drilling	696	5,261
Production	1,758	19,250
Refinery construction and maintenance	2,200	2,000
Pipeline construction [2]	-------	9,550
Total oil and gas	65,654	102,081
Grand total	67,254	105,268

[1] Including southwestern Alaska.
[2] Not separately classified in 1964.
Source: Division of Mines and Minerals, Department of Natural Resources, Alaska.

gold placer camp with appreciable production, was a highly mineralized area with known lode deposits of gold, silver-lead, and antimony. The Stampede antimony deposit was 25 miles northeast of Kantishna. Mining people were critical of the proposal to add this highly mineralized area to the 2 million acres set aside for the National Park.

Wages and Hours.—For the fiscal year 1965 the Employment Security Division of the Alaska Department of Labor reported total insured wages in mining of $12.4 million; insured jobs were listed at 1,092 with 110 insured units reporting.

In the mineral industries covered by the Employment Security Act (operators with hired labor), monthly earnings averaged $1,007. Monthly earnings in metal mining were $768, in nonmetals $1,008, in coal mining $1,095, and in oil and gas (production and exploration) $1,050. The figures for 1964 were $912, $680, $871, $1,022, and $938, respectively.

Transportation. — Transportation Consultants, Inc., and Wilbur Smith and Associates reported on the Alaska highway study ordered by Congress in 1963. The consultants recommended against construction of the Knik Arm and Turnagain Arm crossings in the Anchorage area because of limited benefits as against excessive costs. Construction of roads in Southeastern Alaska to connect with the Canadian highway system was also turned down; there was no indication that the Canadian sections needed to link the two systems would be built. The proposed Fairbanks-to-Nome highway, according to recommendations, should be removed from the primary system designation and built as an access road as part of the tertiary system. Further study was recommended to determine the need to rebuild and extend the Copper River highway beyond the Cordova airport in view of the heavy earthquake damage and the loss of railroad bridges which earlier plans had envisioned using. The March 27, 1964, earthquake resulted

Table 4.—Employment and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1964:								
Coal and peat	199	256	51	417	1	35	86.33	14,981
Metal	502	151	76	635	-------	25	39.37	1,227
Sand and gravel	761	235	179	1,432	-------	25	17.46	780
Stone	200	125	25	216	1	8	41.64	29,079
Total	1,662	199	331	2,700	2	93	35.19	5,344
1965: [p]								
Coal and peat	190	279	53	434	-------	37	85.25	597
Metal	540	180	97	804	-------	21	26.12	848
Sand and gravel	855	235	201	1,609	-------	28	17.40	574
Stone	170	118	20	165	-------	8	48.48	939
Total	1,755	211	371	3,012	-------	94	31.21	671

[p] Preliminary.

Table 5.—Coastwise receipts and foreign mineral trade

(Short tons)

Commodity	1963			1964		
	Coastwise receipts	Imports	Exports	Coastwise receipts	Imports	Exports
Anthracite, bituminous coal and lignite, coal and coke briquettes, and coke	403	10	------	1,663	10	-------
Motor fuel and gasoline	320,324	737	------	401,019	2,136	-------
Gas, oil, distillate, and residual fuel oil	947,436	488	62	1,402,508	------	-------
Petroleum asphalt	13,328	------	------	9,881	2,191	-------
Lubricating oils and greases	4,173	10	------	4,666	23	-------
Petroleum products, not elsewhere classified	27,186	11,564	------	16,251	19,660	-------
Building cement	49,246	18,497	------	55,061	15,186	-------
Building, monument, and other stone manufacturers, not elsewhere classified	13,978	------	------	20,374	3,365	-------
Clays and earths	193	------	------	67	338	-------
Brick and tile	1,178	1	------	1,537	62	-------
Sulfur	20	7,935	------	27	8,457	-------
Sand, gravel, and crushed rock, including limestone	20,854	448	------	9,750	------	-------
Iron ore and concentrate	-------	------	------	41	53	-------
Iron and steel scrap	58	------	8,399	60	------	-------
Iron and steel products	18,388	2,282	------	16,644	14,893	-------
Aluminum metal and alloys in crude and semifabricated forms	22	------	------	132	------	-------
Copper semifabricated forms	452	------	------	191	1	-------
Lead and lead-base alloys in crude and semifabricated forms	11	------	------	12	------	-------
Other nonferrous ores, concentrates, metals and scrap, except precious, in crude and semifabricated forms	-------	------	12,627	2,745	------	17,272
Fertilizer materials	2,962	------	------	593	569	-------

Source: U.S. Army Corps of Engineers. Waterborne Commerce of the United States. Part 4, Pacific Coast, Alaska, and Pacific Islands. Calendar years 1963–64.

in almost complete destruction of the bridges south of the Allen River, thus requiring a thorough reexamination of possible routes.

A comprehensive engineering review of the Copper River project was underway by the Alaska Department of Highways. The review was to include a study of the original proposed alignment following the abandoned railroad, possible alternate alignments between Cordova and the Richardson Highway, and rerouting in the Copper River Delta area. Construction of a highway through the remote and inaccessible Copper River country was seen as a boon to prospecting and to examination of known mineral deposits. The region was among the most highly mineralized areas of Alaska; the copper potential of the Nizina and White River districts in particular was considered highly promising.

Because of changes in Alaska trade since 1960, the Federal Maritime Commission, late in 1964, ordered a detailed study of rate structures and overall conditions in the Alaska trade. Comments on transportation problems were invited from shippers, trade associations, chambers of commerce, port authorities, and government agencies. The study had the objectives of determining (1) a reasonable rate of return for common carriers and (2) the financial condition of each carrier—whether any specific problems relating to financial matters existed which needed consideration.

Sea-Land Service, Inc., a major carrier between Anchorage and Pacific Northwest ports, completed modifications on its two C4 vessels for containership service between Seattle, Anchorage, and Kodiak. The modifications expanded capacity from 178 to 292 Sea-Land van bodies which served as shipboard containers as well as over-the-road trailer bodies. The ships also carried break-bulk cargo. Sea-Land announced that it was considering a shipping route along the Aleutian Chain with headquarters at Kodiak.

The Valdez, seventh Hydrotrain built for Puget Sound-Alaska Van Lines, was launched at yearend. The 400-foot vessel, with a capacity of 48 freight cars, was scheduled for service between Seattle and Port Whittier early in 1966. Puget Sound-

Table 6.—Freight rates, Seattle to selected Alaskan cities 1965 Hydrotrain service [1]
(Cents per hundred pounds)

Commodity	Minimum shipment (pounds)	Seattle to—		
		Anchorage via Whittier	Fairbanks via Whittier	Seward via Whittier
Groceries	60,000	218	277	213
Do	80,000	173	232	168
Do	[2] 100,000	104	163	99
Iron or steel articles	60,000	230	290	220
Do	80,000	178	219	172
Do	100,000	168	209	162
Machinery	60,000	247	290	233
Do	80,000	212	255	198
Do	100,000	202	245	188
Lumber	60,000	206	254	207
Do	80,000	171	219	172
Do	100,000	161	209	162
Ores and concentrates (southbound only) [3]	60,000	109	145	----------
Do	80,000	92	128	----------
Do	100,000	87	123	----------
Petroleum and products	60,000	210	308	210
Do	80,000	175	273	175
Do	100,000	165	263	165

[1] Rates include all-risk insurance.
[2] Excess over 80,000-pound minimum when loaded in or on same car.
[3] Value not to exceed $60 per ton. Rate increases 25 percent for each additional $60 (or fraction) per ton valuation.

Source: Puget Sound-Alaska Van Lines.

Alaska started Hydrotrain service in mid-1963 following the 1962 pioneering of Canadian National Railways in sea-rail service.

Despite one of the coldest winters on record, Sea-Land Services, Inc., was able to maintain regular weekly shipping service to the Port of Anchorage through Cook Inlet without the use of icebreakers. The Port of Anchorage, open throughout the 1964–65 winter for the first time, handled 46,000 tons of general cargo and 243,000 barrels of petroleum compared with no receipts a year ago. Earthquake damage to the Port of Seward caused all shipping to the railbelt area to flow through Anchorage and Whittier.

For the 1965–66 winter, Sea-Land outfitted its C4 vessels with heavy "ice belts" and constant-tension winches; the modified vessels were able to service the Port of Anchorage without the need for icebreakers.

In air transport, Lockheed's four-engine Hercules C–130 propjet made a sensational record hauling equipment and supplies to Interior and North Slope points. Operating under lease to Alaska Airlines, the huge freighter, designed specifically for use on low-grade airstrips, moved more than 2 million pounds between Anchorage or Fairbanks and oil exploration zones on the North Slope in a 30-day test. The Hercules, developed for and proved by the armed services, was making its first nonmilitary appearance in cargo freighting.

In road construction, the Alaska Department of Highways completed 153 miles in the primary system and 126 miles in the secondary system; 381 miles and 74 miles, respectively, were in process. There were 16 primary bridge completions and 5 secondary completions; in process were 9 primary and 10 secondary bridges. Including emergency construction roads and bridges and pioneer access roads, the Department completed 369 miles of road and 36 bridges. In process were 535 miles of road and 34 bridges. Value of all construction contracts was $96.7 million.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Coal (Bituminous). — Tonnage of coal increased 20 percent and value of production 22 percent over the figures for 1964; value per ton was $6.82 compared with $6.72. The U.S. Armed Forces were again the chief consumers of Alaska coals. Military contracts for fiscal year 1966 totaled 631,005 tons versus 638,029 tons for fiscal year 1965. Evan Jones Coal Co., a strip mine operator in the Matanuska field, supplanted Usibelli Coal Mine, Inc., as the leading contractor. Evan Jones, the only military supplier operating in the Matanuska field, contracted for 245,505 tons. In the Nenana (Healy River) field Vitro Minerals Corp., a joint venture of Vitro Corporation of America and Rochester & Pittsburgh Coal Co., was low bidder on the 385,500 ton military tender. Under the small business set-aside, Usibelli was awarded one-half of the contract by meeting the Vitro bid. The 1965 contract marked Vitro's first full year of mining operations in the Nenana field since its 1963 takeover of the property formerly operated by Cripple Creek Coal Co. Vitro had spent most of 1964 in plant construction and mine development.

Early in the year U.S. Army, Alaska, Support Command awarded a contract to Alaska Pipeline Co. to furnish natural gas from the Kenai Peninsula to Fort Richardson and Elmendorf Air Force Base. The contract was contingent on Congressional appropriations to convert powerplants at the military installations from coal to gas. Military officials estimated savings from the conversion at approximately $6 million over a 5-year period after allowing for amortization of conversion costs. At midyear, a House-Senate Conference Committee, reacting to statements that the move would wipe out the Matanuska coal industry and jeopardize the economy of the entire Matanuska Valley, voted to defer action on the conversion for at least 1 year. The House accepted the Committee recommendations in passing the military construction authorization bill.

Except for minor quantities from small fields, all Alaska coal was strip mined at 4 mines, 2 each in the Nenana and Matanuska fields. Of total tonnage mined, 42 percent was cleaned compared with 57 percent in 1964. Stripping ratio was 1.29:1 compared with 2.32:1 in 1964.

Construction of a major power transmission line to link Anchorage and Fairbanks received the endorsement of at least one of the chief electric utility companies in the Anchorage area. The Anchorage-Fairbanks tie-in was first proposed by the Alaska Power Survey team, set up by the Federal Power Commission to survey the State's power needs and capabilities. A 230,000-volt line, estimated to cost from $15 to $20 million, was envisioned using a route along The Alaska Railroad. Nenana coals and Kenai and Beluga River gas were seen as the fuels for generating energy. Pooling of power between Anchorage and Fairbanks was seen as the chief initial benefit; settlements along the route probably would not obtain power immediately because of the cost of step-down gear. The proposal had potential significance for the Nenana coalfields.

Construction of the 22,000-kilowatt, mine-mouth steam-generating plant at Healy for the Golden Valley Electric Association, Inc., of Fairbanks was well underway at yearend. Usibelli Coal Mine, Inc. was awarded an initial contract for 10,000 tons to supply the plant; long-term (10 years) contracts were reported in process of negotiation. Golden Valley served Fairbanks and the surrounding area.

In November, the State Division of Lands opened all lands on which the State had received tentative approval or patent between April 1, 1964, and October 1, 1965, for coal development. Applications for coal prospecting permits were accepted in a 30-day simultaneous filing period beginning November 1.

Petroleum and Natural Gas.—Offshore exploratory drilling in the waters of Cook Inlet increased spectacularly in 1965, resulting in three new oilfield discoveries and extensions to the Middle Ground Shoal oilfield and the Cook Inlet gasfield. At Granite Point, on the west coast of the Inlet south of Tyonek, Mobil Oil Co., in partnership with Union Oil Co. of California, brought in Granite Point No. 1 for 1,230 barrels per day. The well bottomed at 11,565 feet with production reported from 8,650 to 8,770 feet in what was thought to be the Middle Kenai formation, a new oil pay horizon in Tertiary sands.

The Mobil well was certified as a discovery on the Granite Point geological structure and thus eligible for the 5-percent royalty rate for 10 years. Pan American Petroleum Corp., drilling about 8,000 feet north of the Mobil discovery, brought in Tyonek State 18742 No. 1 as a producing well on the same structure. Pan American's well tested at 2,455 barrels per day from a 120-foot pay-zone, the largest flow then recorded in Alaska from a single zone. Pan American's Middle Ground Shoal-State No. 4, completed in 1964, flowed more than 5,000 barrels per day; production, however, was from eight separate pay zones.

At Trading Bay, also on the west coast of the Inlet and 10 miles southwest of Granite Point, Union Oil Co. of California brought in Trading Bay No. 1–A for 1,640 barrels per day. The Union well, also in the Tertiary Kenai sands, produced on a test from the 5,363- 5,444-foot zone. Previous to the Granite Point and Trading Bay discoveries, all oil production in the Cook Inlet Basin, including the Swanson River field on the Kenai Peninsula, had been from the Hemlock zone of Tertiary age at depths of 10,000 feet or more.

Union Oil Co., with Marathon Oil Co., was also successful with a wildcat at McArthur River, about 5 miles southwest of Trading Bay. The Grayling No. 1–A came in for 1,265 barrels per day from a producing zone between 9,375 and 9,770 feet. The well bottomed at 10,227 feet. The three new Cook Inlet discoveries, together with Pan American's Middle Ground Shoal find and the North Cook Inlet-State discovery of Shell Oil Co. (both in 1964) brought the total of oilfields in the Inlet on State-owned lands to five. Pan American extended the known limits of the Middle Ground Shoal field more than 6 miles to the south with Middle Ground Shoal-State 18746 No. 1. Phillips Petroleum Co., Sinclair Oil and Gas Co., and Skelly Oil Co. were associated with Pan American in the venture. The new well, southernmost in the Inlet, tested at 2,148 barrels per day from the 9,176- to 9,680-foot zone; bottom was at 10,298 feet. Pan American was also successful in extending the limits of the Cook Inlet gasfield. Cook Inlet-State 18740 No. 1, drilled to 6,182 feet, tested at 19 million cubic feet of gas per day.

Three gas discoveries were made on upland areas of the Cook Inlet Basin. At the Birch Hill unit, Standard Oil Co. of California's Birch Hill Unit No. 22–25 tested at 17.5 million cubic feet from a zone at 8,200 feet. Total depth was 15,500 feet. The gas from the well, about 5 miles north of the Swanson River oilfield, was to be piped to Swanson River for repressuring in that field. Standard of California, as operator for itself, The Atlantic Refining Co. (through Richfield), Sunray DX Oil Co., Union of California, and Marathon, brought in the North Fork Unit No. 41–35 about 10 miles north of Homer and 8 miles east of Anchor Point on the Kenai Peninsula. Drill-stem tests at about 8,000 feet showed 3.4 million cubic feet on a ½-inch surface choke. North Fork was the southernmost field on the Kenai Peninsula. Mobil Oil Co., with The Atlantic Refining Co., brought in Moquawkie No. 1 on the Moquawkie Indian Reservation at Tyonek on the west side of Cook Inlet. The well was under test at yearend. Mobil announced that gas from the well for noncommercial use would be made available to the Indians free of charge.

In exploratory drilling on the North Slope, British Petroleum Exploration Co. (Alaska), Inc. plugged and abandoned as a dry hole Itkillik Unit No. 1, approximately 11 miles north and 6 miles east of BP's Kuparuk No. 1, abandoned in 1964. On the Arctic Coast, about 6 miles south of the ocean and 11 miles east of the Colville River Delta, Sinclair Oil and Gas Co. (with British Petroleum) spudded the Colville No. 1. The hole was at 3,292 feet and drilling at yearend.

Two legal decisions of major significance to Alaska's oil industry were released during the year. In San Francisco, a U.S. Court of Appeals ruled that States have sovereignty over inland waters provided headlands are not more than 24 miles apart. Alaska's lower Cook Inlet area below the Forelands and the waters of Yakutat Bay in the Gulf of Alaska met the requirements. Previously, the Federal Government had held that submerged lands beyond the 3-mile limit belonged to the U.S. Government. The U.S. Court of Appeals ruling followed an earlier U.S. Supreme Court decision granting California sovereignty over coastal waters

Table 7.—Production of crude petroleum and natural gas

Year	Crude petroleum		Natural gas [1]	
	Thousand 42-gallon barrels	Value (thousands)	Million cubic feet	Value (thousands)
1958	W	W	50	$6
1959	187	$295	133	16
1960	559	1,230	246	30
1961	6,327	17,652	631	129
1962	10,259	31,187	2,184	467
1963	10,740	32,650	4,498	1,111
1964	11,059	33,627	r6,238	1,719
1965	11,128	34,073	7,255	1,799

r Revised.
W Withheld to avoid disclosing individual company confidential data.
[1] Comprises gas either sold or consumed by producers, including losses in transmission, quantities added to storage and increases of gas in pipelines.

within the 24-mile headland line. In the second decision, the U.S. Supreme Court overturned a U.S. Court of Appeals ruling that leases granted by the U.S. Department of the Interior in the Moose Range on the Kenai Peninsula were invalid. Plaintiffs had argued that the Range was closed to leasing at the time the leases were granted, and had been upheld by the Court of Appeals ruling. Included among the leases questioned were the Swanson River oilfield and the Kenai unit gasfield in which operators had invested in excess of $90 million in development.

In development drilling, Shell Oil Co., associated with Atlantic (Richfield), completed three producing wells on the first permanent drilling and production platform erected at Middle Ground Shoal and had a fourth nearing completion at year-end. Shell joined with Pan American to construct twin 8-inch crude oil pipelines to bring MGS oil to shore installations. Each of the lines had a capacity of 50,000 barrels per day. In mid-December, the first MGS oil flowed shoreward.

Total footage drilled in Alaska in 1965 was 268,371 feet compared with 184,609 feet in 1964. Exploratory or stepout drilling was 157,823 feet compared with 177,110 feet in 1964. Development drilling, reflecting the greatly increased activity in Cook Inlet waters, jumped from 7,499 feet in 1964 to 110,548 feet.

METALS

Antimony.—No shipments of antimony ore or concentrate were made in 1965. At

Table 8.—Oil and gas lease acreage under Federal supervision

Year	Thousand acres
1956–60 (average)	20,957
1961	26,808
1962	19,550
1963	14,053
1964	11,600
1965	10,184

Source: 1954–58 Bureau of Land Management; 1959–65 Geological Survey, U.S. Department of the Interior.

the Stampede mine, north of Mount McKinley in the Kantishna district, Yukon River region, Earl R. Pilgrim continued mine development and rehabilitation of the mine surface plant. A small quantity of ore was mined and stockpiled, with a few tons of high grade cobbed from the ore. Assessment work was done on two deposits in southeastern Alaska. The Eagle Creek deposit, Yukon River region, about 25 miles north of Fairbanks, was actively prospected. The deposit was found in 1964.

Beryllium. — Exploration of the Lost River and Camp Creek chrysoberyl deposits on the western end of the Seward Peninsula continued. Except for assessment work, there was no activity on the Prince of Wales Island deposits in southeastern Alaska.

The Lost River Valley was thought to contain the State's principal beryllium resource. Potentially large deposits of chrysoberyl occur in intimate association with fluorite in limestone and dolomite. Metallurgy appeared difficult, with bene-

ficiation tests showing unacceptable recoveries or low-grade concentrates; a major research effort to develop suitable concentrating methods was indicated.

United States Steel Corp. had the two principal deposits, the Lost River mine and the Camp Creek group, under option in 1965. The corporation was interested in the fluorite and tin content of the deposits as well as in the beryllium. During the 1965 season the company completed a number of surface diamond drillholes, probing the mineralization at depth. Results of the drilling and future plans of the corporation were not released.

United States Smelting Refining and Mining Co. was also active on beryllium claims in the Lost River area. The company reported road building; no other information was released.

Copper.—Exploration and development of Kennecott Copper Corp. Ruby Creek deposit near Kobuk in northwestern Alaska progressed satisfactorily. A new camp and post office, called Bornite, was established about 60 miles by winter trail up the Kobuk River from Onion Portage and well north of the Arctic Circle.

In the Copper River country Consolidated Wrangell Mining Co. reported the installation of a 1,000-ton-per-day heavy media plant at the head of Bonanza Creek in the Nizina district (old Kennecott operation) to treat surface talus. The concentrator, put into service in August, operated satisfactorily, producing a high-grade concentrate which was shipped to a Japanese smelter. The heavy media tails were stacked for later treatment, probably by flotation.

Dome Mines, Ltd., of Canada, associated with Sunshine Mining Co., Moneta Porcupine Mines, Ltd., and Tennessee Corp., continued exploratory work on the Pass Creek, Cook Inlet region, copper showing found by State Division of Mines geologists in 1963. Dome took over from Moneta as operator for the project.

Bear Creek Mining Co., exploration subsidiary of Kennecott, did some geological and geochemical work in the Orange Hill area, southeast of Nabesna, Yukon River region. Kennecott did not release any results or conclusions from the 1964 and 1965 work. The Orange Hill deposit was reliably reported to contain more than 200 million tons of quartz diorite running 0.40 percent copper and 0.02 percent molybdenum.

Gold.—Output and value of gold was again down sharply—more than 28 percent below the low figures for 1964. Value,

Table 9.—Mine production of gold, silver, and other metals,[1] in terms of recoverable metals [2]

Year	Mines producing		Material sold or treated [3] (short tons)	Gold (lode and placer)	
	Lode	Placer		Troy ounces	Value (thousands)
1956–60 (average)	4	100	2,559	191,663	$6,708
1961	8	86	645	114,216	3,998
1962	1	66	162	165,259	5,784
1963	4	72	914	99,573	3,485
1964	4	87	2,493	58,416	2,045
1965	6	69	3,305	42,249	1,479

Year	Silver (lode and placer)		Other		Total value (thousands)
	Troy ounces	Value (thousands)	Short tons	Value (thousands)	
1956–60 (average)	25,604	$23	23	$12	$6,743
1961	18,485	17	116	60	4,075
1962	22,199	24	----------	----------	5,808
1963	14,010	18	5	1	3,504
1964	7,336	9	11	7	2,061
1965	7,673	10	41	26	1,515

[1] Includes copper, lead and zinc produced.
[2] Includes recoverable metal content of gravel washed (placer operations), ore milled, old tailings or slimes retreated, and ore shipped to smelters during calendar year indicated.
[3] Does not include gravel washed.

Table 10.—Placer production of gold

Year	Mines producing [1]	Material treated (thousand cubic yards)	Gold recovered		
			Troy ounces	Value	Average value per cubic yard
1956–60 (average)	100	15,572	190,790	$6,677,664	$0.429
1961	86	11,128	113,457	3,970,995	.357
1962	66	8,846	164,966	5,773,810	.653
1963	72	6,264	98,362	3,442,670	.550
1964	87	3,314	56,284	1,969,940	.594
1965	69	1,785	38,686	1,354,010	.758

[1] Excludes itinerant prospectors, "snipers," "highgraders," and others, who gave no evidence of legal right to property.

at $1.48 million, was the lowest since 1894; physical volume was at a 75-year low. The decline was a continuation of a downtrend in gold mining in evidence for more than 10 years. Shutdown of a large dredging operation at Nyac, in the extreme southwest section of the Kuskokwim River region, accentuated the drop.

United States Smelting Refining and Mining Co. (USSR&M) again operated single dredges at Hogatza River in the Hughes district, Yukon River region, and on Chicken Creek in the Fortymile district, also in the Yukon River region. The company did no dredging in the Fairbanks district. Operations at Chicken Creek and Hogatza River were expected to continue for a few years under the then existing conditions.

The only other gold dredges active were two small boats on the Seward Peninsula, and two at Flat in the Yukon River region. The Goodnews Bay Mining Co. dredge produced a small quantity of by-product gold in the course of platinum operations, Kuskokwim River region.

Shell Oil Co. proceeded with offshore placer exploration in the Nome area. The company was reported to have leased the Nome offshore holdings of Nome Gold Coast, Inc. Ocean Mining A. G., a subsidiary of Ocean Science Engineering, Inc. (New York), investigated offshore deposits from Bluff to Tin City along the south coast of the Seward Peninsula. The company consolidated a large group of prospecting permits into a single exploration operation. Approximately 290 miles of geophysical profile traverses, some of it at Platinum in Goodnews Bay where platinum was the chief metal of interest, and considerable bottom testing of offshore areas was accomplished. Sampling was done by shallow drillholes and by diving.

In lode mining, Little Squaw Mining Co. continued exploration and development at the high-grade Chandalar deposits on the south slope of the Brooks Range above the Arctic Circle. Little Squaw was controlled by Grandview Mines and Metaline Mining & Leasing Co., both of Spokane, Wash. The company worked the Mikado and Little Squaw quartz veins. Surface trenching and underground drifting were accomplished under an Office of Minerals Exploration loan. In the fall Little Squaw announced plans for a mill at Chandalar with a minimum capacity of 50 tons per day. The Chandalar deposits had been under exploration since 1959, with considerable ore having been reported as blocked out.

Lode activities elsewhere in the State consisted largely of assessment work. An exception was the Fairbanks district where Keystone Mines, Inc. continued exploration, development, and mining on the Kawalita and adjoining claims near Cleary Summit. Ore was treated at the old Cleary Hill mill.

The State Division of Mines and Minerals reported 409 gold claims staked and 4,723 affidavits of annual assessment work recorded. The 1964 figures were 709 claims and 4,598 affidavits. Late in the year the Division announced transfer of its Fairbanks fire assaying laboratory to the campus of the University of Alaska at College. Assays for gold and silver were to be done at the new location. Samples for which more detailed analyses were required were to be sent to the Division's Anchorage laboratory.

Iron Ore.—Pan American Petroleum Corp., an exploration subsidiary of Standard Oil Co. of Indiana, proceeded with exploration of the Chenik Mountain-Iliamna Lake titaniferous deposits discovered in 1964. The seven large deposits, discovered in the course of geophysical prospecting for petroleum, were near Chenik Mountain, Iliamna Bay, Dutton, Ursus Cove, Pile Bay, Meadow Lake, and Paint River. Pan American had staked 497 claims on the seven deposits, 113 of them in the Iliamna Bay area, said to be the largest iron deposit in the group. The company worked a large exploration crew, serviced by helicopters, in geological and geophysical work and in diamond drilling. Davis Mining Co. continued exploration of its iron claims at Chenik Mountain and Iliamna Bay.

Atlantic Refining Co. staked 59 claims for iron, also in the Iliamna area. The claims were about 70 miles to the northwest of the Chenik Mountain deposit staked by Pan American and 200 miles southwest of Anchorage. The Atlantic claims appeared to cover a discovery by the Federal Geological Survey announced earlier. The Survey described the discovery as consisting of low-grade iron deposits outcropping over an area about 1 mile long by ½ mile wide. Twenty iron-rich outcrops, carrying approximately 20 percent FeO and 1.3 percent TiO_2, were noted in the mineralized area; the P_2O_5 content was listed as 0.1 to 3.2 percent. Atlantic was reported to have a 10-man crew on claimstaking and exploration.

A small magnetite deposit was discovered on the shores of Icy Strait in southeastern Alaska west of Juneau. Described as 10 to 18 feet wide and outcropping over a strike length of 8,000 feet, the deposit was noteworthy for its low TiO_2 content. Spectrographic analyses showed 35 to 55 percent iron, less than 0.006 percent titania, and a trace to 0.60 percent copper.

Mercury. — Despite record prices for mercury, production of the liquid metal was at a 10-year low. However, at the close of the field season there was some evidence of increased interest in prospecting for mercury by both individuals and mining organizations. Small quantities of mercury were reported from the White Mountain deposit (70 miles southeast of McGrath), the Alice and Bessie (formerly the Parks, northwest of Sleetmute) and George River (5 miles north of Georgetown) all in the Kuskokwim River region and from the Fortymile district in the Yukon River region. At yearend there were indications of a 1966 attempt to reopen the Red Devil mine on the Kuskokwim, either with Federal or private funds. Red Devil had been the major Alaska mercury producer, and an important factor in national production, from 1954 to 1962. The mine had been shut down in August 1963 when mercury was selling at under $200 per flask.

Molybdenum. — Some prospecting and geochemical exploration was done in the vicinity of Shakan on Koskiusko Island, Southeastern Alaska region. American Metal Climax, Inc., in Northwestern Alaska, worked a three-man crew, serviced by helicopter, in reconnaissance investigations with molybdenum the metal of chief interest. There was no development of significance at Orange Hill in the Nizina district, Copper River region.

Nickel.—At Spirit Mountain, about 15 miles southeast of Chitina in the Copper River region, Prosper Oil Co. and Valdez Mines, Ltd., had a 12-man crew, serviced by helicopter on exploration. Two diamond drills were used to probe the nickel deposit and to explore a lead showing close by. Some geological work was done also. In Southeastern Alaska, patents were granted on 20 lode claims on the Brady Glacier deposit in Glacier Bay National Monument. Newmont Exploration, Ltd., a subsidiary of Newmont Mining Corp., had been exploring the Brady Glacier deposit for a number of years. Also in southeastern Alaska, Admiralty Alaska Gold Mining Co. continued work on the Funter Bay deposit on Admiralty Island. The Bureau of Mines made a reconnaissance examination of new nickel-copper showings northwest of the Bohemia Basin-Takanis Creek divide on Yakobi Island.

Platinum-Group Metals.—Goodnews Bay Mining Co. continued dredging operations on the Salmon River in the extreme southwestern part of the Kuskokwim River region. The company, a placer platinum producer from the Goodnews Bay deposits for more than 30 years, did not release operating figures for publication. Goodnews Bay was the only United States operation where platinum was the primary metal recovered.

Scrap Metals.—Small quantities of ferrous and nonferrous scrap were shipped from the State. Ferrous scrap was shipped to Seattle for local consumption. Nonferrous scrap consisting of lead, copper, and copper alloy products was separated and prepared either in Alaska or at Seattle. Some prepared nonferrous scrap was reshipped from Seattle to a foreign smelter or dealers.

Silver.—Alaska silver production, reflecting the decrease in gold output, was again well below 10,000 ounces. Silver in Alaska had been almost entirely a byproduct of gold operations.

Sulfur.—Agents acting for French oil and gas interests were reported to be investigating the possibilities of sulfur production from volcanic deposits on Unalaska Island. Surficial deposits of elemental sulfur resulting from solfataric action were known on Unalaska and Akutan Islands in the Aleutian Chain.

Uranium.—The Ross-Adams deposit at Bokan Mountain, Prince of Wales Island was inactive throughout the year. Standard Metals Corp., operator for Standard-Bay West Venture, ceased operations in July, 1964 as a result of the Atomic Energy Commission stretchout in procurement of raw materials. Before the shutdown, Ross-Adams ore had been shipped to the Mexican Hat mill in Utah. Uranium production credited to Alaska in 1965 came from ores mined and shipped in previous years but milled in 1965. Credits in uranium accountability were made in the year processed rather than when mined.

NONMETALS

Gem Stones. — Raw jade from Dahl Creek, a tributary of the Kobuk River (Shungnak district, northwestern Alaska region), from the Shungnak River area, and from Jade Mountain (north of Onion Portage on the Kobuk River) was produced. About 200 pounds of Mentasta marble of specimen grade was recovered in the Slana River area. Small quantities of amethyst from the Fortymile district and agate and jasper from Caribou Creek along the Denali highway were reported. A 5-ton lot of soapstone from Grubstake Gulch in the Willow Creek district (Cook Inlet-Susitna region) was shipped to Palmer. The soapstone was sold to schools and colleges and to sculptors and carvers. Natural gold for specimens and jewelry was collected and sold to mineral dealers and hobbyists.

Sand and Gravel.—Physical volume of sand and gravel increased 16 percent and value 86 percent. Average unit value was $1.14 compared with $0.71 in 1964. The increase in unit value was a result of less production of fill sand and gravel in connection with decreased rehabilitation work from the 1964 earthquake and also of more realistic pricing of sand and gravel used in highway and other construction.

Twenty-five commercial producers accounted for 17 percent of output and 16 percent of value. Average value of commercial production was $1.07 per ton. Commercial operators washed 647,000 tons (12 percent) of output valued at $1.6 million, or $2.44 per ton. Unwashed product was 4,609,000 tons valued at $0.87 per ton. Commercial producers included The Alaska Railroad, an agency of the U.S. Department of the Interior. The railroad was classed as a commercial producer to permit comparability with data published for other States.

Thirteen Federal, State, and municipal agencies (or their contractors) produced sand and gravel. For the Government agencies, output was 25.0 million tons valued at $28.9 million or $1.15 per ton. Washed or otherwise prepared product was 1.2 million tons with a unit value of $3.34. Untreated product amounted to 23.8 million tons at $1.04 per ton. The Alaska Department of Highways, the U.S. Army Corps of Engineers, and the Federal Aviation Agency were the major producers. The Alaska Department of Highways furnished 82 percent of the tonnage and 87 percent of the value credited to Government agencies.

Of total production, 94 percent was used as fill, 5 percent for paving, and 1 percent for building construction. There was no recorded production of industrial sand.

Stone.—Physical volume of stone increased 31 percent over that of 1964; value of output was 17 percent greater. Average value of all stone was $1.88 per ton compared with $2.11 in 1964. Commercial producers accounted for 21 percent of volume and 14 percent of value compared with 40 percent and 28 percent, respectively, in 1964. The Alaska Rail-

Table 11.—Sand and gravel sold or used by producers, by classes of operation and uses
(Thousand short tons and thousand dollars)

Class of operation and use	1964		1965	
	Quantity	Value	Quantity	Value
Construction:				
Building:				
Sand	213	$810	157	$440
Gravel	380	1,212	168	528
Paving:				
Sand	108	259	110	333
Gravel	1,091	3,083	1,340	4,089
Fill:				
Sand	188	366	21	14
Gravel	23,749	12,332	28,443	29,019
Railroad ballast: Gravel	350	406	18	29
Other:				
Sand	2	6	4	4
Total construction	26,081	18,474	30,261	34,456
Miscellaneous gravel	8	14	5	11
Grand total	26,089	18,488	30,266	34,467
Commercial:				
Sand	353	898	190	493
Gravel	4,048	3,223	5,066	5,107
Government-and-contractor: [1]				
Sand	158	543	102	298
Gravel	21,530	13,824	24,908	28,569

[1] Approximate figures for operations by the State, counties, municipalities, and other Government agencies under lease.

road was classed as a commercial producer. Railroad figures were included in commercial production to make stone figures for Alaska comparable with those of the other States.

Among the Government-and-contractor producers, the U.S. Forest Service was the leader in volume and second in value of product. The U.S. Army Corps of Engineers was the leader in value of stone produced. Other important Government-and-contractor producers included the Alaska Department of Highways and the Bureau of Public Roads.

REVIEW BY REGIONS

Alaska Peninsula.—Pan American Oil Corp. and Davis Mining Co. staked claims on deposits containing lead, zinc, silver and gold at Chignik Bay. Pan American, which staked 220 claims early in the year, had a large exploration crew, served by helicopter on diamond drilling and geological and geophysical work.

Aleutian Islands.—Sand and gravel and stone were produced for military installations. Late in the year an underground nuclear explosion was detonated at Amchitka Island (Rat Islands group) in the western Aleutians. Named project "Long Shot," the 80-kiloton nuclear explosion was expected to provide scientists with basic data for distinguishing between natural earth disturbances and underground nuclear blasts.

Bristol Bay.—St. Eugene Mining Corp., Ltd., affiliated with Falconbridge Nickel Mines, Ltd., had an eight-man diamond drilling crew on the Kasna Creek copper deposit near the south shore of Lake Kontrashibuna some 160 miles southwest of Anchorage. Low-grade copper-iron mineralization in a strongly mineralized contact metamorphic zone of considerable length had been known for many years.

Some work was done on a gold-copper prospect at the east end of Battle Lake.

Cook Inlet-Susitna.—Sand and gravel, coal, and stone were the leading mineral commodities supplying practically all of the $11.6 million production. At year-end, however, crude petroleum from the offshore Middle Ground Shoal field began to flow shoreward through the dual 8-inch pipelines constructed by Shell and Pan American. While 1965 oil production

Table 12.—Value of mineral production in Alaska, by regions [1]

(Thousand dollars)

Region	1964	1965	Minerals produced in 1965 in order of value
Alaska Peninsula	$3	$20	Sand and gravel.
Aleutian Islands	540	64	Stone, sand and gravel.
Bristol Bay	-------	2	Sand and gravel.
Cook Inlet-Susitna	11,300	11,631	Sand and gravel, coal, stone, gold, gem stones, silver.
Copper River	3,809	7,154	Sand and gravel, stone, copper, silver.
Kenai Peninsula	35,370	41,952	Petroleum, sand and gravel, natural gas, silver.
Kodiak	10	19	Sand and gravel.
Kuskokwim River	1,210	1,049	Platinum-group metals, mercury, gold, sand and gravel, silver.
Northern Alaska	1,129	215	Natural gas.
Northwestern Alaska	7	25	Sand and gravel, gem stones, gold, silver.
Seward Peninsula	948	1,633	Sand and gravel, gold, tin, stone, silver, gem stones.
Southeastern Alaska	2,197	4,159	Sand and gravel, stone, uranium, gold, silver.
Yukon River	9,424	15,532	Sand and gravel, coal, gold, stone, gem stones, peat, silver, lead, antimony, mercury.
Total	65,947	83,455	

[1] No production reported in Bering Sea region.

was minor, Middle Ground Shoal and other Cook Inlet fields were expected to increase substantially the mineral production of the region; petroleum was seen as by far the leading mineral commodity in the near future.

Chugach Electric Association, Inc., signed a contract with Standard Oil Co. of California to purchase natural gas from Standard's Beluga River gasfield. Chugach was to utilize the gas at a mine-mouth powerplant on which construction was to begin in 1966. Chugach hoped for a power cost of 5½ mills, which was about half the cost of power generation in the area at the time.

Pan American and Associates (Skelly, Sinclair, and Phillips) were reported to be negotiating with Japanese interests for sale of liquefied natural gas from the fields in offshore Cook Inlet. A spokesman for Skelly stated that failing shipment to Far East markets, the possibilities of local production of anhydrous ammonia and other chemicals were to be investigated.

All coal was strip mined. Evan Jones Coal Co. was again the leading producer in the Matanuska field. Alaska Matanuska Coal Co. (operating the Premier mine) was the only other producer of record. The future of coal mining in the Matanuska field was clouded by a proposal to convert the Anchorage area military bases to natural gas. While the Congress did not appropriate funds for the conversion, the action was seen as perhaps a deferral only.

Pan American Oil Corp. continued investigations of the Chenik Mountain-Iliamna Lake iron deposits staked in 1964. Seven large low-grade titaniferous magnetite deposits averaging about 15 percent iron and in close proximity to an ice-free deepwater port and Cook Inlet natural gas, were thought to have potential for export to West Coast or Far Eastern markets.

Permanente Cement Co. reported some exploration of limestone deposits in the Castle Mountain area, Willow Creek district. Permanente had held claims on the East Fork of the Kings River for a number of years.

Bear Creek Mining Co., the exploration subsidiary of Kennecott Copper Corp., examined a copper prospect in the Drift River area on the west side of Cook Inlet below West Forelands.

Some work, either prospecting, development, or rehabilitation was being done on at least six of the small Willow Creek lodes.

Copper River.—The Alaska Department of Highways had underway a study of the Copper River highway connecting Cordova with either Chitina or the Richardson highway near Thompson Pass. Using aerial photography and helicopter transportation, the Department completed reconnaissance of some 150 miles of highway routings in 1965. A preliminary report covering the physical route survey and the economic impact of the proposed route was scheduled for delivery by the end of 1966.

At Ahtell Creek, a tributary of the Slana

River, an eight-man crew was engaged in exploration of a lead-silver deposit discovered by the State Division of Mines and Minerals in 1963. A small scale hand operation continued placer mining on Slate Creek in the Copper River region.

Kenai Peninsula.—Oil and gas from the Swanson River and Kenai unit fields continued to dominate mineral output of the Peninsula; combined value accounted for 85 percent of the total for the region.

The Swanson River field, on a routine operating basis throughout the year, produced 11.1 million barrels of crude oil valued at $34.0 million—almost identical with the 1964 production figures. The field had 22 wells flowing and 28 on gas lift at yearend. Six wells were shutin. Gas injection at Swanson River dropped from 5.5 billion cubic feet in 1964 to 4.7 billion cubic feet; reservoir pressure dropped from 5,650 to 4,040 pounds per square inch. Production of dry gas was 2.1 billion cubic feet compared with 3.8 billion cubic feet in 1964. Wet gas increased from 3.2 billion cubic feet to 3.7 billion cubic feet. With the completion of a 17-mile, 20-inch pipeline by Union Oil Co. and Marathon Oil Co. from the Kenai unit field to Nikiski and a subsequent tie-in by Standard Oil Co. of California to the Swanson River field, pressure maintenance was expected to stabilize at an economic operating level. The Standard Oil tie-in, 18.7 miles of 16-inch line, had a capacity of 100 to 125 million cubic feet per day.

Production of natural gas from all fields on the Kenai Peninsula amounted to 12.0 billion cubic feet. Sales of natural gas totaled 6.2 billion cubic feet valued at $1.4 million. All other gas was used in the field, injected, or blown on production tests. The Kenai unit of Union-Marathon furnished the bulk of gas produced for sale. Six dually completed development wells were drilled at the Kenai unit to supply gas for Swanson River repressuring.

Union-Marathon continued negotiations toward the shipment of Kenai unit gas to Japanese markets in the form of liquefied methane. The 20-inch gasline laid between Nikiski and the Kenai unit was seen as a carrier for gas for a proposed liquefaction plant to be built at the Port of Nikiski.

Kuskokwim River.—Platinum, from the Salmon River dredging operations of Goodnews Bay Mining Co., was the leading mineral commodity of the region. The physical volume of output decreased somewhat from that of 1964, but its value held about the same, reflecting better prices for platinum and allied metals.

Value of gold output dropped sharply as a result of the shutdown of the New York-Alaska Gold Dredging, Inc., operation at Nyac along the Tuluksak River in the southwestern part of the region. The Nyac operation had been active for more than 30 years and over much of this period was second only to the USSR&M in value of gold produced. The company's No. 2 dredge, smallest of the three at Nyac, was purchased for an operation on Marvel Creek.

Production of mercury remained at the low levels of the past years; two or three small operations contributed to the production.

Northern Alaska.—Gas wells at the South Barrow field in Naval Petroleum Research Reserve No. 4 produced 389 million cubic feet of gas during the year. Of this, 48 million cubic feet, valued at $24,000, was sold to Barrow Utilities, Inc., for consumption in the city of Barrow. The remainder was used by the contractor to service buildings and generate power for the Government installations at Point Barrow. B. P. Exploration Co. (Alaska), Inc., plugged and abandoned Itkillik Unit No. 1 as a dry hole. The well, about 20 miles east of Colorado Oil & Gas Corp. gas well in the Gubic unit, was bottomed at 7,751 feet and was the deepest hole drilled on the Arctic Slope. Sinclair Oil and Gas Co. spudded Colville No. 1 in mid-November; by yearend the well was drilling at 3,292 feet. The State received $6.1 million for 754,000 acres of leases on the North Slope in the 14th competitive sale. The lands leased were along the coast of the Beaufort Sea about 200 miles east of Point Barrow.

Northwestern Alaska.—Kennecott Copper Corp. collared the projected 1,100-foot shaft on the Ruby Creek copper deposit at Bornite and by yearend was down 200 feet. Shaftsinking was on a 3-shift, 7-day-week basis with a crew of 75 men. Kennecott stockholders were told that Ruby Creek would probably require 5 years to reach the production stage.

American Metal Climax, Inc., was active in prospecting for molybdenum and other mineral materials in the Brooks Range. The exploration project, based at Nome, had helicopter-supported reconnaissance crews ranging over wide areas of the northwestern and northern Alaska regions.

Seward Peninsula. — Sand and gravel, gold, and tin were the leading mineral commodities with sand and gravel accounting by far for the bulk of the $1.6 million production. Minor values were recorded for stone, silver, and gem stones. Value of gold was less than $100,000. The region was sixth in value of mineral production.

Some prospecting and bulldozer trenching were done on the Independence lead-silver deposit at the juncture of Holtz Creek and the Kugruk River about 20 miles east of Imuruk Lake. A reported 165 new claims were staked on the silver-lead deposit on Hannum Creek southwest of Deering. The activity was thought to be in preparation for an extensive examination of the area in the 1966 field season. At Tin City, Lee Brothers continued work on a nonfloat plant for mining placer tin deposits; there was no record of production in 1965.

Southeastern Alaska.—Preliminary studies on the Snettisham power project 30 miles south of Juneau proceeded on schedule; diamond drilling, road building, and additional geologic studies were accomplished. Continued field studies and preliminary work on docks, camp, and roads were slated for 1966 with major construction on dams and tunnels scheduled for 1967.

Bunker Hill Mining Co. carried out an extensive examination of zinc and lead-silver deposits in the Wrangell area. Work included drilling and geologic studies at Groundhog Basin and near Virginia Lake. Both previously known and examined deposits, and new deposits found under the State Division of Mines and Minerals Prospectors Assistance Program, were under study. Dome Mining Co. did geochemical and geophysical work south of Juneau. At Icy Strait, a newly found deposit of magnetite appeared to be without the usual few percent of titania found in Southeastern ores.

Yukon River.—Sand and gravel, coal, and gold were the leading mineral commodities. The region was second only to the oil and gas producing Kenai Peninsula in value of mineral output. Minor values of stone, gem stones, and peat were recorded.

United States Steel Corp., in addition to examinations for tin on the Seward Peninsula, made geological and geophysical investigations for the lode sources of tin associated with gold in the placers of the Manley Hot Springs-Tofty area 90 miles west of Fairbanks. Appreciable quantities of cassiterite occurring in the placers and in tailings from placer mining had long been known in the area. Previous attempts to discover tin in place had not isolated minable deposits.

The Mineral Industry of Arizona

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the Arizona Bureau of Mines for collecting information on all minerals except fuels.

By Leonard P. Larson [1] and William C. Henkes [2]

The value of the mineral industry of Arizona rose to $580.2 million, the highest on record, 9 percent greater than in 1964. Responding to high demand, the copper industry increased the output of primary copper 12,389 short tons (2 percent) and $47.5 million (11 percent) in value. The average price received for electrolytic copper at the refinery rose from 32.6 cents per pound in 1964 to 35.4 cents per pound in 1965.

The high demand for copper resulted in the increased output of silver and molybdenum, byproducts of milling and smelting copper ores, and stimulated that section of the economy which provided raw materials and services to the industry. Crushed limestone, sandstone, and pyrite were all consumed in greater quantities.

Activity in the Arizona nonmetal industry declined in value. Output of sand and gravel, portland and masonry cements, and stone was less because of reduced construction, primarily because of overbuilding in residential, commercial, and other types of construction. A 3-month summer shutdown of nearly all construction in the State caused by a strike of most construction trade unions also contributed to the lower demand for cement.

Prospecting and development increased over that in 1964. Newmont Development Co. drilled exploratory holes in a ¾-mile area east of the Vekol Mountains, 32 miles south and west of Casa Grande; West Range Co. explored for molybdenum-copper ores at the Ventura mine in the Palmetto district of Santa cruz County; exploration work was continued by Hecla Mining Co. & Newmont Exploration, Ltd., at the Big Bird Development Co. Copper Flats claims in the Lone Star district of Graham County; Arkla Exploration Co. filed on an additional 46 mining claims in the San Francisco mining district, T 17 N, R 19 and 20 W, Mohave County; and the Apache and Big Monument gold and silver mines 12 miles south of Arivaca were diamond drilled and trenched for George Audish of Tucson.

Arizona mine evaluations increased $9.9 million over those of 1964. The largest increase was placed on the Duval Corp. new Mineral Park operation near Kingman, assessed at $6.4 million. The remaining increases were spread among the Inspiration, Kennecott, Magma, and Phelps Dodge holdings in the State.

Kerr-McGee Corp. began exploratory diamond drilling on a large group of claims in Gila, Pinal, and Santa Cruz Counties.

Employment and Injuries.—Final statistics for 1964 of employment and injuries in the mineral industries, excluding the petroleum and natural gas industries, and preliminary data for 1965, compiled by the Federal Bureau of Mines, are given in table 3.

Arkansas Louisiana Gas Co. conducted an extensive core-drilling program for various minerals on the Holbrook tract in Navajo County.

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Table 1.—Mineral production in Arizona[1]

Mineral	1964		1965	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Asbestos ---short tons	W	W	3,469	$441
Clays ---thousand short tons	[2] 168	[2] $213	[3] 129	[3] 164
Copper (recoverable content of ores, etc.) ---short tons	690,988	450,524	703,377	497,991
Diatomite ---do	450	16	295	8
Gem stones	NA	120	NA	120
Gold (recoverable content of ores, etc.) ---troy ounces	153,676	5,379	150,431	5,265
Gypsum ---thousand short tons	147	770	103	540
Iron ore (usable) ---thousand long tons, gross weight	4	32	8	51
Lead (recoverable content of ores, etc.) ---short tons	6,147	1,611	5,913	1,845
Lime ---thousand short tons	177	2,920	204	3,543
Mercury ---76-pound flasks	77	24	158	90
Molybdenum (content of concentrate) ---thousand pounds	6,296	9,532	9,399	15,880
Natural gas (marketed) ---million cubic feet	r 2,014	241	3,106	376
Petroleum (crude) ---thousand 42-gallon barrels	64	W	97	W
Pumice ---thousand short tons	880	1,635	1,273	1,605
Sand and gravel ---do	18,116	20,868	14,918	16,621
Silver (recoverable content of ores, etc.) thousand troy ounces	5,811	7,513	6,095	7,881
Stone ---thousand short tons	3,759	6,283	2,474	4,171
Tungsten concentrate (60-percent WO_3 basis) short tons	16	17	3	5
Uranium ore ---do	102,258	3,253	117,898	3,918
Vanadium ---do	W	575	W	381
Zinc (recoverable content of ores, etc.) ---do	24,690	6,716	21,757	6,353
Value of items that cannot be disclosed: Asbestos (1964), cement, clays (bentonite, fire clay 1964), feldspar, helium, mica (scrap), perlite, pyrites, and values indicated by symbol W	XX	r,[4] 16,111	XX	[5] 12,933
Total	XX	r 534,353	XX	580,182

NA Not available. W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed." XX Not applicable. r Revised.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes bentonite and fire clay; included with "Value of items that cannot be disclosed."

[3] Excludes bentonite; included with "Value of items that cannot be disclosed."

[4] Value of mineral fuels, $1,785,000; value of nonmentals, $14,326,000.

[5] Value of mineral fuels, $2,307,000; value of nonmetals, $10,626,000.

Table 2.—Value of mineral production in constant 1957-59 dollars

(Millions)

Year	Value
1956	$359
1957	359
1958	339
1959	317
1960	380
1961	414
1962	450
1963	r 454
1964	r 473
1965	471

r Revised.

Duval Corp. reported that exploratory drilling in the Supai salt basin in Apache County had disclosed the presence of potash mineralization. Potash was reportedly found in the Permian bed 1,000 feet below the surface.

Legislation and Government Programs.—The United States Government played an increasingly important role in the copper market in 1965 with the release of copper from the Government stockpiles and the request to producers to maintain the 36 cents per pound price of copper. Other steps taken included introduction of legislation to suspend the 1.7-cents-per-pound import tax on copper, effective February 8, 1966 and restriction of copper exports.

Construction projects financed by Federal, State, and municipal funds accounted for much of the production of cement, sand and gravel, and stone. State highway construction contracts awarded during the year totaled $69.9 million. Seventy-three percent ($50.8 million) was for constructing roads in the National System of Interstate and Defense Highways.[3] Of the 1,166.5 designated miles in this system in Arizona,

[3] Engineering News-Record. State Highway Contracting Plans: 1966 Will be a Record Breaker. V. 176, No. 14, Apr. 7, 1966, pp. 74–76.

Table 3.—Employment and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1964:								
Coal	3	---	(1)	3	--	---	---	---
Metal	10,632	302	3,210	25,633	8	785	30.94	3,199
Nonmetal	378	222	85	676	--	10	14.80	536
Sand and gravel	1,115	234	261	2,102	--	53	25.21	562
Stone	681	242	165	1,309	--	13	9.93	199
Total	12,809	290	3,721	29,723	8	861	29.24	2,820
1965:p								
Coal	5	---	(1)	3	--	---	---	---
Metal	11,575	304	3,519	28,102	11	658	23.81	3,715
Nonmetal	285	221	63	508	1	19	39.37	12,232
Sand and gravel	1,150	204	234	1,883	--	27	14.34	660
Stone	655	237	155	1,223	2	18	16.35	10,277
Total	13,670	290	3,971	31,719	14	722	23.20	3,923

pPreliminary.
1Less than 1/2 unit.

645.2 miles was opened to traffic at year-end; 481.2 miles was in the construction, engineering, or right-of-way phase; and 40.1 miles had not been started.[4]

A comprehensive review [5] of the geology of the U.S. Highway from Douglas on the Mexican border to Lupton on the New Mexico border was published by the Arizona Bureau of Mines. The 68-page guide was illustrated with maps, pictures of past and current mining operations, and geological reports correlated to each section of the highway. A geologic log identified the rocks, according to the type and age, seen along the highway. An appended glossary defined the types of rocks.

REVIEW BY MINERAL COMMODITIES

METALS

Copper.—Production from mines in the State was at a record high of 703,400 short tons; most mines were worked at or near capacity. Shipments exceeded production, and stocks declined.

Mines in Arizona yielded more than 52 percent of the domestic primary production and about 18 percent of the free world output. Production from the 12 large open pit and 4 principal underground properties accounted for 97 percent (684,000 tons) of the State total output of 703,377 tons of primary copper; 78 percent was derived from open pit ores, and 22 percent was derived from underground ore. In 1964, the 11 open pit and 5 underground mines accounted for 98 percent of the State total output. The remaining 2 percent was supplied by 72 small operations.

Copper was mined throughout a large area of Arizona and was a significant factor in the economy of 7 of the 14 counties in the State. Rapidly expanding operations in the Tucson area, since 1962, has pushed Pima County ahead of Pinal County in the production of copper. Greenlee and Gila Counties also were substantial producers, followed by Cochise, Yavapai, and Mohave.

Four mines owned by Phelps Dodge Corp. accounted for about 38 percent of the State production. Magma Copper Co. accounted for 16 percent of the total output from its two underground properties. American Smelting and Refining Co. (Asarco), with two open pits that accounted for about 11 percent, was third. Ray Mines Division, Kennecott Copper Corp., accounted for 10 percent followed by Inspiration Consolidated Copper Co. with 9 percent. Duval Corp. and Miami Copper

[4] Bureau of Public Roads. Quarterly Report on the Federal-Aid Highway Program, Dec. 31, 1965. Press Release BPR 66-5, Feb. 9, 1966.
[5] Wilson, Eldred D. Guidebook 1—Highways of Arizona, U.S. Highway 666. Arizona Bu-Mines Bull. 174, 1965, 68 pp.

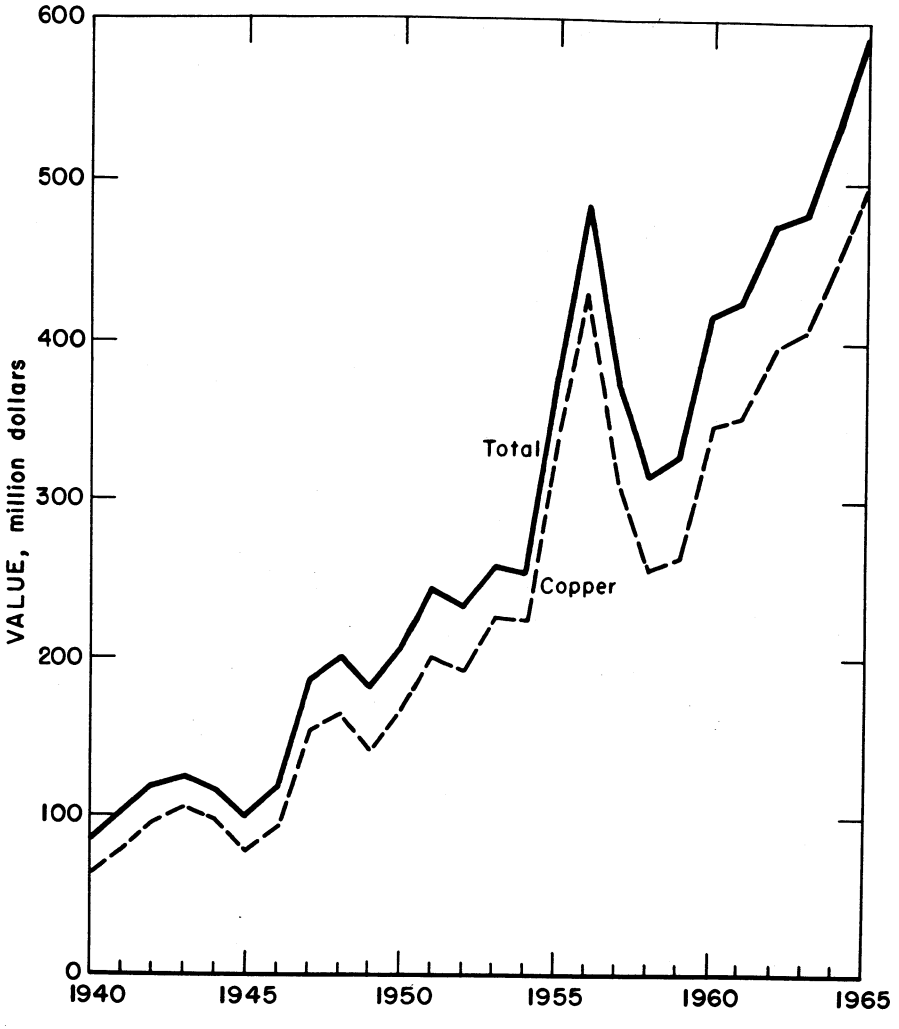

Figure 1.—Value of mine production of copper, and total value of mineral production in Arizona.

Co. yielded about 6 percent and 4 percent, respectively. Operations of Bagdad Copper Corp. and Pima Mining Co. accounted for about 3 percent and 2 percent, respectively. Several smaller firms provided the remaining 1 percent.

Eight primary smelters operated in the State during the year, primarily on ores produced by the company operating the smelter. Phelps Dodge Corp. smelter at Douglas, Inspiration Consolidated Copper Co. smelter at Inspiration, and Asarco at Hayden also smelted ores on a custom or toll basis. Phelps Dodge Corp. controlled about 55 percent of the smelting capacity in the State; Magma Copper Co., Asarco, and Kennecott Copper Corp. each about 13 percent; and Inspiration Consolidated Copper Co. about 6 percent.

Approximately 89 percent of the recoverable copper produced at mines in Arizona was smelted locally. About 9 percent was shipped to copper, lead, and zinc smelters operated by Asarco at Amarillo and El Pa-

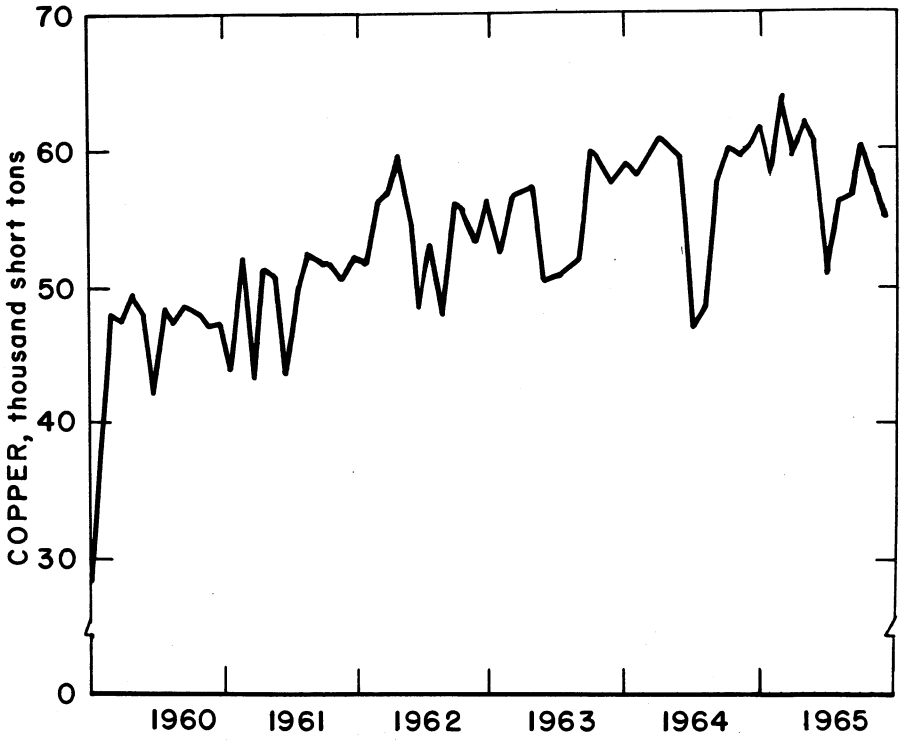

Figure 2.—Mine production of copper in Arizona, 1955–65, by months, in terms of recoverable metal.

Table 4.—Fifteen leading copper-producing mines in 1965, in order of output

Rank in 1965	Rank in 1964	Mine	District	County	Operator	Source of copper in 1965
1	1	Morenci	Copper Mountain	Greenlee	Phelps Dodge Corp.	Copper ore, copper precipitates, gold-silver ore.
2	2	San Manuel	Old Hat	Pinal	Magma Copper Co.	Copper ore.
3	5	Ray	Mineral Creek	do	Kennecott Copper Corp.	Copper ore, copper precipitates.
4	4	New Cornelia	Ajo	Pima	Phelps Dodge Corp.	Copper ore, gold-silver ore.
5	3	Copper Queen, Lavender Pit	Warren	Cochise	do	Copper ore, copper precipitates, silver ore.
6	6	Mission	Pima	Pima	American Smelting and Refining Co.	Copper ore.
7	7	Inspiration	Globe-Miami	Gila	Inspiration Consolidated Copper Co.	Copper ore, copper precipitates.
8	10	Esperanza	Pima	Pima	Duval Corp	Do.
9	8	Silver Bell	Silver Bell	do	American Smelting and Refining Co.	Do.
10	12	Bagdad	Eureka	Yavapai	Bagdad Copper Corp.	Do.
11	11	Copper Cities	Globe-Miami	Gila	Miami Copper Co.	Do.
12	13	Magma	Pioneer	Pinal	Magma Copper Co.	Copper ore, gold-silver ore.
13	--	Mineral Park	Wallapai	Mohave	Duval Corp	Copper ore, copper precipitates.
14	9	Pima	Pima	Pima	Pima Mining Co.	Copper ore.
15	15	Miami	Globe-Miami	Gila	Miami Copper Co.	Copper precipitates.

Table 5.—Ore mined, waste and leach material removed, and total copper production at principal copper open-pit and underground mines

Mine	Ore mined (thousand short tons)		Waste and leach material removed (thousand short tons)		Total copper produced from all sources [1] (short tons)	
	1964	1965	1964	1965	1964	1965
Open pit:						
Morenci	18,632	19,089	30,068	29,601	129,406	127,566
Ray	6,890	8,595	13,330	22,061	58,235	72,153
New Cornelia	10,371	10,655	18,973	15,889	70,818	70,905
Mission	7,561	6,646	27,961	29,282	[2] 53,810	[2] 56,237
Inspiration	5,837	5,799	9,293	9,491	48,908	53,436
Lavender	6,001	5,661	19,017	21,886	41,508	35,687
Esperanza	4,292	4,232	6,071	8,253	[3] 22,550	[3] 21,691
Silver Bell	3,033	3,185	6,974	6,951	[3] 24,142	[3] 21,479
Bagdad	2,063	2,091	12,063	10,568	[3] 19,632	[3] 20,376
Copper Cities	3,164	3,200	6,266	11,668	[3] 21,453	[3] 20,184
Mineral Park	387	4,914	10,238	4,822	[2] 1,350	[3] 19,039
Daisy-Pima	2,850	2,646	[4] 4,718	[4] 9,243	[2] 30,000	[2] 18,000
Underground:						
San Manuel	12,443	13,504	-----	-----	92,588	93,767
Copper Queen	749	766	-----	-----	32,525	30,948
Magma	378	440	-----	-----	17,064	19,452
Miami	([5])	([5])	-----	-----	[6] 9,037	[6] 9,111

[1] Includes copper recovered from leaching of material in place and in dumps.
[2] Gross metal in concentrate shipped.
[3] Gross metal in concentrate and precipitates shipped.
[4] Cubic yards.
[5] All production from in-place leaching.
[6] Gross metal in precipitates shipped.

Source: Bureau of Mines data or company-published annual reports.

Table 6.—Mine production of gold, silver, copper, lead, and zinc, in terms of recoverable metals [1]

Year	Mines producing		Material sold or treated [2] (thousand short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Troy ounces	Value (thousands)	Troy ounces (thousands)	Value (thousands)
1956-60 (average)	128	5	59,703	141,846	$4,965	4,763	$4,311
1961	96	4	72,537	145,959	5,109	5,120	4,733
1962	83	5	79,583	137,207	4,802	5,454	5,917
1963	90	4	81,214	140,030	4,901	5,373	6,873
1964	85	1	86,742	153,676	5,379	5,811	7,513
1965	92	2	93,466	150,431	5,265	6,095	7,881
1890-1965	NA	NA	NA	13,321,041	353,732	387,166	310,482

Year	Copper		Lead		Zinc		Total value (thousands)
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	
1956-60 (average)	495,301	$321,221	10,965	$2,879	32,231	$7,704	$341,080
1961	587,053	352,232	5,937	1,223	29,585	6,804	370,101
1962	644,242	396,853	6,966	1,282	32,888	7,564	416,418
1963	660,977	407,162	5,815	1,256	25,419	5,846	426,038
1964	690,988	450,524	6,147	1,611	24,690	6,716	471,743
1965	703,377	497,991	5,913	1,845	21,757	6,353	519,335
1890-1965	20,482,028	8,826,411	639,619	125,666	985,039	239,083	9,855,374

NA Not available.
[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 or tonnage of precipitates shipped.

Table 7.—Mine production of gold, silver, copper, lead, and zinc in 1965, by counties, in terms of recoverable metals

County	Mines producing [1]		Material sold or treated [2] (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Troy ounces	Value	Troy ounces	Value
Cochise	8	---	6,453,127	44,046	$1,541,610	962,077	$1,243,966
Coconino	1	---	[3] 100,000	---	---	23,248	30,060
Gila	12	---	10,734,696	3,706	129,710	206,025	266,390
Greenlee	3	---	19,090,733	10,968	383,880	512,873	663,145
Maricopa	3	---	536	9	315	6,843	8,848
Mohave	8	---	4,660,607	50	1,750	524,787	678,550
Pima	12	---	27,218,009	39,552	1,384,320	2,145,008	2,773,495
Pinal	17	---	22,636,639	36,279	1,269,765	930,363	1,202,959
Santa Cruz	5	---	5,646	36	1,260	21,795	28,181
Yavapai	17	---	2,553,745	15,771	551,985	759,559	982,110
Yuma	6	2	12,343	14	490	2,670	3,452
Total:							
1965	92	2	93,466,081	150,431	5,265,085	6,095,248	7,881,156
1964	85	1	86,742,262	153,676	5,378,660	5,810,510	7,512,989

	Copper		Lead		Zinc		Total value
	Short tons	Value	Short tons	Value	Short tons	Value	
Cochise	67,021	$47,450,585	6	$1,794	86	$24,981	$50,262,936
Coconino	810	573,268	---	---	---	---	603,328
Gila	95,320	67,486,772	---	---	---	---	67,882,872
Greenlee	127,586	90,330,640	---	---	---	---	91,377,665
Maricopa	12	8,602	---	---	---	---	17,765
Mohave	18,483	13,085,858	[4]	78	28	8,088	13,774,324
Pima	185,727	131,494,963	11	3,323	1,077	314,470	135,970,571
Pinal	184,677	130,751,776	---	---	---	---	133,224,500
Santa Cruz	63	44,392	359	111,914	653	190,807	376,554
Yavapai	23,678	16,763,989	5,465	1,705,236	19,907	5,813,034	25,816,354
Yuma	[4]	71	72	22,511	6	1,664	28,188
Total:							
1965	703,377	497,990,916	5,913	1,844,856	21,757	6,353,044	519,335,057
1964	690,988	450,524,176	6,147	1,610,514	24,690	6,715,680	471,742,019

[1] Operations at miscellaneous cleanups not counted as producing mines; various uranium mines from which copper was recovered as a byproduct not included as they were in the mine count of uranium.
[2] Does not include gravel washed or tonnage of precipitates shipped.
[3] Excludes tonnage of uranium ore milled.
[4] Less than ½ unit.

so, Tex.; 1 percent to the Asarco copper smelter at Tacoma, Wash.; and 1 percent to The National Zinc Co. zinc smelter, Bartlesville, Okla.

Production in the State was 2 percent (12,000 tons) higher than in 1964. In the United States, production increased 8.4 percent (105,000 tons); output from mines in Arizona accounted for 12 percent of this increase.

Porphyry copper ores were mined at open pits in Cochise, Gila, Greenlee, Pima, and Pinal Counties. Copper recovered from the ores ranged from 0.381 to 0.855 percent copper, averaging about 0.651 percent. In 1964, copper recovered from ores from open pit mines had ranged from 0.339 percent to 1 percent recoverable copper, averaging 0.682 percent. In 1965 ore from the underground mines contained from 0.698 to 4.52 percent copper; the lower analysis represents the copper content of the ore block caved at San Manuel and the higher analysis the copper content of the ore at the Magma mine where sandfill methods were used. Companies operating the 12 large open pit mines moved about 76.3 million tons of ore to recover 496,772 tons of copper.

Production of 429,794 tons of copper from five of the largest mines represented 61 percent of the State total; the first 10 major copper-producing mines accounted for 600,304 tons, or 85 percent; and the first 15 accounted for 682,962 tons, or 97 percent of the total. The production of 497,000 tons of copper required the removal of 190.1 million tons of waste and leach material. The ratio of waste and leach material to that of ore at the 12 principal producers was 2.48:1.

Table 8.—Mine production of gold, silver, copper, lead, and zinc in 1965, by classes of ore or other source materials, in terms of recoverable metals

Source	Number of mines [1]	Material sold or treated (short tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Lode ore:							
Dry gold	3	96	39	85	100	---	---
Dry gold-silver	6	114,793	428	9,519	1,795,300	---	---
Dry silver	17	23,847	24	31,348	194,300	1,900	900
Total	26	138,736	491	40,952	1,989,700	1,900	900
Copper	40	92,859,535	133,830	5,352,850	1,308,809,700	13,200	2,212,200
Copper-zinc	4	85,172	87	21,602	4,332,700	22,500	9,398,000
Lead	7	1,403	30	2,812	2,900	109,300	8,900
Lead-zinc	4	336,557	15,402	624,807	650,000	11,463,900	30,865,100
Zinc	1	2,763	---	8,828	114,400	112,200	995,400
Total	56	93,285,430	149,349	6,010,899	1,313,909,700	11,721,100	43,479,600
Other "lode" material:							
Gold tailings	1	19	8	2	---	---	---
Gold-silver and silver tailings [2]	4	29,815	529	15,213	97,400	---	---
Copper cleanup and copper smelter cleanup [2]	[3]	807	43	1,061	176,900	---	---
Copper precipitates	19	63,159	---	---	89,282,500	---	---
Lead cleanup	[3]	2	---	---	---	1,500	---
Lead tailings	2	11,200	1	946	---	60,900	3,400
Lead-zinc mill cleanup	[3]	[4] 72	[4] 2	[4] 26,174	[4] 1,297,800	[4] 40,600	[4] 30,100
Zinc mill cleanup	[3]	[4]	[4]	[4]	[4]	[4]	[4]
Uranium ore	---	---	---	[4]	[4]	---	---
Total	26	105,074	583	43,396	90,854,600	103,000	33,500
Total "lode" material	92	93,529,240	150,423	6,095,247	1,406,754,000	11,826,000	43,514,000
Placer	2	---	8	1	---	---	---
Total, all sources	94	93,529,240	150,431	6,095,248	1,406,754,000	11,826,000	43,514,000

[1] Detail will not necessarily add to totals because some mines produce more than one class of material.
[2] Combined to avoid disclosing individual company confidential data.
[3] From properties not classed as mines.
[4] Lead-zinc mill cleanup, zinc mill cleanup, and uranium ore combined to avoid diclosing individual company confidential data.

Table 9.—Mine production of gold, silver, copper, lead, and zinc in 1965, by types of material processed and methods of recovery, in terms of recoverable metals

Type of material processed and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Lode:					
Amalgamation:					
Ore	20	1	---	---	---
Tailings	8	2	---	---	---
Total	28	3	---	---	---
Concentration and smelting of concentrates:					
Ore [1]	135,681	5,622,805 [2]	1,282,293,300	11,185,500	43,246,700
Direct-smelting:					
Ore	14,140	453,239	29,439,800	598,400	237,200
Cleanings	45	3,987	177,500	42,100	30,100
Precipitates	---	---	89,282,500	---	---
Old tailings	529	15,213	97,400	---	---
Total	14,714	472,439	118,997,200	640,500	267,300
Other:					
Leaching of copper ore	---	---	5,463,500	---	---
Placer	8	1	---	---	---
Grand total	150,431	6,095,248	1,406,754,000	11,826,000	43,514,000

[1] Includes uranium ore concentrate.
[2] Includes copper recovered from leaching of ore at operations that employ "dual-process" treatment of leaching followed by flotation concentration.

Production of copper during the first 6 months averaged about 61,000 tons per month. During the second 6 months, production dropped to 56,000 tons per month.

Cement copper, recovered by precipitation from leach solutions obtained from dump leaching, contained 44,600 tons of recoverable copper, slightly less than the 45,400 tons recovered the previous year. In addition, 2,732 tons was recovered by heap leaching in 1965 compared with 1,044 tons in 1964. Output was to be increased approximately 50 percent with completion of plants currently under construction.

The price of copper increased from 34 to 36 cents per pound in May. Early in November almost all major producers increased their price to 38 cents; a few days later at the urging of the Government, domestic producers returned to the 36-cent level. Copper prices remained at the 36-cent level for the balance of the year. The weighted average domestic price for 1965, calculated from sales of electrolytic copper at producer plants as reported to the Federal Bureau of Mines, was 35.4 cents per pound.

Gold.—Output of gold totaled 150,431 ounces, 2 percent less than in 1964. Eighty-nine percent was recovered as a byproduct in the refining of copper, 10 percent recovered from lead-zinc ores, and 1 percent from other ores. The major mines, listed in order of output, were Copper Queen-Lavender Pit, New Cornelia, San Manuel, Iron King, Magma, Morenci, Christmas, and Ray. The eight leading producers accounted for 148,000 ounces, 98 percent of the total. Two percent of the production came from 43 smaller operations throughout the State.

In its annual report to the shareholders, Phelps Dodge Corp. stated that the combined output of gold recovered as a byproduct of copper mining at Morenci, New Cornelia, and Copper Queen branches totaled 96,000 ounces, 64 percent of the State total.

Magma Copper Co. reported to its shareholders that production of gold at the San Manuel Division was 21,550 ounces. Output at the Superior Division, Magma mine, was 12,748 ounces. Combined output from the two properties was 8 percent above that of 1964, resulting from a slightly higher gold content in the ore and the higher tonnage of ore milled.

Cochise was the leading gold-producing county, followed in close order by Pima and Pinal Counties. Other counties reporting production were Yavapai, Greenlee, Gila, Mohave, Santa Cruz, Yuma, and Maricopa.

Shattuck Denn Mining Corp., third leading producer in the State, recovered gold from lead-zinc ores obtained from the Iron King mine in Yavapai County. According to the company annual report, 1965 production totaled 15,677 ounces compared with 18,749 ounces in 1964.

Iron Ore.—Arkota Steel Corp., the largest producer of iron ore in the State in 1964, was idle. Production of small quantities of hematite ore was reported by Arizona Gypsum Corp. from the Iron Chancellor mine and by G. A. Swartz from the Cowden mine near Seligman, Yavapai County. Magnetite ore produced by H. M. Seitz from the Margaret-Howard mine in Gila County was used as a processing agent. Sponge iron was produced from iron oxides obtained in the smelting process at the Phelps Dodge Corp. smelter at Douglas and from pyrite at Ray Mines.

Lead.—Production of lead declined 4 percent in 1965. Ore produced at the Iron King mine and concentrated in the company mill accounted for most of the output. Concentrates from the company mill were shipped to the Asarco smelter at El Paso for processing. Arivaca Mining Corp., the second largest producer of lead in the State, mined lead-zinc ores from the Arizona, Idiho, and Glove mines in Santa Cruz County. Indiana Mining Corp. operated the Indiana mine near Nogales. Yavapai County with six operators led the State with the production of 5,465 short tons, representing 92 percent of the total output. Santa Cruz County with five operators was second, accounting for 6 percent. The remaining 2 percent came from operations in Cochise, Mohave, Pima, and Yuma Counties.

Mercury.—Output of mercury from seven mines in the Mazatzal Mountains in Gila and Maricopa Counties, principal producing area in the State, reflected the high demand for this commodity in domestic and world markets. Production and value of mine shipments more than doubled with the price of mercury rising from $475 per flask to $740 per flask between January

and May. Since May, prices ranged from $525 to $550 per flask.

Mercury content of ore mined in the State averaged 0.059 percent and ranged from 0.02 to 0.25 percent. Seventy-three percent was furnaced; the balance was retorted. The Pine Mountain mine, Maricopa County, operated by United Nuclear Corp. and Bacon & Brunson, was the largest mercury-producing mine, followed in descending order by National mine, Maricopa County, operated by V. D. Bradley and Dr. Duane Brown; Valley Assay mine, Gila County, operator unknown; Rattlesnake mine, Gila County, operated by Gordon K. Grimes; Mercuria mine, Gila County, operated by Five Points Mining Co.; and an unnamed deposit in Gila County, operated by Associated International Mineral and Mountain State Electric. Sales of mercury totaled 158 flasks valued at $90,000. Buyers of mercury in order of purchases were Chemical Manufacturing Co., Piggott Projects, and Braun Corp.

Molybdenum.—Arizona accounted for 12 percent of the total U.S. molybdenum production.

Molybdenum concentrate produced in the State as a byproduct in the processing of copper ores increased 49 percent. The molybdenum content of the concentrate ranged from 38 to 60.1 percent molybdenum, averaging about 54 percent for 9.4 million pounds produced. The large increase in output resulted primarily from the first full year of operation at the Mineral Park plant operated by Duval Corp. near Kingman, Mohave County, and of the zinc-recovery unit at the Mission mine in Pima County operated by Asarco. The modification of the molybdenum circuit at the San Manuel concentrator, operated by Magma Copper Co., was a contributing factor. Inspiration Consolidated Copper Co. reported a decline in production because of lower grade ores being mined. Asarco reported lower production from the Silver Bell property. Approximately 50.3 million tons of ore was processed in the recovery of 8,782 tons of molybdenite concentrates, containing 4,750 tons of molybdenum.

Shipments of molybdenum concentrates from nine mines in six counties contained 9.4 million pounds of molybdenum valued at $15.9 million. The average price reported for molybdenum in concentrate form was $1.69 per pound. In 1964, the average price per pound of molybdenum in concentrate form was $1.51. Exports of molybdenum concentrates from mines in Arizona contained 2.1 million pounds of molybdenum, 23 percent of the total shipments. Stocks increased.

Listed in order of decreasing production, the mines and operators were San Manuel, Magma Copper Co.; Mineral Park, Duval Corp.; Esperanza, Duval Corp.; Mission, Asarco; Silver Bell, Asarco; Bagdad, Bagdad Copper Corp.; Morenci, Phelps Dodge Corp.; Inspiration, Inspiration Consolidated Copper Co.; and Childs-Aldwinkle, Burney Mines, Inc.

The new molybdenite extraction process installed at San Manuel concentrator, operated by Magma Copper Co., was reported [6] to have increased flotation capacity of the existing plant by at least 25 percent. The change from the sodium hypochlorite-ferrocyanide process to the new process included a conditioning step with hydrogen peroxide, sulfuric acid, sodium cyanide, and zinc sulfate; a two-stage rougher-flotation step with stove oil and sodium ferrocyanide; one-step cleaning with ferrocyanide; one-step cleaning with sodium hypochlorite and potassium ferrocyanide used to treat the pulp; and four cleaning steps with anti-foam Exfoam 636 and potassium ferrocyanide. The high rate of corrosion and the high maintenance cost experienced with the hypochlorite process formerly used was to be greatly reduced.

Following completion in 1966, the $1 million molybdenum recovery unit, Ray Mines was to become the 10th Arizona porphyry copper mine to recover molybdenite as a byproduct of copper mining. The decision to build the plant followed several years of testing and design.

Silver.—Production of silver was only slightly higher than that of the previous year. Copper ores, primarily porphyry, from 16 mines yielded 5,352,850 ounces of silver, 88 percent of the State output. Lead-zinc ores was the source of 10 percent, and other ores 2 percent. In 1965, the ratio of silver to copper was 8.2 ounces of silver for each ton of copper produced

[6] Burke, Harry K., and Shirley, Joseph F. San Manuel's New Process for Molybdenite Recovery. Min. Eng. v. 17, No. 3, March 1965, pp. 79–84.

from copper ores, compared with 7.7 ounces of silver for each ton in 1964. The four leading silver producers in the State—Phelps Dodge Corp., Asarco, Duval Corp., and Shattuck Denn Mining Corp.—accounted for 74 percent of the total State output; in 1964, the same companies furnished 71 percent. Counties in which production was reported, listed in descending order of output, were Pima, Cochise, Pinal, Yavapai, Mohave, Greenlee, Gila, Coconino, Santa Cruz, Maricopa, and Yuma.

Tungsten.—A small quantity of tungsten concentrate (65.51 percent WO_3) was produced from ore mined at the Carboloy mine in Pima County in 1964 and shipped to Kennametals, Inc., Fallon, Nev., by Fernstrom Mining Co.

Uranium Ore.—Shipments of crude ore from 26 operations to processing plants at Tuba City; Grand Junction, Colo.; Shiprock, N. Mex.; and Mexican Hat and Moab, Utah, totaled 117,898 short tons, valued at $3.9 million, an increase of 15 percent in quantity and 20 percent in value. The f.o.b. mine value of the ore produced ranged from $1.96 for crude ore containing 0.07 percent uranium oxide (U_3O_8) to $145.50 per ton for crude ore containing 1.51 percent U_3O_8. The average grade of ore shipped from mines during the year was 0.38 percent U_3O_8, comparable with that shipped in 1964. The average value of the mine shipments was $33.24 per ton. The Orphan Lode mine, owned by Western Equities, Inc., on the south rim of the Grand Canyon, was the principal source.

Vanadium.—Uranium ores in Apache County, and to a lesser extent in Navajo County, contained sufficient quantities of vanadium to warrant recovery.

Zinc.—Ores from four lode mines, three in Yavapai and one in Pima County, yielded 96 percent of the recoverable zinc produced in the State. Output declined 12 percent in quantity and 5 percent in value because of lower grade ore mined at the Iron King mine operated by Shattuck Denn Mining Corp. and because of a decline in ore production at Old Dick Division mines operated by Cyprus Mines Corp. According to the company annual report, reserves of developed ore at the Old Dick and Copper Queen mines were essentially exhausted at yearend.

NONMETALS

Asbestos.—Output of asbestos—dust, sands, and fiber—from three underground mines in the Salt River Valley of south central Arizona totaled 3,500 short tons valued at $441,000. The leading producer, Jacquays Mining Corp., selectively mined and hand-sorted chrysotile asbestos ore at the Regal and Chrysotile mines for shipment to the company mill at Globe. Production also was reported by Asbestos Manufacturing Co. from the Phillips mine and by Metate Asbestos Corp. from the Lucky Seven mine. Prices ranged from $6 per ton for chrysotile sand (tails) to $460 per ton for filter-grade material.

The Fort Apache Indian Agency at Whiteriver issued a call for bids for leasing two tracts of tribal lands in Gila County. The tracts have had a history of commercial production.

Cement.—Activity in the Arizona cement industry declined in 1965. Arizona Portland Cement Co., a division of California Portland Cement Co., and Phoenix Cement Co., a division of American Cement Corp., produced portland and masonry cements at plants in Pima and Yavapai Counties, respectively. Shipments of cement were 24 percent below those of 1964. Average price per barrel for portland and masonry cements remained aprpoximately the same; the downward trend in shipments reflected the decline in construction.

Portland-cement capacity was 5.3 million barrels, the same as in 1964. The entire output was by the dry process. All electrical energy used by the cement industry was purchased. Cement stocks at the end of the year were more than those at yearend 1964. Of the total shipments, 75 percent was shipped by truck and 25 percent by rail. Most of the shipments were in bulk form (83 percent); 17 percent was in containers.

Clays.—The quantity of bentonite and miscellaneous clays produced at mines in the State declined; that of fire clay increased slightly. The lower output of miscellaneous clay was attributed to reduced construction activity. Increased demand for clay products manufactured by McKusick Mosaic Co. accounted for a larger production of fire clay. Miscellaneous clay and shale used in manufacturing building brick and portland cement comprised most of the total output.

Bentonite clays were mined from two deposits, one each in Apache and Yavapai Counties; miscellaneous clay came from three deposits in Pima County, two in Maricopa County, and one in Yavapai County; and fire clay came from a deposit in Gila County. Most of the clays were mined at captive operations.

Diatomite.—A small quantity of crude diatomite—prepared and sold for use as a filler—was mined by Arizona Gypsum Corp. from its White Cliffs property near Mammoth, Pinal County.

Feldspar.—Industrial Minerals Division, International Minerals & Chemical Corp. (IMC), was the only producer of crude and ground feldspar in the State. All of the crude potash feldspar produced by a contractor for IMC from the pegmatite deposits at the Taylor mine was ground in the company mill near Kingman and used in manufacturing glass, pottery, and soaps and abrasives.

Gypsum.—The gypsum industry in Arizona in 1965 consisted of five mining operations; three in Pinal County and one each in Yavapai and Yuma Counties. Output was lower than in the previous year. National Gypsum Co. calcined crude gypsum obtained from the company open pit mine near Winkelman (Pinal County) at the company plant at Phoenix for use in manufacturing wallboard, lath, and other plaster products. Gypsum mined by Arizona Gypsum Co. from deposits near Winkelman and Camp Verde in Pinal and Yavapai Counties was sold uncalcined for use as a cement retarder and as a soil conditioner. Garcia Gypsum Co. sold crude gypsum from an open pit deposit near Mammoth; Harquahala Gypsum Co. sold the product from an underground deposit near Salome for use as a soil supplement.

Lime.—Marketed quicklime (calcium oxide) and hydrated lime (calcium hydroxide) increased 15 percent because of a greater demand for quicklime by the copper industry. Of the quantity sold or used, 94 percent was quicklime and 6 percent was hydrated lime. Chemical and industrial uses consumed most of the output; included were 178,000 tons used by the copper industry. Sales for use by the construction industry, principally for soil stabilization, were higher. A small quantity was consumed in refining magnesium, in manufacturing open-hearth steel, and in gas purification.

Most of the lime was used within the State; a small quantity was shipped to consumers in California, New Mexico, and Mexico. About 48 percent was used by a captive market. Morenci, Ray Mines, and San Manuel used their entire output for concentrating copper ore. Lime was produced and sold by Paul Lime Plant, Inc., in Cochise County; Hoopes & Co. in Gila County; and U.S. Lime Division, The Flintkote Co., in Yavapai County.

Six companies operated six plants in five counties—one each in Cochise, Greenlee, Pinal, and Yavapai, and two in Gila. Greenlee County replaced Cochise County as the leading producer in the State. Cochise County, the second largest producing county, was followed in order by Gila, Yavapai, and Pinal Counties.

Approximately 392,000 tons of limestone was used in producing the lime. Natural gas was used as fuel for one Ellernan, seven rotary, and five shaft kilns used in the State; fuel oil was used for one rotary kiln.

Mica.—A small quantity of scrap mica produced by Buckeye Mica Co., at its mine near Buckeye in Maricopa County, was dry-ground in the company mill in Buckeye. The ground mica was sold for use in manufacturing paint.

Perlite.—Output of crude perlite from three mines in Pinal County increased 4 percent in quantity but declined 11 percent in value. Most of the crude was shipped to processing plants outside the State. Arizona Perlite Roofs, Inc., operated the Adams and Iberri mines near Superior in Pinal County and shipped crude perlite to the Supreme Perlite, Inc., expanding plant in Maricopa County and to an expanding plant outside the State. Expanded perlite produced by Supreme Perlite, Inc., at Phoenix was used as a concrete aggregate, as an aggregate replacing sand in plaster, as loose-fill insulation, and as a soil conditioner. Harborlite Corp. operated the Harborlite perlite mine in Pinal County and shipped crude perlite to company-owned and other expanding plants outside the State.

Pumice.—Output of pumice and pumicite materials from 11 mines—12 operations, collectively, in Apache, Coconino,

Graham, and Yavapai Counties—increased 45 percent in quantity but declined 2 percent in total value. An increased demand for pumice and pumicite material as railroad ballast was the principal reason for the higher output. Pumice produced for use as road base and surfacing material in Apache and Coconino Counties increased, partly offsetting the decline in pumice and pumicite materials used as concrete aggregate. Accounting for 37 percent of the Nation's requirements, Arizona led all other States in the output of pumice and pumicite materials.

Pyrites.—Ray Mines recovered pyrites as a byproduct in milling copper ores. The pyrite was used in manufacturing sulfuric acid and sponge iron. The company also purchased a quantity of pyrite from the Magma mine as a supplemental feed for its sulfuric acid and sponge iron plant. Sulfuric acid was used in leaching copper from waste dumps and with sponge iron in leaching and precipitating oxide copper by the leach-precipitation-flotation process. Production of pyrites increased 29 percent in quantity and in value over that of the preceding year.

Sand and Gravel.—Sand and gravel ranked second in value of mineral output. Of the 14.9 million tons produced, 7.4 million tons was Government-and-contractor output used for highway construction; 7.6 million tons was classified commercial. Production was reported from 59 commercial and 84 Government-and-contractor operations. Approximately 90 percent of 7.3 million tons shipped by commercial carrier was by truck and 10 percent by rail.

Table 10.—Sand and gravel production in 1965, by counties

(Thousand short tons and thousand dollars)

County	Quantity	Value
Apache	277	$367
Cochise	341	350
Coconino	1,016	903
Gila	93	132
Greenlee	104	113
Maricopa	4,737	5,829
Mohave	1,981	2,008
Navajo	1,186	1,201
Pima	1,811	2,173
Pinal	1,824	1,947
Yavapai	680	748
Yuma	868	850
Total	14,918	16,621

Stone.—Production of stone in Arizona declined 34 percent in quantity and value. Lower construction activity, resulting from overbuilding and a 3-month construction strike that occurred during the summer were the primary reasons for the decline. Stone produced by or for the use of Government agencies used in highway construction declined 74 percent in quantity and 72 percent in value below figures for the previous year. Large quantities of limestone were used in manufacturing cement and lime and as a flux in the smelting of copper ores.

MINERAL FUELS

Coal.—Coal owned by the Navajo and Hopi Indians was to be used for generating 1.5 megawatts of power at an electric generating plant to be constructed in Clark County, Nev., by Western Energy Supply & Transmission Associates (WEST), a group of public and private utilities. Under an agreement between Southern California Edison Co. and Peabody Coal Co., Navajo and Hopi coal reserves in the Black Mesa area were to be transported by pipeline or rail to the plant site in Nevada. The generating plant, to be known as the Mohave Steam Station, was to be constructed as a part of the regional power plan developed by WEST. The agreement called for an expected consumption of 140 million tons of coal to be delivered over a 35-year period.

Helium.—Helium was extracted from helium-bearing, naturally occurring gas produced from the Pinta Dome and Navajo Springs fields, Apache County, at the Kerr-McGee Corp., Navajo plant. Based on Arizona Oil and Gas Conservation Commission reports of gas production, helium content of about 8.5 percent, and on assumed helium recovery of 97 to 98 percent, the plant produced an estimated 58 million cubic feet of grade A helium during the year. This output would be an increase of more than 17 percent over the 1964 indicated production of 46 million cubic feet. At $35 per 1,000 cubic feet, the price established by the Federal Bureau of Mines for sale of Government-produced helium to Government and industrial consumers, the Navajo plant output was valued at $2 million.

Kerr-McGee marketed the helium production from the Navajo plant to private customers, principally on the West coast.

Nine wells in the Pinta Dome and two

Table 11.—Sand and gravel sold or used by producers, by classes of operations and uses
(Thousand short tons and thousand dollars)

Class of operation and use	1964		1965	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Construction:				
Building	1,782	$2,346	1,207	$1,601
Paving	782	912	491	591
Fill	[1] 202	[1] 101	153	105
Other	([1])	([1])	11	9
Industrial:				
Blast	[2] 161	[2] 348	[3] 51	[3] 76
Engine	---	---	([3])	([3])
Oil (hydrafrac)	([2])	([2])	18	196
Other	---	---	12	16
Total	2,927	3,707	1,943	2,594
Gravel:				
Construction:				
Building	2,484	3,149	1,553	2,056
Paving	4,117	4,881	3,409	3,945
Railroad ballast	[4] 698	[4] 373	[5] 54	[5] 36
Fill	([4])	([4])	548	535
Other	---	---	([5])	([5])
Miscellaneous	18	28	47	63
Total	7,317	8,431	5,611	6,635
Total sand and gravel	10,244	12,138	7,554	9,229
Goverment-and-contractor operations:				
Sand:				
Paving	1,167	1,373	1,274	1,429
Fill	64	49	92	84
Total	1,231	1,422	1,366	1,513
Gravel:				
Building	16	16	---	---
Paving	6,625	7,292	5,924	5,827
Fill	---	---	66	48
Other	---	---	8	4
Total	6,641	7,308	5,998	5,879
Total sand and gravel	7,872	8,730	7,364	7,392
All operations:				
Sand	4,158	5,129	3,309	4,107
Gravel	13,958	15,739	11,609	12,514
Total	18,116	20,868	14,918	16,621

[1] Fill and "other (construction)" sand combined to avoid disclosing individual company confidential data.

[2] Blast and oil (hydrafrac) sand combined to avoid disclosing individual company confidential data.

[3] Blast and engine sand combined to avoid disclosing individual company confidential data.

[4] Railroad ballast and fill gravel combined to avoid disclosing individual company confidential data.

[5] Railroad ballast and other gravel combined to avoid disclosing individual company confidential data.

Table 12.—Stone production in 1965, by counties

County	Short tons	Value
Apache	16	$24
Cochise	437,984	1,031,808
Coconino	149,981	390,118
Gila	159,649	240,706
Graham	W	W
Greenlee	W	W
Maricopa	2,772	15,176
Mohave	142,737	338,214
Navajo	W	W
Pima	553,882	621,008
Pinal	74,091	153,582
Santa Cruz	513	769
Yavapai	370,756	478,654
Yuma	274,088	397,938
Undistributed	307,572	503,178
Total	2,474,041	4,171,175

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

in the Navajo Springs fields yielded helium-bearing gas.

At yearend, Apache Drilling Co., Phoenix, and La Fleur Corp., Los Angeles, Calif., announced that construction was to begin on a new helium plant at Navajo. The new plant, to be near the Kerr-McGee plant, was expected to be in operation by January 1, 1967; planned output was 1 million cubic feet per month. Apache was to be the operator; La Fleur, owned by Douglas Aircraft Co., was to market the product.

Natural Gas.—Marketed natural gas increased 54 percent over that of 1964. Production was from the Bita Peak, East Boundary Butte, North Toh Atin, and Twin Falls Creek fields. With the exception of output from the one gas well at Bita Peak, all of the gas was associated with crude oil.

Petroleum.—Output of crude petroleum increased 52 percent, to 97,000 barrels. East Boundary Butte had the greatest production, 43,600 barrels; followed by Dry Mesa, 27,600; and Walker Creek, 19,400 barrels.

Thirty-three unsuccessful wells were drilled in the State: 29 exploratory and 4 development wells. Five of the exploratory wells marked the first drilling on lands in the Hopi Reservation—lands first available for leasing in 1964.

Leasing in the State was at a much lower level than in 1964 when the Hopi Reservation was opened for leasing. Total acreage leased in 1965 was 13,280 acres for a bonus of $227,284, an average of slightly more than $17 per acre.

Table 13.—Stone sold or used by producers, by kinds

Year	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
	Basalt and related rocks (traprock)		Granite		Limestone		Marble	
1961	285,371	$285,850	7,155	$7,155	1,099,455	$2,458,371	4,513	$60,732
1962	586,323	879,482	113,274	117,424	1,986,091	2,430,203	12,528	104,929
1963	80,816	208,716	20,705	32,738	1,771,114	2,307,107	22,713	287,042
1964	40,814	36,370	W	W	1,800,623	2,483,623	[1] 22,476	[1] 275,787
1965	W	W	236,735	362,186	1,601,867	2,146,626	W	W
	Sandstone		Slate		Other stone		Total	
1961	334,557	$942,155	------	------	851,276	$872,217	3,582,327	$4,626,480
1962	601,532	1,486,902	84	$837	1,033,310	1,596,130	4,333,142	6,615,907
1963	714,897	1,574,782	------	------	646,370	658,765	3,256,615	5,969,150
1964	788,171	1,675,194	------	------	1,107,096	1,811,973	3,759,180	6,282,947
1965	460,152	1,233,788	------	------	175,287	428,575	2,474,041	4,171,175

W Withheld to avoid disclosing individual company confidential data; included with "Other stone."
[1] Excludes dimension marble; included with "Other stone."

Table 14.—Stone sold or used by producers, by uses

Use	1964		1965	
	Quantity	Value	Quantity	Value
Dimension stone:				
Rough construction----short tons--	2,355	$23,957	3,037	$22,428
Rubble ----------do--	380	1,634	496	11,293
Rough architectural --cubic feet--	23,935	14,192	31,822	26,419
Dressed architectural ----------do--	34,962	57,226	13,252	27,174
Curbing and flagging ----------do--	106,211	122,612	52,744	52,542
Total (approximate, in short tons) ----------	15,300	219,621	10,900	139,856
Crushed and broken stone:				
Riprap ----------short tons--	977,720	1,618,123	286,073	413,228
Metallurgical ----------do--	526,962	1,147,114	530,658	1,138,903
Concrete and roadstone ------do--	676,340	925,825	362,684	731,568
Lime ----------do--	316,871	746,246	391,835	717,420
Other ----------do--	[1]1,246,026	1,626,018	[2] 891,890	[2] 1,030,200
Total ----------do--	3,743,919	6,063,326	2,463,140	4,031,319
Total stone (approximate, in short tons) ----------	3,759,200	6,282,947	2,474,000	4,171,175

[1] Includes stone used in abrasives, agriculture, animal feed, cement, ceramics, cleansers, exposed aggregates, gunite, landscaping, marble fines, mineral food, porcelain, pottery, roofing granules, terrazzo, and tile.

[2] Includes stone used in abrasives, animal feed, cement, landscaping, mineral food, roofing granules; in making book ends, clocks, etc.; and for unspecified use.

Table 15.—Drilling for petroleum in 1965, by counties

County	Dry	Total	Footage
Exploratory completions:			
Apache ----------	16	16	88,936
Coconino ----------	1	1	6,998
Graham ----------	1	1	5,321
Navajo ----------	7	7	37,852
Yavapai ----------	4	4	5,519
Total ----------	29	29	144,626
Development completions:			
Apache ----------	4	4	10,186
Total all drilling ----------	33	33	154,812

Source: Oil and Gas Journal.

REVIEW BY COUNTIES

Apache.—Mineral fuels accounted for 63 percent of the total value of mineral output in the county. All of the helium, the most valuable mineral commodity, petroleum, and natural gas produced in the State came from fields in Apache County. Fifty-five percent of the wildcat drilling in the State was in the county.

Uranium ore was mined at 18 operations —mostly from the Carrizo and Lukachukai Mountains in the northern part of the county. Principal producers were Vanadium Corporation of America; Pioneer Drilling Co.; Climax Uranium Co., a unit of Climax Division, American Metal Climax, Inc. Vanadium was recovered from Apache County uranium ores at the Grand Junction, Colo., and Shiprock, N. Mex., mills which were equipped with vanadium-recovery units.

The sharp decline in the output of sand and gravel and stone reflected a reduction in road construction in the county. Filtrol Corp. mined and processed nonswelling bentonitic clays from the Cheto mine near Sanders for use as a filter in refining mineral and vegetable or animal oils and fats. Pumice mined near Springerville by the Apache County Highway Department was prepared and used in road construction.

Cochise.—Copper mining in Cochise County, principally in the Douglas-Bisbee area, accounted for $50.3 million of the total value of mineral output. Construction materials—lime, sand and gravel, and stone —accounted for the remainder. Cochise County, the leading producer of gold in the State, ranked second in the output of silver and fifth in copper.

Phelps Dodge Corp., Copper Queen Branch, produced most of the gold, silver, and copper at the Copper Queen underground mine and at the Lavender open pit mine in the Warren district at Bisbee. The Copper Queen Branch, the oldest of the three big active branches, was the cradle of mining by Phelps Dodge in Arizona. According to the company annual report, production from this property was less than in 1964. The ratio of waste and leach material to ore mined at the Lavender Pit increased from 3.17:1 reported in 1964 to 3.87:1 in 1965. Part of the ore from the underground mine was shipped to the company smelter at Douglas; part was treated at the Lavender Pit concentrator. All of the concentrate produced at the concentrator was smelted at Douglas.

In November the company announced plans for a minor westward expansion of the Lavender open pit. The enlargement of the mine was expected to extend the life of the pit about 2 years.

Underground exploration continued during the year; the tonnage of ore developed was less than the tonnage mined. The system for pumping sand tailing into mined-out areas as waste fill, introduced into some parts of the mine in 1964, was extended throughout the mines in 1965. The system of waste fill has materially reduced expenses and speeded up mining operations. Metallurgical testing of mixed oxide-sulfide copper-bearing material was carried out at Bisbee. The application of automatic control of grinding in ball mills was studied.

The Douglas smelter, 40 miles east of the Copper Queen Branch operations at Bisbee, treated ores from the underground mines at Bisbee, concentrates from the Lavender Pit concentrator, and copper precipitates from leach material obtained from the Lavender Pit. The smelter also treated a small tonnage of other materials on a custom or toll basis. The tonnage of copper scrap treated at the smelter in 1965 was considerably higher than that of the previous year. During the year, improvements were made in facilities and methods for handling the increased flow of this material. At the Douglas smelter, adaptation of a mechanical tuyere-puncher, developed by the staff, was studied.

Small quantities of gold, silver, copper, lead, and zinc were recovered from ores mined at seven small properties collectively. Siliceous copper ore produced at the Burro claims by Ira L. Moseley & Sons was trucked to Dragoon for rail shipment to the Asarco smelter at El Paso.

Interstate Accounting & Office Service continued work at the Mame mine of Hope Mining and Milling Co. in the Turquoise mining district. Pipelines installed between the Mame shaft and the Musso shaft provided an adequate supply of water for leaching. Cement copper was produced from the leaching of underground stopes.

Table 16.—Value of mineral production in Arizona, by counties

County	1964	1965	Minerals produced in 1965 in order of value
Apache	$5,483,255	$4,347,106	Helium, uranium ore, natural gas, sand and gravel, vanadium, petroleum, pumice, clays, stone.
Cochise	53,727,756	W	Copper, gold, silver, stone, lime, sand and gravel, zinc, lead.
Coconino	7,367,976	W	Uranium ore, pumice, sand and gravel, copper, stone, silver.
Gila	64,278,510	70,389,453	Copper, lime, molybdenum, asbestos, silver, stone, sand and gravel, gold, mercury, iron ore, clays.
Graham	W	W	Stone, pumice.
Greenlee	87,325,743	93,809,251	Copper, lime, molybdenum, silver, stone, gold, sand and gravel.
Maricopa	9,088,660	6,004,733	Sand and gravel, mercury, mica (scrap), clays, stone, silver, copper, gold.
Mohave	2,092,263	19,586,739	Copper, molybdenum, sand and gravel, silver, stone, feldspar, zinc, gold, lead.
Navajo	1,004,117	1,468,466	Sand and gravel, uranium ore, stone, vanadium.
Pima	148,899,356	149,153,395	Copper, cement, molybdenum, silver, sand and gravel, gold, stone, zinc, clays, tungsten concentrate, lead.
Pinal	119,452,151	141,730,125	Copper, molybdenum, sand and gravel, gold, silver, gypsum, lime, pyrites, perlite, stone, diatomite.
Santa Cruz	356,623	377,323	Zinc, lead, copper, silver, gold, stone.
Yavapai	32,570,543	33,054,812	Copper, zinc, cement, lead, silver, molybdenum, sand and gravel, gold, stone, lime, gypsum, clays, iron ore, pumice.
Yuma	2,428,721	1,290,738	Sand and gravel, stone, lead, gypsum, silver, zinc, gold, copper.
Undistributed [1]	r 277,271	58,969,629	
Total	r 534,353,000	580,182,000	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W.

Sandstone quarried by Andrew J. Gilbert Construction Co. at the Gilbert Silica pit near Courtland was used as a smelter flux by Phelps Dodge Corp. at Douglas. A small quantity of miscellaneous stone was quarried for use as riprap by contractors for the Arizona Highway Department.

Sales and shipments of quicklime by Paul Lime Plant, Inc., near Paul Spur, were less than those of the previous year; sales of hydrated lime increased. The company operated four natural-gas-fired rotary kilns. The lime was sold primarily for industrial and chemical uses; smaller quantities were sold for use by the building and agricultural industries.

Limestone—used in producing its lime, as a flux by the copper industry, an aggregate in road construction, as a mineral food, and for other uses—was quarried by Paul Lime Plant, Inc., near Paul Spur.

Coconino.—The county was the leading producer of uranium ore in the State. All of the ore was produced by Western Equities, Inc., at its mine on the south rim of the Grand Canyon. Silver and copper were recovered as byproducts in the processing of uranium ores produced by Western Equities, Inc., at the El Paso Natural Gas Co. Tuba City Mill. Zontelli Western Mining Co. operated its precipitation plant at the Mardun copper sandstone mine in the White Mesa district, Navajo Indian Reservation, for producing cement copper.

Construction materials—pumice, sand and gravel, and stone—comprised 43 percent of the total value of mineral output in the county. Sand and gravel was produced from 14 pits; 80 percent was produced by crews and contractors for the Federal Bureau of Indian Affairs and by contractors for the Federal Forest Service and the Arizona State Highway Department. All of the sand and gravel sold by commercial operators and 83 percent of that used by Government-and-contractor operators was proccessed in portable plants.

About 89 percent of the total production was gravel; the balance was sand. Pumice and pumicite material produced at quarries in the Flagstaff-Winona area was sold for use as concrete aggregate, as railroad ballast, and in road construction. Paul Zanzucchi and Roberta Forehand produced volcanic cinders (pumice) from deposits near Flagstaff which was sold to Harenberg Block Co., Inc., in Flagstaff for manufacturing building block. Peter Kiewit Sons' Co. quarried and crushed sandstone and miscellaneous stone for use in road construction. Companies operating quarries in the Williams-Ash Fork-Drake area quarried and prepared dimension sandstone for use as a building stone and flagging.

Gila.—Output of copper and associated metals from mines in the Globe-Miami and Christmas areas furnished 98 percent of the total value of mineral production in the county. Nonmetallic minerals and mineral products, together with iron ore and mercury, accounted for the remainder.

Inspiration Consolidated Copper Co., operator of the Live Oak and Thornton open pit mines and Christmas underground mine, was the largest producer. According to the company annual report, the Live Oak and Thornton open pit mines were operated continually throughout the year, except for seven holidays and two 1-day wildcat strikes. Mine operations were routine, except for the month of December when heavy rains disrupted surface operations. The high rate of waste stripping was maintained, particularly on the Thornton West extension, established in 1963 and 1964. The division mined and treated 5.8 million tons at an average rate of 16,521 tons per day. The ore contained 0.894 percent total copper (0.416 percent oxide copper and 0.478 percent sulfide copper), indicating that the ore was slightly lower in grade than in the previous year. The ratio of waste to ore was higher (1.64:1 in 1965 and 1.59:1 in 1964); the higher ratio resulted from development work at the Thornton West extension.

The Inspiration Division used several processes for producing copper. Leaching-in-place was employed on waste dumps or mined-out areas. Copper was dissolved and subsequently precipitated as cement copper on scrap iron. In 1965, 7.19 percent of the total output by the Inspiration Division was obtained by this method. Vat leaching, a similar process involving the treatment of ore-grade material (part is acid soluble and part is not), accounted for 40.67 percent of the 1965 production. Leach solutions in this process were stripped of their copper content by electrowinning which produced a refined copper cathode and by precipitation in the form of cement copper. The leached ores were retreated by grinding and flotation concentration to liberate and recover the sulfide copper. This process recovered 40.18 percent of the total copper produced during the year. The remaining 12.8 million pounds representing 11.96 percent of the total production was recovered by separately treating ore particles too small for vat leaching, first by flotation concentration and then by agitation-leaching; the process produced a concentrate and a copper precipitate. Copper concentrates and precipitates obtained from the above processes were further treated by smelting and electrorefining to produce cathodes. A small quantity of copper precipitate was upgraded and sold for powdered metallurgy and chemical operations. Overall recovery through the refinery was 87.05 percent, compared with 85.33 percent in 1964.

Molybdenum content of the concentrate produced by retreating copper concentrates totaled 355,503 pounds, compared with 587,014 pounds in 1964. The smelter treated 176,112 tons of concentrates, precipitates, and other materials; 108,031 tons was company material, 68,081 tons was custom or toll intake. During the year one of the old reverberatories at the smelter was dismantled to permit construction of a large furnace. Design began in February 1965; completion was expected in the second quarter of 1966. The remaining reverberatory was operated at capacity; some material was shipped elsewhere for treatment to avoid accumulation of inventory. The new furnace was to handle normal smelter intake, and the remaining old furnace was to be held on standby.

Operations at the refinery were conducted at or near capacity during most of the year. Extensive repairs were made on the old section of the refinery principally to refining tanks, solution heating equipment, and facilities for byproduct recovery.

The company continued to have difficulty in mining the O'Carroll ore body of the Christmas underground mine, 10

miles north of Hayden. Early in the year, underground mining was curtailed because of ground movement on the 1,300-foot level. Extensive repairs required caused a decrease in production. With ground support a major problem, the ore body was mined in limited segments and back-filled as soon as possible. A new area in the mine was developed for mining by smaller stoping areas, a method permitting earlier back filling. The older areas in the mine were to be more extensively back filled at an earlier date than before. Course mill tailing, obtained from the treatment of open pit and underground ores, together with dump material, was used as back fill.

Concentrates produced from underground ores at the Christmas mine were trucked 36 miles north to Miami and discharged into railroad cars for transportation over the Inspiration railroad, a short distance up the hill to the company smelter for extraction of blister copper. Blister copper for producing refined cathodes was moved to the nearby Inspiration electrolytic refinery.

Miami Copper Co. Division, Tennessee Corp. (a subsidiary of Cities Service Co.) recovered copper from low-grade copper ores obtained from the Copper Cities open pit mine, from leaching low-grade dumps at the Castle Dome property, and from in-place leaching of ore at the Miami mine. The Miami mine, closed in 1959, had been operated by block caving. Copper concentrates produced at the Copper Cities mill were shipped to the smelter operated by Inspiration Consolidated Copper Co. at Inspiration. Copper precipitates from Copper Cities and Miami were trucked to the Phelps Dodge Corp. smelter at Douglas.

Ten other properties yielded ore from which gold, silver, and copper, collectively, were recovered. Ranchers Exploration and Development Corp. increased the output of copper precipitate at the Blue Bird mine near Miami and prepared to expand mining-leaching plant operations to produce 20,000 pounds of cement copper per day. Production was reported to have been limited by shortages of water. Asarco recovered silver and copper from silver tailing contained in dump material from the Christmas tailing dump. Copper ore, shipped from the Copper Hill mine by E. M. Moores, Jr., was used at Inspiration in smelting copper ore.

Nonmetals production accounted for 2 percent of the value of mineral production. Asbestos and lime were the main nonmetallic minerals produced. Jacquays Mining Corp. (Regal and Chrysotile mines), Metate Asbestos Corp. (Lucky Seven mine), and Asbestos Manufacturing Co. (Phillips mine) produced asbestos fiber, dust, and tails from ores obtained from deposits in the Salt River Valley. Crushed limestone produced at quarries operated by Hoopes & Co. near Miami and Ray Mines near Hayden was used in producing quicklime and as a flux in smelting copper ores. A small quantity of noncommercial granite and miscellaneous stone was obtained from deposits on the San Carlos Indian Reservation for use as rip-rap. George O. Gould shipped dimension sandstone from the Yellow Stone quarry near Pine for use as a decorative stone in fireplace (hearth) construction; a small quantity also was sold as rubble. McKusick Mosaic Co. mined fire clay from the Weary Lode No. 2 for use in manufacturing pottery and floor and wall tile.

Five properties yielded ore from which mercury was recovered. Output of crude ore totaled 3,132 tons containing 0.049 percent mercury, ranging from 0.02 to 0.25 percent. Most of the ore was retorted; only 4 percent was furnaced. Gordon K. Grimes, operator of the Rattlesnake mine, was the largest producer. A small quantity of magnetite ore was mined and shipped by H. M. Seitz from the Margaret-Howard mine for use as a processing agent. The deposit, located about 38 miles north of Miami, was as a contact metamorphic or pyrometosomatic replacement of Mescal limestone associated with diabase intrusives.

Graham.—The value of mineral production in Graham County declined. More than half of the value of mineral production was derived from crushed limestone at a stationary plant near Safford. Accounting for the remainder, volcanic cinders produced by Gila Valley Block Co. from the Pumice, Blue Bird, and Triangle claims were used as aggregate in manufacturing lightweight building blocks.

Exploration was conducted at the Copper Flat claims in accord with the terms of a lease with purchase option held by Newmont Exploration, Ltd., & Hecla Mining Co.

Greenlee.—Morenci Branch, Phelps Dodge Corp., the largest producer of copper in the State, was ranked second in the Nation. According to the company annual report, production of copper was 127,566 tons, compared with 129,406 tons in 1964. The open pit mine at Morenci was operated on the equivalent of 6.5 days per week. Operations were continual throughout the year, except for regular 2-week vacation shutdowns. Ratio of waste and leach material to ore was 1.55:1 compared with 1.61:1 in 1964.

Installation of the leach-precipitation-flotation system for recovering part of the nonsulfide copper content of the Morenci ores was completed and was partly in operation at the end of the year. The plant was to reach its designed capacity during the first half of 1966. Built at a cost of $18.7 million, the new system when operating at designed rate was to add 10,000 tons of copper to the annual output of the mine.

Work was continued on the application of X-ray analysis to the continuous analysis of feed, concentrate, and tailing streams in the concentrator and ore-dressing pilot plant. The mechanical tuyere puncher developed by the Morenci staff was installed at the Morenci smelter.

The Blue Ridge Dam project on East Clear Creek, a tributary of the Little Colorado River in central Arizona, begun in May 1963, was completed in November at a total cost of $6.9 million. The project provided additional water for the Morenci operation.

With increased quantities of water available, production of copper from leaching waste dumps was increased. Construction of a new precipitation plant, begun during the year, was to be operated in the second quarter of 1966. The new facilities, when operated on a full-year basis, were to increase copper production at Morenci an additional 15,000 tons per year.

Expansion of the Morenci pit was to require the relocation of a part of the town of Morenci over the next several years. This project was begun in 1965 with the relocation of the industrial railroad, some site preparation and design, and start of construction of the first new buildings, including the administration building and shopping center. Thirty-seven new houses also were under construction.

The Morenci mine yielded significant quantities of gold, silver, and molybdenum as byproducts from treatment of copper ores. Limestone mined by the company at the Morenci quarry was used as a flux and in manufacturing quicklime used for metallurgical purposes. The company also produced crushed sandstone from a quarry near Morenci for use as a flux in smelting copper ores.

Charles E. Stevens reported production of a small quantity of copper ore from the Molinar-Alaska mine in Copper Mountain mining district. The mine was recently reopened following the repairing, retimbering, and laying new track in 1,400-foot adit.

High-grade silica rock from the Harmony claims was quarried and shipped by O. Brice Willis to Phelps Dodge Corp. smelter at Morenci for use as a flux in the reverberatory furnaces.

Nonmetals accounted for about 2 percent of the total value of mineral production in the county. Sand and gravel was produced and most of it prepared in portable plants by contractors for the State highway department and crews of the county highway department for use in road construction and maintenance. A small quantity of miscellaneous crushed stone was produced by contractors for the Arizona Highway Department.

Maricopa.—Maricopa County was the leading producer of sand and gravel, producing 32 percent of the State's entire output. Nonmetals comprised 99 percent of the total value of mineral production of which 97 percent was sand and gravel. Thirteen commercial operators, utilizing 12 stationary and 4 portable plants, produced 4.4 million tons of sand and gravel valued at $5.4 million. More than 4.3 million tons of sand and gravel was produced for the construction industry. Much of the output came from pits in Buckeye, Mesa, Phoenix, and Tempe. United Materials, Inc., supplied most of the blast sand produced in the State. American Sand and Rock Co., a subsidiary of California Portland Cement Co., began producing precast, prestressed, hollow-cored, machine-extruded concrete slabs at its new Phoenix plant on April 6. The company produced sand and gravel for aggregate from pits near Phoenix.

Marble was quarried and dressed at the Harquahala quarry by Agnes D. Mick for decorative use in building construction. Dimension sandstone for rough architectural use was quarried by Apache Building Stone at the Drum, Lemons, and Sunflower quarries. Contractors for the Arizona Highway Department quarried miscellaneous stone for riprap. Scrap mica produced at the Buckeye mine by Buckeye Mica Co. was ground at the company mill near Buckeye for use in manufacturing paint.

More than 75 percent of the output of mercury in the State was recovered by furnacing ores from the Big Sam and Pine Mountain mines north of Sunflower.

Output of crude ore totaled 8,119 short tons, averaging 0.062 and ranging from 0.04 to 0.8 percent mercury. Most of the ore was furnaced, approximately half the ore being treated in 50-ton Gould rotary furnaces, the other half treated in a 100-ton Shutte furnace.

Miscellaneous clay for manufacturing building brick was mined by Phoenix Brick Yard and Wallapai Brick & Clay Products, Inc., at deposits near Phoenix. Small quantities of gold, silver, and copper were recovered from ores mined by several small producers in the county.

Mohave.—The value of mineral production in Mohave County increased eightfold ($2 million in 1964 to $19.6 million in 1965) because of the first full year of production at the Mineral Park copper-molybdenum mine near Kingman, owned and operated by Duval Corp. The corporation produced all of the molybdenum and most of the gold, silver, copper, and zinc output in the county. A small quantity of gold, silver, copper, lead, and zinc, collectively, was obtained from seven lode operations in the Cedar Valley, McConnico, and Wallapai mining districts and in the Hualpai Indian Reservation.

Contractors for the Arizona Highway Department and crews of the Federal Bureau of Reclamation furnished 1 million tons of paving sand and gravel used on highway construction. Commercial production valued at $1.1 million was mainly sand and gravel for buildings and roads. Three commercial operators reported production at four operations. Basalt quarried by Peter Kiewit Sons' Co. was used as concrete and road material. Crushed quartz from the Taylor mine near Kingman, operated by a contractor for IMC, and from the White Spar quarry, operated by C. F. Weeks, was used in manufacturing abrasives. Feldspar, also from the Taylor mine, was ground by IMC and shipped to consumers in California, Ohio, Texas, Washington, Wisconsin, and the Philippines. Miscellaneous stone, quarried by contractors for the Arizona Highway Department, was crushed and used for road construction.

Navajo.—Sand and gravel was the principal mineral commodity, accounting for 82 percent of the total value of mineral output. Contractors for the Federal Bureau of Public Roads, Federal Forest Service, Arizona Highway Department, and the city of Winslow produced 605,000 tons of paving sand and gravel.

Uranium ore production supplied $202,143 of the $1.5 million value of mineral production. The major producer was Industrial Uranium Co., operator of the Moonlight and South Sunlight mines. Properties of the A & B Mining Co., Atlas Minerals Division, Atlas Corp., Robert Shriver, and Grant L. Shumway were operated during the year. A small quantity of vanadium was recovered from uranium ores produced by A & B Mining Co. and Robert Shriver from the Monument No. 1 and Mitchell Mesa mines.

Pima.—Five mines—New Cornelia, Mission, Esperanza, Silver Bell, and Pima—were the source of 99 percent of the copper produced in the county and 26 percent of that produced in the State. Production of copper from the county was 12,845 tons below 1964 output, reflecting principally a lower output at Pima, Daisy, Silver Bell, and Esperanza mines. Output of molybdenum rose 34 percent in quantity and 61 percent in value. Nonmetals—cement, clays, sand and gravel, and stone—production was lower.

The 1965 annual report for Duval Corp. reported total production from the Esperanza open pit mine (33 miles southwest of Tucson) about 21,600 tons of copper and 1.4 million pounds of molybdenum. Production of copper from leach dumps supplemented the output of copper from the 12,000-ton-per-day concentrator operated by the company. On August 1 the company acquired the open pit equipment and employed most of the personnel of the mining

contractor (Isbell Construction Co.) at Esperanza and Mineral Park in Mohave County and commenced mining operations at these properties. The company completed plans for centralizing exploration, research, and planning at Tucson. Construction of a new office-laboratory building neared completion at the end of the year. The centralization of the exploration, research, and planning groups was to improve coordination of personnel and facilitate investigation and evaluation of new projects.

The 1965 annual report issued by Cyprus Mines Corp. stated that Pima Mining Co. (50 percent owned by Cyprus Mines Corp.) mined and milled 2.6 million tons of ore averaging 0.76 percent copper and produced 18,000 tons of contained copper. In 1964, production totaled 2.9 million tons of ore containing 1.17 percent copper and 30,000 tons of contained copper. Copper concentrates produced from ore from open pit mines milled in the company mill were shipped to Asarco for smelting and refining. In April, the company approved plans to expand daily plant capacity to 18,000 tons of ore. By yearend, this expansion was about 70 percent completed and was scheduled to go on stream in April 1966. The larger mill was to lower unit costs and make it profitable to process lower grade ores from areas adjoining the present pit, extending the life of the mine into the 1980's.

Banner Mining Co. reported that proceeds from the mining of Daisy ore by Pima Mining Co. under a custom mining and milling agreement between the two companies increased 80 percent, from $694,623 to $1,247,975. This increase was due, primarily, to increased copper prices.

According to the Phelps Dodge Corp. annual report, production of copper from the New Cornelia Branch, Ajo mine, increased slightly. The ratio of waste to ore mined in the Ajo open pit was 1.49:1, compared with 1.83:1 in 1964. Major developments at the property included the use of a new type of explosive, high-density hot ammonium nitrate, and the installation of remote controls on most of the locomotives used in the mine. The use of the new explosive, although more expensive than other ammonium nitrate explosives, permitted wider spacing between blast holes and a reduction in drilling requirements. The installation of remote controls in the locomotives permitted the trains to be operated by one-man instead of two-man crews. The remaining locomotives were to be similarly equipped in 1966. Automatic control of grinding in ball mills was studied.

In its annual report Asarco stated that production from the Mission copper mine totaled 35.9 million tons; 6.6 million tons was ore. Concentrates produced at the company mill contained 56,237 tons of recoverable copper. Although harder ore reduced grinding capacity at the mill, this reduction was more than offset by higher grade ore mined during the first half of the year. Construction was begun to expand mill capacity 50 percent by early 1967. The molybdenum byproduct plant was operated satisfactorily throughout the year.

At the Silver Bell mine, 40 miles northwest of Tucson, Asarco mined and milled 3.2 million tons of ore from the El Tiro and Oxide pits, recovering 19,167 tons of copper in concentrate form. Leaching of waste dumps provided an additional 2,312 tons of copper as precipitates. Leaching operations were expanded during the year. Molybdenum production was down slightly. Expansion of the company mill to increase capacity by one-sixth was to be completed by mid–1966.

According to its annual report, The Anaconda Company continued plans to expand copper production in Arizona. Exploratory drilling at the Twin Buttes area near Tucson disclosed a large low-grade sulfide copper ore body with appreciable molybdenum. Stripping of 600 feet of overburden was begun in September; plans for a concentrator were being made. Operations were scheduled to begin early in 1969. When complete, the mine and plant were to handle about 30,000 tons of ore per day. A shaft and underground workings at Twin Buttes provided access for investigation of the large zone of copper mineralization. Ore was tested metallurgically through a 200-ton-per-day pilot plant. Additional drilling supplied information concerning the characteristics of the ore and its commercial limitations. Drilling was continued at nearby Helvetia with favorable results.

Most of the gold and silver produced in the county was recovered as byproducts of copper mining. The New Cornelia mine

was the largest source of gold and the second largest of silver. The Mission mine ranked first in the production of silver and zinc. The small quantity of lead produced came from the Mission mine and two small lode mines. A small quantity of tungsten concentrates—recovered from ores obtained, mined, and milled at the Carbaloy mine by Fernstrom Mining Co.—were sold to Kennametals, Inc., Fallon, Nev.

Cement (portland and masonry) was the major nonmetal mineral commodity produced in the county in terms of value of mineral output, followed by sand and gravel and stone.

Arizona Portland Cement Co. manufactured portland and masonry cements by the dry process at its plant near Rillito from crushed limestone produced at the company quarry and from purchased slag, gypsum, and iron ore. Cement produced by the company was shipped to consumers in and out of the State. Grabe Brick Co., Inc., Phoenix Brick Yard, and Tucson Pressed Brick Corp. mined miscellaneous clay for use in manufacturing building brick.

Twelve commercial operators produced a total of 867,000 tons of sand and gravel valued at $1 million from 14 operations. The sand and gravel, processed in 10 stationary and 4 portable plants, was used principally for construction. A small amount was not processed. Contractors and crews of the Arizona Highway Department and the Pima County Highway Department, respectively, used the remainder. A small quantity of marble was mined and crushed at the Andrada quarry by Andrada Marble Co. and sold for use as roofing granules, landscaping, and animal feed. Sandstone produced and crushed by San Antonio Mine Co. near Ajo was sold to the copper producers as a smelter flux. The company also sold a small quantity of dimension sandstone from the San Antonio mine for use in building. Miscellaneous stone quarried by contractors for the Arizona State Highway Department was used as riprap.

Pinal.—Output of copper was 10 percent higher than that of the previous year, principally because of increased output at Ray Mines and the Magma mine. Gold and silver recovered principally as byproducts from copper refining in the county accounted for 2 percent of the total value of mineral production.

Kennecott Copper Corp., in its annual report, stated that Ray Mines Division near Hayden mined and milled 8.6 million tons of ore, compared with 6.9 million tons in 1964. Copper production from all sources totaled 72,153 tons, a 24-percent increase. The average grade of ore mined in 1965 contained 0.86 percent copper compared with 0.87 percent in 1964. Installation of a concentrate dryer permitted higher throughput in the reverberatory furnace and increased copper output. Site preparation and excavation were begun for a new primary crushing facility at the property. The new facility was to include a 54-inch gyratory crusher, a 54-inch conveyor belt, a 60-ton overhead crane, and a loading tunnel. When the new plant is completed, the existing crusher was to be dismantled to make way for planned pit expansion. Completion was scheduled for late 1966.

Pyrite recovered from the mill tailings and purchased from Magma Copper Co. was roasted in a fluidizing reactor as one step in producing sponge iron and sulfur dioxide for manufacturing sulfuric acid. The final reduction to sponge iron was accomplished in two parallel Bruckner furnaces which were directly fed by hot calcines from the fluidizing reactor. Sulfuric acid was used as a solvent for recovering nonsulfide copper in the ore. The sponge iron was used as precipitant for the dissolved nonsulfide copper. Copper from two underground and one open pit mines accounted for $130.4 million (92 percent) of the total value of mineral production in the county.

Magma Copper Co. operated the San Manuel and Magma underground mines. The San Manuel mine was developed by large-scale block-caving system; the Magma mine by square set and retreat-caving but more recently by sandfill. At the San Manuel Division, according to the company annual report, production of all metals, except silver, increased during the year. The sulfide content of the ore mined in 1965 was less than in the previous year; the increased tonnage of ore mined, however, more than compensated for the lower grade. The drop in grade resulted from lower grades of ore being mined in order to maintain the normal sequence of operations. During the year, the company mined 13.5 million tons of ore assaying 0.773 per-

cent sulfide copper, compared with 12.4 million tons assaying 0.828 percent sulfide copper in 1964. Tons of ore mined per operating day increased from 34,756 tons in 1964 to 37,791 tons in the current year. With completion of a $10 million expansion program, plant capacity was increased 12 percent in July. The San Manuel concentrator treated 13.4 million tons of ore at an average of 37,591 tons per operating day. Approximately 88 percent of the total copper and 92 percent of the sulfide copper were recovered. Copper per ton of ore mined in 1965 was 13.89 pounds compared with 14.88 pounds in 1964. A total of 314,750 tons of copper concentrates assaying 30.24 percent copper was processed at the smelter, compared with 316,547 tons assaying 29.91 percent in 1964. Tons smelted per operating day averaged about 880 tons in 1965. Metal production at San Manuel was 93,767 tons of copper, 5.7 million pounds of molybdenum sulfide, 21,550 ounces of gold, and 273,610 ounces of silver.

From quarries operated by the company, San Manuel furnished 58,765 tons of limestone and 14,532 tons of quartzite for metallurgical purposes.

Copper production at the Magma mine increased about 14 percent during the year. The mine yielded 439,911 tons of ore assaying 4.65 percent copper, 0.031 ounce of gold, and 0.99 ounce of silver, compared with 377,575 tons of ore assaying 4.78 percent copper, 0.030 ounce of gold, and 0.85 ounce of silver in 1964. Metal production was 19,452 tons of copper, 12,748 ounces of gold, and 408,366 ounces of silver.

A replacement ore body in a limestone strata lying some 410 feet stratigraphically above the area being developed and mined was discovered by diamond drilling during the last half of the year. Indications were that the new ore body, outlined between the 3,600- and 3,300-foot levels, may contain 2 million tons of ore containing approximately 6 percent copper. Underground workings did not provide access to obtain information regarding the extent of mineralization below the 3,600-foot level. The determination and evaluation of the economic possibilities of the ore body were expected to influence the life of this property.

Americana Investments, Inc., Phoenix, stockpiled gold ore obtained from the Golden Beauty vein at the White Chief mine. Development work, including shaft sinking, was continued to evaluate known mineralized areas at the property. The White Chief mine, owned by Triumph Mines Co., Inc., was held by Americana under a 5-year lease.

Phelps Dodge Corp. received daily shipments of siliceous flux ore from an open pit at the Pico Nos. 1 and 2 mine operated by A. W. Robart.

McFarland & Hullinger shipped open pit copper silica ores from the Del Oro mine and gold-silver tailings from the Mammoth and Tiger tailings dumps to the Asarco smelter at Hayden. Little Hill Mines shipped additional quantities of copper and silver fluxing ores to the smelter from the Canyon Pit, Copper Rose, Gold Hill, and Hilltop open pit mines in the Old Hat mining district.

Nonmetals accounted for 2 percent of the total value of mineral output. Crude gypsum, mined by Arizona Gypsum Co. and National Gypsum Co. near Winkelman and by Garcia Gypsum Co. near Mammoth, was shipped to wallboard and cement plants; some was used locally for agricultural purposes. Arizona Gypsum also produced a small quantity of diatomite from the White Cliffs mine near Mammoth for use as a filler. Lime was produced by San Manuel for use at the San Manuel concentrator. Crude vermiculite from Montana was exfoliated by Ari-Zonolite at a plant in Phoenix; the product was sold for use in acoustical and thermal insulation, as an aggregate in plaster and concrete, and as a soil conditioner. Perlite produced by Arizona Perlite Roofs, Inc., and Harborlite Corp. was expanded at Tucson and out-of-State expanding plants for use in building plasters and other construction applications and as filter aids. Contractors for the Arizona Highway Department and crews and contractors for the Pinal County Highway Department produced most of the sand and gravel in the county.

Santa Cruz.—Gold, silver, copper, lead, and zinc were recovered from five lode mines, collectively, and cleanup at the Trench mill. The Trench mill, located in the Harshaw district, was reopened in the middle of May by Nash-McFarland, Inc. Lead, zinc, and silver ores from the January mine, owned by Asarco and operated by Nash-McFarland, Inc., were hoisted up

the trench shaft and trucked to the mill. Dewatering of the January and Trench mines was started in November 1964; mining began the following April. Arivaca Mining Co., operator of the Glove mine in the Tyndall district, prepared to sink the main vertical shaft at the mine from the 360-foot to the 460-foot level, crosscut to the main ore zone, and raise an additional shaft to the surface. Lead-zinc ore from the mine was trucked to Amado for rail shipment to the Asarco smelter at El Paso. Ore mined by the company at the Arizona mine in the Oro Blanco district was trucked 20 miles to the Cerro Colorado mill northwest of Arivaca for processing. A bulk concentrate containing lead, copper, and zinc was produced and stockpiled for future shipment. Both mine and mill were operated by Arivaca Mining Corp. West Range Co. explored for molybdenum-copper ores at the Ventura mine in the Palmetto district.

Mineral rights to 8,656 acres in the Salero mining camp, located between Patagonia and Tubac, were purchased by Salero International Mining & Milling Co. of California. The camp, first developed in 1895, had been idle nearly 50 years. The property, a high-grade copper, silver, and lead-zinc source, was worked for low-grade ores during World War I.

Yavapai.—Gold, silver, copper, lead, and zinc comprised 78 percent of the total value of mineral production. Except for molybdenum and iron ore, nonmetals production, led by cement, accounted for most of the remainder. The Iron King mine at Humboldt, operated by Iron King Branch of Shattuck Denn Mining Corp., was the leading producer of gold, silver, lead, and zinc in the county. According to the company annual report to shareholders, 44,855 tons of concentrates was recovered at the company mill from the milling of 333,743 tons of ore; the ore contained 15,677 ounces of gold, 589,377 ounces of silver, 71,570 pounds of cadmium, 9,176,020 pounds of lead, 543,451 pounds of copper, and 27,247,330 pounds of zinc. The 333,743 tons of ore mined and processed during the year constituted an alltime high for the Iron King mine. Approximately 92 percent of this production came from the 2,300- and 2,400-foot levels; the remaining 8 percent was produced from the upper levels at the southern end of the ore body. A modified system of sublevel stoping facilitated mining of the lower one-half of the stopes by normal shrinkage methods and the upper one-half by vertical long-hole stoping. This system has resulted in reduced cost and better grade control.

The grade of ore at the Iron King mine had decreased as deeper levels were developed. The company reported that the decrease in grade was offset by lower operating costs and increased metal prices. Overall operating costs were reduced by 2.8 percent.

Exploration was conducted within the mine to evaluate known areas and to search for new ore bodies. Drilling on the north end of the ore zone did not reveal minable widths. Strong mineralization was present and deeper drilling was planned to explore the possibility of greater widths at depths. South of the main ore body, the grade of ore appeared to increase with depth. A program of deeper drilling was planned in this area.

The Bagdad mine, Bagdad Copper Corp., was the principal producer of copper in the county and the tenth largest producer in the State. As reported to shareholders in the annual report, the company produced 20,275 tons of copper. Recovery of copper from sulfide ores was 24.7 million pounds, an increase of 4 percent over the 23.8 million pounds in 1964. Average ore grade during 1965 was 0.83 percent, compared with 0.77 in 1964. The increase in grade accounted for the increased production. Recovery of copper by leaching ores in place increased about 2 percent: 15.5 million pounds in 1964 compared with 15.8 million pounds in 1965. Molybdenum shipments during 1965 were 453,364 pounds, compared with 276,624 pounds in 1964. The sharp increase resulted from changes made in the molybdenum recovery circuit. Stripping was continued at a high rate during the year and was well ahead of mining operations. By the end of 1966, the present ore body was expected to be sufficiently developed to reduce the rate of stripping.

Construction at the refinery, a joint venture between Bagdad Copper Corp. and Chemetals Corp., was being scheduled; the plant was to be completed in May 1966. The primary product of the refinery was to be pure copper powder; the refinery also would be capable of producing high-purity copper briquets suitable for melt stocks.

Bagdad Copper Corp. obtained an option on a mica property at Buckeye. At the time of acquisition, the property was yielding a low-grade ground mica used chiefly as roofing material. During the option period, the company was to study feasibility of adapting new processes which would produce a much higher grade product. During the same period, the company was to evaluate markets for this higher grade product.

Phoenix Cement Co. produced portland and masonry cements at its cement plant near Clarkdale. Limestone, clays, and shale used in manufacturing these cements were obtained from the company-owned Redwall limestone quarry and Lakebed clay deposits. Slag, gypsum, and resin for manufacturing cements were purchased by the company.

Arizona Gypsum Corp. operated gypsum and clay deposits near Camp Verde. Bentonitic clays dug by the company were sold for use in pelletizing ores and for reservoir pond or ditch lining. Crude gypsum ores mined by the company were sold for use as a portland cement retarder and in treating alkali soils. Yavapai Block Co. produced a small quantity of scoria for use as a lightweight aggregate in manufacturing lightweight building block.

U.S. Lime Products produced quicklime and hydrated lime at the lime plant from limestone quarried and crushed by the company at the Nelson quarry. The quicklime was sold for use by the coke, gas, magnesium, and steel industries and in the concentration of copper ores. Hydrated lime was sold for construction purposes, for use in the concentration of copper ores, and for other chemical and industrial uses.

Iron ore obtained from the Cowden and Iron Chancellor hematite deposits, 19 miles south of Seligman, was sold by G. A. Swartz and Arizona Gypsum Corp. for use in manufacturing sponge iron. Ore from the Cowden deposit was hauled by trucks to Seligman, ground to minus 8 mesh, and shipped by rail to Ray Mines for use as sponge iron in the LPF plant at Hayden. Ore from these deposits was high grade, red to black hematite, containing about 61 percent iron, low silica, and moisture.

Contractors for the Arizona Highway Department produced a small quantity of miscellaneous stone used as riprap. Additional quantities of stone were produced by commercial operators: Miscellaneous stone for concrete and road stone and dimension sandstone for building stone.

Sand and gravel was produced by commercial producers, contractors for the Arizona Highway Department, and crews of the Yavapai County Highway Department. Most of the product was paving sand and gravel produced by the Arizona Highway Department; small quantities of building sand and gravel and fill sand were produced by commercial operators.

Yuma.—Sand and gravel and stone—the principal mineral commodities produced in the county—accounted for 97 percent of the value of mineral output. Contractors for the Arizona Highway Department and contractors and crews of the Federal Bureau of Reclamation produced 627,000 tons of paving sand and gravel, valued at $557,000. Commercial operators—Arrow Transit Mix Concrete Co., Inc., Janney Sand and Gravel, Tanner Paving & Materials, Valley Sand and Gravel Co., and Yuma Builders Supply, collectively—produced 241,000 tons of building and paving sand and gravel valued at $293,000. Granite, limestone, and miscellaneous stone produced and crushed by contractors and crews of the Federal Bureau of Reclammation were used for riprap and as a concrete and roadmetal. Dimension sandstone produced by Western States Stone Co. and Apache Building Stone from the Scott-Weaver and Quartzite quarries was sold to the construction industry as rough construction and rough architectural building stone. Agricultural gypsum produced by the Harquahala Gypsum Co. at the Harquahala underground gypsum mine near Salome was sold and used uncalcined as a soil conditioner. Principle markets for the product were in the Aguila, Parker, Yuma, and Blythe, Calif., farming areas.

Gold, silver, copper, lead, and zinc were recovered from small lots of ore produced at five lode and two placer mines; gold, silver, and lead were recovered from lead tailings at the Ruby Nos. 1 and 2 dumps. E. F. Peterson and Associates shipped copper ore from their lease on the Black Mesa copper claims located about 6 miles from Brenda. The ore was trucked 32 miles to McVay for rail shipment to the Asarco smelter at Hayden.

The Mineral Industry of Arkansas

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the Arkansas Geological Commission, Norman F. Williams, Director and State Geologist, Little Rock, Ark., for collecting information on all minerals except fuels.

By Raymond B. Stroud [1]

Total value of Arkansas mineral production established a record high of $179.1 million, an increase of about 2.5 percent over the 1964 value. The increase in value of mineral output signified the fourth consecutive year of gain. Advancement production values, distributed among 11 mineral commodities, totaled about $7.5 million. Important value increases were recorded in output of seven commodities whereas substantial decreases were notable in production of four commodities.

Expanded outputs of bromine, natural gas, and sand and gravel accounted for the major part of the increased mineral value; a drop in output of crude petroleum was the principal cause of the decrease. Quantity of lime output was higher, but value was lower than that in 1964. Tripoli

[1] Geologist, Bureau of Mines, Bartlesville, Okla.

Table 1.—Mineral production in Arkansas [1]

Mineral	1964		1965	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Barite—short tons	233,455	$2,202	249,233	$2,379
Bauxite—long tons dried equivalent	1,561,984	17,431	1,593,085	17,974
Bromine—thousand pounds	W	W	32,254	7,171
Clays—thousand short tons	892	2,152	866	1,890
Coal—do	212	1,503	226	1,643
Gem stones	NA	33	NA	31
Lime—thousand short tons	189	2,814	192	2,776
Natural gas—million cubic feet	75,753	11,806	82,831	12,922
Natural gas liquids:				
Natural gasoline and cycle products—thousand gallons	30,082	1,678	27,787	1,578
LP gases—do	61,616	2,460	69,752	3,139
Petroleum (crude)—thousand 42-gallon barrels	26,737	71,120	25,930	68,974
Sand and gravel—thousand short tons	11,794	14,836	12,806	15,836
Stone (includes slate and shell 1965)—do	20,241	26,172	21,241	26,778
Value of items that cannot be disclosed:				
Abrasive stone, bromine (1964); cement, gypsum, iron ore, phosphate rock, soapstone, and tripoli (1965)	XX	r 20,611	XX	16,019
Total	XX	r 174,818	XX	179,110

r Revised. NA Not available.
XX Not applicable.
W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed".
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

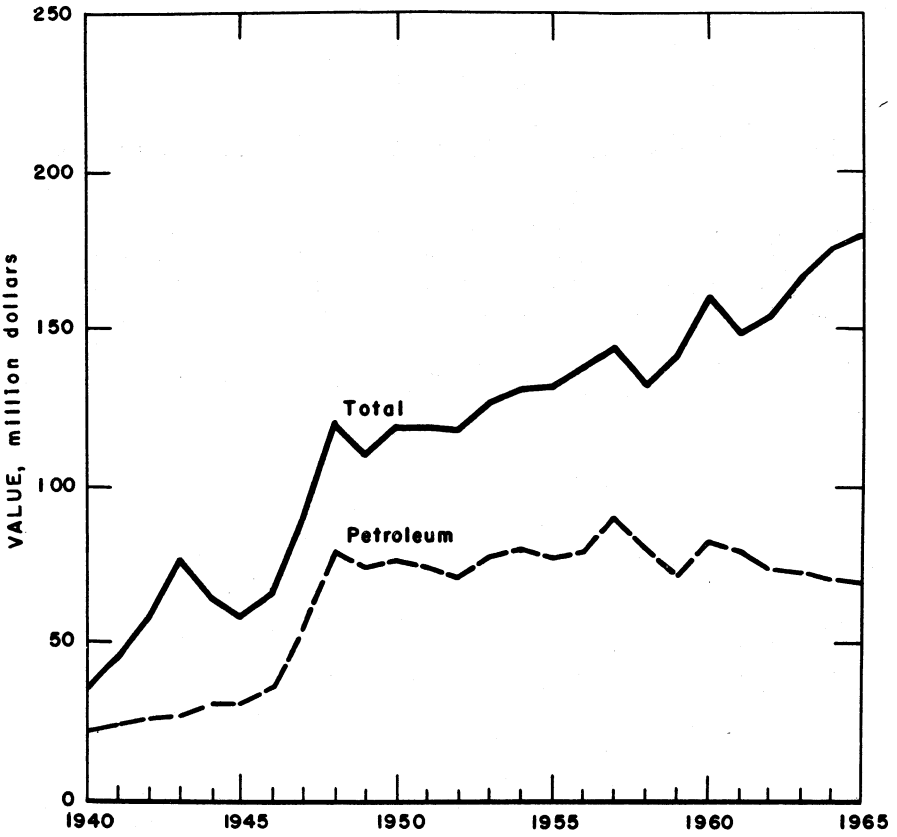

Figure 1.—Value of petroleum and total value of mineral production in Arkansas.

production was sufficient to warrant separate tabulation for the first time in several years.

Union Carbide Corp. announced plans for a $5 million mill for extraction of vanadium oxide from metal-bearing deposits at Wilson Springs in Garland County. The company indicated that plant operation was scheduled for mid-1967, but mining to stockpile ore would start late in 1966. The announcement generated interest in mineral deposits in this part of the State and signified the importance of one of the latent mineral resources of Arkansas.

Arkla Chemical Corp. continued construction of its $33 million Big River agricultural-chemical complex at Helena; the eight-plant installation was scheduled for operation in the last half of 1966. Products of the plants will include 600 tons of finished fertilizer per day; sulfuric, nitric, and phosphoric acids; diammonium phosphate; urea; anhydrous ammonia; and ammonium nitrate.

Continental Oil Co. began constructing its $20 million chemical plant near Blytheville in June. Operation of the plant was scheduled to begin in February 1966, with a production capacity of 1,000 tons of anhydrous ammonia daily. The plant will utilize about 40 million cubic feet of natural gas per day.

Construction of an experimental, nuclear-powered electric plant near Fayetteville was underway at yearend. The $25 million installation is a project of Southwest Atomic Energy Associates.

Arkansas Power & Light Co. began installing a 550,000-kilowatt steam generator near Helena. Operation of the new power unit was scheduled to start in 1968 and

will be in addition to a 357,000-kilowatt generator that was installed at the company's Helena station in 1961. Natural gas will be used as fuel.

Arkansas Electric Co-operative Corp. continued construction of its second steam-electric generating plant (Carl E. Bailey) near Augusta. The $12.5 million plant will have an annual capacity of 125,000 kilowatts and will provide a significant market for part of the State's newly developed natural gas supply sources.

Table 2.—Value of mineral production in constant 1957–59 dollars

(Millions)

Year	Value
1956	$143
1957	141
1958	133
1959	142
1960	158
1961	148
1962	152
1963	r 164
1964	r 172
1965	175

r Revised.

Employment.—Mineral industry payroll totaled about $26.1 million, more than 2 percent above that of 1964. Weekly wages, compared with related data for 1964, averaged $130.95 in metal mining, a 3-percent increase; $96.86 in coal mining, an 8-percent increase; $108.91 in production of crude oil and natural gas, a 4-percent increase; and $98.69 in nonmetallic mining and quarrying, a 5-percent increase. An average of 4,678 workers was employed each month by the mining industry.

Table 3.—Employment and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1964								
Coal	144	167	24	192	-------	2	10.44	52
Metal	1,494	344	514	4,118	-------	41	9.96	374
Nonmetal	642	241	155	1,240	-------	78	62.90	1,946
Sand and gravel	1,104	244	269	2,256	-------	45	19.94	901
Stone	1,861	260	483	3,981	-------	94	23.61	1,426
Total	5,245	276	1,445	11,787	-------	260	22.06	990
1965: p								
Coal	140	171	24	194	-------	3	15.46	77
Metal	1,940	301	584	4,679	1	45	9.83	1,622
Nonmetal	740	253	187	1,536	-------	49	31.90	761
Sand and gravel	1,000	284	284	2,385	-------	47	19.71	591
Stone	2,055	250	513	4,446	1	120	27.22	3,135
Total	5,875	271	1,592	13,240	2	264	20.09	1,822

p Preliminary.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Production of petroleum, natural gas, natural gas liquids, and coal, ranked in order of value, contributed 49 percent of the entire mineral value assigned to Arkansas. This is the first time in the history of statistical reporting that production of mineral fuels failed to account for more than half of the State's total mineral value. Combined value of the mineral fuels was $88.3 million, about the same as in 1964. Value increases shared by production of natural gas, natural gas liquids, and coal offset a decrease in value of petroleum output and resulted in consistency of the mineral fuels total value.

Coal (Bituminous).—Eight coal mines (four strip and four underground) produced 1,000 or more tons each. The total number of mines, three less than in 1964, accounted for a 6-percent increase in quantity of coal mined and a corresponding 9-percent increase in value over comparable 1964 data. Coal from strip

mines comprised 67 percent of the total coal output. Production of coal from underground and strip mines increased by less than 1 percent and about 9 percent, respectively. Johnson County coal output, from five mines, was 57 percent of the State's total; remaining coal production came from Franklin and Sebastian Counties.

Table 4.—Coal (bituminous) production [1]

(Thousand short tons and thousand dollars)

Year	Quantity	Value
1956–60 (average)	462	$3,584
1961	395	2,888
1962	256	1,809
1963	221	1,505
1964	212	1,503
1965	226	1,643

[1] Data from mines producing 1,000 tons or greater.

Oil and Gas Exploration and Development.—Development drilling in the State declined considerably, but there was increased exploratory drilling. Of the total number of holes bored, 77 percent was in southern counties. A wildcat well drilled in Pope County resulted in discovery of Furgerson field. The new source of natural gas was in the Allen No. 2 Sand of the Atoka Formation. New gas pools were also found in the Booger Hollow, Dover, Mansfield, and Dyer fields in north Arkansas. A new depth record of 13,837 feet was established in a dry hole in Logan County.

Table 5.—Oil and gas drilling in 1965, by counties

County	Development			Exploratory			Total
	Oil	Gas	Dry	Oil	Gas	Dry	
Ashley	----	----	----	----	----	1	1
Bradley	3	----	----	----	----	1	4
Calhoun	2	----	----	----	----	8	10
Columbia	6	----	4	1	----	6	17
Craighead	----	----	----	----	----	1	1
Crawford	----	11	1	----	----	1	13
Franklin	----	9	7	----	----	2	18
Hempstead	----	----	----	----	----	1	1
Johnson	----	7	4	----	----	----	11
Lafayette	20	----	21	3	----	14	58
Little River	----	----	----	----	----	1	1
Logan	----	3	----	----	----	3	6
Miller	1	----	3	----	----	5	9
Nevada	2	----	4	----	----	8	14
Ouachita	25	----	12	----	----	3	40
Pope	----	4	3	----	1	1	9
Pulaski	----	----	----	----	----	1	1
Scott	----	2	----	----	----	2	4
Sebastian	----	8	5	----	----	3	16
Sevier	----	----	----	----	----	1	1
Union	40	1	31	1	----	29	102
Total:							
1965	99	45	95	5	1	92	337
1964	165	45	117	1	1	85	414

Source: Arkansas Oil and Gas Statistical Bulletin, v. 24, No. 12, December 1964, through v. 26, No. 2, February 1966.

Medlock, Big Branch, Brushy Lake, Sunview, and Boggy Bottom oilfields were found by wildcat wells drilled in Columbia, Lafayette, and Union Counties. New oil pools were found in Plainfield, Gum Creek, Cypress Creek, South Hillsboro, Lick Creek, and Tom Creek oilfields, also in southern Arkansas.

A 58 percent success ratio was indicated in north Arkansas; 45 of 78 wells drilled resulted in gas wells. In south Arkansas, the success ratio was about 40 percent; 105 wells were completed as producers.

Pipeline Construction.—Arkansas-Louisiana Gas Co. completed its "North Arkansas Inch", a natural gas pipeline extending 240 miles across north Arkansas. The pipeline diameter ranges from 18 to 24 inches, and the Arkansas segment was part of a $25 million interstate pipeline system. Natural gas will be supplied for both domestic and industrial purposes. The Continental Oil Co. plant near Blytheville, Arkla Chemical Corp. fertilizer

Table 6.—Estimated proved recoverable reserves of crude oil, natural gas liquids, and natural gas

	Proved reserves, Dec. 31, 1964	Changes in proved reserves, due to extensions and new discoveries in 1965	Proved reserves Dec. 31, 1965 (production was deducted)	Change from 1964, percent
Crude oil----------thousand barrels--	205,160	20,803	201,026	−2
Natural gas liquids [1]----------do----	19,010	−2,511	14,756	−22
Natural gas----------million cubic feet--	2,100,092	258,497	2,269,012	+8

[1] Includes condensate, natural gasoline, and LP gases.
Source: American Gas Association, American Petroleum Institute, and Canadian Petroleum Association. Proved Reserves of Crude Oil, Natural Gas Liquids, and Natural Gas. V. 20, Dec. 31, 1965, pp. 12–13, 24.

plant, Arkansas Power & Light Co. steam-electric generating plant at Helena, and the Arkansas Electric Co-operative Corp. steam-electric generating plant near Augusta will be the principal industrial users of natural gas supplied by the pipeline.

Natural Gas. — Output of natural gas reached a new record high, thus extending the upward trend for the ninth consecutive year. Value of the commodity was sufficient to rank it sixth among mineral commodities produced in the State.

Eight north Arkansas counties, led by Franklin, accounted for 75 percent of the total value of natural gas production. Columbia County was the leader among six south Arkansas counties registering outputs of the commodity. Sebastian, Columbia, Lafayette, and Crawford Counties, listed in order of value, followed Franklin County. Range in value was from about $1.1 million in Crawford County to about $4.7 million in Franklin County.

Natural Gas Liquids.—The overall output of natural gas liquids gained over that of 1964. Production of natural gasoline and cycle products declined, but the loss was offset by a substantial gain in output of liquefied petroleum gases. The commodities were recovered in six processing plants in Columbia, Lafayette, and Union Counties. Columbia County, with one plant, accounted for about 70 percent of the output. Humble Oil & Refining Co. acquired the McKamie plant in Lafayette County, formerly operated by McKamie Gas Cleaning Co.

Petroleum.—Output and value of crude petroleum diminished for the fifth consecutive year. Despite the decrease, the commodity continued to be the State's most important mineral product in terms of value, accounting for about 38 percent of the total value. Producing wells numbered 6,014 at yearend, 4 less than in 1964. Crude oil was obtained in eight counties in south Arkansas with Columbia,

Table 7.—Gross withdrawals and disposition of natural gas
(Million cubic feet)

Year	Gross withdrawals [1]			Disposition			
	From gas wells	From oil wells	Total	Marketed production [2] Quantity	Marketed production [2] Value (thousands)	Repressuring	Vented and wasted [3]
1956–60 (average)--------	26,940	39,980	66,920	38,101	$3,374	23,124	5,695
1961----------	45,800	42,100	87,900	59,547	8,039	25,748	2,605
1962----------	62,000	41,600	103,600	66,213	9,866	35,315	2,072
1963----------	57,700	41,500	99,200	76,101	11,796	19,191	3,908
1964----------	58,900	41,900	100,800	75,753	11,806	21,411	3,636
1965----------	57,500	46,500	104,000	82,831	12,922	20,155	1,014

[1] Marketed production plus quantities used in repressuring, vented, and wasted.
[2] Comprises gas sold or consumed by producers, including losses in transmission, quantities added to storage, and increases in gas in pipelines.
[3] Includes direct waste on producing properties and residue blown to air.

Table 8.—Natural gas liquids production
(Thousand gallons and thousand dollars)

Year	Natural gasoline and cycle products		LP gases		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
1956–60 (average)	38,777	$2,420	58,536	$2,783	97,313	$5,203
1961	27,889	1,640	75,157	3,286	103,046	4,926
1962	29,415	1,673	69,452	2,432	98,867	4,105
1963	26,219	1,466	66,377	2,497	92,596	3,963
1964	30,082	1,678	61,616	2,460	91,698	4,138
1965	27,787	1,578	69,752	3,139	97,539	4,717

Union, and Lafayette accounting for 78 percent of the total.

During the year, 42 pressure maintenance and secondary recovery projects were operated, utilizing water, gas, steam, and in-situ combustion methods.

Magnolia field in Columbia County retained its lead in production with about 27 percent of the total output.

Six refineries in south Arkansas processed an average of 78,818 barrels of crude oil daily during the year.

The State's oil and gas industry made progress toward eliminating pollution by brines recovered with oil and gas. More than 275 million barrels of brine was discarded into pits or injected into disposal wells, used in pressure maintenance projects.

NONMETALS

Value of the output of 13 commodities classified as nonmetals contributed about 41 percent of the total value of Arkansas mineral production. Nonmetals, ranked in order of value, were stone, sand and gravel, cement, bromine, lime, barite, clays, gypsum, abrasive stone, tripoli, soapstone, gem stones, and phosphate rock. Of the 13 nonmetals, 5 registered value decreases. Tripoli production was sufficient to warrant separate tabulation for the first time since 1949.

Construction projects by U.S. Army Corps of Engineers for development of river basins again created a major market for stone. About 3.4 million tons of stone valued at $2 million was consumed by Corps of Engineers projects. At yearend, both Dardanelle lock and dam and the Millwood dam projects were virtually complete. Construction of the final portion of the lock at the Dardanelle project was scheduled to begin in 1967. Beaver Dam was completed and construction of De

Table 9.—Crude petroleum production, by fields
(Thousand 42-gallon barrels and thousand dollars)

Field [1]	1964		1965	
	Quantity	Value	Quantity	Value
Champagnolle	662	$1,754	567	$1,508
El Dorado	457	1,211	367	976
Fouke	929	2,462	777	2,067
Irma			547	1,455
Magnolia	6,529	17,302	6,990	18,593
McKamie-Patton	1,579	4,184	1,292	3,437
Midway	2,403	6,368	2,436	6,480
Sandy Bend	550	1,458	506	1,346
Schuler	1,531	4,057	1,416	3,767
Smackover	3,168	8,395	3,226	8,581
Stephens	983	2,605	1,250	3,325
Village	420	1,113	388	1,032
Wesson	1,040	2,756	1,003	2,668
Other fields [2 3]	6,486	17,455	5,165	13,739
Total	26,737	71.120	25,930	68,974

[1] Breakdown of individual fields as reported in the "Oil and Gas Journal".
[2] Includes oil consumed on leases and net change in stocks held on leases for the State.
[3] Bureau of Mines figures.

Table 10.—Crude petroleum production, indicated demand, and stocks in 1965, by months

(Thousand 42-gallon barrels)

Month	Production	Indicated demand	Stocks originating in Arkansas
January	2,215	2,255	904
February	1,984	2,123	765
March	2,227	1,987	1,005
April	2,162	2,272	895
May	2,201	2,239	857
June	2,171	2,241	787
July	2,215	2,297	705
August	2,236	2,282	659
September	2,236	2,261	634
October	2,217	2,070	781
November	2,047	2,014	814
December	2,019	2,238	709
Total:			
1965	25,930	26,279	XX
1964	26,737	26,904	XX

XX Not applicable.

Gray and Gillham dams continued at yearend. Construction at 10 of the remaining 11 lock and dam projects to provide navigation on the Arkansas River was also underway at yearend. A principal part of the stone output was used in channel rectification and revetment projects along the Arkansas River. This part of the overall Arkansas River Project was classified as about 65 percent complete.

Arkansas State Highway Department started and completed several highway construction projects that provided markets for about 22 percent of the stone production and 44 percent of the sand and gravel output. Other Federal and State construction programs and public and residential building accounted for the remaining production of stone and sand and gravel.

Abrasive Stone. — Crude novaculite, mined by three companies in Garland County, was processed for oilstones and other types of abrasives. The crude stone had an average value of about 11 cents per pound. Total output and value of the commodity was substantially higher than in 1964.

Barite.—Output and value of barite increased over the 1964 figures. The gain reversed a 3-year downward trend. Magnet Cove Barium Corp. and Baroid Division of National Lead Co. mined and ground barite in Hot Spring County principally for use in well-drilling mud. The Milwhite Co., Inc., ground barite at a company plant in Saline County for various industrial applications. Arkansas continued to rank second in the United States in barite output.

Table 11.—Primary barite sold or used by producers

Year	Short tons	Value (thousands)
1956–60 (average)	352,550	$3,227
1961	277,855	2,630
1962	258,691	2,232
1963	236,077	2,161
1964	233,455	2,202
1965	249,233	2,379

Bromine.—A substantial rise in sales of bromine and bromine compounds accounted for a marked increase in bromine output during the year. Arkansas Chemicals, Inc., and Michigan Chemical Corp. were joined by Great Lakes Chemical Corp. in extraction of bromine from brines at plants in Union County. The latter company began bromine production late in the year upon completion of a new plant. The new bromine plant utilizes brines pumped from sources in the Smackover Formation at a depth of about 7,600 feet. Brines from Smackover Limestone contain 4,300 to 6,000 parts per million bromine. Establishment of the third bromine extraction plant in Arkansas ranked the State second in bromine productive capacity in the United States. Ethylene dibromide, the principal bromine compound, is used as a gasoline additive.

Cement.—A slight decrease in total cement output, comprised of portland and masonry cements, was registered for the first time since 1957. Part of the decrease was attributable to lower demand by U.S. Army Corps of Engineers projects which were nearing completion and which formerly provided a major market. Increased highway construction, other types of public construction and building, and residential building continued as principal markets for cement. Although below the record-high-production year of 1964, cement output remained substantially higher than in former years. Shipments of cement to Arkansas destinations, provided by both in-State and out-of-State plants, increased 19 percent over the 1964 shipments.

Arkansas Cement Corp. was adding new facilities to its cement plant at Foreman, thereby increasing cement production capacity to 5 million barrels annually. The expansion, which will cost an estimated $13 million, includes installation of a new 4,400-horsepower finish mill, material handling equipment, clinker cooling and crushing equipment, storage facilities for finished cement, and a third kiln. The plant operation consumes about 22.5 million cubic feet of natural gas per day. The new facilities were scheduled for use by midsummer 1966.

Table 12.—Shipments of portland cement to Arkansas consumers

Year	Thousand 376-pound barrels
1956–60 (average)	2,176
1961	2,968
1962	3,053
1963	3,556
1964	3,807
1965	4,519

Clays.—Clay production, classified as kaolin, fire clay, and miscellaneous, was 3 percent below that of 1964. Value of the clay output decreased more than $260,000. The drop was ascribed to reduced production of high-quality clays. In 15 counties, 14 firms mined and processed clays. Tonnage of miscellaneous clay was slightly higher than that mined in 1964. Kaolin for fire brick and chemical use was mined in two counties. Fire clay was produced in 3 counties, and miscellaneous clay was mined in 13 counties for brick and similar type products, for use in cement, and for lightweight aggregate. Hot Spring, Pulaski, Sebastian, Little River, and Johnson Counties, ranked in order of tonnage produced, were the source of 68 percent of clay produced in the State.

Gypsum.—Dulin Bauxite Co., Gypsum Division, and Dierks Forests, Inc., produced slightly less gypsum than in 1964; however, value of the output gained over that of 1964. Gypsum mined and processed near Highland in Pike County was used principally in cement. In Howard County, wallboard was manufactured from mined, crushed, and calcined gypsum. Part of Arkansas gypsum production was used as soil conditioner.

Lime.—Saline County continued to lead among five counties having lime production. Most of the lime production was for metallurgical use, but substantial amounts were consumed by chemical and paper industries. Lesser quantities of lime were used for sugar refining, water purification, agriculture, and building. Lime used or sold, including regenerated lime, totaled more than 339,000 tons valued at $5.6 million. Producers in Ashley, Jefferson, and Ouachita Counties accounted for the regenerated lime output.

Table 13.—Clays sold or used by producers, by kinds

(Thousand short tons and thousand dollars)

Year	Miscellaneous clay		Fire clay		Total clay	
	Quantity	Value	Quantity	Value	Quantity	Value
1956–60 (average)	341	$342	361	$1,591	702	$1,933
1961	434	428	339	1,330	773	1,758
1962	368	365	286	1,328	654	1,693
1963	574	573	195	1,190	769	1,763
1964	649	636	243	1,516	892	2,152
1965	663	662	[1] 203	[1] 1,228	866	1,890

[1] Includes kaolin clay.

Table 14.—Sand and gravel sold or used by producers
(Thousand short tons and thousand dollars)

Year	Commercial		Government-and-contractor		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
1956–60 (average)	6,374	$6,413	3,092	$2,554	9,466	$8,967
1961	5,933	6,892	3,456	2,182	9,389	9,074
1962	6,717	7,946	4,130	2,060	10,847	10,006
1963	7,699	9,096	4,400	4,493	12,099	13,589
1964	8,637	10,990	3,157	3,846	11,794	14,836
1965	9,559	12,001	3,247	3,835	12,806	15,836

Phosphate Rock. — Output of ground phosphate rock for direct-soil application dropped significantly. Peyton Creek Phosphate Rock Mining Co., the State's only producer, continued mining and crushing operations in Van Buren County, but on a greatly reduced scale.

Sand and Gravel.—Production of sand and gravel was reported in 62 of the State's 75 counties. Of 134 plants classed as commercial producers, only 2 had outputs over 700,000 tons. The remaining plants in this category had production rates ranging downward from less than 400,000 to less than 25,000 tons. Seventy-five of the plants had outputs of 25,000 tons or less. Average unit value of commercial sand and gravel was $1.25.

Average unit value of sand and gravel used by Government-and-contractor markets was $1.18. A total of 3.2 million tons of sand and gravel thus classified was produced from 104 plant operations in 43 counties.

Table 15.—Sand and gravel sold or used by producers, by classes of operations and uses
(Thousand short tons and thousand dollars)

Class of operation and use	1964		1965	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	1,676	$1,857	1,734	$1,990
Paving	1,414	1,369	1,599	1,803
Other [1]	578	1,166	714	1,330
Total	3,668	4,392	4,047	5,123
Gravel:				
Building	1,745	2,728	1,928	2,823
Paving	3,186	3,833	3,444	3,985
Fill	16	14	108	54
Other [2]	22	23	32	16
Total	4,969	6,598	5,512	6,878
Total sand and gravel	8,637	10,990	9,559	12,001
Government-and-contractor operations:				
Sand: Paving	1,442	1,226	1,241	1,091
Gravel:				
Paving	1,709	2,616	2,006	2,744
Fill	6	4	--	--
Total	1,715	2,620	2,006	2,744
Total sand and gravel	3,157	3,846	3,247	3,835
Grand total	11,794	14,836	12,806	15,836

[1] Includes fill, glass, molding, and other construction, industrial, and ground sand.
[2] Includes other construction, railroad ballast (1965), and miscellaneous gravel.

The five leading counties, ranked in order of production, were Miller, Crawford, Clark, Pulaski, and Calhoun. Distribution of sand and gravel output in these counties ranged from more than 600,000 to more than 1 million tons. Total output of sand and gravel was nearly 9 percent higher, and value increased about 7 percent compared with that of 1964. Value of the output was the highest on record.

Soapstone.—Soapstone, mined and processed by The Milwhite Co., Inc., in Saline County, decreased slightly during the year. The commodity was produced for the 13th consecutive year for use as filler in insecticides and roofing.

Stone.—Production of stone exceeded 21 million tons and was larger than the previous high-record year, 1962. Value of the 1965 output was $26.8 million and again placed the commodity second among the leading mineral products of the State. Crushed sandstone contributed over one-third of the total stone value and was followed in order by crushed syenite and limestone. The three stone types accounted for 92 percent of the total tonnage and 89 percent of the total value. Dimension marble and sandstone, limestone for lime and cement, slate, and shell accounted for the remaining tonnage and value. Slate production came from Montgomery, Howard, Saline, and Pike Counties. Most of the output was used for manufacture of roofing granules. Mussel shell production (recorded for the first time in several years) was used as a seeding agent in generation of cultured pearls.

Major uses of stone were for riprap, concrete aggregate, roadstone, railroad ballast, fill, and roofing granules. Crushed limestone was produced in 17 counties, crushed sandstone in 25, syenite in 1, marble in 2, dimension sandstone in 2, mussel shell in 4, and slate in 4.

Commercial stone accounted for 72 percent of the total output and 80 percent of total value.

Forty-two counties supplied the various stone types, and 128 producers including both commercial and Government-and-contractor operations furnished the output. Average unit value of commercial stone was $1.36 per ton; average unit value of Government-and-contractor stone was $0.87 per ton.

Table 16.—Stone sold or used by producers
(Thousand short tons and thousand dollars)

Year	Quantity	Value
1961	12,029	$12,402
1962	20,611	19,866
1963	18,913	22,727
1964	20,241	26,172
1965	21,241	26,778

Sulfur (Recovered Elemental).—Byproduct sulfur recovered from treatment of sour natural gas at three plants was about 10 percent higher in quantity and value than in 1964. Olin Mathieson Chemical Corp. led with output in Lafayette County. Arkla Chemical Co. and Monsanto Co. with plants in Columbia and Union Counties, respectively, were responsible for the remaining production.

Tripoli.—Caddo Minerals Co., Inc., mined a substantial amount of tripoli from deposits in Pike and Montgomery Counties. The crude rock was ground at a plant in Pike County for abrasive applications. Tripoli deposits in this part of Arkansas result from weathering of exposures of Arkansas novaculite.

METALS

Bauxite, the principal ore of aluminum, continued to be the State's most significant metal. A small quantity of iron ore was sold for use in cement manufacture.

Aluminum.—Production of primary aluminum in the United States was 8 percent higher than in 1964. A significant part of the output was from two aluminum-reduction works in Hot Spring and Clark Counties. Aluminum produced at the plants was substantially higher than in 1964. Reynolds Metals Co. acquired the General Motors Corp. aluminum casting plant at Jones Mills in Hot Spring County. The company plans to convert the plant to production of wire and cable. Operations were scheduled for early 1967.

Bauxite.—Three mining companies in Arkansas, Aluminum Company of America, Reynolds Mining Corp., and American Cyanamid Co., collectively accounted for a 2-percent increase in bauxite output. Most of the increase resulted from the greater demand for aluminum. Reynolds Mining Corp. began utilizing a new walking dragline equipped with a 25-cubic-yard bucket. Reynolds Metals Co. added

Table 17.—Bauxite mine production and shipments from mines and processing plants to consumers
(Thousand long tons and thousand dollars)

Year	Mine production			Shipments		
	Crude	Dry equivalent	Value	As shipped	Dry equivalent	Value
1956–60 (average)	1,875	1,570	$15,317	1,822	1,557	$16,487
1961	1,419	1,179	13,462	1,244	1,080	13,220
1962	1,523	1,270	14,606	1,715	1,481	17,535
1963	1,771	1,478	16,701	1,725	1,483	17,543
1964	1,864	1,562	17,431	1,773	1,531	17,859
1965	1,911	1,593	17,974	2,100	1,803	20,786

facilities at its Hurricane Creek alumina plant to make low-soda aluminas for the ceramics industry.

Bauxite output in Arkansas comprised 96 percent of the total produced in the United States. Alcoa continued to lead in bauxite production in the State and Reynolds Mining Corp. was a close second.

Iron Ore.—Southwest Enterprises, Inc., shipped a small quantity of finely ground iron ore from stockpile. The company transferred most of its mining activities to Texas, and mine and plant operations in Arkansas were placed on a standby basis.

REVIEW BY COUNTIES

Production of minerals was reported in 73 of the State's 75 counties, 1 less than in 1964; only Lee and Sharp Counties were without mineral output. Value of the mineral output increased in 48 counties and decreased in 26. Mineral value exceeded $1 million in 25 counties and was above $500,000 in 6 other counties. Ten counties had mineral output values greater than $5 million. Columbia, Union, Saline, Lafayette, and Pulaski, ranked according to mineral value, accounted for about 56 percent of the total mineral value in the State.

Sand and gravel, the most widespread mineral resource, was produced in 62 counties; stone, including shell and slate, was mined in 42; production of clay, including kaolin, was recorded in 15; natural gas in 14; petroleum in 8; lime in 5; natural gas liquids, coal, and by-product sulfur in 3; bauxite, cement, gypsum, and gem stones in 2; and abrasive stone, barite, bromine, iron ore, phosphate rock, soapstone, and tripoli in 1.

Each of the counties covered in the following discussions registered mineral values exceeding $300,000 except for Garland County, which had the State's only output of abrasive stone.

Ashley.—Combined value of lime and sand and gravel output was about 8 percent lower than in 1964. Crossett Paper Mills used quicklime in paper manufacture. St. Francis Material Co., Georgia-Pacific Corp., and Arkansas State Highway Department accounted for most of the sand and gravel output. The commodity was used for construction, building, and paving.

Benton. — Output of crushed stone dropped markedly whereas sand and gravel production increased. The net result was a substantial loss in value compared with that of 1964. McClinton Brothers Co., Ozark Construction, Inc., and Southeast Construction Co. quarried and processed limestone for concrete aggregate, roadstone, and aglime. Paul Davis produced sand and gravel for paving and construction purposes.

Bradley.—Mineral output comprised of petroleum and sand and gravel decreased in volume, and value was about 10 percent under that of 1964; value of the petroleum output was nearly $100,000 lower. Moro Gravel Co. and O'Neill Bros. Sand & Gravel Co. supplied part of the sand and gravel production. Arkansas Highway Department was responsible for most of the output used for paving. Three of four wells drilled in the county were completed as oil producers.

Calhoun.—The county ranked third in the State in output of sand and gravel.

Table 18.—Value of mineral production in Arkansas, by counties [1]

County	1964 [r]	1965	Minerals produced in 1965 in order of value
Arkansas	$56,000	$70,800	Sand and gravel, shell.
Ashley	448,772	412,996	Sand and gravel, lime.
Baxter	79,298	68,328	Sand and gravel, stone.
Benton	518,192	323,287	Stone, sand and gravel.
Boone	132,921	W	Stone.
Bradley	1,103,632	989,202	Petroleum, sand and gravel.
Calhoun	902,720	1,159,190	Sand and gravel, petroleum.
Carroll	W	133,034	Sand and gravel, stone.
Chicot	203,000	211,000	Sand and gravel.
Clark	348,904	717,523	Sand and gravel, stone, clays.
Clay	170,000	325,000	Sand and gravel.
Cleburne	161,140	378,367	Stone.
Cleveland	43,000	28,000	Sand and gravel.
Columbia	31,564,228	33,858,056	Petroleum, natural gas liquids, natural gas, sand and gravel.
Conway	382,325	403,598	Stone, natural gas, sand and gravel.
Craighead	389,500	292,000	Sand and gravel, clays.
Crawford	2,762,320	2,670,414	Natural gas, stone, sand and gravel.
Crittenden	20,000	57,000	Sand and gravel.
Cross	265,000	303,029	Sand and gravel, stone.
Dallas	79,000	70,000	Sand and gravel.
Desha	185,000	236,000	Do.
Drew	110,000	105,000	Do.
Faulkner	688,629	1,335,871	Stone, sand and gravel.
Franklin	5,505,074	5,528,037	Natural gas, coal, stone, sand and gravel.
Fulton	61,301	155,000	Sand and gravel.
Garland	209,920	259,292	Sand and gravel, abrasive stone, gem stones.
Grant	345,000	191,000	Sand and gravel.
Greene	247,000	321,000	Do.
Hempstead	65,608	240,156	Sand and gravel, clays.
Hot Spring	3,019,989	3,891,894	Barite, sand and gravel, stone, clays.
Howard	7,457,554	6,111,725	Cement, gypsum, stone, clays, slate, sand and gravel.
Independence	2,215,167	2,546,658	Stone, lime, sand and gravel, shell.
Izard	1,679,296	1,797,501	Sand and gravel, stone.
Jackson	W	204,000	Sand and gravel, shell, stone.
Jefferson	W	615,210	Lime, sand and gravel.
Johnson	2,347,985	2,807,608	Coal, stone, natural gas, sand and gravel, clays.
Lafayette	16,961,345	15,655,092	Petroleum, natural gas liquids, natural gas, sand and gravel.
Lawrence	1,102,056	1,433,609	Stone, sand and gravel.
Lincoln	113,000	207,000	Sand and gravel.
Little River	10,640,615	10,912,092	Cement, stone, sand and gravel, clays.
Logan	1,322,792	1,033,652	Natural gas, stone, sand and gravel.
Lonoke	1,136,917	1,358,811	Stone, sand and gravel, clays.
Madison	132,275	143,725	Stone.
Marion	88,623	103,550	Sand and gravel, stone.
Miller	6,977,404	6,123,244	Petroleum, sand and gravel, natural gas, clays.
Mississippi	137,000	63,000	Sand and gravel.
Monroe	2,000	40,100	Shell, sand and gravel.
Montgomery	801,150	684,833	Slate, stone, sand and gravel.
Nevada	2,404,464	2,857,439	Petroleum, sand and gravel, iron ore, natural gas
Newton	521,730	113,429	Stone.
Ouachita	7,590,672	7,463,357	Petroleum, sand and gravel, natural gas, clays.
Perry	220,800	335,291	Stone.
Phillips	W	246,000	Sand and gravel.
Pike	695,531	1,177,982	Stone, gypsum, sand and gravel, tripoli, gem stones, slate.
Poinsett	287,000	W	Sand and gravel.
Polk	72,533	233,142	Sand and gravel, stone, clays.
Pope	1,581,208	1,942,660	Stone, natural gas, sand and gravel.
Prairie	9,000	112,000	Sand and gravel.
Pulaski	11,579,789	11,763,596	Stone, clays, sand and gravel, bauxite.
Randolph	30,296	W	Stone.
St. Francis	332,000	544,000	Sand and gravel.
Saline	19,208,141	19,847,395	Bauxite, lime, stone, sand and gravel, clays, soapstone, slate.
Scott	116,000	68,432	Stone.
Searcy	112,902	17,086	Do.
Sebastian	1,826,230	2,740,312	Natural gas, stone, sand and gravel, clays, coal.
Sevier	2,346,602	708,000	Sand and gravel.
Sharp	177,851	----------	
Stone	20,000	70,207	Stone.
Union	18,708,508	20,184,005	Petroleum, bromine, natural gas, natural gas liquids, clays, sand and gravel.
Van Buren	484,900	67,490	Stone, phosphate rock.
Washington	783,848	1,016,851	Stone, natural gas, sand and gravel.
White	326,638	331,940	Stone.
Woodruff	4,000	1,000	Sand and gravel.
Yell	536,061	231,515	Sand and gravel, stone.
Undistributed	1,658,644	461,387	
Total	174,818,000	179,110,000	

[r] Revised.
W Withheld to avoid disclosing individual company confidential data; included with "Undistributed".
[1] Lee County is not listed because no production was reported in 1964 or 1965.

St. Francis Material Co. was the largest individual producer. Arkansas State Highway Department used about 68 percent of the county's total output of sand and gravel for road construction and paving.

Clark.—Production of sand and gravel accounted for 98 percent of the value. Small quantities of stone and clays were also produced. Arkadelphia Sand & Gravel Co. and Arkansas State Highway Department were responsible for most of the output. Construction of highways related to the De Gray Dam on Caddo River consumed major quantities of the commodity.

Columbia.—The county continued as the value leader in mineral production in the State for the ninth consecutive year. The county led in petroleum production with 42 percent of the total output in the State, ranked third in natural gas output, and first in production of natural gas liquids. Arkla Chemical Corp. processed natural gas for production of LP gases, natural gasoline and cycle products, and sulfur. Berry Asphalt Co. operated a petroleum refinery at Magnolia.

Of 17 wells, 7 were completed as oil producers; 1 well resulted in discovery of a new source of supply, Medlock field. A small output of sand and gravel was used by the Columbia County Highway Department and Arkansas State Highway Department.

Crawford. — Value of mineral output contributed by production of natural gas, stone, and sand and gravel was less than $100,000 under that of 1964. An increase of more than $275,000 in value of natural gas and a substantial increase in value of sand and gravel were insufficient to offset a nearly $500,000 loss in value of stone output. Only one exploratory well, classed as a dry hole, was drilled for natural gas in the county. Arkhola Sand & Gravel Co., Mississippi Valley Engineering & Construction Co., and others produced crushed sandstone for construction and building applications. Arkhola Sand & Gravel Co. accounted for the major part of the sand and gravel production.

Faulkner.—Construction projects by U.S. Army Corps of Engineers relating to improvement of the Arkansas River Basin and highway construction by Arkansas State Highway Department accounted for a major increase in output of crushed sandstone and sand and gravel. Combined value of the commodities was nearly double that reported in 1964.

Franklin.—The county led the State in production of natural gas valued at $4.7 million. Garland Coal & Mining Co. reported an increased production of bituminous coal. Crushed sandstone was consumed by projects conducted by U.S. Army Corps of Engineers and Arkansas State Highway Department. Increased quantities of sand and gravel were also used in U.S. Army Corps of Engineers projects. The county ranked 10th in the State in total value of mineral output. Of 18 wells drilled for natural gas, 9 were successful in discovery of new sources of supply.

Garland.—Value of mineral output was comprised of sand and gravel, novaculite (for abrasive purposes), silica sand (classified as tripoli by Arkansas Geological Commission), and quartz crystals. Output was about 24 percent higher than that of 1964. The county has been the source of crude novaculite for oilstones and whetstones for many years. Norton Pike, Division of Norton Co., Arkansas Oilstone Co., and Arkansas Abrasives, Inc., were responsible for the novaculite output. Malvern Minerals Co. quarried and processed silica sand (tripoli) for abrasive applications. Smith Brothers Construction & Material Co. produced sand and gravel for concrete blocks, aggregate, and other purposes.

Hot Spring.—A 29-percent increase in value of mineral output was attributable to increased production of barite, sand and gravel, stone, and clays. Barite was mined from a major deposit about 12 miles northwest of Malvern by Baroid Division, National Lead Co. and Magnet Cove Barium Corp. The crude ore was processed at plants near the mine site and in Malvern. The State continued to rank second in domestic output of barite. Acme Brick Co. (Malvern and Perla plants) and Malvern Brick & Tile Co. mined high-quality clays for refractory brick, building brick, tile, and heavy clay products. The county ranked first in the State in quantity of clay mined and was ranked second in value of clay output. Malvern Gravel Co. provided most of the sand and gravel production; the company was joined by two others in producing crushed novaculite for highway construction, railroad ballast, and

concrete aggregate. Malvern Gravel Co. also marketed a small tonnage of novaculite for use in manufacture of refractory bricks.

Howard.—Total value of mineral output was 18 percent under that of 1964. Ideal Cement Co. continued as the major industry in the county with output of portland and masonry cements from chalk, marl, and clay mined in the county and blended with portions of iron ore, gypsum, and sand produced elsewhere. Dierks Forests, Inc., manufactured wallboard from gypsum mined and processed in the county. Industrial Minerals, Inc., mined and ground slate at a plant near Dierks for filler applications. Construction of Gillham Dam, a flood-control project, continued on Cossatot River in northwest Howard County.

Independence.—Value of mineral production expanded 15 percent for the second consecutive year of similar gain. The increase was due to mining of larger quantities of sand and gravel by Galloway Sand & Gravel Co. and Mobley Construction Co., Inc., and to a more than $250,000 increase in value of limestone produced by Batesville White Lime Co., Four Brothers Co., Freshour Corp., Limestone Products, Inc., and Midwest Lime Co. The latter is a new operation with a mine and crushing plant about 5 miles north of Batesville. The county ranked second in the State in value of stone. Batesville White Lime Co. continued to be the largest producer of limestone. The stone was used for lime manufacture, agricultural stone, concrete aggregate, and road construction. Batesville Marble Co. increased its output of dressed marble for building and monumental purposes. Bristow Stone Co. furnished dimension sandstone for interior and exterior building. Highway construction supplied much of the market for sand and gravel and stone output. A small output of mussel shell added to overall mineral value.

Izard.—Value of mineral output increased by 7 percent over that recorded in 1964. Part of the gain was due to expanded production of silica sand by Silica Products Co., Inc., and National Silica Co. The county continued to rank second in value of sand and gravel production in the State. Output of limestone for use by the aluminum industry continued to be of prime importance, and the county ranked sixth in the State in terms of total output of stone. Wolford Marble Co. quarried a small quantity of marble for exterior building applications.

Jefferson.—Expanded output of sand and gravel coupled with lime production boosted the total value of the mineral output to over $615,000. Lime was produced for paper manufacture by Dierks Paper Co. Pine Bluff Sand & Gravel Co. accounted for the county's entire output of sand and gravel. Arkla Chemical Corp. produced chlorine and caustic soda from salt.

Johnson.—A 20-percent increase in value of mineral output was attributable to gains in output of stone, coal, and natural gas and initial production of sand and gravel. Clays were mined and processed for brick manufacture and heavy clay products by Eureka Brick & Tile Co. Ben M. Hogan Co., Inc., and Freshour Corp. supplied crushed sandstone for concrete aggregate and roadstone to Arkansas State Highway Department construction projects. Clarksville Coal Co., Dixie Construction Co., Johnson Coal Co., Inc., and Prairie Coal Co. mined bituminous coal valued at $962,103. The county led in coal output with 57 percent of the total mined in the State. Of 11 wells drilled for natural gas, 7 were completed as producers. Sand and gravel was produced by Mobley Construction Co., Inc., for building and construction purposes.

Lafayette.—The county retained its position as fourth in the State in terms of value of mineral output. It was third in production of petroleum and second among counties in south Arkansas having natural gas outputs. Austral Oil Co., Humble Oil & Refining Co., and Sunray DX Oil Co. operated plants to recover natural gas liquids from natural gas. Byproduct sulfur was extracted from sour natural gas by Olin Mathieson Chemical Corp. at McKamie. The county was second in drilling activity; 23 of 58 wells were oil productive. Three new oilfields were discovered as a result of wildcat drilling. Gifford-Hill & Co., Inc., was the county's leading producer of sand and gravel.

Lawrence.—Value of the mineral output, consisting of crushed limestone and sand and gravel, was 30 percent over that of 1964. The county ranked first in the

State in limestone production. Five companies mined and crushed limestone, mostly for concrete aggregate and road construction. A minor part of the output was used for agricultural purposes. Black Rock Sand-Gravel Co., Inc., and L. F. Parker accounted for the sand and gravel output.

Little River.—The county, with a mineral output of cement, chalk, clay, and sand and gravel, was sixth in the State in terms of value of mineral production. Arkansas Cement Corp. was adding facilities (nearly completed at yearend) to expand annual cement plant capacity to 5 million barrels. The company used increased quantities of clays, chalk, gypsum, and iron ore for cement manufacture. Ark-La Limestone Corp. supplied ground chalk for aglime. Arkansas State Highway Department furnished markets for 83,000 tons of sand and gravel, a substantial increase over the 1964 tonnage.

Logan. — Value of mineral production was 22 percent under that of 1964. Increase in value of natural gas and sand and gravel outputs was insufficient to offset a $500,000 decrease in stone output. The county led the State in production of dimension sandstone with 99 percent of the total. Five companies—Logan County Building Stone Co., Inc., Rainbow Stone Co., John Swartz Quarry, Sunset Stone Co., and Wild Rose Stone Co.—accounted for dimension stone production. Arkansas dimension sandstone found wide acceptance for exterior and interior building applications and was used both in and outside the State.

Production of crushed sandstone for construction decreased significantly because of completion of projects formerly providing much of the market. Three field development wells found new supplies of natural gas whereas three wildcat wells were classified as dry holes. The county was fourth in production of natural gas among north Arkansas counties. Arkansas State Highway Department was the recipient of most of the sand and gravel output which was used for road construction.

Lonoke. — A substantial increase in crushed sandstone output accounted for the entire gain in mineral value distributed among production of stone, clays, and sand and gravel. Arkansas Lightweight Aggregate Corp. supplied lightweight aggregate for concrete products from clays mined near Lonoke. Arkansas State Highway Department provided a market for the entire output of sand and gravel. Southeast Construction Co., Inc., and G. P. Freshour quarried and crushed sandstone for road construction, concrete aggregate, and riprap.

Miller.—Combined value of petroleum, sand and gravel, natural gas, and clays was 12 percent under that of 1964. Sharp drops in outputs of petroleum and natural gas accounted for the loss and offset gains in value of sand and gravel and clays. The county led the State in output of sand and gravel. Gifford-Hill & Co., Inc., and other producers for Arkansas State Highway Department again set a new record in terms of tonnage and value. W. S. Dickey Clay Manufacturing Co. mined and processed fire clay and miscellaneous clays for brick manufacture and other clay purposes. Only one of nine wells drilled in the county was a successful oil producer.

Montgomery.—Substantial decreases in output of stone and sand and gravel and a minor drop in slate output accounted for an overall reduction of 15 percent compared with mineral value in 1964. Bird & Son, Inc., continued as the major mineral industry in the county with a substantial output of slate for roofing granules and slate flour for filler in industrial compounds. U.S. Forest Service used a small quantity of sand and gravel for road maintenance. Four Brothers, Inc., mined and crushed sandstone for road construction projects.

Nevada.—Increased production of petroleum, natural gas, and sand and gravel offset a major decrease in iron ore output and accounted for a 19-percent rise in total mineral value. Southwest Enterprises, Inc., shipped a small quantity of iron ore for use in cement manufacture. Arkansas State Highway Department obtained sand and gravel from contractors for use on highway building projects. Of 14 wells drilled for oil, only 2 were completed as oil producers. Petroleum valued at $2.6 million was produced from six oilfields in the county.

Ouachita.—Petroleum, the county's most significant mineral product, contributed 95 percent of the total mineral value. Hope Brick Works mined and processed

clays for brick and tile at an increased rate over that of 1964. Pine Bluff Sand & Gravel Co. and Standard Gravel Co. were major sources of sand and gravel used for building and construction. Of 40 wells drilled, 25 were oil productive, and the county was again fourth in oil output.

Pike.—Value of six mineral products exceeded $1 million and was 69 percent above that of 1964. The most substantial growth was in stone output. Arkansas Rock & Gravel Co. (Division of McAlester Fuel Co.) accounted for the total production of crushed sandstone from a quarry a few miles northwest of Murfreesboro. The company also dredged sand and gravel from Little Missouri River in increased quantities over that of 1964. Caddo Minerals Co., Inc., quarried and processed tripoli for abrasive applications. The company also ground slate into flour for use as a filler in industrial products. Tourists found several diamonds near Murfreesboro. The diamonds are associated with a peridotite pipe exposed by erosion. Dulin Bauxite Co., Gypsum Division, quarried and crushed gypsum at an expanded rate for use primarily as an additive in cement.

Pope.—Combined value of outputs of crushed sandstone by Ben M. Hogan Co., Inc., and others, sand and gravel produced by Mobley Construction Co., Inc., and natural gas equalled nearly $2 million. The total mineral value was about 23 percent higher than that of 1964 and was due to the record output of stone in the county. Arkansas State Highway Department and U.S. Army Corps of Engineers were the principal markets for stone. Five of nine wells drilled for natural gas were classified as producers. One of the successful wells resulted in the discovery of Furgerson field, a new source of natural gas.

Pulaski.—Total value of the mineral output was sufficient to rank the county fifth in the State in terms of overall value of mineral production. Output of bauxite, which was much greater than in 1964, and increased stone production accounted for the gain in mineral value. Clay and sand and gravel production was substantially lower than in 1964. The county retained its rank as first in value of stone output, accounting for 35 percent of the total tonnage produced in the State. The county ranked fourth in value of sand and gravel.

Jeffrey Stone Co. was the principal producer of crushed sandstone, and Big Rock Stone and Material Co. quarried and processed the major part of the syenite output. The syenite was used for riprap, concrete aggregate, roadstone, railroad ballast, and for roofing granule manufacture. Crushed sandstone was used for riprap, concrete aggregate, and railroad ballast. U.S. Army Corps of Engineers projects provided major markets for the stone output. Big Rock Stone & Material Co. and Jeffrey Sand Co. accounted for the whole of the sand and gravel output.

Reynolds Mining Corp. resumed bauxite production at its Pulaski County mines. A. P. Green Refractories Co. and Stauffer Chemical Co. mined and processed kaolin and high-alumina clays for refractories and alumina chemicals. Also, Stauffer Chemical Co. and Porocel Corp. processed bauxite for chemical-and-oil industry applications. The 3-M Co. (Minnesota Mining & Manufacturing Co.) manufactured roofing granules from crushed syenite for the 20th consecutive year.

Saline.—Despite a 3-percent gain in total value of mineral production, the county dropped from second to third place in the State. Even so, the mineral value established a new record high. Gains in outputs of bauxite, slate, and lime, and production of crushed sandstone and resumption of clay output were sufficient to offset value losses ascribed to outputs of soapstone and sand and gravel. The Milwhite Co., Inc., mined slate and soapstone in northwest Saline County and processed the commodities at its plant in Bryant. Ben M. Hogan Co., Inc., quarried and crushed sandstone for highway construction. Belvedere Sand & Gravel Co., the principal supplier, was joined by Holland Gravel Co., Inc., and others in accounting for sand and gravel production. Aluminum Company of America (Alcoa), Reynolds Mining Corp., and American Cyanamid Co. accounted for the bauxite output which was mined in increasing quantities. Alcoa and Reynolds Metals Co. converted limestone into lime for use in bauxite processing plants near Benton. A. P. Green Refractories Co. (formerly A. P. Green Fire Brick Co.) mined kaolin for the first time in several years. The

company operations were at the Hogue mine, about 2 miles southeast of Bryant.

Sebastian.—Substantial increases in production of natural gas, stone, sand and gravel, and clays ranked in order of significance, accounted for a 50-percent gain in total mineral value. Nearly $600,000 of the increase was due to production of natural gas. Of 13 field development wells, 8 resulted in new sources of gas supply, but 3 wildcat wells were classified as dry holes. The county continued to rank second in natural gas output. S. & S. Co. mined and processed shale for lightweight aggregate, and Acme Brick Co. manufactured building brick and other clay products from high-quality clays. Shoffner Sand & Gravel Co. furnished most of sand and gravel tonnage for building and construction. Freshour Corp. and Mississippi Valley Engineering & Construction Co. quarried and crushed sandstone at double the 1964 rate. U.S. Army Corps of Engineers and Arkansas State Highway Department provided major markets for the stone output. The coal industry operated one underground and one strip mine, each producing in excess of 1,000 tons annually.

Sevier.—Sand and gravel, the county's only mineral product, was produced in much less abundant quantities but was still sufficient to rank the county fifth in the State in sand and gravel output. Braswell Sand & Gravel Co., Inc., was the major supplier of the commodity. The company conducted dredging and washing operations near the confluence of Little and Cossatot Rivers 10 miles north of Ashdown. Millwood Dam, located downstream, may eventually cause inundation of the sand and gravel deposits exploited for the past several years.

Union.—The county resumed its position of second leading producer of minerals because of the substantial increase in bromine output. Of the fuel minerals produced in the county, only output of natural gas liquids increased over the 1964 output. Output of petroleum was enough to rank the county second in the State, but lesser quantities of oil as well as natural gas were produced. The county retained its lead in number of wells drilled for oil and gas, and 42 of a total 102 wells were productive. One new field, Boggy Bottom, was discovered by Caddo Oil Co. American Oil Co., Cross Oil & Refining Co., Lion Oil Co., and Macmillan Ring-Free Oil Co., Inc., operated oil refineries, and Denton Corp. and Gay Oil Co. processed wet natural gas at their respective plants. Clay for brick and tile manufacture was mined and processed by El Dorado Brick Co. A small quantity of sand and gravel was produced by Ouachita Towing & Gravel, Inc.

Washington. — Total value of mineral output comprised of stone, natural gas, and sand and gravel was about 30 percent over that of 1964. Value of crushed limestone produced mainly by McClinton Bros. Co. and Reynolds and Williams was substantially higher than in 1964. Marked decreases were recorded in outputs of natural gas and sand and gravel.

The Mineral Industry of California

This chapter has been prepared under a cooperative agreement for the collection of mineral data between the Bureau of Mines, U.S. Department of the Interior, and the California Department of Natural Resources, Division of Mines and Geology.

By L. E. Davis [1]

Secondary recovery of petroleum by recently developed steam-injection techniques was responsible for 62 percent of the total increase in the value of California's mineral production in 1965 over that of 1964. Petroleum production rose in both quantity and value. Mineral fuels remained the dominant group and their overall value increased nearly 3 percent.

Of 28 nonmetallic mineral commodities produced, value of output for 17 declined; the increase as a group was credited to a record output of sand and gravel together with substantial gains for asbestos and boron compounds. Value increases over 1964 totals were reported for 8 of 13 metals, led by mercury which had a marked advance in both quantity and value.

Consumption, Trade, and Markets.—Despite its abundance of mineral resources, California was not self-sufficient in minerals, particularly mineral fuels. Refinery receipts of crude oil (all sources), and natural gas receipts (pipeline), rose 3 percent from 1964. Plants within the State processed 3 percent less wet gas with an output of natural gas liquids that was more than 7 percent lower. California was third highest in petroleum production but consumed more petroleum products than any other State.

Trends and Developments.—California oil production reached 900,000 barrels daily at yearend, representing a net increase of about 70,000 barrels daily over 1964 figures. Credit for the increase went to steam-injection operations on secondary recovery projects. The total number of new oil wells completed was down 11 percent from the 1964 total; however, the quality of the oil was considerably better and the initial production rate was higher by 18 barrels daily.

The principal areas of new onshore development were the Northeast and Main of McKittrick field, Kern County. Permission to drill from new "office type" buildings in downtown Los Angeles resulted in the development of two new pools. Statewide, 2 new oilfields and 13 new pools were discovered during the year. Offshore development in the Wilmington field new East Area yielded 10,000 barrels daily from 18 new wells producing at yearend while offshore drilling in the Huntington Beach field resulted in an additional 5,000 barrels daily during the year. Exact definition of State and Federal boundaries of offshore lands was established which stimulated bidding and development.

Five major oil companies were either constructing new or enlarging existing hydrocracking facilities, although no new units had been placed on stream by yearend. Union Oil Co. added 21,600 barrels daily to hydrocracking capacity at its Wilmington plant, substantially increasing the State's overall hydrocracking capacity.

Despite 11 dry gas discoveries, marketed natural gas output was virtually unchanged from that of 1964. Output of natural gas liquids was lower, declining more than 7 percent.

In 1965 Pacific Cement & Aggregates,

[1] Physical scientist, Bureau of Mines, San Francisco, Calif.

Table 1.—Mineral production in California [1]

Mineral	1964 Quantity	1964 Value (thousands)	1965 Quantity	1965 Value (thousands)
Asbestos—short tons	55,041	$4,419	74,587	$6,177
Barite (crude)—do	5,604	45	4,000	21
Boron minerals—do	776,000	60,871	807,000	64,180
Calcite (optical grade)—pounds	4	2	W	W
Cement—thousand 376-pound barrels	47,204	149,933	45,352	144,852
Clays—thousand short tons	8,685	8,433	3,207	7,226
Copper (recoverable content of ores, etc.)—do	1,035	675	1,165	825
Feldspar—long tons	102,264	W	95,975	W
Gem stones	NA	200	NA	200
Gold (recoverable content of ores, etc.)—troy ounces	71,028	2,486	62,885	2,201
Gypsum—thousand short tons	1,893	4,539	1,611	3,881
Lead (recoverable content of ores, etc.)—short tons	1,546	405	1,810	565
Lime—thousand short tons	577	r 10,294	602	11,073
Magnesium compounds from sea water bitterns (partly estimated)—short tons, MgO equivalent	94,739	7,143	101,563	8,302
Mercury—76-pound flasks	10,291	3,240	13,404	7,650
Natural gas—million cubic feet	660,444	198,551	660,384	204,059
Natural-gas liquids:				
Natural gasoline and cycle products—thousand gallons	720,373	54,088	655,780	49,850
LP gases—do	352,614	15,893	339,082	15,467
Peat—short tons	35,391	443	30,905	434
Petroleum (crude)—thousand 42-gallon barrels	300,009	729,022	316,428	753,099
Pumice, pumicite and volcanic cinder—thousand short tons	443	1,937	676	1,744
Salt (common)—do	1,525	W	1,638	W
Sand and gravel—do	112,995	129,333	118,310	136,227
Silver (recoverable content of ores, etc.)—troy ounces	172,000	222	196,787	254
Stone [2]—thousand short tons	45,805	63,566	42,575	59,668
Sulfur ore—long tons	520	3	360	2
Talc, pyrophyllite and soapstone—short tons	132,601	1,631	141,074	1,725
Wollastonite—do	3,625	36	W	W
Zinc (recoverable content of ores, etc.)—do	143	39	225	66
Value of items that cannot be disclosed: Bromine, carbon dioxide, calcium chloride, coal (lignite), diatomite, iodine, iron ore, lithium minerals, mica (scrap), molybdenum, perlite, platinum-group metals, potassium salts, rare-earth metals, sodium carbonate, sodium sulfate, tin concentrates, tungsten concentrate, uranium, and values indicated by symbol W	XX	r 113,043	XX	119,640
Total	XX	r 1,560,492	XX	1,599,388

r Revised. W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed." NA Not available. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Includes slate.

Table 2.—Value of mineral production in constant 1957–59 dollars

(Millions)

Year	Value
1956	$1,660
1957	1,659
1958	1,517
1959	1,456
1960	1,417
1961	1,418
1962	1,434
1963	r 1,488
1964	r 1,524
1965	1,553

r Revised.

Inc., San Francisco, became a division of Lone Star Cement Corp. of New York. Southwestern Portland Cement Co. installed a new kiln at its limestone quarry near Victorville as part of a program to increase the annual capacity of its cement plant to 7.5 million barrels. Ideal Cement Co. announced plans to construct a new 6-million-barrel-per-year plant adjacent to its existing Redwood City facility. No completion date was set, but start of construction on new storage silos was scheduled for early 1966. Pacific Western Industries, Inc., Los Angeles, initially named Southern California Cement Co., began construction of a new 3-million-barrel-per-year cement plant at Tejon Ranch near Lebec, Kern County, with

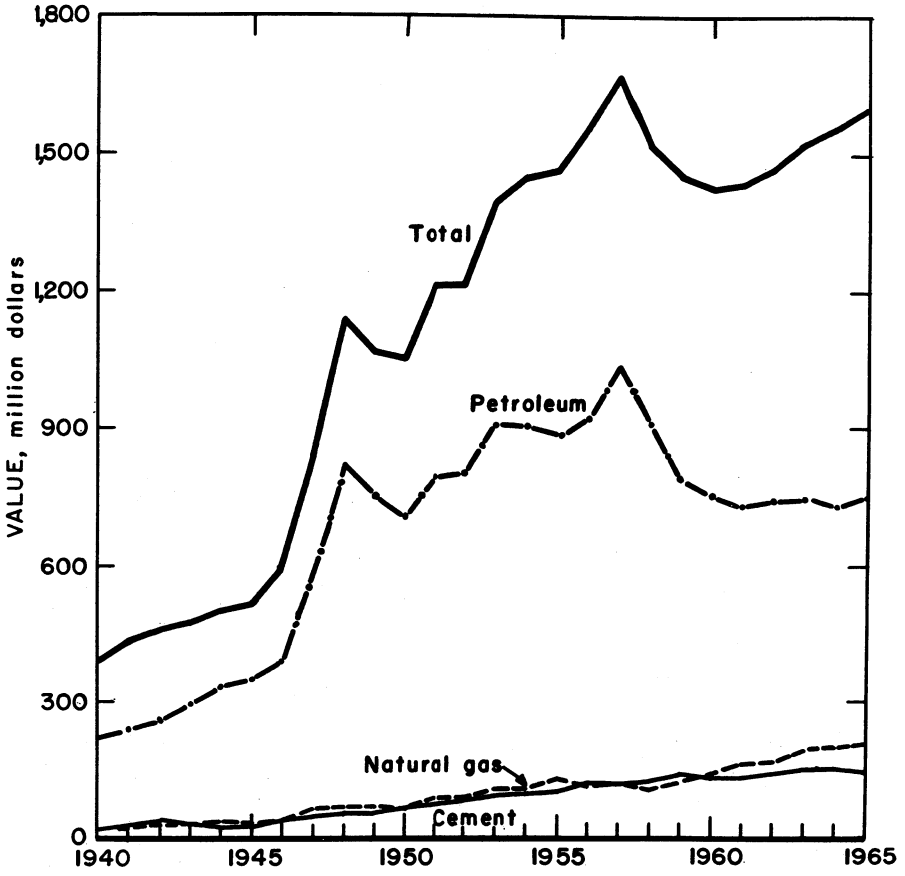

Figure 1.—Value of petroleum, natural gas, cement, and total value of mineral production in California.

completion scheduled by yearend 1966. American Cement Corp. dedicated its $2 million technical center (completed late in 1965) at Crestmore, Riverside County, and doubled white cement capacity with the addition of a new kiln and grinding facilities. Kaiser Cement and Gypsum Corp. merged with Longhorn Portland Cement Co., San Antonio, Tex.

Kaiser Aluminum & Chemical Corp. completed a new tunnel kiln at its Moss Landing refractories plant, and was expanding facilities to produce an extra-high-purity material for use in making basic refractories. The company also completed plans for a multimillion-dollar research and technical center at Pleasanton with construction to begin early in 1966. Modernization was underway at the South San Francisco plant of Merck & Co., Inc. The Long Beach gypsum products plant of National Gypsum Co. and the Fremont wallboard plant of The Flintkote Co. went on stream in September. Leslie Salt Co. increased vacuum salt capacity in its Newark plant 20 percent, and improved processing at its rock salt plant near Amboy. Natomas Co. sold a plant site at Folsom and leased adjoining land for the production of aggregate materials over a 20-year period. The lease, covering a minimum of 20 million tons of aggregates, provides for installation of a large modern aggregate plant. At Westend, Stauffer Chemical Co.

Table 3.—Employment and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1964:								
Coal and peat	38	184	7	51	-------	4	78.43	294
Metal	1,981	226	448	3,594	-------	92	25.60	1,204
Nonmetal	4,834	274	1,323	10,529	3	173	16.72	2,179
Sand and gravel	5,028	237	1,194	9,571	1	206	21.63	2,042
Stone	4,954	281	1,391	11,146	4	153	14.09	2,606
Total	16,835	259	4,363	34,891	8	628	18.23	2,174
1965: p								
Coal and peat	35	200	7	58	-------	2	34.48	86
Metal	2,540	219	555	4,439	1	101	22.98	2,441
Nonmetal	5,070	287	1,457	11,385	1	164	14.49	1,110
Sand and gravel	5,185	237	1,231	9,868	9	212	22.40	6,074
Stone	5,090	283	1,440	11,330	6	128	11.83	3,837
Total	17,920	262	4,690	37,080	17	607	16.83	3,422

p Preliminary.

Table 4.—Principal custom mills, commercial grinding plants, and primary smelters in 1965

Company	County	Nearest city or town	Minerals processed	Remarks
C. K. Williams Division of Chas. Pfizer & Co., Inc.	Alameda	Emeryville	Nonmetals	Commercial grinding.
American Smelting and Refining Company.	Contra Costa	Selby	Lead, zinc, silver, gold.	Smelter, refinery, and fuming plant.
The Wilbur Ellis Co	Fresno	Fresno	Nonmetals	Commercial grinding.
Huntley Industrial Minerals Co	Inyo	Bishop	----do	Do.
Butte Lode Mining Co	Kern	Randsburg	Gold and silver.	Custom mill.
American Minerals Co	Los Angeles	Los Angeles	Nonmetals	Commercial grinding.
Western Talc Co	----do	----do	----do	Contract grinding.
Industrial Minerals & Chemical Co.	Sacramento	Florin	----do	Do.
Kaiser Steel Corp	San Bernardino.	Fontana	Iron ore	Blast furnaces, steel plants, fabricating plants.
Minerals, Pigments and Metals Division of Chas. Pfizer & Co., Inc.	----do	Victorville	Nonmetals	Commercial grinding.
Yuba Minerals & Milling Co	Sutter	Sutter	Nonmetals	Do.

enlarged its soda ash plant and placed expanded sodium sulfate and borax facilities in production.

Borax production capacity was increased more than 50 percent. U.S. Borax & Chemical Corp. completed expansion of its fused borax facility at Boron, and announced a new anhydrous boric acid plant would be built. Antigorite was being mined and ground at the Sierra Asbestos property, Tuolumne County. The company expected to market the ground material (92 percent through 325 mesh, water washed) as a mineral filler. Port Costa Clay Products Co., Division of Homestake Mining Co., planned to complete construction on its integrated brick and lightweight aggregate (expanded shale) plant, Contra Costa County, early in 1966. Pittsburgh Plate Glass Co. purchased 200 acres near Fresno and began constructing a large sheetglass plant. New technology was to be used to produce tempered safety glass in sheets larger than 52 by 92 inches. Production was scheduled for March 1966. Aluminum Silicates Co. leased its kyanite mine near Ogilby to Western Industrial Minerals, Winterhaven. Western planned to process kyanite in an existing mill formerly used to process mica schist. Johns-Manville Corp. began constructing a new multimillion-dollar floor

tile plant at Hayward.

Kaiser Steel Corp. completed its iron-ore pelletizing plant at Eagle Mountain and made its first export shipment of pellets from the plant in December. The company also completed expansion and modernization of facilities to produce electrical-resistance-weld pipe and "thin tin" plate products, at its Fontana steel plant. Molycorp placed its new europium oxide extraction plant at Mountain Pass on stream in September. Rare-earth chloride production capacity was increased more than 50 percent. The company stated that a new concentrating mill, with an annual capacity of 30 million pounds of rare-earth oxides, would be completed in May 1966. A mid-1966 completion date was scheduled by National Lead Co. at Oakland for new warehousing facilities to improve service to its titanium pigment customers in northern California. Union Carbide Corp. completed an addition to its Pine Creek tungsten mill that will permit recovery of high-purity byproduct molybdenum and copper metals. The company considered the new process a significant technical advancement. Nevcal Minerals, Inc., (a new California company) reactivated the Desert Antimony mine in the Clark Mountain area, San Bernardino County. The company expected to make its first ore shipment to Laredo, Tex., early in 1966. A new metals smelting and refining plant was to be built in Richmond for Morris P. Kirk & Son, Inc., a wholly owned subsidiary of National Lead Co. The plant would be used to refine and make alloys of lead, antimony, tin, and zinc for the printing industry.

Legislative and Government Programs. —Public land orders restored over 31,000 acres of land to mineral location and leasing under U.S. mining laws, most of which was restored by the Bureau of Land Management, U.S. Department of the Interior. Other land orders withdrew 63,000 acres for use by Federal agencies, principally the Department of Defense (U.S. Navy), the U.S. Forest Service, and the U.S. Fish and Wildlife Service. At yearend applications for withdrawal were pending for additional lands totaling nearly 15,600 acres. California received U.S. Treasury checks in the amount of $2,775,305.57 in bonuses, royalties, and rentals from mineral leases and permits on Federal lands within the State borders in 1965, nearly $319,000 less than in 1964.

Of the three California producers who had been certified since enactment of the Lead-Zinc Stabilization Program in October 1962, two were active as of December 31, 1965. The third producer had not responded to amendment changes. No payments were made on 1965 production.

For the year ending December 31, 1965, the Office of Minerals Exploration (OME) received 522 inquiries and requests for application forms from persons interested in exploring for California minerals. Twelve applications were processed, three contracts were let, and seven contracts were in force at yearend.

In cooperation with the City of Long Beach, the Bureau of Mines San Francisco Petroleum Research Laboratory completed a study on scale formation in oil well pumps in the Wilmington field where over 500,000 barrels daily of sea water was being injected. The study showed that the scales were primarily barium sulfate formed by combination of sulfate from the injected sea water and barium in the interstitial water with the petroleum, and that the produced waters were unstable and supersaturated with barium sulfate.[2]

A laboratory study of the displacement of gas from porous media by water was completed [3] and work was initiated on another gas displacement problem, that of pressure-saturation characteristics of flooded gas sands. Significant advancements were made during 1965 in the development of mathematical and computer techniques for forecasting the performances of waterfloods in secondary oil recovery operations and a cooperative agreement was negotiated with the Office of Naval Petroleum Reserves to make a study of the reservoir and aquifer in the Elk Hills-Asphalto 24–Z area to determine a water-injection program which would insure pressure main-

[2] Gates, George L., and W. Hodge Caraway. Instrumental Techniques for Rapid Analysis of California Oil Well Scales. BuMines Rept. of Inv. 6602, 1965, 10 pp.

Gates, George L., and W. Hodge Caraway. Oil Well Scale Formation in Waterflood Operations Using Ocean Brines, Wilmington, Calif. BuMines Rept. of Inv. 6658, 1965, 28 pp.

[3] Crowell, D. C., G. W. Dean, and A. G. Loomis. Efficiency of Gas Displacement from a Water-Drive Reservoir. BuMines Rept. of Inv. 6735, 1966, 28 pp.

tenance and minimize oil migration from the Steven sand in Naval Petroleum Reserve No. 1.

At the Bureau of Mines Marine Mineral Technology Center at Tiburon techniques were investigated for sampling marine mineral deposits in cooperation with industry, and with State and Federal agencies. Considerable data were compiled on known marine deposits. The center acquired two research vessels from the U.S. Navy Reserve Fleet and made shakedown cruises off the California coast at Monterey Bay, and the Washington coast at Neah Bay and Grays Harbor, testing shipboard gear and sampling equipment.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS [4]

Carbon Black.—Carbon black production increased substantially over the 1964 figure. Two plants in Kern County, Continental Carbon Co. at Bakersfield and United Carbon Co. at Mojave, produced five grades of carbon black from liquid hydrocarbons. At Pittsburg, Contra Costa County, Shell Chemical Co. produced thermal black as a byproduct of hydrogen production in its ammonia fertilizer plant. Carbon black output averaged about 5 pounds per gallon from liquid hydrocarbons and 7 pounds per thousand cubic feet from natural gas. The carbon blacks were consumed by the rubber, chemical, and metal industries.

Carbon Dioxide. — Tidewater Oil Co. extracted carbon dioxide from natural gas in its natural gasoline plant near Taft, Kern County. The output was about 10 percent below that in 1964. The product was sold principally to bottlers of carbonated beverages. Standard Oil Co. of California extracted carbon dioxide in a similar plant in the same area only to insure the natural gas would meet pipeline specifications; the product was not marketed.

A new plant was built in 1965 incorporating a new technique, the Lacy-Keller process, for removal of hydrogen sulfide and mercaptons but leaving the carbon dioxide to avoid shrinking the gas stream. The plant, in the Long Beach area, went on stream before yearend.

Coal (Lignite).—American Lignite Products Co., Inc., California's only commercial lignite producer, mined lignite at its open pit mine near Ione, Amador County. The company used a solvent-extraction process to recover several grades of wax. The plant products were sold principally to the carbon paper, polish, and rubber industries. Overall production was up about 40 percent from that of 1964.

Coke.—Kaiser Steel Corp. operated California's only coking facilities at its integrated Fontana steel plant. The coke was consumed in the producer's blast furnace and the coke breeze was utilized in the nearby agglomerating plant. Production and consumption were 3 percent above 1964 figures. Kaiser obtained most of its coking coal from captive mines at Sunnyside, Utah, but was opening a new mine in the York Canyon area near Ratan, N. Mex., to supplement shipments from Utah.

Natural Gas.—Marketed production of natural gas remained virtually unchanged from that of 1964 with 56 percent of the output coming from oil zones. The most active development drilling occurred in the Dutch Slough (six wells), Grimes (eight wells), and Rice Creek (eight wells) fields in the Sacramento Valley. According to the California Division of Oil and Gas, 1,035 wells were producing at yearend. Significant production increases were reported from the Butte Sink, Lindsey Slough, McMullin Ranch, Millar, Rice Creek, Willow Pass, and Woodland fields in the Sacramento Valley, and the Asphalto, Coles Levee North, Molino Offshore, and Montalvo West fields in the San Joaquin Valley and South Coastal areas. Large declines occurred in the Angle Slough (abandoned), Cache Slough, and Thornton gasfields in the Sacramento Valley, and in the Buena Vista, Dudley Ridge (abandoned), Elk Hills, Railroad Gap (abandoned), and Semitropic Northwest fields of the San Joaquin Valley.

Exploratory drilling resulted in the discovery of four new gasfields, and four new producing zones in old fields. The new fields were the Black Butte, Davis Southeast, Sherman Island, and San Joaquin Northwest. The first three were in the

[4] Prepared by Calvin H. Riggs, petroleum and natural gas engineer, Bureau of Mines, San Francisco, Calif.

Table 5.—Natural gas, natural gas liquids, and petroleum produced in 1965, by counties

County	Natural gas [1] (million cubic feet)		Natural gas liquids		Petroleum [1] (thousand barrels)
	Oil zones	Dry gas zones	Natural gasoline and cycle products (thousand gallons)	LP gases (thousand gallons)	
Butte		9,427			
Colusa		13,631			
Contra Costa	3,982	6,869			785
Fresno	26,580	111	W	W	21,860
Glenn		16,553			
Humboldt		2,097			
Kern	109,435	5,958	171,296	103,541	110,845
Kings	21,021	1,460	W	W	1,229
Los Angeles	71,848	1,854	158,532	60,172	78,770
Madera		2,071			
Monterey	3,023				12,780
Orange	30,225		101,187	18,987	36,053
Riverside					2
Sacramento		42,106			
San Benito	74	437			176
San Bernardino	40				57
San Joaquin		45,474			
San Luis Obispo	714		W	W	1,123
San Mateo	3				44
Santa Barbara	40,906	40,770	69,914	46,706	26,682
Solano		42,913			
Sonoma		40			
Sutter		44,325			
Tehama		1,620			
Tulare		4,102			53
Ventura	52,149	419	104,186	60,914	25,969
Yolo		1,551			
Undistributed			50,665	48,762	
Total	360,000	283,788	655,780	339,082	316,428

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] Quantity figures for natural gas and petroleum by courtesy of California Department of Conservation, Division of Oil and Gas.

Sacramento Valley, the fourth in San Joaquin Valley. Three gasfields discovered in 1964 began producing in 1965.

The quantity of gas injected for repressuring and pressure-maintenance operations, was down almost 5 percent from 1964.

Natural Gas Liquids.—Continuing the decline begun in 1960, production of natural gas liquids decreased 7 percent and the volume of wet gas processed decreased 3 percent from the 1964 totals. Outputs of natural gasoline and cycle products and liquefied petroleum (LP) gas, maintained the 2-to-1 ratio of previous years. Of the eight contiguous counties where natural gas liquids were produced, Orange County, with a 14-percent rise over the 1964 figure, was the only county to report an increase. Several plants were shut down during the year and changes were made in others. At yearend 63 plants were operating, 2 less than in 1964. Increased demand for LP gas caused some shifts in operating procedures, with emphasis on butane recovery. Total value of the natural gas liquids output dropped 7 percent from that of 1964, although the unit price was 7.6 cents for natural gasoline and cycle products (up 0.1 cent).

Peat. — Production and sales of peat dropped for the second consecutive year. About 55 percent of the output was reed-sedge material by two producers in Contra Costa County and one in Riverside County. A Modoc County deposit yielded all the peat moss and an Orange County pit yielded all the humus material. The humus was sold directly from the pit in an unprepared state; the reed-sedge material was shredded before packaging and the peat moss was kiln dried before shredding. Less than 30 percent of the material was sold in bulk. Only a few hundred tons, all reed-sedge material, was sold for other than general soil improvement uses.

Petroleum.—Production from 41,206 active oil wells, in 15 counties, rose more

than 5 percent above the 1964 output to average 867,000 barrels daily during the year. However, only six oil-producing counties recorded increases in production. Development was concentrated in the San Joaquin Valley and South Coastal regions.

Completion of 18 new wells in the East Wilmington offshore oilfield, where oil reserves are estimated at about 1.8 billion barrels, accounted for increases in daily oil production of 5,482 barrels. Five other oilfields—McKittrick, Kern River, Midway-Sunset, Huntington Beach, and San Ardo—reported increases in daily production exceeding 5,000 barrels.

Thermal recovery methods, mainly employing steam injection, accounted for higher production rates estimated at 75,000 barrels daily from 5,000 wells on 280 projects in 38 fields. More than half the projects were in Kern County. Sixteen other injection projects, in the pilot stage, had shown no rise in production rates. Many new projects were started during the year, and several former projects were extended with larger volumes of steam injected into individual wells. Many wells had been "steamed" four or five times with continued good results, but at least 12 projects had been abandoned as too costly. Of all active projects, 62 percent were in pools where oil gravities were less than 14° API.

Waterflood projects totaled 155, including 15 new projects, with more than 1.5 million barrels of water injected daily. Gas was injected on 48 projects, including 5 new efforts. Both gas and water were used on 20 projects. At yearend there were 20 active in situ combustion projects, the most important of which were in the Midway-Sunset, Belridge, and San Ardo fields, with 3 projects each. Seven of the latter projects had been enlarged during the year but no new projects were begun, since secondary recovery emphasis shifted to steam injection.

The California Division of Oil and Gas reported that operators filed 2,571 notices of intention to drill, 345 less than in 1964, and 1,985 new wells were completed to production. The success ratio for 367 exploratory wells drilled was 14.3 percent. New oil discoveries included five new fields, three of which were of major importance: Belmont Surfside, Orange County; and Sawtelle and Las Cienegas-Good Shepherd, Los Angeles County. In addition, 10 new productive zones were developed in older fields. Total footage drilled, including service wells, was 8,113,082 down 16 percent from the 1964 level. Exploratory drilling totaled 2,177,442 feet, including the 312,729 feet drilled in 61 successful wells.

Capacity at the State's 31 operating refineries was increased less than 1 percent to 1,359,120 barrels daily.

Some obsolete plants were shut in, raising total shut-in capacity to 33,400 barrels daily. Daily coking capacity at the Arroyo Grande plant of Union Oil Co. was increased 3,850 barrels to 19,350 barrels by yearend. Gulf Oil Corp. acquired the Santa Fe Springs 45,000-barrel-per-day plant when it purchased all holdings of Wilshire Oil Co. Sequoia Refining Co. did not finish construction of its new Contra Costa County refinery, and the proposed construction at Moss Landing, Monterey County, by Humble Oil & Refining Co. was deferred to another possible site. In general, refineries were operating near capacity pending completion of new units. Increased demand for liquefied petroleum gas induced slight modifications in operating procedures.

NONMETALS

Asbestos.—Most of the 1965 increase in U.S. asbestos production was credited to California producers, who accounted for 63 percent of the total output. As in 1964, most of the asbestos was used in the manufacture of products for the construction industry. Five companies produced asbestos (chrysotile) fiber—Asbestos Bonding Co., Napa County; Atlas Minerals Corp. and Coalinga Asbestos Co., Fresno County; Pacific Asbestos Corp., Calaveras County; and Union Carbide Corp., San Benito County. The latter processed the crude mineral in a Monterey County fiber plant. Four of the five producers prepared only group 7 fiber while the fifth prepared and shipped groups 4, 5, and 6 fiber to domestic and foreign customers.

Barite.—Production of crude barite dropped sharply and the tonnage sold or used was only 70 percent of that in 1964. Barite mined at the Loftus claims, Shasta County was shipped to the producer's plant at Sutter. Crude barite from the Baro claims, Tulare County, the Paycheck mine

and two other properties near Barstow, San Bernardino County, and the Walton deposit near Bishop, Inyo County, and a jigging plant product from Little Lake, Inyo County, were ground in a plant at Rosamond, Kern County. A third producer in Inyo County (Gunter Canyon), shipped to Rosamond and to a grinder at Terminal Island, Los Angeles County. Crude barite mined at the White Swan property, Imperial County, was ground by the producer at Campo.

Shipments of ground barite were down 30 percent from those in 1964, and demand was lower in all use categories. Of all crude barite ground in California plants, 89 percent came from Nevada mines. A barium chemicals plant at Modesto used crude barite from the operator's Nevada property.

Boron Minerals and Compounds.—All domestic production and most of the world supply of boron minerals and compounds came from bedded borate deposits in Kern and Inyo Counties and from the brines of Searles Lake, San Bernardino County. U.S. Borax and Chemical Corp. refined crude borates from the company's open pit mine at Boron, Kern County, in plants in Kern and Los Angeles Counties. In addition to an increase in its anhydrous boron compounds production facility, U.S. Borax expanded its capacity to manufacture primary borates, and developed a new process for producing anhydrous boric acid. In Inyo County, Kern County Land Co. mined colemanite near Ryan, and U.S. Borax mined sodium-calcium borates near Shoshone and natural calcium borate near Furnace Creek. American Potash & Chemical Corp. and Stauffer Chemical Co. extracted boron compounds from brines in plants at Searles Lake. Stauffer increased the capacity of its borax refinery. The company also produced high purity boron chemicals in its San Francisco plant using purchased Kern County borates. Although gains were reported for both domestic and foreign markets, exports sales were chiefly responsible for the rise above 1964 figures.

Bromine and Bromine Compounds.—American Potash & Chemical Corp. produced elemental bromine in the treatment of Searles Lake brines at Trona, San Bernardino County. Output was slightly above that of 1964 and was sold to the chemical and pharmaceutical industries. FMC Corp. recovered elemental bromine from salt-works bitterns in the company's Newark, Alameda County, plant and converted it to ethylene dibromide. Production of ethylene dibromide was less than in 1964. The output was sold principally for use as a fumigant in agriculture, although some was consumed in preparing a gasoline antiknock compound.

Calcite (Optical Grade).—A few pounds of optical grade calcite was mined from claims at Mount Baldwin, Mono County, for Bausch & Lomb, Inc., and shipped to the company at Rochester, N.Y. Techniques for mining several unusually large calcite crystals found on the claims without damaging them had not been developed.

Calcium Chloride. — Liquid calcium chloride was recovered from Bristol Lake brine, San Bernardino County, by Leslie Salt Co., and National Chloride Co. of America. Hill Bros. Chemical Co. purchased the liquid and prepared a flake product in a plant near Bristol Lake. Less liquid and flake products were produced and sold than in 1964. The finished products were used principally as hygroscopic agents and as fireproofing materials by customers in southern California, Nevada, and Arizona.

Cement.—Production and shipments of portland cement were down 2 million barrels from the 1964 totals. In southern California shipments from mills declined 3 million barrels because of lower demand for construction. In contrast, shipments from northern California mills reached an alltime high of 19.6 million barrels. Over 3 million barrels were shipped from all plants to out-of-State customers. Total apparent consumption in California was 42 million barrels, including receipts from other States.

Cement companies continued their long-range replacement of old equipment to reduce operating costs and plant expansion to meet projected future demands. By yearend total annual production capacity had been increased to 57,150,000 barrels with completion of expanded capacity at the gray and white cement plants of Riverside Cement Co. at Crestmore.

Clays.—Nearly 3 million tons of clay was mined at captive operations, a drop of 19 percent from 1964. The total output, sold and used, was down 12 percent. The decline was attributed to reduced

Table 6.—Finished portland cement

(Thousand 376-pound barrels and thousand dollars)

District [1]	Active plants	Capacity Dec. 31	Production	Shipments from mills			Stocks at mills Dec. 31	Estimated consumption
				Quantity	Value			
					Total	Average per barrel		
1964:								
Northern California	6	21,150	18,999	18,418	$59,834	$3.25	1,745	17,141
Southern California	7	35,400	28,982	28,786	90,099	3.13	1,748	26,874
Total	13	56,550	47,981	47,204	149,933	3.18	3,493	44,015
1965:								
Northern California	6	21,150	19,402	19,619	63,804	3.25	1,511	18,394
Southern California	7	36,000	25,770	25,733	81,048	3.15	1,744	23,800
Total	13	57,150	45,172	45,352	144,852	3.19	3,255	42,194

[1] Northern and southern California are divided by the northern boundaries of San Luis Obispo and Kern Counties and the western boundaries of Inyo and Mono Counties.

Table 7.—Source and destination of shipments of portland cement

(Thousand 376-pound barrels)

Destination	Source				Total	
	Northern California mills		Southern California mills			
	1964	1965	1964	1965	1964	1965
Northern California	16,033	16,904	961	1,170	16,994	18,074
Southern California	418	482	26,430	23,294	26,848	23,776
Nevada	622	303	1,157	969	1,779	1,272
Oregon	W	W	W	W	[1]	[2]
Arizona	-------	-------	184	204	184	204
Other	[3] 1,345	[3] 1,930	[4] 54	[4] 96	1,399	2,026
Total	18,418	19,619	28,786	25,733	47,204	45,352
Building material dealers	1,463	1,404	3,773	3,307	5,236	4,711
Concrete product manufacturers	1,415	1,526	3,191	2,766	4,606	4,292
Ready-mixed concrete	11,912	12,791	19,167	16,943	31,079	29,734
Contractors and Government agencies	3,563	3,713	2,570	2,446	6,133	6,159
Miscellaneous and own use	65	185	85	271	150	456
Total	18,418	19,619	28,786	25,733	47,204	45,352

W Withheld to avoid disclosing individual company confidential data; included with "Other."
[1] Included with "Other"; total 538,000 barrels shipped from northern and southern California to Oregon.
[2] Included with "Other"; total 1,085,000 barrels shipped from northern and southern California to Oregon.
[3] Includes Alaska, Colorado, Idaho, New Mexico (1965), Oregon, Washington, and U.S. possessions and territories (1965).
[4] Includes Colorado, Hawaii, Iowa, Michigan, Missouri (1965), New Mexico, Oregon, Texas, Utah, Washington, and foreign countries.

home building activity, which adversely affected the demand for clay products.

Ball clay was mined at two properties, one each in San Bernardino and Stanislaus Counties. Bentonite was produced from six mines, two each in Inyo and San Bernardino Counties, and one each in Imperial and San Benito Counties. Fullers earth production was limited to two deposits in Inyo County. Kaolin was mined from one Mono County deposit and two properties in Orange County. Fire and stoneware clays were mined from 21 deposits in 8 counties, and miscellaneous clay from 64 properties in 33 counties.

Fire clays and miscellaneous clay used in making cement and heavy clay products represented over 64 percent of all

Table 8.—Clays sold or used in 1965, by counties

County	Clays used in cement and heavy clay products	Total clays	
	Short tons	Short tons	Value
Alameda	20,030	21,330	$35,954
Amador	15,404	74,400	406,572
Calaveras	192,339	W	W
Contra Costa	53,900	53,900	81,120
Inyo	----------	9,124	39,553
Kern	51,975	W	122,415
Lake	100	2,200	13,000
Los Angeles	385,215	385,988	501,038
Madera	7,650	7,650	9,563
Orange	72,328	241,425	852,426
Placer	147,797	W	W
Riverside	324,390	384,616	874,770
Sacramento	14,405	17,626	25,091
San Bernardino	203,407	269,011	914,105
San Joaquin	35,483	W	W
San Luis Obispo	9,150	9,150	11,438
San Mateo	177,945	W	W
Santa Clara	20,150	20,150	20,150
Santa Cruz	193,919	W	W
Shasta	90,583	W	W
Stanislaus	2,801	4,157	21,921
Sutter	23,875	W	W
Yuba	20,055	W	W
Other counties [1]	101,817	1,706,509	3,296,729
Total	2,164,718	3,207,236	7,225,845

W Withheld to avoid disclosing individual company confidential data; included with "Other counties."
[1] Includes Fresno, Imperial, Marin, Mono, Napa, Plumas, San Benito, San Diego, Siskiyou, Sonoma, Trinity, Tulare, and Ventura, and counties indicated by symbol W; withheld to avoid disclosing individual company confidential data.

clays sold or used.

Diatomite.—Most of the diatomite production came from four open pit operations near Lompoc, Santa Barbara County. A new producer worked an open pit deposit in Kern County, near Maricopa. In Napa County, interplant shipments of diatomaceous silica were made from stockpile and the material ground for pozzolan. Comparatively low-grade diatomaceous material was mined in Tuolumne County and used for lightweight aggregate. Crude diatomite sales rose more than sixfold while prepared sales were only slightly above the 1964 figure. Sales, in order of greatest demand, were for filtration, filler, lightweight aggregate, pozzolan, insulation, and absorbent uses.

Feldspar.—Del Monte Properties Co. and Owens-Illinois Glass Co. mined and processed dune sands from the Monterey peninsula. Both companies removed heavy minerals from the sand, Del Monte by froth flotation and Owens-Illinois by magnetic separation. Del Monte produced feldspar and silica concentrates by flotation and blended and ground the products to customer specifications, principally for manufacturers of sanitary ware. Owens-Illinois shipped the upgraded feldspathic sand to company glass plants. In all instances output was below 1964 figures.

Gypsum.—Production of crude gypsum was more than 280,000 tons less than the record high in 1964. The drop was caused by a decline in southern California residential construction and the availability of byproduct agricultural gypsum from phosphoric acid plants.

Two of three wallboard plants under construction in 1964 were completed and in production at yearend, at Long Beach and at Fremont. The third, at Santa Fe Springs, was expected to be on stream early in 1966.

Crude gypsum from mines in California, Nevada, and Mexico was calcined in California gypsum products plants. The combined calcined product from nine operating plants in the State totaled about 200,000 tons less than in 1964.

Iodine.—Crude iodine was extracted from waste oil brines of the Los Angeles basin in the Seal Beach plant of The Dow

Chemical Co. Some of the output was consumed in making iodides of potassium and titanium. Dow announced the projected closing of this plant in August 1966, because of foreign competition. When the plant is closed oil producers in the basin will have to find other means for disposing of brine from their wells.

Deepwater Chemical Co. operated a plant at Compton, Los Angeles County, on purchased foreign crude iodine, and produced various iodides and iodates. The company also resublimed some crude iodine for resale.

Lime.—Production of lime and dead-burned dolomite exceeded 600,000 tons for the first time. Nearly 517,000 tons was sold or used for chemical and industrial uses, including about 200,000 tons in sugar refining. The largest gain was in lime used in recovering magnesium compounds from sea water and bitterns. Construction and agricultural uses for lime declined. Dead-burned dolomite for use in making refractories rose.

Producers used 428,000 tons of lime in their own plants and sold 174,000 tons to California and out-of-State customers. California consumers received nearly 200,000 tons of lime from producers in Arizona, Missouri, Nevada, Ohio, Texas, and Utah, 12,000 tons less than in 1964. Purchases from California producers, however, more than offset that decline.

During the year, construction began on a plant at Richmond to produce hydrated lime for soil stabilization and other construction uses. Completion was scheduled for April 1966. The raw material source will be bulk quicklime from an out-of-State plant of the owner.

Lithium Compounds.—American Potash & Chemical Corp. recovered lithium in the form of dilithium sodium phosphate from the brines of Searles Lake in its Trona plant, San Bernardino County. The phosphate was converted to finished lithium carbonate and sold as a source for lithium oxide. Production and sales were appreciably lower than in 1964.

Magnesium Compounds. — Production, sales, and producer consumption of all magnesia grades except U.S.P. and technical were higher than in 1964. FMC Corp. operated plants in Alameda and San Diego Counties to extract magnesium hydroxide from salt-works bitterns. The San Diego plant also produced magnesium chloride. Merck & Co., Inc., in San Mateo County, and Kaiser Aluminum and Chemical Corp. in Monterey County, recovered magnesia from sea water. The latter consumed most of its output in the manufacture of refractories, primarily for use in the Fontana plant of Kaiser Steel Corp.

Mica. — Western Non-Metallics mined and processed mica (sericite schist) near Ogilby, Imperial County, until November, at which time the company terminated all operations. In the same area, Western Industrial Minerals mined and stockpiled crude mica, but made no shipments. Sunshine Mica Co. at Los Nietos, Los Angeles County, ground scrap mica obtained from South Dakota. Plant products from both Western Non-Metallics and Sunshine Mica were used principally in the manufacture of paint and roofing materials.

The mica flotation plant under construction in Mariposa County in 1964 was completed early in 1965. However, the plant failed to yield a suitable product and the entire flowsheet was undergoing major modifications at yearend.

Perlite.—Crude perlite production, and the tonnage sold or used, dropped 26 and 16 percent, respectively, from 1964. A high percentage of the output was mined by American Perlite Co. from its Fish Springs property near Zurich, Inyo County, and shipped to expanding plants in Fresno and Los Angeles Counties, and Clark County, Nev. Perlite Aggregates, Inc. (formerly Perlite Rock Co.), expanded crude perlite from the Alvo mine, Napa County, in its St. Helena plant for company use in various construction products.

A total of 12 expanding plants, 7 of which were in Los Angeles County, operated in 6 counties. Production and sales of expanded products rose 45 percent from 1964. About 55 percent of the expanded output was used as plaster aggregate, 20 percent for filter aids, 7 percent for concrete aggregate, 6 percent as loose-fill insulation, 4 percent in soil conditioners, 3 percent as filler, and 5 percent for all other uses.

Potassium Salts.—American Potash & Chemical Corp., California's only producer of potassium compounds, extracted potassium chloride from Searles Lake brines at

Table 9.—Pumice [1] sold or used by producers in 1965, by counties

County	Crude		Prepared		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
Amador	151	$151	----------	----------	151	$151
Inyo	273	273	W	W	W	W
Kern	----------	----------	1,262	$44,812	1,262	44,812
Lake	W	W	W	W	173,782	284,207
Lassen	W	W	W	W	153,081	165,081
Madera	----------	----------	W	W	W	W
Modoc	W	W	W	W	70,121	46,733
Mono	----------	----------	14,293	777,959	14,293	777,959
Napa	1,164	2,156	----------	----------	1,164	2,156
San Bernardino	238	357	17,976	39,012	18,214	39,369
Shasta	26,771	27,355	----------	----------	26,771	27,355
Siskiyou	155,712	126,241	26,000	52,000	181,712	178,241
Tehama	9,951	8,976	----------	----------	9,951	8,976
Undistributed	326,420	286,082	95,956	378,708	25,665	169,042
Total	520,680	451,591	155,487	1,292,491	676,167	1,744,082

W Withheld to avoid disclosing company confidential data; included with "Undistributed."
[1] Includes pumicite and volcanic cinder.

Trona, San Bernardino County, and converted part of the output to potassium sulfate. Overall production and sales were slightly lower, although potassium sulfate output was appreciably above that of 1964. Customers used the products for direct application to soils and in the manufacture of fertilizers.

Pumice.—Combined output of pumice, pumicite, and volcanic cinder rose more than 50 percent. Although production of prepared material was 7 percent lower, the tonnage of crude, principally volcanic cinder, increased 89 percent above that in 1964. Major declines occurred for such uses as cleansing and scouring compounds, concrete admixture, and road construction. Important increases were reported for concrete aggregate, railroad ballast, and abrasive uses other than cleansing and scouring. The use of volcanic cinder for concrete aggregate was nearly triple the 1964 figure. Less than one-fourth of the combined output of all materials was crushed, screened, ground, or otherwise processed before shipment.

Salt.—Eight companies produced crude salt by solar evaporation at 10 plants in 8 counties. A high percentage of the output was recovered from sea water at salt ponds in three San Francisco Bay area counties—Alameda, Napa, and San Mateo. In Alameda County, Leslie Salt Co. produced all grades of salt, including crude, kiln dried, and vacuum refined. Morton Salt Co. refined crude salt in an adjacent plant. All other plants in the State produced only a crude product, although the Kern County plant had kiln-drying equipment. Some rock salt was produced at Bristol Lake, San Bernardino County, by Leslie. One new producer, Standard Salt & Chemical Co., a subsidiary of National Chloride Co. of America, harvested salt from solar evaporating ponds at Danby Dry Lake, San Bernardino County, as a result of preparatory work begun in 1962. Salt was shipped to all Western States (including Alaska and Hawaii), Wisconsin, Puerto Rico, and Canada, Japan, Central America, the Philippines, and other South Pacific Islands.

Sand and Gravel.—Production of sand and gravel reached an alltime high of 118 million tons, about 5 million tons more than in 1964. A 15-percent rise in output of paving aggregate more than offset a 4-percent drop in building construction use. Interstate and State highway construction continued at a record level. Most of the work was on sections of Interstate 5 in Tehama, Sacramento, Kings, and Kern Counties, and on Interstate 10 in Riverside County.

Production of building sand and gravel declined in southern California, most notably at plants in Los Angeles, Ventura, Orange, and San Bernardino Counties. Output increased in northern California, principally at plants in San Joaquin, Alameda, Stanislaus, and Sacramento Counties.

Sand and gravel was produced in all 58 counties, ranging from 5,000 tons in Sierra County to more than 25 million tons in

Table 10.—Sand and gravel sold or used by producers

(Thousand short tons and thousand dollars)

Year	Sand		Gravel		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
1956–60 (average)	32,958	$38,384	52,080	$60,678	85,038	$99,062
1961	42,379	51,080	67,802	73,031	110,181	124,111
1962	47,463	54,293	60,197	70,629	107,660	124,922
1963	47,831	53,658	64,354	74,520	112,185	128,178
1964	45,297	53,309	67,698	76,024	112,995	129,333
1965	48,536	58,152	69,774	78,075	118,310	136,227

Table 11.—Sand and gravel sold or used by producers, by classes of operation and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1964		1965	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Glass	833	$3,924	869	$4,138
Molding	57	271	87	399
Building	21,994	24,542	22,323	26,291
Paving	11,896	12,799	12,598	13,820
Blast	260	954	225	942
Engine	56	163	42	131
Filter	29	101	12	56
Other	4,422	3,970	4,786	3,993
Total	39,547	46,724	40,942	49,770
Gravel:				
Building	26,371	31,395	24,859	29,958
Paving	26,927	31,258	28,461	33,093
Railroad ballast	170	193	132	134
Other	3,856	3,767	2,876	2,849
Total	57,324	66,613	56,328	66,034
Total sand and gravel	96,871	113,337	97,270	115,804
Government-and-contractor operations: [1]				
Sand:				
Building	197	285	19	21
Paving	5,000	5,854	6,930	7,729
Fill	549	441	574	548
Other	4	5	71	84
Total	5,750	6,585	7,594	8,382
Gravel:				
Building	491	599	99	117
Paving	8,705	7,818	12,680	11,281
Fill	1,054	881	456	456
Other	124	113	211	187
Total	10,374	9,411	13,446	12,041
Total sand and gravel	16,124	15,996	21,040	20,423
All operations:				
Sand	45,297	53,309	48,536	58,152
Gravel	67,698	76,024	69,774	78,075
Grand total	112,995	129,333	118,310	136,227

[1] Includes figures for State, counties, municipalities, and other Government agencies.

Table 12.—Sand and gravel production in 1965, by counties
(Thousand short tons and thousand dollars)

County	Quantity	Value	County	Quantity	Value
Alameda	10,532	$12,515	Plumas	203	$270
Butte	1,126	1,260	Riverside	3,425	4,806
Colusa	294	309	Sacramento	7,009	8,446
Contra Costa	418	406	San Benito	298	356
Del Norte	444	437	San Bernardino	7,597	7,556
El Dorado	272	420	San Diego	5,806	8,652
Fresno	3,942	4,527	San Joaquin	3,529	4,182
Glenn	279	312	San Luis Obispo	631	743
Humboldt	908	1,216	Santa Barbara	1,449	1,585
Imperial	714	699	Santa Clara	3,516	3,210
Inyo	173	231	Santa Cruz	1,142	1,247
Kern	3,929	4,904	Shasta	1,584	1,528
Kings	1,783	2,048	Sierra	5	7
Lake	427	490	Siskiyou	352	434
Los Angeles	25,267	27,543	Solano	255	318
Madera	380	370	Sonoma	2,819	3,594
Marin	275	296	Stanislaus	1,195	1,322
Mariposa	58	85	Tehama	4,015	2,388
Mendocino	407	624	Trinity	140	181
Merced	2,007	2,591	Tulare	1,289	1,479
Modoc	176	213	Tuolumne	17	7
Mono	29	29	Ventura	3,955	3,698
Monterey	840	1,684	Yolo	2,017	2,624
Napa	67	89	Yuba	1,086	1,368
Nevada	414	730	Other counties [1]	1,469	3,337
Orange	7,957	8,292			
Placer	389	569	Total	118,310	136,227

[1] Includes Alpine, Amador, Calaveras, Lassen, San Francisco, San Mateo, and Sutter Counties, combined to avoid disclosing individual company confidential data.

Los Angeles County. Five other counties yielded more than 5 million tons each—Alameda, Orange, San Bernardino, Sacramento, and San Diego.

Outputs of ground and unground specialty sands were appreciably below 1964, particularly for such uses as sandblasting, industrial fillers, and filtration, while the tonnages of glass sand and molding sand sold or used by producers rose 7 percent above 1964 figures.

Sodium Compounds.—Sales of sodium compounds were slightly above 1964 figures, although outputs of salt cake and sodium sesquicarbonate were lower. U.S. Borax & Chemical Corp. produced byproduct anhydrous sodium sulfate in its Wilmington refinery, Los Angeles County, from borates mined by the company in Kern County; Pittsburgh Plate Glass Co. produced carbonate and sesquicarbonate from Owens Lake brines, Inyo County; and American Potash & Chemical Corp. and Stauffer Chemical Co. both produced carbonate and sulfate from Searles Lake brines, San Bernardino County. Stauffer increased the capacity of its salt-cake plant 35 percent during the year. Stauffer also recovered byproduct sodium sulfate from purchased Kern County borates in its San Francisco plant.

Stone.—Stone production was 3 million tons less than the record high of 1964. The decline occurred principally in the northern California counties where the tonnages required for flood control and water resource projects were lower. Also, nearly 1 million tons less stone was used in Merced County for the San Luis dam, reservoir, and canal project.

Highway construction consumed large quantities of crushed stone, principally basalt, granite, and sandstone, which were quarried near the project sites. Less limestone was used by cement companies in southern California but the tonnage processed for industrial and chemical uses, particularly for whiting and fertilizer filler, rose significantly.

Larger quantities of rough dimension building stone were quarried for the northern California market, and more quartz and quartzite was produced for making refractory (silica) brick than in 1964. A favorable market for plates, slabs, and flagging resulted in a greater slate output. A lag in residential building construction adversely affected sales of crushed stone for terrazzo and roofing granules.

Sulfur. — Six plants—two in Contra Costa County, three in Los Angeles Coun-

Table 13.—Stone sold or used by producers, by uses

Use		1964		1965	
		Quantity	Value	Quantity	Value
Dimension stone:					
Rough construction and rubble	short tons	79,901	$826,193	98,130	$685,391
Rough architectural	cubic feet	104,928	924,276	95,227	659,372
Approximate equivalent	short tons	8,745	----------	7,912	----------
Monuments and mausoleums	cubic feet	39,871	371,500	20,268	321,812
Approximate equivalent in	short tons	3,336	----------	1,726	----------
Flagging	cubic feet	27,611	53,221	43,863	71,369
Approximate equivalent in	short tons	2,351	----------	3,742	----------
Total dimension stone approximate, in short tons		94,333	2,175,190	111,510	1,737,944
Crushed and broken stone:					
Riprap	short tons	12,130,652	14,424,676	9,171,137	9,908,418
Metallurgical	do	W	W	W	W
Concrete and roadstone	do	15,510,319	19,321,432	16,273,902	21,377,686
Railroad ballast	do	W	W	W	W
Agricultural	do	19,342	132,375	20,329	118,099
Chemical	do	W	W	33,587	398,727
Miscellaneous [1]	do	[2] 18,049,958	[2] 27,512,207	[3] 16,964,090	[3] 26,126,968
Total crushed and broken stone	do	45,710,271	61,390,690	42,463,045	57,929,898
Grand total approximate	do	45,804,604	63,565,880	42,574,555	59,667,842

W Withheld to avoid disclosing individual company confidential data.
[1] Includes whiting substitute, filler, mineral food, poultry grit, stucco, roofing granules, filter beds, terrazzo, miscellaneous, and uses indicated by symbol W.
[2] Includes 12,989,143 tons of limestone and oystershell used in cement valued at $12,193,577 and 668,183 tons of limestone used in lime valued at $2,032,335.
[3] Includes 12,352,383 tons of limestone and oystershell used in cement valued at $11,897,936 and 640,320 tons of limestone used in lime valued at $1,972,412.

ty, and one in San Luis Obispo County—recovered elemental sulfur from sour-natural and refinery gases, as a byproduct of petroleum refining, using a modified Klaus process. Production rose 11 percent, but shipments were up only 6 percent because more sulfur was used by the producers to make other products.

Sulfur ore was mined and shipped from the S Bar S deposit, Lake County, for use as a soil aid. All other sulfur deposits were idle throughout the year.

Talc, Soapstone, and Pyrophyllite.—Combined production of talc, soapstone, and pyrophyllite increased 6 percent; shipments to grinders exceeded the 1964 figure by 11 percent, and consumer receipts from mines increased 15 percent. Overall consumption was lower, principally because of lower demand for use in the paint and rubber industries. Exports (all talc) were only a fraction of those in 1964.

Substitute materials, such as diopside from Arizona, were finding limited use in replacing talc for certain ceramic uses.

Water.—Thermal Power Co. discovered a deep steam zone at 5,000 feet under The Big Geyser field, Sonoma County, and 3.5 miles to the east drilled two successful steam wells at The Little Geyser field. Two wells in The Big Geyser field were deepened, resulting in an increase in pressure and production of steam equivalent to 15,000 kilowatts. Five new wells with a combined production capability equivalent to 54,000 kilowatts were drilled in the Sulphur Bank field. Pacific Gas & Electric Co. was constructing its third geothermal-electric unit (27,500 kilowatts) in this field.

State pollution control regulations prohibiting the discharge of waste brines into the Salton Sea curtailed plans for large-scale commercial development of geothermal energy and chemical resources from wells in that area. As a consequence, Western Geothermal, Inc., late in the year delayed experimental pilot-plant operations and development in the area, and Earth Energy, Inc., shut down its operations indefinitely.

Table 14.—Stone [1] production in 1965, by counties

(Thousand short tons and thousand dollars)

County	Quantity	Value	County	Quantity	Value
Alameda	2,925	$2,193	Plumas	17	$10
Amador	18	113	Riverside	1,457	3,497
Butte	3	3	Sacramento	(2)	1
Calaveras	W	W	San Benito	W	W
Colusa	(2)	(2)	San Bernardino	5,806	9,006
Contra Costa	3,571	5,250	San Diego	1,241	2,481
Del Norte	81	33	San Luis Obispo	W	W
El Dorado	417	1,491	San Mateo	1,357	2,037
Fresno	44	60	Santa Barbara	25	158
Humboldt	230	310	Santa Clara	5,479	4,495
Imperial	134	87	Santa Cruz	1,328	1,787
Inyo	147	848	Shasta	542	724
Kern	2,419	3,060	Sierra	1	1
Kings	194	379	Siskiyou	218	141
Lake	1	2	Solano	109	191
Lassen	19	22	Sonoma	419	626
Los Angeles	1,841	3,105	Sutter	15	60
Madera	W	W	Tehama	38	32
Marin	W	W	Trinity	94	81
Mariposa	3	54	Tulare	176	392
Mendocino	40	103	Tuolumne	286	1,062
Merced	5,982	4,810	Ventura	275	1,047
Modoc	7	7	Yuba	61	99
Mono	(2)	(2)	Other counties	5,469	9,707
Monterey	W	W			
Napa	W	W	Total	42,575	59,668
Nevada	69	23			
Placer	17	80			

W Withheld to avoid disclosing individual company data. Included with "Other counties."
[1] Includes stone used in cement and lime.
[2] Less than ½ unit.

Table 15.—Stone sold or used by producers, by kinds

(Thousand short tons and thousand dollars)

Year	Quantity	Value	Quantity	Value	Quantity	Value
	Granite		Basalt and related rocks (traprock)		Limestone [1]	
1961	4,867	$7,233	1,880	$2,225	16,669	$23,989
1962	4,484	5,975	1,886	2,200	15,694	24,082
1963	3,814	6,098	2,024	2,801	16,447	22,806
1964	3,994	5,479	2,282	3,144	16,908	23,582
1965	4,286	6,193	2,480	3,035	15,840	22,959
	Sandstone		Other stone [2]		Total	
1961	3,286	$5,222	7,148	$11,658	33,850	$50,327
1962	2,399	4,038	10,313	18,427	34,776	54,722
1963	3,363	5,898	12,329	20,650	37,977	58,253
1964	3,065	6,118	19,556	25,243	45,805	63,566
1965	4,061	7,202	15,908	20,279	42,575	59,668

[1] Includes limestone and oyster-shell used in cement and lime as follows (in thousand short tons and thousand dollars): 1961, 12,778 tons, $15,312; 1962, 12,799 tons, $15,393; 1963, 13,242 tons, $13,580; 1964, 13,657 tons, $14,226; 1965, 12,993 tons, $13,870.
[2] Includes light-colored volcanics, schist, serpentine, river boulders, and such other stone as cannot properly be classed in any main group; also marble and slate.

The U.S. Department of the Interior reported on plans to cooperate in two major studies for advancing the technology of desalting sea water. One of these was the development of a saline water conversion test center to be built at a still-to-be-selected site in southern California in cooperation with the California Department of Water Resources.

A report on the second study, prepared by Bechtel Corp. for the Metropolitan Water District in southern California with

financial assistance from the U.S. Department of the Interior's Office of Saline Water and the U.S. Atomic Energy Commission, dealt with the technical and economic feasibility of a large-scale combination electric power and water desalting plant. The dual-purpose plant considered in the study included two 3-million-thermal-kilowatt nuclear reactors, three turbine generators with a gross capacity of 1.8 kilowatts, and a multistage flash-type water distillation plant capable of producing 150 million gallons of water daily. Cost of the plant was estimated at $357 million.

Secretary of the Interior Stewart L. Udall announced apportionment of nearly $76 million to States and territories from the first full year's revenues into the Land and Water Conservation Fund, administered by the Bureau of Outdoor Recreation, U.S. Department of the Interior. Amounts must be matched by the States and territories and used to finance 50 percent of approved costs of planning, acquiring, and developing outdoor recreation areas and facilities. California's apportionment was $4,296,894.

Other Nonmetals.—Chas. Pfizer & Co., Inc., produced natural and manufactured iron oxide pigments in a plant at Emeryville, Alameda County, the State's only such facility. Output was nearly 10 percent below that in 1964, with declines reported for all natural oxides and increases for most manufactured products.

Phosphate rock from mines in Idaho and Wyoming, and pebble phosphate from Florida, was shipped to California producers of chemicals and fertilizers. Pebble phosphate shipments into the State exceeded those of phosphate rock for the first time.

Blast furnace slag from Kaiser Steel Corp. at Fontana was used for railroad ballast, prepared for roofing granules, substituted for sand as fill material, made into mineral wool for insulation, expanded for lightweight aggregate, used as a sewage filter medium and paving material, and used as a filler in fertilizer.

California Zonolite Co. exfoliated crude vermiculite from Montana at plants in Alameda, Los Angeles, and Sacramento Counties. The Alameda County plant was new in 1965. La Habra Products Co. exfoliated crude vermiculite imported from South Africa in an Orange County plant. The plant products were used chiefly as aggregate in plaster and concrete, and as a soil conditioner in the horticulture industry. All sales except those for aggregate use were lower than in 1964.

Wollastonite mined on the J. O. claims, Inyo County, was shipped for test by a ceramic tile manufacturer. Float wollastonite collected near Midland, Riverside County, was sold for building and ornamental stone.

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Copper.—The only active copper property was the Carlton group of claims a few miles southwest of Goldstone, San Bernardino County, from which a few tons of ore was shipped to an Arizona smelter. A carload of copper ore was shipped from an undisclosed location in California to the smelter at Tacoma, Wash., by a logging company. Most of the copper was produced as a byproduct during milling of tungsten ores at Pine Creek, Inyo County, and from underground leaching operations at the Iron Mountain mine, Shasta County. Silver ore mined in Alpine County, lead and lead-zinc ores from Inyo County mines, and lead ore from a property in San Bernardino all contained recoverable copper.

Work at the copper mines in the Engels-Superior area, Plumas County, was limited to assessment work, and the Early Bird mine, Shasta County, was idle throughout the year.

Gold.—Gold production declined for the third consecutive year. Placer output was down 11 percent and lode output decreased 15 percent. Gold from placers represented 93 percent of the total. One bucketline dredging operation (3 dredges), 2 dragline excavating and sluicing operations, 1 suction dredge, and 16 nonfloating washing plants recovered 96 percent of the placer gold. All but one of the nonfloat plants were sand and gravel preparation plants where placer gold was recovered as a byproduct. Placer gold recovery also was reported from 1 drift mine and 21 small hand-panning and sluicing operations.

Lode gold output was lower although there were three more operating gold mines, including one gold-silver property, than in 1964. The Original 16 to 1 mine, Sierra County, was the major producer, but production and all other activi-

Table 16.—Mine production of gold, silver, copper, lead, and zinc in 1965, by counties in terms of recoverable metals

County	Mines producing [1]		Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Troy ounces	Value	Troy ounces	Value
Amador	(2)	(2)	10	$350	1	$1
Butte	2	(2)	24	840	7	9
Del Norte	----------	1	2	70	----------	----------
El Dorado	----------	(2)	9	315	1	1
Fresno	----------	(2)	339	11,865	42	54
Inyo	10	----------	356	12,460	170,185	220,049
Kern	3	----------	64	2,240	W	W
Los Angeles	----------	(2)	106	3,710	14	18
Madera	----------	(2)	12	420	2	3
Mariposa	1	1	38	1,330	9	12
Merced	----------	(2)	9	315	1	1
Nevada	(2)	5	1,287	45,045	79	103
Placer	3	3	775	27,125	112	145
Plumas	----------	(2)	16	560	----------	----------
San Bernardino	9	(2)	11	385	1,054	1,363
San Diego	1	----------	10	350	3	4
Shasta	4	1	119	4,165	19	25
Sierra	5	8	2,633	92,155	418	540
Siskiyou	----------	3	1,106	38,710	171	221
Stanislaus	----------	(2)	48	1,680	5	6
Tulare	----------	(2)	23	805	3	4
Tuolumne	3	----------	17	595	3	4
Yuba	----------	3	53,986	1,889,510	2,905	3,756
Undistributed [3]	10	2	1,885	65,975	21,753	28,127
Total	51	27	62,885	2,200,975	196,787	254,446

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Amador	----------	----------	----------	----------	----------	----------	$351
Butte	----------	----------	----------	----------	----------	----------	849
Del Norte	----------	----------	----------	----------	----------	----------	70
El Dorado	----------	----------	----------	----------	----------	----------	316
Fresno	----------	----------	----------	----------	----------	----------	11,919
Inyo	W	W	3,599,100	561,460	W	W	W
Kern	----------	----------	----------	----------	----------	----------	W
Los Angeles	----------	----------	----------	----------	----------	----------	3,728
Madera	----------	----------	----------	----------	----------	----------	423
Mariposa	----------	----------	----------	----------	----------	----------	1,342
Merced	----------	----------	----------	----------	----------	----------	316
Nevada	----------	----------	----------	----------	----------	----------	45,148
Placer	----------	----------	100	16	----------	----------	27,286
Plumas	----------	----------	----------	----------	----------	----------	560
San Bernardino	1,100	389	15,900	2,480	8,200	1,197	5,814
San Diego	----------	----------	----------	----------	----------	----------	354
Shasta	W	W	----------	----------	----------	----------	W
Sierra	----------	----------	----------	----------	----------	----------	92,695
Siskiyou	----------	----------	----------	----------	----------	----------	38,931
Stanislaus	----------	----------	----------	----------	----------	----------	1,686
Tulare	----------	----------	----------	----------	----------	----------	809
Tuolumne	----------	----------	----------	----------	----------	----------	599
Yuba	----------	----------	----------	----------	----------	----------	1,893,266
Undistributed [3]	2,328,900	824,431	4,900	764	441,800	64,503	1,784,199
Total	2,330,000	824,820	3,620,000	564,720	450,000	65,700	3,910,661

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed".

[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] Includes Alpine, Calaveras, Humboldt, Sacramento, and Trinity Counties and counties indicated by sympol W.

ty at the mine was halted by yearend because exploration during the year failed to find new ore reserves. Only five other properties yielded more than 100 ounces of gold each—The Zaca silver mine, Alpine County; the Empire Star gold property (cleanup and old tailings), Nevada County; the Pine Creek Tungsten mine, Inyo County; an unnamed gold deposit, Placer County; and the Kelly gold mine,

Table 17.—Gold produced at placer mines, by classes of mines and methods of recovery [1]

Class and method	Mines producing [2]	Number of washing plants (dredges)	Material treated (thousand cubic yards)	Gold recovered		
				Troy ounces	Value	Average value per cubic yard
Surface placers:						
Gravel mechanically handled:						
Bucketline dredges:						
1956–60 (average)	3	8	28,092	115,318	$4,036,116	$0.144
1961	2	5	23,651	82,316	2,881,060	.122
1962	3	6	17,547	93,707	3,279,745	.187
1963	2	6	12,817	77,448	2,710,680	.212
1964	1	3	11,611	62,422	2,184,770	.188
1965	1	3	12,412	53,937	1,887,795	.152
Dragline dredges:[3]						
1956–60 (average)	7	7	180	917	32,081	.178
1961	3	3	493	309	10,815	.022
1962	6	6	472	761	26,635	.056
1963	3	3	256	1,109	38,815	.152
1964	1	1	132	545	19,075	.145
1965	2	2	540	1,096	38,360	.071
Suction dredges:						
1956–60 (average)	2	2	7	23	798	.114
1961	5	5	64	22	770	.012
1962	5	5	(4)	20	700	5.833
1963	10	10	12	178	6,230	.498
1964	3	3	1	112	3,920	3.439
1965	1	1	(4)	8	280	.560
Nonfloating washing plants:[3 5]						
1956–60 (average)	6	15	5	1,122	39,277	.756
1961	6	9	340	557	19,495	.039
1962	4	10	187	679	23,765	.127
1963	2	19	(4)	1,349	47,215	89.085
1964	2	18	5	1,203	42,105	.381
1965	1	16	(4)	1,047	36,645	3.500
Gravel hydraulically handled:						
1956–60 (average)	5	--------	6	83	2,891	.482
1961	2	--------	2	3	105	.050
1962	4	--------	21	85	2,975	.141
1963	4	--------	13	100	3,500	.279
1964	1	--------	2	73	2,555	1.278
1965	-----	--------	----------	----------	-------------	-------
Small-scale hand method:[6]						
1956–60 (average)[7]	29	--------	51	1,149	40,222	.789
1961	27	--------	119	1,105	38,675	.324
1962	14	--------	266	661	23,135	.087
1963	51	--------	54	2,612	91,420	1.701
1964	30	--------	54	1,420	49,700	.918
1965	21	--------	24	2,476	86,660	3.617
Underground placers: Drift:						
1956–60 (average)	5	--------	2	71	2,471	1.236
1961	3	--------	2	55	1,925	1.250
1962	1	--------	1	5	175	.170
1963	7	--------	4	202	7,070	1.656
1964	1	--------	16	163	5,705	.352
1965	1	--------	(4)	7	245	4.900
Grand total placers:						
1956–60 (average)	57	--------	28,343	118,683	4,153,856	.147
1961	48	--------	24,671	84,367	2,952,845	.119
1962	37	--------	18,494	95,918	3,357,130	.182
1963	79	--------	r 13,156	82,998	2,904,930	.221
1964	39	--------	11,821	65,938	2,307,830	.195
1965	27	--------	12,976	58,571	2,049,985	.158
1848–1965	-----	--------	NA	68,351,062	1,528,024,816	NA

r Revised. NA Not available.

[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; byproduct gold is included with gold recovered, but material treated and average value per cubic yard refer only to straight gold dredging.

[4] Less than 1,000 cubic yards.

[5] Includes all placer operations using power excavator and washing plants both on dry land; when the washing plant is a movable outfit, it is termed "dryland dredge."

[6] Includes all operations in which hand labor is principal factor in delivering gravel to sluices, long toms.

[7] Includes gold recovered by electrostatic separation; combined to avoid disclosing individual company confidential data.

Table 18.—Mine production of gold, silver, lead, and zinc, in terms of recoverable metals [1]

Year	Mines producing [2]		Material sold or treated [3] (thousand short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Troy ounces	Value (thousand dollars)	Troy ounces	Value (thousand dollars)
1956–60 (average)	99	57	185	163,814	$5,733	400,255	$362
1961	79	48	46	97,644	3,418	93,351	86
1962	65	37	43	106,272	3,720	132,505	144
1963	50	79	21	86,867	3,040	156,528	200
1964	43	39	16	71,028	2,486	171,621	222
1965	51	27	20	62,885	2,201	196,787	254
1848–1965	-----	------	NA	106,129,343	2,416,630	119,675,172	97,753

Year	Copper		Lead		Zinc		Total value (thousand dollars)
	Short tons	Value (thousand dollars)	Short tons	Value (thousand dollars)	Short tons	Value (thousand dollars)	
1956–60 (average)	861	$560	2,712	$819	2,322	$609	$8,083
1961	1,382	829	103	21	304	70	4,424
1962	1,162	716	455	84	322	74	4,738
1963	916	564	823	178	101	23	4,005
1964	1,035	675	1,546	405	143	39	3,827
1965	1,165	825	1,810	565	225	66	3,911
1848–1965	643,048	211,168	268,055	53,594	151,044	35,674	2,814,819

NA Not available.
[1] Includes recoverable metal content of gravel washed (placer operations); ore milled; old tailings or slimes retreated; 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.

Table 19.—Mine production of gold, silver, copper, lead, and zinc in 1965, by types of material processed and methods of recovery, in terms of recoverable metals [1]

Type of material processed, and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Lode:					
Amalgamation:					
Ore	2,266	452	----------	----------	---------
Old tailings	30	7	----------	----------	---------
Total	2,296	459	----------	----------	---------
Concentration and smelting of concentrates: Ore [2]	1,729	104,276	2,278,400	99,600	15,900
Direct smelting: Ore and copper precipitates [3]	289	88,767	51,600	3,520,400	434,100
Placer	58,571	3,285	----------	----------	---------
Grand total	62,885	196,787	2,330,000	3,620,000	450,000

[1] Includes gold recovered as "natural gold."
[2] Includes tungsten-ore concentrate.
[3] Combined to avoid disclosing individual company confidential data.

Trinity County. These six mines accounted for nearly 85 percent of all lode gold recovered.

Iron Ore.—Production of usable iron ore increased 9 percent above that in 1964. Shipments to domestic consumers were up less than 1 percent while exports rose 42 percent. The Eagle Mountain mine, Riverside County, again yielded most of the State output. An iron-ore pelletizing plant

Table 20.—Mine production of gold, silver, copper, lead, and zinc in 1965, by classes of ore or other source materials in terms of recoverable metals

Source	Number of mines [1]	Material sold or treated (short tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Lode ore:							
Gold	33	7,086	3,270	826	----------	100	----------
Gold-silver	1	2,700	634	19,815	700	3,900	4,000
Silver	6	282	42	1,841	----------	2,000	1,700
Copper and tungsten ore	2	[2] 50	170	79,869	2,313,800	800	----------
Lead	8	8,881	103	86,253	12,500	3,411,600	384,400
Lead-zinc	1	523	65	4,891	3,000	201,600	59,900
Total	51	19,522	4,284	193,495	2,330,000	3,620,000	450,000
Other lode material: Old tailings	([3])	70	30	7	----------	----------	----------
Total lode material	51	19,592	4,314	193,502	2,330,000	3,620.000	450,000
Placer	27	([4])	58,571	3,285	----------	----------	----------
Total all sources	78	19,592	62,885	196,787	2,330,000	3,620,000	450,000

[1] Detail will not necessarily add to total, because some mines produce more than one class of material.
[2] Tungsten-ore tonnage not included.
[3] From property not classed as a mine.
[4] 12,960,623 cubic yards. Does not include material washed at commercial gravel plants to produce 1,043 ounces of byproduct gold and 106 ounces of byproduct silver included in placer totals.

at the mine site was placed on stream in September, and pellets were shipped to the producer's plant and for export for the first time late in 1965. In San Bernardino County, production of concentrate increased at the Iron Age mine, and output of direct-shipping-grade ore from the Silver Lake mine rose significantly. In both instances most of the production was shipped to domestic consumers and the remainder was stockpiled. The Iron Mountain mine, Shasta County, was idle, but ore shipments were made from stockpile to a domestic steel plant.

The bulk-loading facility in the Los Angeles outer harbor, built to handle pelletized iron ore, was completed December 1. Initial design capacity was 2,700 long tons per hour, with an eventual capacity of 4,000 long tons per hour.

Lead.—Except for minor quantities of recoverable lead contained in precious and base metal ores, lead production came from four mines in Inyo County. Lead-zinc ore from the Columbia mine, and lead ores from the Jubilee, Queen of Sheba, and Santa Rosa mines accounted for more than 99 percent of the total lead recovered. About 264 tons more lead was recovered from all ores, including dump material, than in 1964.

Mercury.—Stimulated by an average unit price that was $256 per flask above the previous alltime high in 1964, production and shipments of mercury rose 30 and 27 percent, respectively. Production was reported from 84 properties, 45 more than in 1964, and 63 percent more ore was mined. Although 98 operators reported production, only 11 had yields of more than 100 flasks each. The State's three major mercury producers—New Idria Mining and Chemical Co., San Benito County; Buena Vista Mines, Inc., San Luis Obispo County; and Sonoma International, Inc., Sonoma County—accounted for 74 percent of the production and shipments.

Molybdenum.—Union Carbide Corp. recovered molybdenite and powellite as byproducts in the treatment of tungsten ores from the Pine Creek mine, Inyo County. Production and shipments of molybdenite were below 1964 figures but those for powellite rose nearly 30 and 53 percent, respectively. Most of the powellite was consigned to domestic consumers; domestic shipments of molybdenite were only slightly higher than exports.

Late in 1965, Union Carbide completed an addition to its tungsten mill to recover high-purity byproduct molybdenum metal by a newly developed process considered by the company to be of significant technical importance.

Pig Iron, Sinter, and Ferrous Scrap.—Kaiser Steel Corp. produced all of the

Table 21.—Mercury production, by methods of recovery

Year	Operating mines	Recovery method: Furnaced [1] Ore treated (short tons)	Furnaced [1] 76-pound flasks	Retorted Ore treated (short tons)	Retorted 76-pound flasks	Unclassified 76-pound flasks [2]	Total 76-pound flasks	Total Value [3]
1956–60 (average)	51	110,056	14,913	9,391	1,570	268	16,751	$3,877,824
1961	36	118,264	17,776	2,431	883	29	18,688	3,692,936
1962	37	79,948	15,407	3,728	496	48	15,951	3,049,991
1963	31	61,595	13,273	4,068	303	16	13,592	2,575,004
1964	39	89,630	8,949	12,595	1,334	8	10,291	3,239,504
1965	84	137,079	11,219	21,060	2,168	17	13,404	7,650,333

[1] Includes ore and mercury from dumps not separable.
[2] Includes mercury recovered from miscellaneous dump material, placer, and cleanup operations.
[3] Value calculated at average New York price.

State's pig iron, in a blast furnace at Fontana, San Bernardino County. The furnace consumed about 3 percent more ore (concentrates) and 6 percent more agglomerates (sinter and pellets), but pig iron production was down slightly. The output was 95 percent basic pig iron and 5 percent direct casting. No foundry pig was produced although a small tonnage was sold from stock. Kaiser steel furnaces consumed 9 percent less ore (concentrate), 2 percent more pig iron (hot metal), and 20 percent more scrap (home and purchased). Only one other steel producer, U.S. Steel Corp. at Torrance, Los Angeles County, used pig iron in addition to scrap. All others operated on ferrous scrap alone. Overall iron and steel scrap consumption rose 10 percent. Use at steel furnaces increased 11 percent and that at iron furnaces rose 4 percent.

Late in 1965 the Bureau of Mines began a field investigation of automobile body and chassis scrap accumulation and utilization in southern California. The study included markets, scrap preparation methods (including shredding), the flow pattern of scrap from the motorist through dismantler and processor to consumer, transportation of stripped automobile bodies, and the problem of abandoned vehicles.

Table 22.—Ferrous scrap and pig iron consumption
(Thousand short tons)

Year	Ferrous scrap	Pig iron
1956–60 (average)	2,381	1,435
1961	2,250	2,192
1962	2,248	1,818
1963	2,415	1,891
1964	2,575	2,250
1965	2,829	2,319

Platinum.—Platinum-group metals were recovered from stream and ancient riverbed gravels at a bucketline dredging operation on the Yuba River near the old town of Hammonton, Yuba County. This was the only reported recovery of platinum in California.

Rare-Earth Minerals.—Sales of rare-earth mineral products increased sharply as a

Table 23.—Ferrous scrap and pig iron consumption by types of furnaces and miscellaneous uses
(Thousand short tons)

Ferrous scrap and pig iron charged to—	1964	1965
Steel furnaces: [1]		
Scrap	2,178	2,409
Pig iron	2,049	2,111
Total	4,227	4,520
Iron furnaces: [2]		
Scrap	376	391
Pig iron	201	208
Total	577	599
Miscellaneous uses: [3] Scrap	21	29
Total scrap	2,575	2,829
Total pig iron	2,250	2,319
Grand total	4,825	5,148

[1] Includes open hearth, electric furnace, and basic oxygen process.
[2] Includes cupola and direct castings; no air furnaces for 1965.
[3] Includes rerolling copper precipitation, nonferrous, and chemical uses.

result of completion of the Molycorp europium oxide extraction plant at Mountain Pass, San Bernardino County, in July. The plant, utilizing a solvent extraction process, exceeded its rated capacity of 500 pounds of product a month in December. As a result, the company planned to replace the existing mill in May 1966 with a concentrating plant having an annual production capacity of 30 million pounds of rare-earth oxides annually and to double the capacity of the europium oxide plant. Expansion of facilities was prompted by the demand for europium oxide in color television tube phosphors.

Silver.—Ores from four lode mines—one silver (Zaca), Alpine County, and one tungsten (Pine Creek) and two lead (Jubilee and Santa Rosa), Inyo County—yielded 94 percent of the recoverable lode silver and 92 percent of all silver recovered in 1965. Lode silver production rose 15 percent; placer silver (recovered as a coproduct in placer gold mining) declined 10 percent.

Exploration and development continued at the Red Gap claims, Alpine County, and the Rainbow claims, San Bernardino County, but no ores were mined, milled, or shipped.

Tin.—Only one-third as much ore was mined and treated, and one-sixth as much tin concentrate produced at the Meeke-Hogan mine, Kern County, as in 1964. The concentrate was consigned to a New York broker for export to a customer in England.

Tungsten.—The Pine Creek mine, Inyo County, of Union Carbide Corp. yielded virtually all the tungsten produced in California. The company purchased a few units from two comparatively small operators who produced ore or concentrate at undisclosed locations in California. Purchases also were made from producers and former producers in Nevada, Texas, and Washington, and from stocks held by a Texas firm. Some of the produced and purchased concentrates were converted to paratungstate in the Pine Creek chemical plant. The company also shipped concentrates and paratungstate to customers throughout the United States. Because of a unit price increase, the value of shipments rose, although the quantity shipped was lower than in 1964.

During the year, extensive work was done at the Strawberry tungsten mine, Madera County, by the owner. New equipment was installed throughout the mill, increasing capacity by 60 percent. Production was expected to begin in April 1966, weather permitting.

Uranium.—Uranium mine activity was limited to production from the Juniper mine, Tuolumne County, by Garn L. Moody and Paradox Mining Co. Both producers shipped to a processing plant at Moab, Utah. Total shipments were only a fraction of those in 1964, and the grade of ore shipped was appreciably lower.

Zinc.—Nine mines in three counties yielded all the recoverable zinc. Over 97 percent of the output came from ores of four Inyo County mines—one lead-zinc, Columbia; and three lead, Jubilee, Queen of Sheba, and Santa Rosa.

REVIEW BY COUNTIES

Alameda.—Salt was harvested from several thousand acres of evaporating ponds in the south San Francisco Bay area and processed and refined in plants at Newark and Mount Eden. Leslie Salt Co. supplied crude salt to the adjacent Morton Salt Co. refinery and sold salt-works bitterns to FMC Corp. which recovered magnesium hydroxide and bromine from liquor in a nearby plant. FMC used dolomite from a quarry outside the county to make lime used in the process. Byproduct gypsum was another plant product. A Newark gypsum products plant used crude gypsum from the producer's Nevada mine. A new wallboard plant went on stream in Fremont during September. It also used crude gypsum from a company mine in Nevada. A plant in Emeryville made insulation, using purchased California-produced magnesia as a raw material. A Berkeley chemical plant used magnesite obtained from Nevada, to make epsom salts. An Alvarado sugar refinery purchased limestone to make lime and carbon dioxide used in the refining process. Basalt was quarried near Oakland. Clay mined near Niles was used in making floor and wall tile.

Steel plants at Emeryville and Union

Table 24.—Value of mineral production in California, by counties

County	1964	1965	Minerals produced in 1965 in order of value
Alameda	$21,983,423	$22,775,728	Sand and gravel, salt, stone, magnesium compounds, lime, bromine, clays.
Alpine	63,469	81,251	Sand and gravel, silver, gold, lead, zinc, copper.
Amador	2,716,986	3,059,571	Sand and gravel, clays, stone, coal, soapstone, gold, pumicite, silver.
Butte	4,632,529	3,620,599	Natural gas, sand and gravel, stone, gold, silver.
Calaveras	18,439,155	18,127,702	Cement, asbestos, stone, clays, sand and gravel, gold, silver.
Colusa	4,888,677	4,016,858	Natural gas, sand and gravel, mercury, stone.
Contra Costa	11,797,352	11,639,527	Stone, natural gas, petroleum, sand and gravel, peat, clays.
Del Norte	W	470,525	Sand and gravel, stone, mercury, gold.
El Dorado	2,900,370	2,617,346	Stone, lime, sand and gravel, soapstone, gold, silver.
Fresno	78,308,961	74,742,040	Petroleum, natural gas, sand and gravel, asbestos, natural gas liquids, stone, clays, gold, mercury, silver.
Glenn	5,875,254	5,419,879	Natural gas, sand and gravel, lime.
Humboldt	2,539,122	2,155,768	Sand and gravel, natural gas, stone, gold, silver.
Imperial	3,261,101	2,856,839	Gypsum, sand and gravel, lime, stone, clays, mica, barite.
Inyo	15,750.395	18,083,716	Tungsten, sodium carbonate, talc, molybdenum, stone, copper, lead, sand and gravel, silver, pumice and volcanic cinder, perlite, zinc, boron, clays, gold, barite, wollastonite.
Kern	365,159,930	381,528,961	Petroleum, boron, natural gas, cement, natural gas liquids, sand and gravel, stone, gypsum, sodium sulfate, diatomite, clays, salt, carbon dioxide, pumicite, mercury, tin, gold, silver.
Kings	15,090,788	17,190,739	Natural gas, natural gas liquids, petroleum, sand and gravel, stone, mercury.
Lake	724,793	817,742	Sand and gravel, volcanic cinder, mercury, clays, sulfur ore, stone.
Lassen	373,468	W	Sand and gravel, volcanic cinder, stone.
Los Angeles	264,718,753	266,816,956	Petroleum, sand and gravel, natural gas, natural gas liquids, stone, clays, iodine, gold, soapstone, silver.
Madera	3,395,678	1,558,545	Natural gas, stone, sand and gravel, pumicite, clays, gold, silver.
Marin	3,433,785	3,169,924	Stone, sand and gravel, mercury, clays.
Mariposa	87,367	140,618	Sand and gravel, stone, gold, silver.
Mendocino	1,302,030	755,375	Sand and gravel, stone, mercury.
Merced	9,809,822	7,407,520	Stone, sand and gravel, gypsum, gold, silver.
Modoc	614,277	470,200	Sand and gravel, peat, pumice and volcanic cinder, stone.
Mono	970,518	833,287	Pumice, sand and gravel, clays, pyrophyllite, calcite (optical grade), stone.
Monterey	29,120,767	31,702,808	Petroleum, lime, magnesium compounds, sand and gravel, stone, natural gas, feldspar, salt, mercury.
Napa	1,894,189	2,068,284	Stone, salt, clays, sand and gravel, asbestos, mercury, diatomite, pumice, perlite.
Nevada	2,386,654	798,640	Sand and gravel, gold, stone, silver.
Orange	105,346,940	113,560,571	Petroleum, natural gas, natural gas liquids, sand and gravel, clays, lime, salt, iodine, peat.
Placer	3,385,120	1,190,463	Sand and gravel, clays, stone, gold, silver, lead.
Plumas	97,645	286,992	Sand and gravel, stone, clays, gold.
Riverside	62,150,754	59,581,465	Iron ore, cement, sand and gravel, stone, clays, gypsum, peat, wollastonite, petroleum.
Sacramento	21,143,735	21,751,206	Natural gas, sand and gravel, clays, gold, stone, silver.
San Benito	8,210,100	10,691,141	Mercury, cement, stone, asbestos, petroleum, sand and gravel, natural gas, clays.
San Bernardino	r114,447,736	111,192,922	Cement, boron, stone, potassium salts, sodium carbonate, sand and gravel, sodium sulfate, iron ore, rare-earth minerals, salt, lime, clays, lithium minerals, talc and pyrophyllite, calcium chloride, bromine, petroleum, pumicite and volcanic cinder, natural gas, barite, lead, silver, zinc, copper, gold.
San Diego	11,803,212	11,799,776	Sand and gravel, stone, magnesium compounds, salt, clays, pyrophyllite, gold, silver.
San Francisco	W	W	Sand and gravel.
San Joaquin	17,630,462	17,169,039	Natural gas, sand and gravel, lime, clays.
San Luis Obispo	8,135,223	6,477,715	Petroleum, mercury, sand and gravel, natural gas liquids, stone, natural gas, gypsum, clays.
San Mateo	13,367,312	14,509,513	Cement, magnesium compounds, stone, salt, sand and gravel, clays, petroleum, natural gas.
Santa Barbara	120,378,076	126,012,581	Petroleum, diatomite, natural gas, natural gas liquids, sand and gravel, lime, mercury, stone.
Santa Clara	30,147,736	33,634,912	Cement, stone, sand and gravel, mercury, clays.
Santa Cruz	11,355,363	12,271,234	Cement, stone, sand and gravel, clays.

See footnotes at end of table.

Table 24.—Value of mineral production in California, by counties—Continued

Country	1964	1965	Minerals produced in 1965 in order of value
Shasta	6,729,158	7,733,039	Cement, sand and gravel, stone clays, mercury, volcanic cinder, iron ore, copper, barite, gold, silver.
Sierra	249,860	101,058	Gold, sand and gravel, stone, silver.
Siskiyou	872,449	799,497	Sand and gravel, pumice and volcanic cinder, stone, gold, clays, silver.
Solano	13,438,850	14,026,648	Natural gas, sand and gravel, stone.
Sonoma	4,357,159	5,551,505	Sand and gravel, mercury, stone, clays, natural gas.
Stanislaus	1,484,110	1,345,607	Sand and gravel, clays, gold, silver.
Sutter	W	13,275,844	Natural gas, sand and gravel, stone, clays.
Tehama	1,132,859	2,904,388	Sand and gravel, natural gas, stone, volcanic cinder.
Trinity	62,022	295,340	Sand and gravel, stone, gold, mercury, clays, silver.
Tulare	2,675,976	3,303,002	Sand and gravel, natural gas, stone, petroleum, barite, clays, gold, silver.
Tuolumne	1,831,988	1,678,461	Stone, lime, uranium, sand and gravel, diatomite, gold, silver.
Ventura	106,014,408	104,321,786	Petroleum, natural gas, natural gas liquids, sand and gravel, stone, clays, gypsum.
Yolo	3,705,816	3,920,781	Sand and gravel, lime, natural gas.
Yuba	3,564,179	3,391,949	Gold, sand and gravel, stone, clay, platinum, silver.
Undistributed [1]	14,534,139	11,682,617	
Total	1,560,492,000	1,599,388,000	

[r] Revised. W Withheld to avoid disclosing individual company confidential data; included with "Undistributed".

[1] Includes gem stones, mercury, copper, gold, tungsten, lead, and silver that cannot be assigned to specific counties and value indicated by symbol W.

City used iron and steel scrap as the only metal source in open-hearth furnace operations.

Alpine.—Ore from the Zaca mine in the Monitor area was milled and the concentrate shipped to the Selby smelter for recovery of contained gold, silver, copper, lead, and zinc.

Amador.—Pits in the Ione area were worked for sand used in flint glassware, other glass products, molding and filler uses and for clays, some of which were used in making mortar and refractories. Rhyolite was quarried near Volcano for dressed building stone, and quartzite was obtained from the Custer quarry near Ione for use in making silica brick. Soapstone mined at the Lavina deposit near Sutter Creek was shipped to a grinding plant near Sacramento. A relatively small tonnage of pumicite was mined in the Buena Vista Peaks area for use as lightweight aggregate. Sandstone was quarried near Ione.

Some placer gold and silver were recovered by individuals who panned stream gravels at several locations.

Butte.—Natural gas production from the county's six dry-gas fields declined 2 percent from that in 1964.

Individuals panned stream gravels in the Forbestown area to recover placer gold and silver. Gold ore from the 3 Ravines lode claims in the Big Bar Mountain area was treated by amalgamation to recover gold and silver ore from the Bailey property near Ord Ferry Station and was shipped to the Selby smelter for recovery of these metals.

Calaveras. — Portland cement was produced in a wet process plant at San Andreas and shipped to customers in Nevada and northern California. The producer obtained clay, shale, and limestone for the plant from pits and quarries near Burson and San Andreas. Rhyolite was quarried near Altaville, Avery, and Rail Road Flat for landscape rock and roofing granules. Groups 4, 5, 6, and 7 asbestos fibers were produced at the Pacific asbestos mine and milling operation near Copperopolis.

Amalgamation was used to recover gold and silver from ore mined at the Carson Hill group of claims near Angels Camp; however, some of the mined ore was shipped to the Selby smelter for recovery of these metals.

Colusa.—Natural gas production was 2 percent lower than in 1964. Although a significant increase was reported from the Butte Sink field, declines were recorded at the Arbuckle, Grimes West, Kirk, and Sycamore fields.

A few flasks of mercury were recovered by retorting ore mined from the Rathburn group of claims in the Wilbur Springs area.

Contra Costa County.—Natural gas production dropped 8 percent below the 1964 figure. The overall decline was attributed to a 21-percent drop in gas production associated with oil from the Brentwood field. The Concord field also registered a decrease while significant increases were reported at the Willow Pass and Los Medanos fields, and withdrawals were begun from the Dutch Slough field. A new pool was discovered in the Domongine formation at the River Break field.

Petroleum refineries operated throughout the year at Martinez, Richmond, Avon, and Oleum. Sulfur recovery plants were operated at all except the Martinez refinery. Stack gases of the Selby lead smelter were treated to recover sulfuric acid and liquid sulfur dioxide. A Pittsburg chemical plant produced a thermal carbon black as a byproduct in fertilizer manufacture. A Martinez chemical plant reclaimed copper from solution residues and shipped the metal to a Tacoma, Wash., smelter for recovery of copper, gold, silver, and lead.

Crude gypsum from Mexico was calcined in plants at Antioch and Richmond for use in making gypsum-based products. At Nichols, byproduct gypsum from a phosphoric acid plant was sold for agricultural use. Sand near Cowell was prepared primarily for sale as a molding sand although some was sold to the building trade. Sandstone was quarried near El Sobrante, in Pacheco, and in Richmond. Basalt was also quarried near Orinda.

Reed-sedge peat was dredged in the San Joaquin River delta and dried, shredded, and packaged for sale to nurseries.

Del Norte.—A small quantity of mercury was retorted from ore of the Webb property near Patrick Creek. Weekend prospectors panned stream gravels along the Smith River to recover a small quantity of placer gold.

Basalt was quarried near Crescent City.

El Dorado.—Limestone was quarried near Diamond Springs principally for use in making lime and whiting, although lesser quantities were sold to sugar refineries. Large tonnages of lime were sold to steel plants and for soil stabilization use. Limestone was quarried near Somerset for dimension building stone, and near Cool and Shingle Springs for glass making, sugar refining, foundry flux, and other industrial uses. Slate quarried at Chili Bar was crushed for roofing granules or ground for flour, and rhyolite near Diamond Springs was quarried for dimension stone. Soapstone from the Shrub deposit near Shingle Springs was ground in the producer's San Francisco plant.

Individuals panned stream gravels along the American River near Folsom and recovered a few ounces of placer gold and silver.

Fresno.—Crude oil production was down 7 percent and natural wet gas output dropped 10 percent from the 1964 totals. Fresno was sixth among the producing counties in both petroleum and natural gas from oil zones. Some natural (dry) gas also was produced. A new gasfield, the San Joaquin Northwest, was discovered during the year but was shut in at yearend. No new oil discoveries were made. Two processing plants in the county extracted natural gasoline and cycle products and liquid petroleum gas from oil-zone gas.

Two companies produced chrysotile asbestos fiber (group 7 shorts) at mines and milling plants in the Joaquin Ridge area northwest of Coalinga. Crude perlite, purchased from California and Nevada producers, was expanded in a Fresno plant for lightweight aggregate use. At Helm, byproduct gypsum was produced at a phosphoric acid plant and sold for agricultural use. Granite was quarried near Clovis and Sanger.

Placer gold and silver were recovered as byproducts in four sand and gravel washing plants on the San Joaquin River near Friant. A few flasks of mercury were retorted from ores of the Mercy mine near Mercy Hot Springs.

Glenn.—Dry natural gas production was down 8 percent from the 1964 level, yet the county ranked sixth among the State's dry gas producing counties. A new gasfield, the Black Butte, was discovered with the gas in the Forbes formation. At yearend, however, the field was still shut in.

A Hamilton City beet sugar refinery purchased limestone to produce lime and carbon dioxide used in the refining process.

Humboldt. — Production of dry natural gas was 18 percent above that in 1964 owing to increased output from the Tompkins Hill field, the county's major producing field. The Grizzly Bluff field, discovered in 1964, still had not been placed in production at the end of 1965.

Gold ore from the Hoopa mine near Arcata was milled and the concentrate shipped to the Selby smelter for recovery of gold and silver.

Imperial.—Gypsum was mined from the Fish Creek Mountain deposit and calcined in the producer's Plaster City gypsum products plant. A beet sugar refinery at Carlton purchased limestone to produce lime and carbon dioxide used in the refining process. Bentonite was mined near Brawley for use as a filler in livestock feeds. Barite was mined from the White Swan claims near Blythe. A small tonnage was shipped to the producer's Campo mill but was not ground. Mica (sericite schist) was mined and stockpiled at the mine site near Ogilby. Owners of the Drifted Snow mica claims in the same area ceased operations in November. Granite was quarried near Plaster City.

Inyo.—The Pine Creek tungsten mine operated throughout the year. The mine was the source of all tungsten and molybdenum produced in the State, a high percentage of the recoverable copper, and a considerable quantity of the recoverable silver. Lead ores from the Santa Rosa mine near Keeler, and the Jubilee and Queen of Sheba mines west of Shoshone, together with lead-zinc ore from the Columbia mine in the Shoshone area, yielded most of the State's recoverable lead and zinc, and much of the recovered silver. Dump material shipped from the Hard Trip mine contained recoverable lead, zinc, and silver. Gold ores mined at properties in the Chloride Cliff, Independence, and Wildrose areas were treated to recover small quantities of gold and silver.

Soda ash and sodium sesquicarbonate were recovered from Owens Lake brines in a plant at Bartlett. Colemanite from the De Bely open pit mine in Corkscrew Canyon and ulexite from the Gerstley underground mine near Shoshone, were shipped to the producer's boron refinery in Kern County. Some colemanite also was mined and shipped from the Kern Borate mine near Death Valley Junction.

Production was reported from 12 talc mines in 1965. All of the talc mined at the Markley was stockpiled. Output from the Warm Springs deposit of Grantham Mines was greater than from all others combined. Talc from this mine was shipped to grinders in southern California, Nebraska, and Mexico. Talc also was ground in plants at Keeler and Laws.

Limestone was quarried at the West End deposit north of Searles Lake and used in the producer's processing plant at Trona. White and black marble were quarried near Lone Pine for ceramic use, dressed building stone, and other building trades uses. Travertine was quarried near Ballarat for landscape use, and quartzite was obtained from several quarries near Lone Pine for use in making silica brick. Sandstone was also quarried near Lone Pine. Pumice from several deposits near Coso Junction and volcanic cinder from the Red Hill deposit near Little Lake were processed in a plant at Sykes siding for lightweight aggregate use. Perlite from the Fish Springs quarry near Zurich was shipped to expanding plants outside the County. Fullers earth from the Calearth and Jones deposits near Olancha was prepared for use as a carrier in insecticides and as a clarifier for mineral and vegetable oils. Bentonite from the Ibex deposit near Tecopa and the Side Hill property near Death Valley was prepared for filler use in dry insecticides and animal feeds, and used in reservoir linings. Crude barite mined in the Gunter Canyon area near Laws was shipped to grinders in Kern and Los Angeles Counties.

Kern.—Kern County was by far the leading producer of petroleum and natural gas among the State's producing counties. Crude oil output was up nearly 12 percent while natural gas yield was less than 1 percent above the 1964 figure. The increase in crude oil was the direct result of thermal recovery projects, principally in the Midway-Sunset, Kern River, and South Belridge fields. Most of the projects were the steam-injection type. Twelve new oil discoveries were made in 1965.

Natural gas liquids production, from the county's wet gas processing plants, continued a decline (over 8 percent in 1965) begun in 1958. Eight oil refineries, all in the Bakersfield area, operated throughout the year. Carbon dioxide was extracted from natural (oil-zone) gas in two plants near Taft. The output from one plant was not marketed. Production of carbon black in plants at Bakersfield and Mojave increased slightly.

Crude borates were mined from the Boron open pit mine and refined or partially refined in an adjacent plant. Some partially refined borates were shipped to the company refinery in Los Angeles County for final processing. The Boron plant

also processed crude borates from the producer's Inyo County mines, and produced sodium sulfate as a byproduct of borate refining. Plant products were shipped to domestic and foreign customers.

Portland cement was produced in plants at Mojave and Monolith. Limestone and quartz used in the process were obtained from nearby quarries by the producers. Clays used in cement were purchased by the Mojave plant and mined from company-owned pits for the Monolith plant. Although some cement was bagged, most shipments were made in bulk, chiefly to ready-mixed concrete plants in California and Nevada. The State's largest gypsum mine, at Lost Hills, operated throughout the year producing agricultural gypsum. Crude gypsum also was mined near McKittrick and Taft. Overall sales for agricultural use dropped 12 percent from those in 1964. Blast sand was prepared from material mined near Bakersfield. Limestone quarried near Weldon was processed for agricultural use and poultry grit.

Clays near Boron, McKittrick, and Rosamond were used in oil-well drilling muds; others near Cantil were used for making stoneware; and those near Mojave were prepared for absorbent use. Solar-evaporated salt was harvested from Koehn dry lake and processed in the Saltdale plant. Diatomite was mined for the first time near Maricopa and sold for insulation, abrasive, and filler uses. Pumicite from the Calsilco claims north of Saltdale was prepared for use as an absorbent. Sandstone was quarried near Monolith and Rosamond.

Gold ores from the Big Dyke and Butte Lode mines near Randsburg were treated by amalgamation to recover gold and silver. Silver ore containing recoverable gold was mined and milled at the Whitmore property near Mojave, and the concentrate sold to a Mojave gold and silver refiner. Tables, retorts, and a furnace were used to recover mercury from ore of the Tehachapi mine.

Kings.—Crude oil production was up 1 percent, but oil zone natural gas declined 3 percent. Although the volume of wet gas processed in the county's three plants was less, output of natural gas liquids (liquid petroleum gas) was above that in 1964. Dry natural gas production was comparatively small and about 20 percent below the 1964 figure. The county's only oil refinery, at Hanford, was in operation during 1965.

Relatively small quantities of mercury were retorted from ores of the Dawson and Cal-Tex properties in the Diablo Range.

Lake.—Volcanic cinder was mined from four deposits, two each near Clearlake Oaks and Clearlake Highlands. While most of the total production was used as lightweight aggregate and fill, a moderate tonnage from the Clearlake Oaks area was sold for landscaping and decorative rock. Shale was quarried at the Konocti deposit and used chiefly for surfacing roads.

Mercury was recovered from the ores of 10 mines and prospects in the county by retorting. Output from two mines, the Konocti and Harrison, was more than the combined production of the other eight.

Lassen. — Volcanic cinder was mined from the Poison Lake deposit and used by the producer for lightweight concrete aggregate. Crews of the California Division of Highways and the U.S. Forest Service mined large tonnages of volcanic cinder for use in constructing and surfacing roads. Some cinder from Forest Service land was sold to manufacturers of concrete block and other users of lightweight aggregate.

Los Angeles.—Crude oil production rose 2 percent, but natural gas from oil zones dropped nearly 9 percent. A relatively small quantity of dry natural gas was produced and the volume was 30 percent below that of 1964. Five new oil discoveries were made in 1965. The Los Angeles Downtown field, discovered in 1964, began producing. THUMS Long Beach Development Co., a combine of five major oil companies, began development of the offshore East Wilmington field from Pier J, and by yearend 18 wells had been completed to production. Sixteen petroleum refineries were in operation and sulfur recovery plants were operated in conjunction with three—at Santa Fe Springs, Wilmington, and Long Beach. Natural gas liquids plants in the county processed 4 percent less wet gas and yielded nearly 13 percent less plant product.

Molding sand was prepared for foundry use in a portable washing plant at Vernon, and blast and engine sand in a stationary plant at El Segundo. Stone was quarried at Palos Verdes and Saugus and sold for use as flagging. A gypsum products plant

at South Gate used crude gypsum shipped from the producer's Nevada mine. One Long Beach plant producing a full range of gypsum products used crude gypsum from Mexico during the entire year. A second Long Beach plant, also using crude gypsum shipped from Mexico, was completed and went on stream in September. A new wallboard plant and warehouse were nearing completion at yearend near Santa Fe Springs.

Shale from the Katz quarry in the San Fernando area was processed for use as a carrier in dry insecticides. Soapstone mined from a deposit in Sierra Pelona Valley was shipped to a Los Angeles grinding plant. Five plants in the county ground talc and soapstone received from California and Nevada producers. Eight plants in the Los Angeles area expanded perlite obtained from California and out-of-State mines. Primary barite from a Nevada mine was ground for use in oil-well drilling muds in a Harbor City plant. Waste oil-well brines of the Los Angeles basin were pumped to an iodine recovery plant in Orange County. Granite was quarried at several locations in the northwest section of the county. Sandstone was also quarried near Solemint Junction.

Two sand and gravel preparation plants on the San Gabriel River channel used sluice boxes to recover byproduct placer gold and silver.

Madera. — Dry natural gas production was 6 percent higher than in 1964. Nearly 90 percent of the total came from the Gill Ranch field; the remainder from the Moffat Ranch field. There was no production from the Chowchilla field in 1965.

Granite from a quarry near Raymond was dressed for architectural and monumental use. Pumicite was mined from the Taylor deposit south of Belleview and prepared for use as a diluent in agricultural insecticides. Clay from a pit near Madera was used in making adobe brick.

Byproduct placer gold and silver were recovered at two sand and gravel preparation plants, one on the San Joaquin River near Friant and one in Grub Gulch near Potters Ridge.

Marin.—A gravity concentrator and re-
ores of the Chileno and Gambonini mines near Marshall. A small quantity of mer-
torts were used to recover mercury from
cury was recovered at the Corda prospect by retorting hand-sorted ore.

Shale was quarried at San Pedro Hill and expanded for use as lightweight aggregate. A plant at Sausalito expanded perlite purchased from a Colorado producer. Basalt was quarried near Novato and sandstone was quarried near San Rafael.

Mariposa.—Slate was produced at the Mt. Buillion quarry near Mariposa, for flagging and roofing granules, and in blocks and slabs for milling. Rough dimension stone was quarried at Haigh's quarry near Coulterville.

A few ounces of gold and silver were recovered by amalgamation from gold ore mined in Wheeler Gulch near Kittridge. Placer gold and silver were recovered at the Lucky Seven property on Black Creek near Coulterville, and as byproducts in a sand and gravel washing plant at Morman Bar.

Mendocino.—The Janusz "B" and Empress mercury properties near Hopland were worked by the same operator. The ores were retorted to recover the metal.

Merced.—Gypsite was mined near Los Banos and sold for agricultural use.

Byproduct placer gold and silver were recovered in a sand and gravel washing plant on the Merced River near Snelling.

Modoc.—Peat moss was obtained from a bog in Jess Valley, near Likely, and dried, shredded, and packaged for sale as a soil improvement agent.

Pumice was mined from the Free deposits near Glass Mountain and used for lightweight concrete aggregate. Crews and contractors for the California Division of Highways mined volcanic cinder for use in road repair and maintenance. The U.S. Forest Service sold several thousand tons of volcanic cinder for aggregate use.

Mono.—Pumice was mined from four deposits in Mono County. Material from one deposit near Lee Vining was sold for landscaping and decorative use; that from a second deposit was prepared for abrasive uses. Pumice from the Cowan property near Benton was used for lightweight concrete aggregate and that from the Boyd deposit near Chalfant was used as aggregate in decking (insulating) plaster.

Kaolin from the Hot Creek deposit in the Casa Diablo area was sold for use in cement. Pyrophyllite from the Pacific mine near White Mountain was ground in the producer's plant at Laws, Inyo County.

Monterey.—Crude oil production was up 20 percent from the 1964 total, but the natural gas yield from oil zones dropped 23 percent. The increase in crude oil output came from the San Ardo field as the result of extensive drilling in 1964, assisted by thermal recovery projects. Nine new wells were added in the field during 1965.

Dolomite was quarried and upgraded at Natividad to produce dead-burned dolomite used at steel furnaces, and calcined dolomite for a magnesia plant at Moss Landing. Some crushed dolomite was sold to glass and fertilizer manufacturers, and for roofing granules, riprap, and roadstone. A beet sugar refinery at Spreckels purchased limestone and produced lime and carbon dioxide used in the refining process. Industrial sand was produced from beach and dune deposits near Castroville, Marina, and Sand City for blast, engine, and filtration uses. Near Pacific Grove, two producers worked dune sands, principally for the feldspar content, to produce ground and unground products for foundry, glass, ceramic, and other industrial uses. Crude salt was harvested from solar evaporating ponds near Moss Landing and sold to local ice companies, water softening firms, and food processors. A King City asbestos fiber mill operated on ore received from the owner's San Benito County mine. Granite was quarried in Carmel Valley, also near Pebble Beach and Salinas.

A few flasks of mercury were retorted from ores mined on the Patriquin and Poppy properties in the Parkfield area.

Napa.—Crude salt was harvested from solar evaporating ponds along San Pablo Bay. Shale was mined near Oakville and expanded in a Napa plant. The plant also prepared a pozzolan for cement using diatomaceous silica obtained from a deposit near Napa. Asbestos fiber products were produced for the building trade at the Phoenix mine and plant in the Napa area. Pumice was obtained from the Pearl quarry in the Mt. George area for use as fill and aggregate. Perlite from the Alvo plant was used as plaster aggregate and soil conditioner. Basalt was quarried near Napa.

Mercury was recovered from ores and dump material of Oat Hill, Red Crystal, and Corona mines, and by three operators who worked James Creek to recover the metal washed down into the creek bottom from the old Oat Hill operation. Two unnamed prospects in the same area also yielded some mercury. All ores were retorted except at the Corona mine where a furnace was used.

Nevada. — Lode gold production was limited to that recovered in cleanup operation and the treatment of old tailing by amalgamation at the Empire North Star and Willow Valley groups of claims. Five placer properties were active in 1965 but only one, the Empire State, yielded appreciable quantities of gold and silver. Considerable gold and silver was recovered by individuals who panned stream gravels in the French Corral, Washington, Grass Valley, Graniteville, You Bet, and North Columbia areas.

Orange.—Crude oil production rose 10 percent above that in 1964 but the output of natural gas from oil zones was 5 percent lower. The Huntington Beach field continued its upward production trend with 87 new well completions in 1965. Also, 27 new wells were completed in the Yorba Linda field. A new oil-producing area was discovered in the Belmont offshore field. About 3 percent less wet gas was processed in the county's five plants (one less than in 1964); however, the output of natural gas liquids rose 15 percent.

Silica sand was mined in Trabucco Canyon for use in cement and refractories. Sand-clay mixtures also were mined there and in the El Toro area for foundry ganister. Both producers prepared washed kaolin and sand for sale. Shale was mined and expanded for lightweight aggregate near San Clemente. A beet sugar refinery near Dyer purchased limestone and produced lime and carbon dioxide used in the refining process. Crude salt was harvested from solar evaporating ponds at Corona Del Mar and iodine was extracted from waste oil well brines in a Seal Beach plant. Peat humus was obtained from a pit near Huntington Beach and sold in bulk or mixed with earth for sale as topsoil.

Placer.—Industrial sand was produced at a Bear River deposit near Auburn and sold for blast, engine, and filter uses. Granite was quarried near Rocklin for building and monumental stone. Granite was also quarried near Auburn. Clays

from the Lincoln area were used in making structural tile and other heavy clay products. A pit near Roseville yielded high-alumina clay used in making a specialty brick product.

Gold ores from the Bowman (Butcher Ranch) and two unidentified prospects were treated or concentrated to recover gold and silver. Ancient riverbed and stream gravels were worked at three placer properties, one at Colfax and two at Iowa Hill, to recover a few ounces of gold by small-scale hand methods. All other placer gold and silver was recovered by weekend prospectors and "snipers" who panned stream gravels at various locations.

Plumas.—Except for construction materials, mineral and metal production was limited to a few ounces of placer gold recovered by various individuals who panned stream gravels in the Granite Basin and Quincy areas. The Cameron and Comeback drift mines in the Seneca area reported exploration work but no production was sold or shipped.

Riverside.—Production of iron ore at the Eagle Mountain mine rose 13 percent over that in 1964. Shipments of concentrate were lower but the producer's pelletizing was completed and on stream before yearend. As a result, shipments of concentrate and pellets combined were 7 percent more than the 1964 concentrate shipments. Less usable iron ore was shipped to the producer's steel furnaces, but exports were 42 percent higher than in 1964.

Regular and white portland cements were produced at Crestmore, using raw materials from a nearby underground limestone quarry and sand and clay from pits near Corona and Riverside. Some Corona sand was used in making glass and clays of the area were used in stoneware and pottery. Quartzite from the Painted Hills quarry was used for building stone. Gypsum was mined and calcined at Midland for use in plaster and wallboard. Sandstone was quarried near Whitewater and granite was quarried at several locations in the western part of the county.

Reed-sedge peat from a deposit near Banning was air-dried and shredded for bulk shipment to customers. Crude oil production was from two wells in the Prado Dam field; the yield was less than in 1964.

Sacramento.—Sacramento dropped to fourth place among dry natural gas producing counties when production fell 12 percent below that in 1964. Production declines were reported at the Thornton and West Thornton-Walnut Grove fields; output at all other fields increased slightly or was unchanged. A new field, Sherman Island, was discovered in the Rio Vista area in 1965.

Clays mined in the Ione area were used in stoneware products, linoleum and oilcloth, and as a carrier in fungicides and insecticides.

Metal production was virtually limited to byproduct placer gold and silver recovered at a sand and gravel washing plant on the American River near Folsom. About 25 ounces of placer gold was recovered by weekend prospectors who panned stream gravels in the same area.

San Benito.—Portland cement was produced in a wet-process plant at San Juan Bautista. Raw materials for the plant were obtained from a nearby limestone quarry and a shale deposit in Santa Cruz County. Clinker from the producer's San Mateo County plant also was ground at the San Juan Bautista plant to meet cement demands of California customers. Limestone was quarried near Hollister for use in an Alameda County magnesia plant. Granite was quarried near Logan.

Asbestos ore was mined from a property in the southeast corner of the county and processed in the producer's plant in Monterey County. Bentonite was mined from the Lewis pit near Idria and prepared for use as a water seal in reservoirs, a carrier in dry insecticides, in making foundry refractories, and was pelletized for absorbent use.

Of the 10 active mercury mines and prospects, only 3—New Idria, Aurora, and Juniper—had yields exceeding 15 flasks of the metal. The New Idria mine continued to be the Nation's largest mercury producer.

Relatively small quantities of crude oil and natural gas (wet and dry) were produced. Crude oil output was down 7 percent and natural gas output dropped 25 percent from 1964 figures.

San Bernardino.—Four portland cement plants, at Colton, Cushenbury, Oro

Grande, and Victorville, were in operation in the county, representing a combined annual capacity of over 22 million barrels. All producers quarried limestone for plant use at company-owned quarries. All except the Victorville plant obtained silica and clay or shale requirements from company-owned deposits. The Victorville plant purchased its clay and silica requirements. Lime was produced in Lucerne Valley to supply the building trade and other industrial and chemical customers. Limestone was quarried near Wrightwood for foundry flux, and near Yucca Valley for architectural stone. Marble was quarried near Mount Baldwin for building stone, and near Victorville for terrazzo. Dimension quartz and quartzite were quarried near Big Bear Lake for decorative wall and fireplace use. Near Hinkley and Oro Grande quartz and quartzite were crushed or otherwise prepared for filler and filter uses, and for use in making refractories and rock wool. Granite was quarried at several locations in the southwest part of the county. Sandstone was also quarried near Big Bear Lake, Hinkley, Oro Grande, and Twentynine Palms.

Searles Lake brines were processed in plants at Trona and Westend to extract boron, lithium, and sodium compounds, potassium salts, and bromine. Calcium chloride was recovered as a liquid from Bristol Lake brines by two companies. A third company purchased the liquid and produced a flake product. Solar-evaporated salt was harvested at Searles and Bristol dry lakes. Solar salt harvested near Rice was used as a water-softening agent by the Metropolitan Water District of Southern California. Rock salt was mined by one company near Amboy.

Iron ore production at the Iron Age mine east of Twentynine Palms increased 22 percent above that in 1964. The coarse fraction of the ore was used in open-hearth steelmaking and the fines were sold to cement producers. Production at the Silver Lake iron mine rose 52 percent; all of the output was shipped to the producer's Fontana steel plant. Copper ore was shipped from the Carlton group of claims in the Goldstone area to an Arizona smelter, and silver concentrate from the Kitchen property north of Big Bear was consigned to a Utah smelter. Shipments of ore were made to the Selby smelter from the Argentite silver claim near Newberry, the Mohawk lead property in the Clark Mountain area, and the Stewart Wonder silver prospect near Trona. Selby also received concentrate from the Desert View gold property near Nipton and the Silver Buddy lead-silver claims in the Kelso area. A few ounces of placer gold were recovered by individuals who panned stream gravels in the Twentynine Palms area.

Ball clay was mined at the Hart deposit near Ivanpah and used in making whiteware and floor and wall tile. Bentonite from the Honey Brown property near Vidal was used as a filler in animal feeds. Near Newberry and Dagget hectorite was mined for use in clarifying beverages. Shale was mined from the Pavolite pit near Chino and expanded for lightweight aggregate. Four companies worked 11 talc deposits in the county, yielding nearly one-third the State's talc output. The Victorite pyrophyllite deposit near Victorville was idle, but shipments were made from stock to a grinder in Victorville. Crude barite was shipped from the Leviathan (Paycheck) mine near Calico, and from two barite prospects near Barstow, to a grinding plant in Kern County. Volcanic cinders were mined from deposits near Valley Wells, Cima, and Yucca Valley. The material was used for lightweight aggregate or roofing rock. Pumicite was obtained from a deposit in the Opal Mountain area and processed for sale as a soil conditioner.

Relatively small quantities of crude oil and oil-zone natural gas were produced from small fields in the extreme southwest corner of the county. Outputs of oil and gas declined 8 and 32 percent, respectively, from 1964 figures.

San Diego.—Silica sand was produced near Oceanside and prepared for use in glass and stucco, as molding and blast sand in foundries, and for sand traps on golf courses. Black granite was quarried at several locations near Escondido for architectural and monumental uses. Some granite was also quarried in San Diego. Quartz was quarried near Campo for decorative building stone.

Solar-evaporated salt was harvested from ponds on South Bay and processed in a Chula Vista plant for sale to local customers. Saltworks bitterns were sold

to a nearby plant for extraction of magnesium chloride. Pyrophyllite was mined from three properties in the San Dieguito area. The Four-Gee mine supplied a Los Angeles chemical plant; material from the Pioneer and Harris properties was ground by the producers for use as a carrier in insecticides. The owner of the Harris deposit also expanded perlite received from out-of-State producers.

Gold ore from the Eagle Nest group of claims in the Pine Valley area was amalgamated to recover gold and silver.

San Francisco.—Commercial Minerals Co. purchased clay, limestone, and talc, and ground or prepared the materials to customer specifications.

San Joaquin.—San Joaquin surpassed all other counties in dry natural gas production. The output was 2 percent above that in 1964. Production at the McMullin Ranch field again rose significantly. During the year, the productive area of the River Island field was extended with a well completion by Signal Oil and Gas Company.

Beet sugar refineries at Manteca and Tracy calcined purchased limestone to produce lime and carbon dioxide used in the refining processes. A fertilizer company at Lathrop produced byproduct gypsum in the manufacture of phosphoric acid and sold the product for agricultural use.

San Luis Obispo.—Crude oil production declined 4 percent whereas that of natural gas from oil zones increased 1 percent compared with production in 1964. Twenty-five percent less gas was processed at the county's only processing plant at the Russell Ranch field, yielding 14 percent less natural gas liquids. A sulfur recovery plant was operated in conjunction with the county's lone oil refinery at Arroyo Grande.

Ore from the underground Buena Vista mine near Klau was furnaced to recover mercury. Production was more than double that of 1964. Although nine other mercury mines and prospects were active, only one other, the nearby Klau, yielded more than 10 flasks of mercury.

Industrial sand was mined near Oceano and processed principally for foundry use. Limestone was produced at the Lime Mountain quarry near Adelaide and sold to sugar refiners or for agricultural use. The Santa Rita limestone quarry at Arroyo Grande was idle throughout 1965. Dimension stone and stone for flagging were quarried near Paso Robles. Gypsite was mined from the Cariso deposit near Simmler and sold for agricultural use.

San Mateo.—A portland cement plant at Redwood City used oystershell and clay dredged from the bay as raw materials. During the year a new shell washer was installed and plans announced for a new 6-million-barrel-per-year plant to be built adjacent to the existing plant. Other companies dredged oystershell from the bay and sold the washed shell for use as poultry grit, filler in animal feeds, and soil additive. Dimension and crushed stone were produced at the Langley Hill basalt quarry near Woodside for building and riprap. Sandstone was quarried near Brisbane.

Magnesia was extracted from seawater in a South San Francisco plant, using a purchased limestone-dolomite mixture as the precipitant. Solar-evaporated salt was harvested from ponds that extended into Alameda and Santa Clara Counties. The crude salt was prepared for shipment, principally export, at a Redwood City bayside plant. Gypsum was imported from Mexico and stockpiled at Redwood City for agricultural use and as a cement raw material.

Less than 45,000 barrels of crude oil was produced, down 20 percent from the 1964 total. A small quantity of natural gas was obtained with the oil.

Santa Barbara.—County fields yielded 1 percent less crude oil, 15 percent more wet natural gas, and 13 percent more dry natural gas than in 1964. Petroleum and wet gas increases in the Cat Canyon (95 new wells) and Casmalia (36 new wells) fields were the result of development drilling. A total of 179 new wells was drilled in the county. Higher yields of dry natural gas came principally from three offshore fields—the Caliente, the Gaviota, and the Molino. Production of natural gas liquids fell 11 percent, reversing an upward trend begun in 1960. Two oil refineries were operated near Santa Maria.

Most of the California diatomite production, and a high percentage of the U.S. output, came from three operations, two near Lompoc and one near Santa Maria. A fourth producer, north of Lompoc, mined and processed diatomite for

specialty products. A beet sugar refinery at Betteravia calcined limestone to produce lime required in the refining process. Stone was quarried near Guadalupe, Lompoc, and Santa Barbara for flagging and decorative use. Near Goleta, sandstone was quarried for curbing and flagging, and for rough and dressed building stone. Sandstone was also quarried near Carpenteria.

Ore from the Gibraltar mine, north of Santa Barbara, was furnaced to recover over 250 flasks of mercury. Small quantities of the metal were retorted from ores of the Apex and Tres Tacos properties.

Santa Clara. — California's largest producing cement plant was operated at Permanente. The producer obtained limestone for the plant from a nearby quarry, and sold some of the stone to local contractors for roofing granules and other uses. Sandstone was quarried near Los Gatos.

Lessees worked various sections of the New Almaden mine to produce nearly half the mercury output in the county. San Jose Mining Co. was by far the major producer, and the only lessee using a furnace to recover the metal. The Guadalupe was the only other active mercury mine and used both a furnace and retorts in recovering mercury from the ore.

Santa Cruz.—Portland cement was produced in a plant at Davenport using limestone and shale from nearby quarries. Shale also was mined at the Chittenden quarry for use by a San Benito County cement producer. Limestone was quarried near Santa Cruz for building stone and poultry grit. Sand from deposits in the Felton, Santa Cruz, and Scotts Valley areas was shipped to customers in the San Francisco peninsula counties. Granite was quarried near Felton and Soquel.

Shasta.—Portland cement was produced in a plant at Redding, using clay from nearby pits and limestone from the Gray Rock quarry. Some limestone was sold to sugar refineries.

Mercury was retorted from ore mined at the Welty property near Dunsmuir. Iron ore was shipped from stockpile at the Iron Mountain mine to a domestic steel plant. Cement copper was recovered from the mine water of the idle Hornet pyrite mine at Iron Mountain. Gold ore and cleanup operations at three properties in the French Gulch area, and ore from the Black Spider gold prospect in the Shasta area, yielded recoverable gold and silver. Byproduct placer gold and silver were recovered in the Shea Sand and Gravel washing plant near Redding. Weekend prospectors panned stream gravels in the Cottonwood Creek, French Gulch, Redding, and Shasta areas and recovered small quantities of placer gold and silver.

Volcanic cinder was mined on the H & H Ranch near Glenburn and on the Sanford property near Fall River Mills, principally for use in road construction. However, some of the Sanford material was used in leachlines, and for landscaping and roofing granules. Volcanic cinder (scoria) from the Black Butte deposit near Manton was used for lightweight aggregate. Crude barite mined from the Castella (Loftus claims) property was shipped to the producer's Sacramento County grinding plant.

Sierra.—Five lode gold mines were active, but only the Original 16 to 1 mine at Alleghany yielded significant quantities of gold and silver. Except for a sluicing operation and a suction dredge at Alleghany, and an operation in ancient riverbed gravels in the Downieville area, all placer gold and silver was recovered by individuals or weekend prospectors who worked stream gravels by small-scale hand methods, chiefly in the Alleghany, Camptonville, Downieville, and Sierra City areas.

Siskiyou.—About 100,000 tons of volcanic cinder was mined and used by county, State, and Federal agencies, and tract developers, for road construction and repair. An additional 35,000 tons was used for railroad ballast. Building supply and block companies mined and used 15,000 tons of pumice and 10,000 tons of volcanic cinder for concrete aggregate, landscape rock, and roofing granules.

Dragline operations on the Klamath and Salmon rivers yielded all but a few ounces of the placer gold and silver recovered in the county. Small quantities of placer gold were panned from stream gravels along the two rivers by individuals.

Solano.—Production of natural gas declined 2 percent from 1964, but Solano remained third highest among the State's dry gas producing counties. Two new

gasfields were discovered in 1965, the Davis Southeast and the Millar. The latter was still shut in at yearend. A well completion by Signal Oil & Gas Co. extended the Lindsey Slough field.

At the Tolenas limestone quarry near Fairfield, building stone and terrazzo chips were produced. Some basalt was quarried between Benicia and Cordelia.

Sonoma.—Six mercury mines and prospects were active but only three—the Mount Jackson, Socrates, and Eagle Rock (Culver-Baer)—yielded more than 10 flasks each. The Mount Jackson, in the Guerneville area was by far the major producer with an output larger than all others combined. The Eagle Rock was worked by two operators in 1965.

Building stone and flagging were produced from the Trinity sandstone quarry near Glen Ellen. Basalt was quarried near Forestville and Petaluma.

A small quantity of dry natural gas was produced from the Petaluma field. The volume withdrawn was more than 12 percent below that withdrawn in 1964.

Stanislaus.—Ball clay was mined at the Rodden property near Knights Ferry and sold for use in making whiteware.

Two nonfloating sand and gravel washing plants, one near Oakdale on the Stanislaus River and another near La Grange on the Tuolumne River, recovered byproduct placer gold and silver.

Sutter.—Dry natural gas output was less than 1 percent below that in 1964. Sutter County yielded more dry gas than any county except San Joaquin. Eight new wells were drilled in the Grimes field and three were drilled in the Sutter Buttes field during 1965.

A custom grinding plant for processing nonmetalic minerals was operated at Sutter.

Tehama.—Dry natural gas production was 29 percent above that in 1964, principally as a result of well completions that extended the Rice Creek field, and initial production from the Red Bank field (discovered in 1964).

Crews of the California Division of Highways mined volcanic cinder for use in road maintenance and repair. Contractors for Tehama County mined the material for use as concrete aggregate.

Trinity.—Three lode gold mines reported activity in 1965 but only one, the Kelley mine in the Hayfork area, yielded more than token quantities of gold and silver. Ground sluicing was used to recover specimen placer gold from ancient riverbed gravels on Crow Creek. Individuals panned stream gravels along the Trinity River and recovered small quantities of placer gold and silver.

A few flasks of mercury were retorted from ore of the Altoona mine in the Castle Creek area. The mine had been idle since 1960.

Tulare.—Crude oil production was nearly 2 percent above the 1964 output but the dry natural gas yield was 18 percent lower. The Deer Creek oilfield and the Trico gasfield yielded all the county's crude oil and natural gas.

Crude barite was mined at the Baro claims in the Bald Mountain area and shipped to a Kern County grinding plant. Previously mined barite at the Barite King property in Nine Mile Canyon was sent to a plant in Little Lake, Inyo County, for upgrading. Limestone was quarried near Orosi for dimension building stone, and near Porterville for filler in animal feeds, and for making mineral wool and poultry grit.

Byproduct placer gold and silver were recovered in a sand and gravel washing plant on the Tule River.

Tuolumne.—Limestone was quarried at Columbia (surface) and Sonora (underground) and used to make lime for construction, chemical, glass, agricultural, and other uses. Marble was quarried in the Sonora area for terrazzo. Diatomite was mined near Keystone for use as lightweight aggregate.

Three lode gold prospects were active in the Sonora-Columbia area. Ores from the Golden Star and Lazar were treated by amalgamation and the bullion shipped to the U.S. Mint in San Francisco. Concentrate was produced at the Hidden Fortune and consigned to the Selby smelter in Contra Costa County.

Ventura.—Crude oil production was 7 percent below the 1964 output and the natural gas yield from oil zones was 11 percent lower. A normal decline occurred in most older fields. However, large declines were reported in other fields: West Montalvo was down 30 percent; Oxnard, 13 percent; Oakridge, 12 percent; South Mountain and Saticoy, 9 percent each; and Rincon, 7 percent. At the Sespe

Canyon group, where 18 new wells were completed, petroleum output rose 80 percent. Production of natural gas liquids from the county's 10 processing plants was lower, continuing a decline begun in 1960. Though relatively small, the dry natural gas yield was 37 percent higher.

Shale was quarried near Frazier Park and Ventura. In both instances the material was expanded by the producer for use as lightweight aggregate. Limestone was obtained from the Tapo Alto quarry and prepared for use as a filler in animal feeds and fertilizer, and for poultry grit. Sandstone was quarried at several locations in the southwest part of the county. Industrial sands from pits in the Santa Paula and Oxnard areas were prepared for foundry, filtration, and other industrial uses. Gypsum was mined near Maricopa and shipped to the producer's Kern County cement plant.

Yolo.—Dry natural gas production was up about 1 percent from the 1964 total. The increase was credited to the Woodland field (discovered in 1963) which came into full production in 1965. All other gasfields in the county reported normal declines.

Sugar refineries at Clarksburg and Woodland calcined purchased limestone to produce lime and carbon dioxide used in the refining process. Blast and engine sands were prepared from sand dug from pits near Marysville.

Yuba.—Three bucketline dredges operated on the Yuba River in the Marysville area and recovered a high percentage of the State's placer gold and silver output. All California's platinum group metals were recovered as a byproduct of this dredging operation. Except for the Good Luck "7" Mining Co. operation (nonfloat washing plant) near Challenge, the remaining placer gold and silver was recovered by individuals who sluiced and panned stream gravels in the Camptonville, Dobbins, and Smartville areas.

Old tailings from the dredging operations were the source for very large tonnages of sand and gravel used by the construction industry.

The Mineral Industry of Colorado

By Carl L. Bieniewski [1] and William C. Henkes [2]

The mining and petroleum industries of Colorado in 1965 produced mineral commodities valued at $331.2 million—an increase of 5 percent over that of 1964. Substantial increases in the production of coal, molybdenum, and vanadium caused the higher value.

The State continued as the principal domestic source of molybdenum, tin, and vanadium.

Highlighting petroleum-industry activity during the year were the development of the Cache field in Montezuma County and the experimental work conducted on oil shale. Climax Molybdenum Co., Climax Division, American Metal Climax, Inc., surpassed its 1964 ore-production record at the Climax mine. As a result of dam and highway construction, stone production reached a record high for the State.

Fuels accounted for $144.5 million or 44 percent of the State total value of mineral production, metals for $135.7 million or 41 percent, and nonmetals for $51 million or 15 percent.

Employment and Injuries.—Preliminary data for 1965 and final data for 1964 compiled by the Federal Bureau of Mines for employment and injuries in the mineral industries, excluding the petroleum industry, are shown in table 3.

Legislation and Government Programs.—Four contracts entered into by the Office of Minerals Exploration (OME) since 1962 were still in effect; two provided financial assistance for exploring gold-silver prospects in San Juan and Rio Grande Counties and two for exploring silver prospects in Mineral and Pitkin Counties. No new contracts were executed during the year.

On October 28, the U.S. Atomic Energy Commission (AEC) and Mining and Metals Division, Union Carbide Corp., signed a stretchout contract for purchasing, through December 31, 1970, uranium oxide concentrate produced at the company uranium mills at Rifle and Uravan. Under the new contract, the company in the 1963–66 period was to defer production and delivery of 2,520,000 pounds of U_3O_8 from ore mined from properties owned or controlled by the company. The same amount was to be produced and delivered during 1967–68. In 1969–70, AEC was to purchase an amount equal to that actually produced and delivered during 1967–68, subject to a maximum of 2,520,000 pounds of U_3O_8. The total quantity estimated that could be delivered from January 1, 1963, through December 31, 1970, under the contract was approximately 16,745,000 pounds of U_3O_8 including U_3O_8 in concentrates derived from ores produced from eligible independent sources. The price to be paid for the U_3O_8 through 1968 was to be $8 per pound and that in 1969 and 1970 to be 85 percent of an allowable production cost per pound based on the production costs in the 1963–68 period, plus $1.60 per pound—subject to a maximum total price of $6.70 per pound.

Public Service Company of Colorado (PSC) announced plans to construct a $110 million, 330-megawatt, nuclear powerplant using uranium and thorium fuel. AEC was to assist the company in financing the plant to be built by General Dynamics Corp. 4 miles northwest of Platteville at the junction of the South Platte and St. Vrain Rivers.

In February the Department of the Interior Oil Shale Advisory Board, appointed by Secretary Stewart L. Udall in 1964,

[1] Mining engineer, Bureau of Mines, Denver, Colo.
[2] Petroleum engineer, Bureau of Mines, Denver, Colo.

Table 1.—Mineral production in Colorado[1]

Mineral	1964		1965	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Carbon dioxide (natural)—thousand cubic feet	211,830	$36	155,668	$26
Clays—thousand short tons	558	1,275	631	1,446
Coal (bituminous)—do	4,355	23,427	4,790	24,431
Copper (recoverable content of ores, etc.) short tons	4,653	3,034	3,828	2,710
Feldspar—long tons	W	W	521	3
Gem stones	NA	80	NA	80
Gold (recoverable content of ores, etc.) troy ounces	42,122	1,474	37,228	1,303
Gypsum—thousand short tons	100	398	102	427
Iron ore (usable) thousand long tons, gross weight	35	231	114	787
Lead (recoverable content of ores, etc.) short tons	20,563	5,388	22,495	7,018
Lime—thousand short tons	138	2,193	118	2,074
Molybdenum (content of concentrate) thousand pounds	46,378	69,207	[2] 50,715	[2] 78,609
Natural gas (marketed)—million cubic feet	[r] 113,691	13,489	126,381	16,303
Natural gas liquids:				
LP gases—thousand gallons	88,916	3,894	91,399	3,930
Natural gasoline and cycle products—do	52,400	2,845	54,180	3,034
Peat—short tons	27,931	188	31,179	236
Petroleum (crude)—thousand 42-gallon barrels	34,755	100,094	33,511	96,512
Pumice—thousand short tons	61	114	56	134
Pyrites—thousand long tons	W	W	30	90
Sand and gravel—thousand short tons	20,746	22,227	20,810	22,041
Silver (recoverable content of ores, etc.) thousand troy ounces	2,626	3,396	2,051	2,652
Stone—thousand short tons	3,217	6,805	4,789	8,638
Tin (content of concentrate)—long tons	W	W	32	76
Tungsten concentrate (60-percent WO_3 basis) short tons	W	W	1,176	1,985
Uranium ore—do	833,282	13,389	574,795	10,651
Vanadium—do	3,312	9,916	4,017	14,056
Vermiculite—thousand short tons	(3)	1	---	---
Zinc (recoverable content of ores, etc.) short tons	53,682	14,602	53,870	15,730
Value of items that cannot be disclosed: Beryllium concentrate, cement, fluorspar, perlite, salt, and values indicated by footnote 2 and symbol W	XX	[4] 18,308	XX	16,234
Total	XX	316,011	XX	331,216

NA Not available. [r] Revised. W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed." XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes shipments and value of Nye Metals, Inc.; included with "Value of items that cannot be disclosed."

[3] Less than ½ unit.

[4] Value of metals, $1,291,000; value of nonmetals, $17,017,000.

issued a report[3] on the development of oil shale resources on public lands.

In April, Governor John A. Love signed Colorado's first involuntary unitization law. The law, patterned after Interstate Oil Compact Commission recommendation, permitted The Oil and Gas Conservation Commission of the State of Colorado to order unit operation of an oil and/or gas pool or parts of a pool when 80 percent of the working-interest and nonpaying-interest owners had agreed to the proposed unitization.

A State legislative committee began a study of surface mines to determine whether legislation should be passed setting forth rules and regulations about rehabilitation of the disturbed lands.

Three major strip-mining operators entered into a voluntary agreement with the Colorado Department of Natural Resources for the restoration and vegetation of surface-mined coal lands.

Contracts awarded for road work in the State totaled $49.2 million.[4] Of this money 47 percent went for road building in the

[3] U.S. Department of the Interior. Interim Report of the Oil Shale Advisory Board to the Secretary of the Interior. Feb. 1, 1965.

[4] Engineering News-Record. State Highway Contracting Plans: 1966 Will Be a Record Breaker. V. 176, No. 14, Apr. 7, 1966, pp. 74–76.

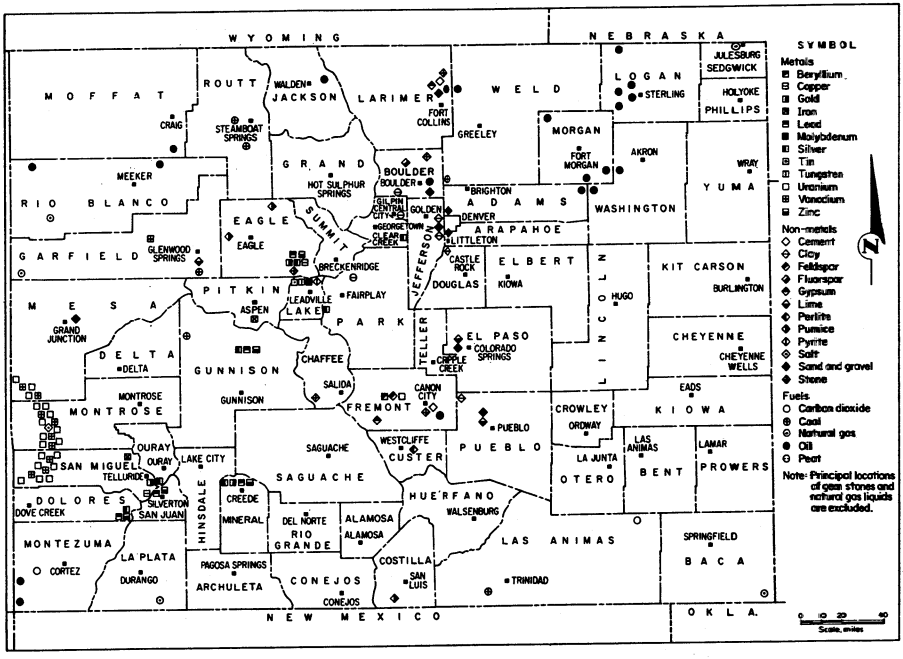

Figure 1.—Major mineral production areas in Colorado in 1965.

Table 2.—Value of mineral production in constant 1957–59 dollars

(Millions)

Year	Value
1956	$336
1957	335
1958	309
1959	319
1960	344
1961	344
1962	304
1963	r 308
1964	r 302
1965	312

r Revised.

National System of Interstate and Defense Highways. Under the Federal-Aid Program for Primary and Secondary Highway Systems (ABC program), 247.4 miles of roads was built.[5] Dam construction work was continued throughout the year on the Curecanti and Fryingpan-Arkansas projects and on the Homestake Transmountain Water Diversion project of the municipalities of Aurora and Colorado Springs.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Asphalt and Related Bitumens (Gilsonite).—At its refinery near Fruita, American Gilsonite Co. processed gilsonite for electrode-grade coke, gasoline, asphalts, and road oils. Gilsonite was transported to the refinery from the company mining operations at Bonanza, Utah, by pipeline. The company planned changes in refinery operations to recover additional products for use by the chemical industry. Plans for building a de-ashing unit announced in 1964 were abandoned.

In December, Colorado Bitumuls Co., Inc., a Denver firm, began constructing a plant in Grand Junction for producing water-emulsion asphalts.

Carbon Dioxide.—Output of carbon dioxide decreased 27 percent. Most of the marketed carbon dioxide production was from the McElmo field, Montezuma County; sales from this one-well pool were 153.2

[5] Bureau of Public Roads. Quarterly Report on The Federal-Aid Highway Program, Dec. 31, 1965. Press Release BPR 66–5, Feb. 9, 1966.

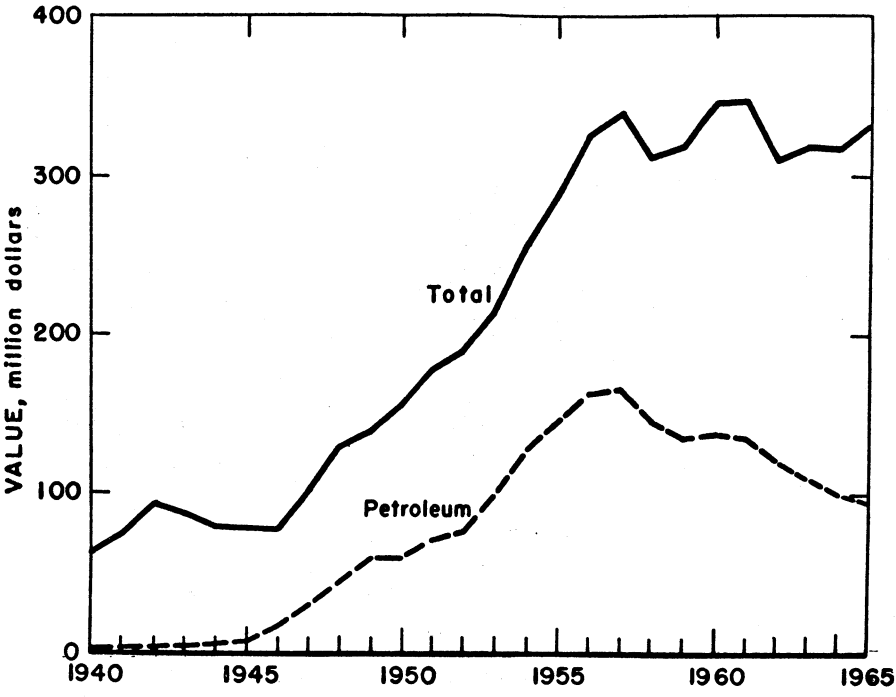

Figure 2.—Value of petroleum, and total value of mineral production in Colorado.

million cubic feet. The Nina View field, Las Animas County, was shut in during the year; gas sales, before the field was shut in, totaled nearly 2.5 million cubic feet. Large quantities of carbon dioxide also were produced in Jackson County; however, because of traces of entrained hydrocarbons, most of it was not marketed.

Coal (Bituminous).—Coal production, the highest since 1949, was 10 percent or 435,000 tons greater than in 1964. The increase was due mainly to production from the newly developed Seneca strip mine of Seneca Coals, Ltd., in Routt County. The operation provided fuel for the new 150-megawatt steam-electric generating plant of the Colorado-Ute Electric Association near Hayden.

Of the 79 coal-mining operations with production exceeding 1,000 tons, 72 were underground mines having a total production of 3.5 million tons, 73 percent of the State total production. The Allen underground mine of The Colorado Fuel and Iron Corp. (CF&I) in Las Animas County had the greatest production of all coal mines in the State. Routt County was the leading county accounting for 25 percent of the State total.

Production from the seven strip mines was 1.3 million tons or 27 percent of the State total coal production. Three of the seven mines each had production exceeding 100,000 tons, three each between 10,000 and 100,000 tons.

Of the 4.8 million tons of coal produced, 1.2 million tons was captive production and 3.6 million tons was sold on the open market. Nearly all of the captive production was used for making steel in Colorado and Utah. The principal purchaser and consumer of coal was the electric-utility industry; 16 of the 21 steam-generating plants in the State used coal for electric-power generation.

The average value per ton for coal produced from underground mines was $5.73 and that from strip mines $3.35, compared with $5.92 and $3.43, respectively, in 1964.

Under a contract awarded by the Federal Bureau of Mines in October, two small

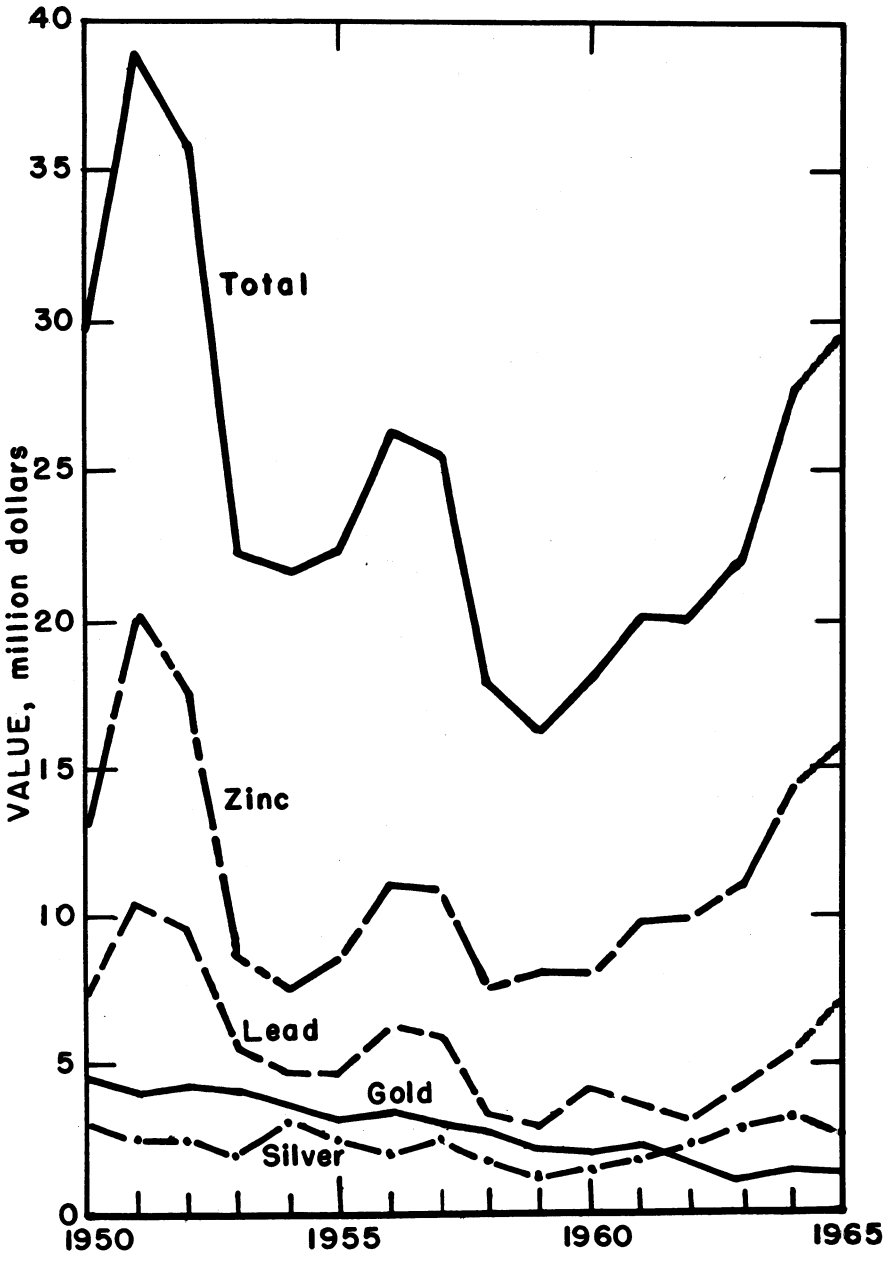

Figure 3.—Value of mine production of gold, silver, lead, and zinc, and total value of these minerals (including copper) in Colorado.

coal-outcrop fires that threatened coal reserves in northwestern Colorado were to be brought under control. Clyde Morris of Dodson, Mont., won the contract with a bid of $11,635.

The worst gas and coal-dust explosion since the 1942 coal mine disaster at the Wadge mine in Routt County occurred on December 28 in the Dutch Creek mine of Mid-Continent Coal and Coke Co. near

Table 3.—Employment and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injures		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1964:								
Coal	1,569	207	325	2,559	4	113	45.72	13,449
Peat	25	120	3	22	------	1	46.36	93
Metal	4,361	250	1,115	8,918	9	353	40.59	8,425
Nonmetal	410	156	64	505	------	15	29.68	1,735
Sand and gravel	1,378	208	287	2,321	------	47	20.25	394
Stone	876	189	165	1,324	------	41	30.96	696
Total	8,619	225	1,959	15,649	13	570	37.25	7,173
1965: p								
Coal	1,500	225	337	2,691	11	119	48.31	28,595
Peat	35	86	3	23	------	2	87.39	2,840
Metal	4,355	262	1,142	9,136	3	352	38.86	3,599
Nonmetal	405	153	62	492	1	12	26.42	13,959
Sand and gravel	1,070	208	222	1,799	3	36	21.68	10,346
Stone	915	210	192	1,537	1	39	26.02	4,283
Total	8,280	236	1,958	15,678	19	560	36.93	9,054

p Preliminary.

Table 4.—Coal (bituminous) production, by counties

(Excludes mines producing less than 1,000 short tons)

County	Production (short tons)	
	1964	1965
Delta	62,576	186,233
El Paso	1,141	--------
Fremont	292,704	282,331
Garfield	8,234	6,975
Gunnison	462,985	304,761
Huerfano	49,921	48,279
La Plata	26,780	26,024
Las Animas	801,484	871,061
Mesa	92,843	113,390
Moffat	175,471	194,671
Montrose	90,213	67,175
Pitkin	657,008	767,876
Rio Blanco	7,065	6,110
Routt	861,373	1,211,147
Weld	765,447	704,425
Total	4,355,245	4,790,458

Redstone in Pitkin County. Of the 30 men in the mine at the time of the explosion, 9 perished almost immediately from the force of the explosion, burns, and possible carbon monoxide poisoning; 21 men escaped uninjured. The mine had been classified as gassy in accordance with the laws of the State and under the provision of the Federal Coal Mine Safety Act.

According to Federal Bureau of Mines investigation, the disaster was caused by ignition of an accumulation of methane by an electric arc or spark when a temporary splice in the trailing cable of the loading machine shorted out.

Natural Gas.—Marketed natural gas increased 11 percent in volume and 21 percent in value. The increase in gas sales was largely attributed to construction of new gas pipelines in western and southeastern Colorado. Total production of natural gas, as reported by the State Oil and Gas Conservation Commission,[6] was 133 billion cubic feet, a 1-percent increase.

The principal counties, in gas sales, were La Plata first, followed by Moffat, Rio Blanco, and Morgan. Output from La Plata, Moffat, and Rio Blanco Counties increased 12, 13, and 6 percent, respectively.

The five largest dry-gas fields were Ignacio-Blanco (36 billion cubic feet), Piceance (4.6 billion cubic feet), West Hiawatha (4 billion cubic feet), Powder Wash (4 billion cubic feet), and Sugar Loaf (3.4 billion cubic feet). Wet gas from the Rangely Weber formation amounted to 31.7 billion cubic feet. Adena and Wilson Creek fields also yielded large quantities of wet gas: 4 billion and 2.4 billion cubic feet, respectively.

The State had 701 producing gas wells at yearend. During the year 53 new gas wells were completed, including a significant discovery well in Kit Carson County.

The Oil and Gas Conservation Commission, in a report to the Interstate Oil Compact Commission, stated that an estimated

[6] The Oil and Gas Conservation Commission of the State of Colorado. Colorado Oil & Gas Statistics, 1965, part II. All petroleum and natural gas production figures cited in the county section also are from this work.

398.5 billion cubic feet of gas reserves was shut in; 82 percent was in northwestern, 14 percent in southwestern, and the remainder in eastern Colorado.[7]

Continental Oil Co. discovered the Smokey Hill field in Kit Carson County; the discovery well was completed with a flow gauge of 6.6 million cubic feet of gas per day from the Morrow formation (Pennsylvanian). Of great significance was the helium content of the gas: Analysis indicated 4.31 percent helium, 69.13 percent nitrogen, and 25.68 percent hydrocarbons.

Garfield Gas Gathering Co. was sold to Cascade Natural Gas Corp. of Seattle, Wash. The new firm continued constructing 35 miles of gathering system and 115 miles of 14-inch and 10-inch interstate pipeline from Divide Creek field to the Mountain Fuel Supply Co. pipeline at Bonanza, Utah. At a cost of $7 million, this system opened the Divide Creek field to markets nearly 10 years after its discovery. Cascade made agreements with Mountain Fuel Supply Co. to furnish the latter with 25 million cubic feet of gas per day during the first year of operation and 50 million cubic feet daily during the second year.

A second significant gas pipeline was that of Baca Gas Gathering System, Inc. The line, 40 miles of 30-inch and 12-inch pipe, connected the Midway, Flank, and Greenwood gasfields, Baca County, to Panhandle Eastern Pipe Line Co. facilities in Morton County, Kans.

At midyear, Western Slope Gas Co., a subsidiary of PSC, announced plans to store gas in the virtually depleted Asbury Creek gasfield, near Grand Junction. The field had an estimated capacity of 2.9 billion cubic feet of gas at a pressure of 800 pounds per square inch; the ultimate injection rate was to be 5 million cubic feet daily. Storage was to be in the Dakota sandstone (Cretaceous). The reservoir was to serve a dual purpose: It would enable Western Slope Gas to stabilize the Btu content of marketed gas by blending the low-Btu gas from the Garmesa area with the high-Btu gas from the Dragon Trail and Lower Horse Draw areas; and it would permit the more uniform year-round operation of the Continental Oil Co. Fruita gas plant which extracted liquids from the gas.

In addition to the approved Asbury Creek field, there were two underground gas-storage facilities with an ultimate gas-storage capacity of 8.2 billion cubic feet: the Leyden coal mine, Jefferson county; and the Springdale field, Logan County. The Fort Morgan field, Morgan County, was to be converted to gas storage with a capacity of 12.9 billion cubic feet.[8]

Natural Gas Liquids.—Production of natural gas liquids at the 14 extraction plants increased 3 percent. Associated Oil & Gas Co. commenced operations in May at its Loveland plant, Larimer County; by year-end, the plant had produced 13,042 barrels of liquids.

In March, Continental Oil Co. released details of its new dry-desiccant (charcoal) adsorption process used at the Fruita gas plant, completed in December 1963. The process increased recovery of propane in a

[7] Work cited in footnote 6, part I, p. 6.
[8] Work cited in footnote 6, part III, p. 5.

Table 5.—Natural gas liquids extraction plants in 1965

Plant	County	Owner	Gas input (million cubic feet)	Products (thousand barrels)
Adena	Morgan	Union Oil Co. of Calif	5,658	497
Bijou	do	Associated Oil & Gas Co	1,465	209
Ft. Morgan	do	Natural Gas Producers	1,559	36
Fruita	Mesa	Continental Oil Co	4,871	93
Little Beaver	Washington	do	1,695	319
Loveland	Larimer	Associated Oil & Gas Co	104	13
McClave	Kiowa	Fleetwood Drilling Co	670	9
Minto	Logan	Sunray DX Oil Co	51	10
Padroni	do	Associated Oil & Gas Co	1,079	16
Rangely	Rio Blanco	Chevron Oil Co	31,452	1,148
Roggen	Weld	McWood Corp	293	34
San Juan	La Plata	El Paso Natural Gas Co	53,653	808
Vallery	Morgan	Associated Oil & Gas Co	853	67
Yenter	Logan	do	3,296	283

Source: The Oil and Gas Conservation Commission of the State of Colorado. Colorado Oil and Gas Statistics, 1965. Part IV, Gasoline and Extraction Plants, 4 pp.

gas stream from 60 to 70 percent in a typical dry-desiccant plant to 75 percent. The fully automated plant—operated unattended 16 hours daily—had a daily capacity of 20 million cubic feet of gas. For the first year of operation, downtime averaged less than 1 percent. The plant processed 4.9 billion cubic feet of gas owned by Western Slope Gas Co. and extracted 93,000 barrels of liquids.

Oil Shale.—Research on oil shale was conducted throughout the year at the Government experimental oil-shale facilities near Rifle, leased to Colorado School of Mines Research Foundation, Inc. Experiments were conducted and operational runs made to determine effects of shale rate, air rate, recycle-gas rate, preheated combustion air, shale-bed height and shale-particle size on oil yield.

The recovery of oil and oil mist and the problem of dust carryover in the oil product were also investigated. The Anvil Points mine was reactivated to supply shale for the pilot-plant retort operations. All work was done under contract by Socony-Mobil Oil Co., Inc., who with Humble Oil & Refining Co., Continental Oil Co., Pan American Petroleum Corp., Phillips Petroleum Co., and Sinclair Research, Inc., a division of Sinclair Oil and Gas Co., had a cooperative agreement with the Colorado School of Mines Research Foundation, Inc., for sharing the research information.

A 6-inch-diameter drillhole, designated as Colorado Corehole No. 1, pierced the thickest oil shale deposit ever found in the State. The hole, drilled for the Federal Bureau of Mines, was located in the NW¼ NE¼ SE¼ sec 13, T 1 N, R 98 W, Rio Blanco County. The core samples showed the oil shale to be essentially continuous from the point where it was first encountered, about 950 feet below the surface, to the bottom of the 2,600-foot hole. Stratigraphic studies indicated that the deposit may extend downward for another 600 feet. Data obtained from the corehole was to be used in evaluating the site for a possible underground retorting experiment.

Colony Development Co. constructed a prototype oil shale plant near Grand Valley; the plant was to test a method of extraction developed by The Oil Shale Corp. (TOSCO), one of three companies which formed Colony. Designed to extract 700 to 800 barrels per day from 1,000 tons of oil shale, the plant was operated on a test basis in the latter part of the year. The company signed a contract with the Federal Bureau of Reclamation for obtaining water from the Colorado River for use in the prototype plant and later for a large commercial plant.

The second annual symposium on oil shale was held in Denver on April 22–23 under the joint sponsorship of the Colorado School of Mines and the Colorado School of Mines Research Foundation, Inc.[9]

In a new report,[10] the U.S. Geological Survey estimated that the equivalent of 80 billion barrels of oil exists in high-grade accessible shale in the Green River formation in Colorado, Utah, and Wyoming.

Denver Research Institute of the University of Denver announced that a new research program would be undertaken on the public-policy questions raised in developing the shale oil industry. The first study was to deal with the economic impact of a shale oil industry on the Western Slope of Colorado.

Peat.—Peat production, surpassing the 1964 high of 27,931 tons by 3,248 tons, was as follows: Moss, 20,768 tons; humus, 6,671 tons; and reed-sedge, 3,740 tons. The peat was produced at 16 operations: 5 in Boulder County, 3 in Park County, 2 each in Gilpin and La Plata Counties, and 1 each in Alamosa, Chaffee, Lake, and Teller Counties. Boulder was the leading county with 8,685 tons. Of the 31,179 tons produced, 27,229 tons was used for general soil improvement and 3,950 tons for mixed fertilizer and packing material. Except for 2,642 tons packaged, the peat was bulk shipped. Only 6,071 tons of the total output was processed. The average price per ton for unprepared peat was $6.62 and that for processed peat $11.50.

Petroleum.—Production of crude petroleum declined steadily since the peak year of 1957, except for a slight increase in 1960; this trend continued through 1965, with output 4 percent lower than in the previous year. In spite of this decline, petroleum continued to be the most valuable

[9] Second Symposium on Oil Shale. Quarterly of the Colorado School of Mines. V. 60, No. 3, July 1965, 200 pp.

[10] Duncan, Donald C., and Vernon E. Swanson. Organic-Rich Shale of the United States and World Land Areas. Geol. Survey Circ. 523, 1965, 30 pp.

single mineral commodity, accounting for 29 percent of the total value of mineral production.

The Rangely Weber reservoir was the source of 44 percent of the State production. At yearend, after 22 years [11] of operation, Rangely (Weber) had a cumulative

[11] Although oil was discovered in the Weber sand in 1933, development did not begin until 1944.

Table 6.—Crude petroleum production, by counties

(Thousand 42-gallon barrels)

County	1964	1965	Principal fields in 1965, in order of production
Adams	492	601	Mocassin, Badger Creek, Middlemist, Beacon, Deer Trail, Windy Hill.
Archuleta	70	68	Price Gramps.
Baca	197	166	Flank.
Bent	6	2	Bent's Fort.
Boulder	2	2	Boulder.
Fremont	24	21	Florence-Canon City.
Jackson	355	303	McCallum, Battleship.
Kiowa	16	15	Brandon.
La Plata	43	30	Red Mesa.
Larimer	393	302	Loveland, Wellington, Fort Collins.
Logan	3,495	3,510	Northwest Graylin, Mount Hope, Divide, Saber, Lewis Creek, West Padroni.
Moffat	856	808	Powder Wash, Iles, Danforth Hills, Buck Peak.
Montezuma	513	1,309	Cache, Flodine Park.
Morgan	2,283	1,488	Adena, Sand River, Zorichak, Bijou.
Prowers	4	3	Comanche.
Rio Blanco	18,109	17,769	Rangely, Wilson Creek.
Routt	81	94	North Sage Creek, Grassy Creek, Tow Creek.
Washington	6,224	5,381	Plum Bush Creek, Bison, Big Beaver, Rush Willadel, Lindon, Little Beaver.
Weld	1,592	1,636	Black Hollow, Pierce, Southwest Roggen, New Raymer, Loam.
Yuma	------	3	Eastward.
Total	34,755	33,511	

Source: The Oil and Gas Conservation Commission of the State of Colorado. Colorado Oil and Gas Statistics, 1965. Part II: Oil & Gas Production, 83 pp.

Table 7.—Principal oilfields in 1965

Field	County	Production		Cumulative production to Jan. 1, 1966	
		Oil (barrels)	Gas (thousand cubic feet)	Oil (barrels)	Gas (thousand cubic feet)
Rangely (Weber)	Rio Blanco	14,662,288	31,680,987	369,016,301	611,186,382
Wilson Creek	do	2,559,147	2,373,972	58,159,470	32,027,110
Cache	Montezuma	1,032,336	1,376,590	1,229,295	1,539,552
Adena	Morgan	828,530	3,966,316	57,430,193	63,585,433
Plum Bush Creek	Washington	759,294	89,302	15,608,124	1,740,050
Black Hollow	Weld	758,470	28,173	7,120,390	192,770
Rangely (Mancos)	Rio Blanco	503,702	----------	10,018,442	----------
Bison	Washington	410,612	673	2,276,027	2,467
Big Beaver	do	407,361	86,098	9,344,533	1,371,509
Rush-Willadel	do	388,435	658	1,510,805	10,765
Graylin, NW	Logan	385,106	53,619	10,874,404	10,945,936
Mount Hope	do	368,332	3,236	5,514,477	6,837,601
Pierce	Weld	331,200	17,489	5,670,615	143,496
Divide	Logan	329,301	7,268	3,621,904	3,995,914
Lindon	Washington	290,862	964	1,709,071	10,462
Little Beaver	do	285,713	533,062	15,449,482	18,304,045
Blade	do	255,927	----------	1,310,230	----------
Saber	Logan-Weld	251,941	1,261,230	395,472	2,877,057
Flodine Park	Montezuma	224,384	945,152	1,095,407	2,808,644
McCallum	Jackson	217,098	[1] 9,509,491	5,150,468	[1] 429,939,644
Monte	Washington	210,855	----------	220,001	----------
Lewis Creek	Logan	194,072	320,240	4,952,453	3,575,010
Padroni, W	do	189,436	----------	1,849,264	251,221
Bobcat	Washington	185,852	279,250	6,466,303	5,009,522
Loveland	Larimer	173,278	137,107	691,977	639,652

[1] Carbon dioxide.

Source: The Oil and Gas Conservation Commission of the State of Colorado. Colorado Oil and Gas Statistics, 1965. Part II, Oil and Gas Production, 83 pp.

Table 8.—Drilling for petroleum in 1965, by counties

County	Oil	Gas	Dry	Total	Footage
Exploratory completions:					
Adams			8	8	51,964
Arapahoe			4	4	22,897
Archuleta			1	1	3,152
Baca			6	6	31,806
Bent			1	1	5,692
Cheyenne			3	3	17,512
Dolores			1	1	10,465
Elbert			2	2	14,590
El Paso			2	2	17,955
Grand			1	1	3,019
Gunnison			1	1	200
Jackson			2	2	6,151
Kiowa			2	2	11,260
Kit Carson		1	1	2	11,835
La Plata			1	1	2,550
Larimer			3	3	16,628
Lincoln			2	2	12,287
Logan	3		33	36	187,917
Mesa			3	3	9,698
Moffat			6	6	21,974
Montezuma			9	9	30,931
Morgan	2		10	12	69,675
Otero			1	1	6,722
Prowers			1	1	5,983
Pueblo			1	1	2,620
Rio Blanco			8	8	40,801
Routt			1	1	1,120
San Miguel			2	2	12,508
Washington	3		83	86	391,677
Weld	3		21	24	135,274
Yuma	1		11	12	55,032
Total	12	1	231	244	1,211,895
Development completions:					
Adams	7	2	12	[1] 22	116,970
Baca	2	6	5	13	58,045
Boulder			1	1	1,580
Garfield		1	1	2	10,720
Jackson			2	2	7,565
Kiowa	1		2	3	15,506
La Plata		22	1	23	154,753
Larimer	5		5	10	49,619
Logan	7		18	25	128,728
Mesa	1	4	1	6	34,544
Moffat	2	8	7	17	99,816
Montezuma	19		27	46	130,118
Morgan	4	3	11	18	100,006
Phillips			1	1	3,833
Pitkin			1	1	4,543
Prowers		1	3	4	20,729
Rio Blanco	31	4	33	68	217,757
Sedgwick			2	2	7,246
Washington	10	1	35	46	211,801
Weld	12		11	23	140,989
Total	101	52	179	[1] 333	1,514,868
Total all drilling	113	53	410	[1] 577	2,726,763

[1] Includes 1 service well.

Source: Oil and Gas Journal.

production of nearly 369 million barrels, thus ranking it as one of the leading fields in the Nation. In the Rocky Mountain region, it was exceeded in total production only by the 76-year-old Salt Creek field, Wyoming. The 25 principal oilfields in the State yielded 78 percent of the oil production.

The outstanding petroleum development was the Cache field, Montezuma County. The field, discovered in 1964, had 15 producing wells drilled and completed during the year. Production was from the Ismay zone of the Paradox formation (Pennsylvanian); in 1965, output was more than 1 million barrels.

The State had 41 fluid-injection projects in 40 fields. In the Wilson Creek field, gas and water were injected into the Morrison formation (Jurassic); water was injected into the Sundance formation (Jurassic). Of the projects 37 were water-injection, 1 was gas, and 3 were combined gas and water-injection. Water injection was begun in the Muddy sandstone reservoir (Cretaceous) in the Clarks Lake field, Larimer County, on August 5. No fluid was injected into the Aztec Wash field Tocito reservoir (Cretaceous) nor into the Phegley field "D" sandstone reservoir (Cretaceous). Injection into the Xenia-West field "J" sandstone reservoir (Cretaceous) was stopped in May.[12]

Drilling increased by 12 wells, although total footage decreased 113,000 feet. Exploratory drilling declined 12 percent; the success ratio was 5.3 percent, compared with 11.9 percent for 1964. Rio Blanco County had the most development activity and Washington County the most wildcat drilling.

One of the most significant 1965 discoveries was the Mississippian oil found in the Brandon field, Kiowa County. Fremont Petroleum Co. deepened an old well in the small Brandon Lansing-Kansas City (Pennsylvanian) field and completed it as a new-pay discovery in the Mississippian, pumping 138 barrels of oil per day. In the 3 months of 1965 after its completion, the well yielded 11,803 barrels of oil.

On June 19, the Union Pacific Railroad Co. announced the sale of its interests in the Rangely oilfield. The price to the purchaser, Pan American Petroleum Corp., reportedly was $62 million. Union Pacific

[12] Work cited in footnote 6, Part III, 13 pp.

Table 9.—Oil and gas discoveries in 1965

County and field	Well	Operator	Location			Producing formation	Gross producing interval (feet)	Total depth (feet)	Initial production		Date of completion	Remarks[1]
			Section	Township	Range				Barrels of oil per day	Thousand cubic feet of gas per day		
Garfield County:												
Mam Creek.	No. 1 Shaeffer	Chevron Oil Co.	12	7 S	93 W	Mesaverde	6,778–6,924	8,733	---	1,300	Nov. 16	Flowed; new pay; OWWO.
Kiowa County:												
Brandon.	No. 1 Harrison	Fremont Petroleum Co.	9	19 S	45 W	Mississippian	4,781–4,787½	5,040	138	----	Sept. 24	Pumped; new pay; OWDD.
Kit Carson County:												
Smoky Hill.	No. 2 Lowe	Continental Oil Co.	1	11 S	46 W	Morrow	5,477–5,485	5,755	---	6,639	Jan. 26	Flowed; new field.
Larimer County:												
Kelim.	No. 1 Rausler	Reserve Petroleum Co.	2	5 N	68 W	Niobrara	7,010–7,130	8,157	60	----	Jan. 16	Pumped; new field; OWWO.
Logan County:												
Bluff	No. 1 Propst	Stuarco Oil Co., Inc.-Don C. Winslow.	10	10 N	53 W	"J" Sandstone	5,034½–5,036	5,100	60	----	Aug. 24	Pumped; new field.
Camino	No. 1 B State	Patrick A. Doheny.	9	6 N	52 W	"D" Sandstone	4,511–4,514	4,657	117	----	Feb. 7	Do.
Dude	No. 1 McConley	Bander & Couch	30	8 N	53 W	"J" Sandstone	4,982–4,988	5,070	135	----	Aug. 9	Pumped; combined with Key field.
Shoreline	No. 1 Whitacre	Toltek Drilling Co.-Lee Swedlund.	9	9 N	53 W	----- do	4,875–4,884	5,175	15	----	Dec. 23[2]	Pumped; new field.
						"O" Sandstone	5,088–5,091					
						"D" Sandstone	4,724–4,728	5,175	---	8,700	Mar. 19	Well flowed; reworked.
Moffat County:												
Buck Peak.	No. 2 Voloshin	The Atlantic Refining Co.	25	6 N	90 W	Trout Creek	1,798–1,916	3,851	---	1,928	Oct. 19	Flowed; new pay.
Morgan County:												
Boxer	No. 1 Rigli	Champlin Petroleum Co., Stuarco Oil Co., Inc., Robert Schulein.	32	2 N	58 W	"D" Sandstone	5,821–5,824	5,826	68	----	Apr. 19	Flowed; new field.

Table 9.—Oil and gas discoveries in 1965—Continued

County and field	Well	Operator	Location			Producing formation	Gross producing interval (feet)	Total depth (feet)	Initial production		Date of completion	Remarks [1]
			Section	Township	Range				Barrels of oil per day	Thousand cubic feet of gas per day		
Gringo	No. 1 Bolinger	Exeter Drilling Co., N. M. Tobison, Prudential Oil Co.	30	1 N	55 W	"J" Sandstone	5,034–5,035½	5,121	20	----	Nov. 21	Pumped; new field.
Unnamed	No. 1 Huey-Lee	Millard Huey	12	2 N	57 W	Muddy	5,430–?	5,542	3	----	Jan. 20	Pumped; new field; OWWO.
Washington County:												
Azure	No. 1 Egbert	Allison Drilling Co., Inc., Jim Stubbs.	13	1 S	55 W	"D" Sandstone	4,755½–4,759½	4,901	125	----	Jan. 16	Pumped; extension.
Faro	No. 1 Hickert	R. E. Hibbert	24	3 S	52 W	"J" Sandstone	4,246–4,250	4,343	222	----	May 7	Swabbed; new field.
Monte	No. 1 Cowles	R. E. Hibbert-Allison Drilling Co., Inc.	25	3 S	52 W	do	4,215–4,218	4,330	150	----	Nov. 26[2]	Pumped; new field.
Weld County:												
Jade	No. 2 Lauer	John T. Dixon	12	7 N	59 W	Timpas	6,040–6,059	6,105	2	----	Nov. 11[2]	Do.
Tampa	No. 1 Berglund	Texaco Inc	19	2 N	63 W	"J" Sandstone	7,392–7,402	7,458	44	377	Oct. 27	Flowed; new field; OWWO.
Voltage	No. 1 Rothrock	Clark Oil & Refining Corp.	2	7 N	57 W	do	6,105–6,107	6,156	79	----	Mar. 31	Pumped; new field.
Wild Horse	No. 1 Nickerson	do	9	7 N	58 W	"D" Sandstone	6,359–6,368	6,488	80	----	Oct. 17	Do.
Wrangler	No. 1 Eulalia Cervi.	Bright & Schiff	26	10 N	56 W	do	5,714–5,716	5,790	35	1,000	Sept. 14	Flowed; new field.
Yuma County:												
Eastward.	No. 1 Pioneer Farms.	Stuarco Oil Co., Inc., Petroleum, Inc., Equity Oil Co., Carver-Dodge Oil Co.	21	3 N	48 W	"D" Sandstone	3,723–3,728	3,852	29	----	Sept. 22	Pumped; new field.

[1] OWWO—Old well workover; OWDD—Old well drilled deeper.
[2] Well completed in 1964.

Source: Petroleum Information Corp.: 1965 Resume, Oil and Gas Operations in the Rocky Mountain Region.

had held nearly 13 percent interest in the Weber reservoir unit.

The State's oil refineries processed 12.8 million barrels of crude oil, 14 percent more than in 1964. Of this oil, 10.2 million barrels was received from out of State; Wyoming supplied 9.4 million barrels, Montana 709,000 barrels, and Utah 116,000 barrels. Of the shipments of crude oil out of the State, most, 16.4 million barrels, went to Utah; the balance went mainly to Ohio, Illinois, and Indiana. At yearend, two refineries were in operation: Continental Oil Co. and Tenneco Oil Co., both in Denver. The Denver and Alamosa refineries of Oriental Refining Co. were shut down throughout the year. The former Uinta Oil Refining Co. plant at Rangely was purchased by Lubco Oil & Refining Co. in December 1964 and was inactive in 1965. Continental Oil Co. purchased the Denver refinery of Empire Petroleum Co. The refinery, located across the street from Continental's 20,000-barrel-per-day refinery, was to complete the range of products offered by Continental.

Wyco Pipe Line Co. built an 89-mile, 6-inch, and a 4-mile, 8-inch products pipeline from the southern end of its existing system at Denver southward to Fountain.

METALS

Beryllium.—A small quantity of beryllium concentrates (beryl) came from four operations in Boulder, Fremont, and Jefferson Counties. The beryl, purchased by Beryl Ores Co., Arvada, was used in the preparation of beryllium compounds for the ceramic industry.

Cadmium.—Cadmium was recovered from flue dust, dross, and byproduct materials from company smelters and other sources at the Globe smelter of American Smelting and Refining Co. (Asarco) in Denver. The output was not included in the State mineral production because the origin of the processed materials could not be determined.

Copper.—Although the same number of mines (45) had copper production as in 1964, the output of recoverable copper was 18 percent less than that of 1964. The decline in output was caused by decreases in ore production at the two major mines, the Idarado mine of Idarado Mining Co. in Ouray and San Miguel Counties and the Eagle mine of The New Jersey Zinc Co. in Eagle County. The weighted average price of copper for the year was 35.4 cents per pound, a 2.8 cents increase over that of 1964. The price increase kept the value of copper production from decreasing more than 11 percent below the 1964 output value. San Miguel was the leading county with 43 percent of the State output.

Gold.—Gold production was down 4,894 troy ounces. Most of the gold was recovered as a byproduct from milling base-metal ores. Of the 42 base-metal mines with some reported gold production, only three—the Idarado mine in Ouray and San Miguel Counties, the Eagle mine in Eagle County, and the Sunnyside mine in San Juan County—had production greater than 1,000 troy ounces. However, because of decreases in ore production, the Idarado and Eagle mines also accounted for most of the drop in gold production.

Production from placer mines totaled 1,184 troy ounces, 3 percent of the State gold production. Of the 13 mining operations classed as placer mines, 8 were sand and gravel operations in the Denver area at which gold was recovered as a byproduct. A few ounces of gold was recovered from mill tailings and smelter cleanups.

Iron Ore.—Output of iron ore, slightly more than triple that of 1964, came from four mining operations. Magnetite ore mined by Pitkin Iron Corp. in Pitkin County was sold for use in making steel and cement. Brown ore (limonite) mined by Sigma Mining Co. and Minerals Pigments & Metals Division, Chas. Pfizer & Co., Inc., in San Miguel County was used for making paint pigments; output by Theresa B. Robinson in San Miguel County was sold for soil amendment.

General Chemical Division, Allied Chemical Corp., produced agglomerates (cinder) from processing pyrite at its sulfuric acid plant in Denver. The agglomerates, containing 64.7 percent iron, were sold for use in making steel and cement. Because this material was classified as a secondary product, the output and value were not included as mineral production in the State.

Lead.—Lead production increased 9 percent in quantity and 30 percent in value. The greater increase in value was due to an increase in the average weighted price

Table 10.—Mine production of gold, silver, copper, lead, and zinc, in terms of recoverable metals [1]

Year	Mines producing		Material sold or treated [2] (thousand short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Troy ounces	Value (thousands)	Troy ounces (thousands)	Value (thousands)
1956–60 (average)	93	16	943	77,500	$2,712	2,026	$1,833
1961	57	19	938	67,515	2,363	1,965	1,817
1962	25	16	872	48,882	1,711	2,088	2,265
1963	47	19	975	33,605	1,176	2,307	2,951
1964	58	19	1,052	42,122	1,474	2,626	3,396
1965	58	13	1,021	37,228	1,303	2,051	2,652
1858–1965	NA	NA	NA	40,775,923	921,034	777,538	613,300

Year	Copper		Lead		Zinc		Total value (thousands)
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	
1956–60 (average)	3,945	$2,554	17,192	$4,549	38,209	$9,143	$20,791
1961	4,141	2,485	17,755	3,658	42,647	9,809	20,132
1962	4,534	2,793	17,411	3,204	43,351	9,971	19,944
1963	4,169	2,568	19,918	4,302	48,109	11,065	22,062
1964	4,653	3,034	20,563	5,388	53,682	14,602	27,894
1965	3,828	2,710	22,495	7,018	53,870	15,730	29,413
1858–1965	320,356	107,679	2,859,465	350,859	2,166,515	419,301	2,412,173

NA Not available.

[1] Includes recoverable metal content of gravel washed (placer operations), ore milled, old tailings or slimes retreated, and ore, old slag, or tailings shipped to smelters during the calendar year indicated.

[2] Does not include gravel washed.

Table 11.—Mine production of gold, silver, copper, lead, and zinc in 1965, by counties, in terms of recoverable metals

County	Mines producing [1]		Material sold or treated [2] (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Troy ounces	Value	Troy ounces	Value
Adams	----	4	[3] 34,571	[3] 922	[3] $32,270	[3] 102,380	[3] $132,378
Boulder	1	----	101	7	245	19	25
Clear Creek	10	----	2,706	94	3,290	56,240	72,719
Custer	2	----	(3)	(3)	(3)	(3)	(3)
Dolores	2	----	(3)	(3)	(3)	(3)	(3)
Eagle	1	----	272,428	3,024	105,840	529,536	684,690
Gilpin	2	4	2,516	49	1,715	33	43
Gunnison	3	----	87,546	145	5,075	404,602	523,150
Hinsdale	2	----	212	----	----	1,073	1,387
Jefferson	----	4	----	364	12,740	61	79
Lake	1	----	2,007	45	1,575	2,036	2,632
La Plata	2	----	1,068	40	1,400	183	237
Mineral	2	----	43,182	547	19,145	185,449	239,785
Ouray	7	----	81,694	6,009	210,315	119,537	154,561
Park	6	1	4,949	79	2,765	24,346	31,479
Pueblo	----	----	194	1	35	303	392
Saguache	2	----	(3)	(3)	(3)	(3)	(3)
San Juan	9	----	182,704	2,052	71,820	218,665	282,734
San Miguel	4	----	300,763	23,814	833,490	404,496	523,013
Summit	2	----	3,899	36	1,260	2,146	2,775
Total:							
1965	58	13	1,020,540	37,228	1,302,980	2,051,105	2,652,079
1964	58	19	1,051,503	42,122	1,474,270	2,626,431	3,395,975

Table 11.—Mine production of gold, silver, copper, lead, and zinc in 1965, by counties, in terms of recoverable metals—Continued

County	Copper		Lead		Zinc		Total value
	Short tons	Value	Short tons	Value	Short tons	Value	
Adams	[3] 43	[3] $30,126	[3] 1,671	[3] $521,367	[3] 1,658	[3] $484,150	[3] $1,200,291
Boulder	-----	-----	-----	-----	-----	-----	270
Clear Creek	3	2,301	49	15,257	45	13,257	106,824
Custer	([3])	([3])	([3])	([3])	([3])	([3])	([3])
Dolores	([3])	([3])	([3])	([3])	([3])	([3])	([3])
Eagle	701	496,591	3,151	983,237	24,632	7,192,442	9,462,800
Gilpin	([4])	36	([4])	16	-----	-----	1,810
Gunnison	319	225,604	2,561	799,063	4,423	1,291,648	2,844,540
Hinsdale	([4])	248	10	3,229	10	2,891	7,755
Jefferson	-----	-----	-----	-----	-----	-----	12,819
Lake	1	814	26	8,003	10	2,993	16,017
La Plata	([4])	35	([4])	16	-----	-----	1,688
Mineral	239	169,035	1,549	483,319	2,286	667,395	1,578,679
Ouray	413	292,510	1,833	571,818	2,436	711,210	1,940,414
Park	11	7,788	186	58,110	46	13,534	113,676
Pueblo	1	496	1	156	71	20,688	21,767
Saguache	([3])	([3])	([3])	([3])	([3])	([3])	([3])
San Juan	453	320,830	4,328	1,350,211	8,658	2,528,811	4,553,906
San Miguel	1,641	1,161,934	7,012	2,187,650	9,560	2,791,418	7,497,505
Summit	3	1,876	118	36,988	35	10,103	53,002
Total:							
1965	3,828	2,710,224	22,495	7,018,440	53,870	15,730,040	29,413,763
1964	4,653	3,033,756	20,563	5,387,506	53,682	14,601,504	27,893,011

[1] Operations at slag dumps and old mill or miscellaneous cleanups not counted as producing mines.
[2] Does not include gravel washed.
[3] Production of Adams, Custer, Dolores, and Saguache combined to avoid disclosing individual company confidential data.
[4] Less than ½ unit.

Table 12.—Mine production of gold, silver, copper, lead, and zinc in 1965, by classes of ore or other source materials, in terms of recoverable metals

Source	Number of mines [1]	Material sold or treated (short tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Lode ore:							
Dry gold	6	1,215	117	141	100	200	----------
Dry gold-silver	3	223	33	415	300	2,700	----------
Dry silver	7	5,483	49	62,874	8,000	97,600	90,000
Total	16	6,921	199	63,430	8,400	100,500	90,000
Copper and zinc	2	278,115	3,052	538,347	1,636,100	6,302,800	49,263,800
Copper-lead-zinc	4	378,213	29,695	518,883	4,142,100	17,742,900	24,078,100
Copper-zinc	1	431	-----	136	7,300	800	10,200
Lead	12	5,534	105	30,827	18,600	511,400	91,600
Lead-zinc	23	346,658	2,921	896,972	1,839,800	20,279,300	34,044,100
Zinc	1	([2])	([2])	([2])	([2])	([2])	([2])
Total	41	1,008,951	35,773	1,985,165	7,643,900	44,837,200	107,487,800
Other "lode" material:							
Gold mill cleanup	([3])	1	4	--------	--------	--------	----------
Gold tailings	1	2,466	22	3	--------	--------	----------
Copper slag	([3])	14	1	303	1,400	1,000	----------
Copper-lead cleanup	([3])	7	9	502	600	7,300	200
Lead-zinc tailings	1	2,000	36	1,534	1,700	44,000	20,300
Zinc cleanup	([3])	180	-----	--------	--------	--------	141,700
Total	2	4,668	72	2,342	3,700	52,300	162,200
Total "lode" material	58	1,020,540	36,044	2,050,937	7,656,000	44,990,000	107,740,000
Gravel (placer operations)	13	--------	1,184	168	--------	--------	----------
Total all sources	71	1,020,540	37,228	2,051,105	7,656,000	44,990,000	107,740,000

[1] Detail will not necessarily add to totals because some mines produce more than one class of material.
[2] Copper and zinc combined to avoid disclosing individual company confidential data.
[3] From properties not classed as mines.

Table 13.—Mine production of gold, silver, copper, lead, and zinc in 1965, by types of material processed and methods of recovery, in terms of recoverable metals

Type of material processed and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Lode:					
Amalgamation:					
Ore	9,694	3,375	-------	-------	-------
Cleanup	4	-------	-------	-------	-------
Tailing	22	3	-------	-------	-------
Total	9,720	3,378	-------	-------	-------
Concentration, and smelting of concentrates:					
Ore	23,961	1,694,436	6,585,300	44,782,700	107,476,400
Tailing	36	1,534	1,700	44,000	20,300
Total	23,997	1,695,970	6,587,000	44,826,700	107,496,700
Direct-smelting:					
Ore	2,317	350,784	1,067,000	155,000	101,400
Slag	1	303	1,400	1,000	-------
Cleanup	9	502	600	7,300	141,900
Total	2,327	351,589	1,069,000	163,300	243,300
Placer	1,184	168	-------	-------	-------
Grand total	37,228	2,051,105	7,656,000	44,990,000	107,740,000

per pound; the price was 15.6 cents, compared with 13.1 cents in 1964. Although ore production from the largest base-metal mine—the Idarado in Ouray and San Miguel Counties—was less than in 1964, the ore mined contained a higher percentage of lead, resulting in a substantial increase (over 400 tons) in output of lead from this operation. Significant increases of lead production were reported for the Keystone mine in Gunnison County and the Rico Argentine mine in Dolores County.

Lead was produced at 51 mines in 16 counties. Mines with lead production of 500 tons or more, in order of output, were the Idarado in Ouray and San Miguel Counties, Sunnyside in San Juan County, Eagle in Eagle County, Keystone in Gunnison County, Emperius in Mineral County, and Rico Argentine in Dolores County. Output from these six mines totaled 20,929 tons or 93 percent of the State total lead production. Supplying 31 percent of the State output, San Miguel County had the most production.

Molybdenum.—Virtually all of the State production came from the Climax mine. Production from the mine was 9 percent greater than in 1964, and accounted for 53 percent of the total output in the Nation. According to the corporation 1965 annual report, the Climax mine in Lake County was operated around the clock on a 7-day-per-week basis throughout the year. A total of 14,350,000 tons of ore was mined, establishing a new mine record and surpassing the previous record set last year by 650,000 tons. Daily ore production averaged about 39,900 tons, including 4,000 tons per day from the newly developed Ceresco Ridge of the Climax ore body.

Construction work was continued on a hydrometallurgical plant for treating oxidized molybdenum in the ore and on development of a third mining level at the Climax mine. Construction and mine development was carried on at the company Urad mine near Empire, Clear Creek County. Surface exploration drilling had intersected another molybdenite ore zone at the Urad property below and to the side of the ore body being readied for mining; however, further work was required to determine the full extent of this new ore zone.

High-grade molybdenum ore was mined by Nye Metals, Inc., from its Wilma mine near Black Hawk in Gilpin County.

Silver.—Output of silver was 575,000 ounces below that of 1964. As with gold, most of the silver was a byproduct from milling base-metal ores. The two largest base-metal mines, the Idarado mine in Ouray and San Miguel Counties and the Eagle mine in Eagle County, had the greatest declines in silver production. In addition, three other major base-metal

mines—the Cascade-Hall Tunnel mine in Clear Creek County, the Emperius mine in Mineral County, and the Keystone mine in Gunnison County—had substantial decreases in silver production, 10,000 troy ounces or more. The only base-metal mines with significant increases, 10,000 troy ounces or more, were the Brenneman and Sunnyside mines in San Juan County, the Hilltop mine in Park County, and the Rico Argentine mine in Dolores County.

Only 5 of the 58 lode mines had production each exceeding 100,000 troy ounces of silver. In order of most production, these were the Eagle, Idarado, Keystone, Emperius, and Sunnyside mines. The silver production from these five mines totaled 1.8 million troy ounces, 87 percent of the State silver output.

Silver also was recovered from nine placer operations; eight of which were sand and gravel pits classed as placer operations.

Silver was produced in 20 counties, 4 less than in 1964. Eagle County continued to have the largest output; Gunnison was ranked second in order, surpassing San Miguel County.

Thallium.—Thallium was recovered and thallium sulfate produced at the Globe smelter of Asarco in Denver.

Tin.—Tin production, 32 long tons, surpassed the previous output record established last year. A tin concentrate was produced from treating tailings obtained from milling molybdenum ore at the Climax mine in Lake County. The tin concentrate was sold to Lenway Mining and Development Corp. which upgraded the concentrate at its mill near Boulder.

Tungsten.—Output of tungsten concentrate was produced by Climax Molybdenum Co. as a byproduct of treating tailings from its molybdenum ore mill at the Climax mine.

Uranium Ore.—Output of uranium ore was about one-third less than that of 1964, thereby continuing the decline in production for the fourth straight year. The 1965 decrease of 258,487 tons was the greatest decline for any of these years. The average grade of the ore was 0.23 percent U_3O_8, an increase of 0.02 above that of 1964. The ore came from 244 mining operations in 7 counties compared with 276 in 12 counties in 1964. Montrose County, with 46 percent of the State total production, had the largest production of the counties; however, the output for the county was 46,566 tons below that of 1964.

Uranium ore was processed at five mills —Climax Uranium Co., a unit of Climax Division, American Metal Climax, Inc., mill at Grand Junction; Union Carbide Corp. mills at Rifle and Uravan; Atlas Minerals Division, Atlas Corp., mill at Moab, Utah; and Vanadium Corporation of America (VCA) mill at Shiprock, N.Mex. Cotter Corp. ceased processing uranium ore at its mill at Canon City in January 1965 upon

Table 14.—Mine production of uranium ore, by counties [1]

County	1964				1965			
	Number operations	Ore (short tons)	U_3O_8 contained (pounds)	F.o.b. mine value [2]	Number operations	Ore (short tons)	U_3O_8 contained (pounds)	F.o.b. mine value [2]
Boulder	2	W	W	W	---	---	---	---
Fremont	2	W	W	W	2	W	W	W
Garfield	---	---	---	---	2	W	W	W
Grand	1	34	72	$160	---	---	---	---
Jefferson	4	12,528	223,513	1,046,039	---	---	---	---
Larimer	2	W	W	W	---	---	---	---
Mesa	40	90,559	541,730	2,293,256	45	102,500	598,214	$2,520,532
Moffat	11	W	W	W	---	---	---	---
Montezuma	1	11	42	159	1	25	63	171
Montrose	134	311,150	1,346,398	5,267,333	135	264,584	1,294,972	5,243,825
Rio Blanco	2	W	W	W	3	W	W	W
Saguache	2	W	W	W	---	---	---	---
San Miguel	75	144,046	640,703	2,597,392	56	144,320	673,530	2,772,963
Undistributed	---	274,954	748,322	2,184,382	---	63,366	75,006	113,569
Total	276	833,282	3,500,780	13,388,721	244	574,795	2,641,785	10,651,060

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] Receipts at mills based on data supplied to the Bureau of Mines by AEC.
[2] F.o.b. mine value; base price, grade premiums, and exploration allowances. Calculated according to AEC Circular 5, revised, price schedule.

completion of its purchase contract with AEC.

In September, VCA purchased the Colorado uranium-vanadium mining properties and equipment of Dulaney Mining Co. Ore from these properties was to be processed at the company uranium mill at Shiprock, N.Mex.

At a Colorado River Basin water-quality control meeting held at Grand Junction in December, health officials voiced warnings that abandoned uranium mine and mill dumps, sources of radioactive pollution, were threatening streams and rivers. The officials called for some form of guarantees for long-term responsibility and control for the large piles of solid wastes left at the closed-down uranium operations in Colorado. The uranium milling industry was praised for its voluntary cooperative efforts while the plants were being operated.

Vanadium.—Production of vanadium ore from the reopened Rifle Creek mine of Union Carbide Corp. in Garfield County and the mining of uranium ores containing more vanadium than that of last year in San Miguel County resulted in an increase of 21 percent above that of 1964. Averaging 1.47 percent V_2O_5, uranium ores from which vanadium was recovered came from mines in Fremont, Garfield, Mesa, Montezuma, Montrose, Rio Blanco, and San Miguel Counties. Vanadium oxide (fused vanadium oxide) was recovered from ores of Colorado origin at uranium processing mills of Climax Uranium Co., Grand Junction, Union Carbide Corp., Rifle, and VCA, Shiprock, N.Mex. An intermediate vanadium product recovered by Union Carbide Corp. at its Uravan uranium mill was shipped to Rifle for further processing.

Zinc.—Zinc production was virtually the same as in 1964; the output value, however, was 8 percent higher because of an increase in the average weighted price from 13.6 to 14.6 cents per pound. Of the 40 mines with zinc production, 7 had outputs exceeding 500 tons. The seven mines in order of output were the Eagle in Eagle County, Idarado in Ouray and San Miguel Counties, Sunnyside in San Juan County, Keystone in Gunnison County, Emperius in Mineral County, Rico Argentine in Dolores County, and Brenneman in San Juan County. A total of 52,928 tons of zinc, 98 percent of the State total output, was produced from these mines. Eagle County alone accounted for 46 percent of the State total output. Six other counties had substantial zinc produciton (1,000 tons or more).

On September 29, Gulf & Western Industries, Inc., and The New Jersey Zinc Co. approved, in principle, a plan to merge the two companies with Gulf & Western to be the surviving corporation. At yearend, the merger, although approved by both boards of directors, was being delayed because of a lawsuit brought by a New Jersey Zinc stockholder who opposed the merger.

NONMETALS

Cement.—Portland cement was produced and shipped from the Ideal Cement Co. plants at Boettcher and Portland; shipments were about the same as in 1964. Ready-mixed concrete companies purchased slightly more than one-half of the portland cement. Other customers in order of quantities purchased were highway contractors, concrete product manufacturers, building material dealers, other contractors, and those classified as miscellaneous. Masonry cement also was produced at both cement plants; however, shipments were made only from the Portland plant and were 19 percent below those of 1964. Of all shipments, 89 percent of the portland cement and 95 percent of the masonry cement went to markets in Colorado. The balance of the shipments was to the surrounding States, except for some very small quantities shipped to southern California, Nevada, New Jersey, Ohio, and Oklahoma.

At yearend, the Colorado Supreme Court upheld the change in Boulder County zoning regulations to permit construction of a cement plant near Lyons; the change had been contested by some nearby residents. The plant was to be built for Rocky Mountain Cement Co., a division of Martin Marietta Corp.

Clays.—Output of clays was 73,000 tons (13 percent) more than that of 1964; all types of clay increased in production. Miscellaneous clay (including shale) was 65.3 percent of the clay production, fire clay 34.5 percent, and bentonite 0.02 percent. Output came from 61 operations in 12 counties. Jefferson County had the most clay production, 62.5 percent of the total output of the State.

Except for 130 tons used as a bonding agent for animal feed, the output of ben-

tonite was used for lining reservoir ponds. The principal uses for fire clay were for making building brick (86,213 tons), vitrified sewer pipe (55,095 tons), and firebrick (53,924 tons). Other uses were for flue lining, zinc retorts, mortar, art pottery, heavy clay products, clay crucibles, foundry mold bonds, and high-alumina refractory brick. Miscellaneous clay (including shale) was used to make building brick, lightweight aggregate, and vitrified sewer pipe.

Denver Fire Clay Co., a lessee of a State mineral lease for mining clay on State land acquired by the U.S. Army for expanding the Fort Carson Military Reservation, was given permission to mine the property 3 months during each year. Near yearend the company, a brick manufacturer for 88 years, announced that it sold its clay refractories product line and manufacturing facilities in Denver to Kaiser Refractories, a division of Kaiser Aluminum & Chemical Corp.

Feldspar.—Feldspar was produced only by Lockhart & Sons from the Mica Lode mine in Fremont County.

Fluorspar.—The output of finished fluorspar increased 31 percent. All of the finished fluorspar was acid grade produced by General Chemical for making hydrofluoric acid. Except for a few tons purchased, the crude fluorspar was obtained from the company mine at Jamestown.

Gypsum.—Gypsum production increased slightly, 2 percent or 2,000 tons over that of 1964. The output came from four mines in Fremont County and two in Larimer. Part of the crude gypsum was calcined and used in manufacturing wallboard, lath, and other gypsum building products. Uncalcined gypsum was used as a portland-cement retarder and as a soil conditioner.

Lime.—Lime production declined 14 percent or 20,000 tons below that of 1964. Decreases in output were reported by the sugar companies and the steel industry, the two largest lime producers. Of the quicklime produced, 63 percent was at 12 beet-sugar mills for sugar refining. Some quicklime was used for making insecticides, magnesium, and steel; in ore concentration; and for water treatment. The hydrated lime was used in ore concentration, petroleum refining, and tanning. Most of the lime production was marketed in the State.

Perlite.—Crude perlite was obtained by Persolite Products, Inc., from its mine in Custer County. Except for a small quantity sold, the crude perlite was expanded at the company plant at Florence. Crude perlite from New Mexico was expanded at two other plants—one operated by Great Lakes Carbon Corp. at Antonito and one by Western Mineral Products Co. in Denver. The expanded material was used mostly for making building plaster, filter aids, and insulation; as a concrete aggregate; and for oil well cementing and soil conditioning.

Pumice.—Pumice production, consisting of scoria and volcanic cinders, was 8 percent less than in 1964. Scoria from deposits in Costilla and Routt Counties was used as decorative stone in rock gardens, railroad ballast, and roofing granules. Volcanic cinders from deposits in Eagle County was used as an aggregate in making building blocks.

Table 15.—Clay production by counties

County	1964		1965	
	Short tons	Value	Short tons	Value
Bent	250	$3,125	250	$3,125
Boulder	13,611	W	13,381	22,186
Custer	1,531	6,890	1,772	7,974
Douglas	75,530	193,516	93,179	267,860
Elbert	W	W	W	W
El Paso	W	W	W	W
Fremont	25,945	104,138	26,895	106,650
Huerfano	W	W	W	W
Jefferson	348,306	520,172	393,984	598,341
Las Animas	13,195	32,663	8,765	25,260
Mesa	------	-------	276	552
Pueblo	37,134	211,714	61,089	303,566
Undistributed	42,407	202,798	30,991	110,874
Total	557,909	1,275,016	630,582	1,446,388

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

Pyrites.—The only pyrite produced was that recovered by Climax Molybdenum Co. as a byproduct from milling molybdenum ore at its Climax operation. Output was sold to General Chemical for making sulfuric acid at its Denver plant.

Salt.—From a well in Montrose County, Union Carbide Corp. pumped brine for use in milling uranium-vanadium ores at its plant in Uravan.

Sand and Gravel.—Sand and gravel production—64,000 tons more than in 1964—came within 100,000 tons of equaling the 1959 record output of 20.9 million tons. Based on value, sand and gravel was the most important nonmetal mineral commodity produced in the State; the value, $22 million, represented 7 percent of the State value of mineral production.

Gravel production was 16.8 million tons and that of sand 4 million tons, representing 81 and 19 percent, respectively, of total output of sand and gravel.

The average price for gravel was $1.05 per ton and for sand $1.11 per ton.

Commercially classed operators produced 11.2 million tons of sand and gravel, 54 percent of the State total output. The five leading commercial producers, ranked according to output, were Cooley Gravel Co., Peter Kiewit Sons' Co., Asphalt Paving Co., The Brannan Sand & Gravel Co., and Schultz-Lindsay Construction Co.; their combined output was 4 million tons. Noncommercial production, that produced for Governmental agencies, either by contractors or by Government crews, was 9.6 million tons, 46 percent of the total output. Of the 320 operations, 129 were commercial and 191 classed as Government-and-contractor.

Only 1.1 million tons of sand and gravel was unprocessed or pit-run material. The balance, 19.7 million tons, was either washed, crushed, screened, or combinations thereof. Of the 300 processing plants operated, 243 were portable and 57 stationary. The average price for pit-run sand and gravel was $0.50 per ton and that of processed was $1.09 per ton.

Road construction and maintenance required 14.7 million tons of sand and gravel, a decrease of 700,000 tons below the 1964 output. Sand and gravel used in building construction was 5 million tons, an increase of 700,000 tons. Engine sand, fill, filtration, and miscellaneous uses consumed the balance of 1.1 million tons.

Table 16.—Sand and gravel production in 1965, by counties
(Thousand short tons and thousand dollars)

County	Quantity	Value	County	Quantity	Value
Adams	2,797	$3,031	La Plata	160	$154
Alamosa	173	173	Larimer	1,432	1,554
Arapahoe	1,227	1,271	Las Animas	267	277
Archuleta	199	196	Lincoln	117	86
Baca	105	92	Logan	497	588
Bent	104	105	Mesa	1,057	1,124
Boulder	1,169	1,241	Moffat	230	218
Chaffee	W	W	Montezuma	386	408
Cheyenne	W	W	Montrose	245	259
Clear Creek	20	21	Morgan	398	436
Conejos	118	117	Otero	215	219
Costilla	13	8	Ouray	16	16
Crowley	34	34	Park	221	214
Custer	72	72	Phillips	156	156
Delta	146	146	Pitkin	246	294
Dolores	2	2	Prowers	W	W
Douglas	635	674	Pueblo	1,210	1,501
Eagle	34	41	Rio Blanco	174	161
Elbert	137	133	Rio Grande	59	83
El Paso	1,171	1,236	Routt	W	W
Fremont	89	101	Saguache	8	8
Garfield	148	176	San Miguel	192	214
Gilpin	5	5	Sedgwick	94	81
Grand	296	301	Summit	105	114
Gunnison	533	517	Teller	54	52
Hinsdale	6	6	Washington	W	W
Huerfano	147	146	Weld	403	369
Jackson	21	11	Yuma	195	195
Jefferson	2,251	2,424	Undistributed	551	574
Kiowa	170	97			
Kit Carson	131	116	Total	20,810	22,041
Lake	169	193			

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

Table 17.—Sand and gravel sold or used by producers, by classes of operations and uses
(Thousand short tons and thousand dollars)

Class of operation and use	1964		1965	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Construction:				
Building	1,960	$2,260	2,087	$2,444
Paving	618	764	775	896
Fill	118	61	127	87
Other	2	2	-----	-----
Industrial:				
Blast	2	7	-----	-----
Engine	-----	-----	[1] 24	[1] 67
Filtration	1	4		
Other	1	3		
Total	2,702	3,101	3,013	3,494
Gravel:				
Construction:				
Building	2,338	3,044	2,834	3,656
Paving	3,505	4,112	5,112	5,427
Railroad ballast	1	1	1	1
Fill	341	405	158	101
Other	-----	-----	1	5
Miscellaneous	119	146	70	67
Total	6,304	7,708	8,176	9,257
Total sand and gravel	9,006	10,809	11,189	12,751
Government-and-contractor operations:				
Sand:				
Building	3	3	4	4
Paving	1,503	1,500	963	934
Fill	3	3	24	29
Total	1,509	1,506	991	967
Gravel:				
Building	10	10	125	125
Paving	9,821	9,553	7,878	7,657
Fill	400	349	567	481
Other	-----	-----	60	60
Total	10,231	9,912	8,630	8,323
Total sand and gravel	11,740	11,418	9,621	9,290
All operations:				
Sand	4,211	4,607	4,004	4,461
Gravel	16,535	17,620	16,806	17,580
Total	20,746	22,227	20,810	22,041

[1] Engine, filtration, and "other" (industrial) sand combined to avoid disclosing individual company confidential data.

Sand and gravel production was reported for all counties except Denver, Mineral, and San Juan Counties. Some Government-and-contractor production was reported in 59 counties, but only 39 had commercial production. Eight counties had production of 1 million tons or more.

Six major sand and gravel operations on the South Platte River in the Denver area were damaged and temporarily closed because of the June 16 flood.

At yearend, sand and gravel operations and developments in the southwest part of Arapahoe County were under legal protest by local residents and organizations as being detrimental and hazardous to the residential communities in the area.

Stone.—Stone production established a record high, 1.6 million tons above the 1964 record output of 3.2 million tons. The main reason for the big increase was 1.9 million tons of crushed granite produced in Pitkin County for dam embankment on the Homestake Dam project of the cities of Aurora and Colorado Springs. The State output came from 168 operations, 28 more than in 1964. Pitkin, the leading county, was the only one with production exceeding 1 million tons.

Table 18.—Stone production in 1965, by counties

County	Short tons	Value	County	Short tons	Value
Adams	1,546	$3,367	Jefferson	13,358	$85,644
Alamosa	4,300	8,600	Kit Carson	1,380	3,105
Arapahoe	9,968	21,896	La Plata	326	734
Archuleta	3,363	6,734	Larimer	668,635	1,550,099
Baca	495	990	Las Animas	9,743	19,605
Bent	695	1,390	Mesa	9,350	32,973
Boulder	131,214	301,382	Mineral	9,410	11,706
Chaffee	W	W	Moffat	640	1,280
Clear Creek	3	7	Montezuma	288	648
Conejos	4,474	9,992	Montrose	282	564
Crowley	315	709	Otero	2,000	4,000
Custer	W	W	Park	3,745	12,068
Dolores	104,765	105,063	Pitkin	1,926,750	2,886,750
Douglas	24,389	108,277	Pueblo	1,572	4,373
Eagle	W	W	Rio Blanco	798	1,796
Elbert	2,000	4,500	Rio Grande	400	800
El Paso	523,272	808,866	Saguache	1,000	2,000
Fremont	751,700	1,449,127	Teller	495	6,850
Garfield	W	W	Washington	1,351	3,040
Grand	W	W	Weld	888	1,832
Gunnison	221,143	356,665	Undistributed	335,987	786,404
Huerfano	412	927			
Jackson	16,395	32,790	Total	4,788,847	8,637,553

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

Table 19.—Stone sold or used by producers, by kinds

Year	Basalt and related rocks (traprock)		Granite		Limestone		Marble	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1961	-----	------	10,528	$145,988	2,221,902	$4,255,761	9,350	$75,171
1962	-----	------	20,872	161,315	2,164,513	4,395,440	9,094	79,960
1963	72,915	$83,173	73,580	199,984	2,139,431	4,170,148	8,749	64,063
1964	5,535	5,535	483,361	858,884	2,272,932	4,412,764	10,105	72,666
1965	W	W	2,058,617	3,089,379	2,203,606	4,066,926	2,230	32,597

Year	Sandstone		Other stone		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1961	52,281	$427,356	157,229	$396,288	2,451,290	$5,300,564
1962	67,378	493,597	90,854	467,000	2,352,711	5,597,312
1963	107,731	635,054	107,271	540,743	2,509,677	5,693,165
1964	95,155	733,577	350,204	721,883	3,217,292	6,805,309
1965	189,329	832,623	335,065	616,028	4,788,847	8,637,553

W Withheld to avoid disclosing individual company confidential data; included with "Other stone."

Limestone and granite accounted for 46 and 43 percent, respectively, of the State total stone production. The balance was comprised of basalt, marble, sandstone, and miscellaneous stone (unclassified as to kind). Limestone was used chiefly for making cement and lime, as concrete and road-base aggregate, and as a flux in making steel; granite for dam embankment and as building and monumental dimension stone; sandstone as concrete and road-base aggregate, building dimension stone, and for making cement; marble for terrazzo and building dimension stone; basalt as riprap; and miscellaneous stone as concrete and road-base aggregate and riprap.

Table 20.—Stone sold or used by producers, by uses

Use	1964		1965	
	Quantity	Value	Quantity	Value
Dimension stone:				
Rough construction and rubble---short tons	11,471	$129,463	5,978	$67,230
Rough architectural---cubic feet	78,139	63,566	45,165	75,180
Dressed architectural---do	102,005	212,353	105,105	240,727
Rough monumental---do	7,500	28,150	4,798	26,000
Dressed monumental---do	300	12,000	1,190	10,000
Curbing and flagging---do	50,163	42,393	59,076	59,635
Total (approximate, in short tons)	30,400	487,925	22,900	478,772
Crushed and broken stone:				
Concrete and roadstone---short tons	693,746	1,267,705	913,175	1,188,043
Lime---do	202,810	418,113	193,067	402,030
Metallurgical---do	275,122	624,334	254,832	609,362
Riprap---do	202,099	443,576	156,076	327,714
Other---do	[1] 1,813,086	[1] 3,563,656	[2] 3,248,831	[2] 5,631,632
Total---do	3,186,863	6,317,384	4,765,981	8,158,781
Total stone (approximate, in short tons)	3,217,300	6,805,309	4,788,900	8,637,553

[1] Includes stone used in abrasives, agriculture, asphalt filler, cement, coal dust, decorative aggregates, dam embankment, erosion control, filler, foundry, ground cover, landscaping, mineral wool, precasting, poultry grit, roofing granules, stone sand, stucco, and terrazzo.
[2] Includes stone used in abrasives, architectural aggregate, asphalt filler, cement, coal dust, concrete aggregates, dam embankment, decorative building, erosion control, filter beds, foundry, ground cover, landscaping, mineral food, poultry grit, precasting, roofing granules, stone sand, and terrazzo.

REVIEW BY COUNTIES

Mineral production was reported from 62 of the 63 counties; Denver County had no production. Only those counties with significant mineral production or activity are discussed; see table 21 for additional details.

Table 21.—Value of mineral production in Colorado, by counties

County	1964	1965	Minerals produced in 1965, in order of value
Adams	$3,913,896	$5,168,704	Sand and gravel, petroleum, natural gas, lime, gold, stone, silver.
Alamosa	15,600	182,430	Sand and gravel, stone, peat.
Arapahoe	1,782,428	1,292,896	Sand and gravel, stone.
Archuleta	339,300	397,734	Sand and gravel, petroleum, stone.
Baca	885,030	1,011,990	Petroleum, natural gas, sand and gravel, stone.
Bent	197,125	162,515	Sand and gravel, natural gas, petroleum, clays, stone.
Boulder	2,078,687	2,198,011	Sand and gravel, fluorspar, stone, lime, peat, clays, petroleum, gold, beryllium concentrate, silver.
Chaffee	857,541	656,422	Stone, sand and gravel, peat.
Cheyenne	32,000	W	Sand and gravel.
Clear Creek	W	127,831	Silver, sand and gravel, lead, zinc, gold, copper, stone.
Conejos	40,920	126,992	Sand and gravel, stone.
Costilla	W	W	Pumice, sand and gravel.
Crowley	W	W	Sand and gravel, lime, stone.
Custer	92,649	159,465	Sand and gravel, zinc, perlite, lead, silver, stone, clays, gold, copper.
Delta	W	1,367,032	Coal, sand and gravel, lime.
Denver	W	----------	
Dolores	W	W	Lead, zinc, stone, silver, copper, gold, sand and gravel.
Douglas	824,647	1,050,137	Sand and gravel, clays, stone.
Eagle	W	9,526,590	Zinc, lead, silver, copper, gold, sand and gravel, pumice, stone.
Elbert	W	W	Sand and gravel, clays, stone.
El Paso	2,899,133	2,255,125	Sand and gravel, stone, lime, clays.
Fremont	11,136,242	11,179,458	Cement, stone, coal, gypsum, clays, sand and gravel, petroleum, uranium ore, feldspar, vanadium, beryllium concentrate.

Table 21.—Value of mineral production in Colorado, by counties—Continued

County	1964	1965	Minerals produced in 1965, in order of value
Garfield	$678,633	$2,521,829	Vanadium, natural gas, lime, sand and gravel, stone, coal, uranium ore.
Gilpin	89,464	113,559	Molybdenum, peat, sand and gravel, gold, silver, copper, lead.
Grand	W	W	Sand and gravel, stone.
Gunnison	5,995,738	5,482,542	Coal, zinc, lead, silver, sand and gravel, stone, copper, gold.
Hinsdale	7,128	13,755	Sand and gravel, lead, zinc, silver, copper.
Huerfano	753,212	463,117	Coal, sand and gravel, clays, stone.
Jackson	1,198,174	958,790	Petroleum, natural gas, stone, sand and gravel.
Jefferson	4,137,745	3,120,805	Sand and gravel, clays, stone, gold, silver, beryllium concentrate.
Kiowa	519,758	436,000	Natural gas, sand and gravel, petroleum, natural gas liquids.
Kit Carson	124,293	119,105	Sand and gravel, stone.
Lake	70,705,037	81,001,305	Molybdenum, tungsten concentrate, sand and gravel, pyrites, tin, peat, lead, zinc, silver, gold, copper.
La Plata	6,757,687	8,669,923	Natural gas, natural gas liquids, sand and gravel, coal, petroleum, peat, gold, stone, silver, copper, lead.
Larimer	12,565,663	11,896,256	Cement, sand and gravel, stone, petroleum, lime, gypsum, natural gas liquids, natural gas.
Las Animas	5,393,007	5,951,626	Coal, sand and gravel, clays, stone, carbon dioxide.
Lincoln	420,192	86,000	Sand and gravel.
Logan	12,095,670	12,003,400	Petroleum, natural gas, natural gas liquids, sand and gravel, lime.
Mesa	5,623,730	6,903,154	Uranium ore, vanadium, sand and gravel, coal, natural gas, natural gas liquids. stone, clays.
Mineral	1,632,646	1,590,385	Zinc, lead, silver, copper, gold, stone.
Moffat	7,135,018	5,825,404	Natural gas, petroleum, coal, sand and gravel, stone.
Montezuma	2,125,730	4,584,283	Petroleum, sand and gravel, natural gas, carbon dioxide, stone, vanadium, uranium ore.
Montrose	11,469,665	11,539,155	Vanadium, uranium ore, coal, sand and gravel, salt, stone.
Morgan	10,156,000	7,835,000	Petroleum, natural gas liquids, natural gas, sand and gravel, lime.
Otero	W	W	Sand and gravel, lime, stone.
Ouray	1,805,198	1,956,414	Zinc, lead, copper, gold, silver, sand and gravel.
Park	287,422	397,944	Sand and gravel, peat, lead, silver, zinc, stone, copper, gold.
Phillips	---	156,000	Sand and gravel.
Pitkin	W	9,781,447	Coal, stone, iron ore, sand and gravel, natural gas.
Prowers	152,486	136,000	Sand and gravel, petroleum.
Pueblo	W	W	Sand and gravel, lime, clays, zinc, stone, copper, silver, lead, gold.
Rio Blanco	56,463,928	55,582,130	Petroleum, natural gas liquids, natural gas, sand and gravel, coal, vanadium, uranium ore, stone.
Rio Grande	105,000	83,800	Sand and gravel, stone.
Routt	3,322,279	4,458,507	Coal, petroleum, pumice, sand and gravel.
Saguache	W	W	Lead, zinc, silver, copper, sand and gravel, stone, gold.
San Juan	W	4,553,906	Zinc, lead, copper, silver, gold.
San Miguel	12,689,553	15,244,780	Vanadium, zinc, uranium ore, lead, copper, gold, silver, sand and gravel, iron ore.
Sedgwick	203,000	200,400	Sand and gravel, natural gas, lime.
Summit	409,100	167,002	Sand and gravel, lead, zinc, silver, copper, gold.
Teller	48,180	94,850	Sand and gravel, peat, stone.
Washington	19,161,000	16,728,040	Petroleum, natural gas liquids, sand and gravel, natural gas, stone.
Weld	10,721,932	8,541,143	Petroleum, coal, sand and gravel, natural gas, lime, natural gas liquids, stone.
Yuma	209,016	202,000	Sand and gravel, petroleum.
Undistributed [1]	25,753,216	4,953,052	
Total	316,011,000	331,216,000	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed".

[1] Includes some beryllium concentrate and gem stones that cannot be assigned to specific counties and value indicated by symbol W.

Adams.—The value of mineral production was 32 percent more than in 1964 because of a 948,000-ton increase in output of sand and gravel. The county led the State in output of sand and gravel. Commercial operators produced 2.2 million tons of the county output of 2.8 million tons. Commercial producers, in order of output, were The Brannan Sand & Gravel Co.; Boise Cascade Sand & Gravel Co.; Cooley Gravel Co.; Tower Construction Co.; Asphalt Paving Co.; Albert Free & Sons, Inc.; Jones Fine Sand Co.; Acme Sand & Gravel Co., Inc.; Superior Sand & Gravel Co.; Adams Aggregates, Inc.; and Commercial Asphalt & Aggregate Co. The balance of 600,000 tons of sand and gravel was produced by maintenance crews of the Adams County Highway Department and contractors for the Colorado Department of Highways for road maintenance and construction.

The Great Western Sugar Co. produced lime for sugar refining at its beet-sugar plant at Brighton. Contractors for the Colorado Department of Highways produced miscellaneous classified stone for riprap and road material. Byproduct gold and silver were recovered from four commercial sand and gravel operations.

Petroleum and natural gas accounted for 40 percent of the value of mineral production. Petroleum output increased 109,000 barrels, 22 percent; the newly discovered (1964) Moccasin field yielded 246,606 barrels of oil, 41 percent of the county production. Waterflood projects were active at the Badger Creek and Middlemist fields.

Arapahoe.—Of the 1.2 million tons of sand and gravel produced, 1.1 million tons was obtained by six commercial operators. Of the commercial production, 53 percent was used for building and 47 percent for road construction. Crews for the Arapahoe County Highway Department and a contractor for the Colorado Department of Highways produced 116,000 tons of paving gravel. Stone production, 31,000 tons less than that of 1964, was produced by two contractors for the Colorado Department of Highways for road construction.

Archuleta.—Decreases in petroleum and stone production were not enough to offset the increase in sand and gravel output; thus the county value of mineral production increased by $58,000. Output of sand and gravel, increasing 72,000 tons, was paving sand and gravel produced by crews and a contractor for the Colorado Department of Highways and a contractor for the Federal Forest Service. Crews and a contractor for the Colorado Department of Highways also mined miscellaneous stone for making aggregate and riprap.

The two oilfields, Price Gramps and Chromo, had slightly less production than in 1964; Price Gramps yielded 65,713 barrels.

On May 11, the Bureau of Reclamation awarded a contract to Colorado Constructors, Inc., and A. S. Horner Construction Co., Inc., for constructing the 8.5-mile Blanco tunnel, a diversion dam, and appurtenant structures. The two companies submitted the low bid of $10.6 million for this phase of the San Juan-Chama project. A "mole type" tunnel driver was to be used to bore the Blanco tunnel.

Baca.—Mineral fuels accounted for 91 percent of the value of mineral production. Although petroleum output declined 16 percent, it was the most valuable mineral commodity. Production of natural gas increased almost fourfold to 3.7 billion cubic feet; much of this increase resulted from new pipeline outlets for the fields. The Flank field, with output of 165,571 barrels, accounted for virtually all of the oil production and for over half of the gas, 54 percent. Greenwood, Midway, and Walsh fields yielded large amounts of gas.

F. W. Concrete & Construction Co. produced gravel for building and road construction. Gravel for road construction was also produced by a crew and a contractor for the Colorado Department of Highways. The contractor also produced crushed stone (miscellaneous) for the same use.

Boulder.—Of the $2.2 million value of mineral production in the county, $2.1 million was derived from the output of nonmetallic mineral commodities. Sand and gravel production, valued at $1.2 million, accounted for 56 percent of the county total value. Of the output of sand and gravel, 70 percent was produced by four commercial operators and the remaining 30 percent by contractors working on road projects for the Federal Bureau of Public Roads and the Colorado Department of Highways.

Stone production increased 100,000 tons. Although production of dimension sandstone was only 8,027 tons, the value was $144,470, 48 percent of the value of the

stone produced in the county. The output of dimension stone came from five quarries. All types of building stone and curbing were produced. Miscellaneous crushed stone was quarried by one commercial operator, King Mountain Rock Co., and by contractors working for the Colorado Department of Highways. Most of the crushed stone was used for road construction.

Clay production, about the same as in 1964, consisted of fire clay and miscellaneous clay mined from five pits. Fire clay was produced by El Dorado Clay Co. for making firebrick and vitrified sewer pipe and by Stroud Whisenhunt for making building brick. Colorado Brick Co., Denver Brick & Pipe Co., and El Dorado Clay Co. mined miscellaneous clay for making building brick.

The output of peat was 8,685 tons of moss peat produced from five deposits. The peat, all bulk shipped, was used for general soil improvement.

General Chemical mined crude fluorspar at its Burlington mine and produced acid-grade fluorspar from the ore at its mill at Valmont for making hydrofluoric acid. The Great Western Sugar Co. produced quicklime for refining sugar at its plant in Longmont. A small amount of gold was recovered from cleanup of a mill and ore from a mining operation; in addition to the gold, some silver was recovered from the ore. Some beryl was obtained from the Pole Hill mine. The one-well Boulder oilfield produced 2,304 barrels of oil from fractured Pierre shale (Cretaceous).

Chaffee.—The value of mineral production was $200,000 below that of 1964, mainly because of a drop in output of sand and gravel resulting from completion of road-construction projects in the county. Part of the decrease was due to the lack of gold, silver, copper, lead, and zinc production; metal-mining operations active in 1964 had no reported production. The only output of sand and gravel was that produced by Hart Rok Redi Mixt Concrete for building and that by a crew and contractor for the Colorado Department of Highways for road work. Glacier View Peat Corp. began a peat operation near Salida and mined reed-sedge peat for use as general soil improvement; some of the peat sold was bulk and some packaged. Most of the output of stone was crushed limestone mined at the Monarch quarry by CF&I and shipped to the company steel mill at Pueblo; part of the limestone was used as flux and part for making lime needed in the basic-oxygen steelmaking process. Alpine Industrial, Inc., produced crushed granite for use as poultry grit. Granite mined by Colorado Granite Co. from the Crystal quarry was finished into dressed monumental stone.

Clear Creek.—Because all mineral commodities had substantial decreases in output and one, iron ore mined in 1964, had no output in 1965, the value of mineral production was only $127,831. Gold production dropped from 265 to 94 troy ounces and silver from 163,681 to 56,240 troy ounces. Moreover, the output of copper, lead, and zinc was only slightly more than one-third that of 1964. Except for a few ounces of gold and silver recovered from placer material mined in 1964, the metallic production came from 10 underground mines, the largest being the Cascade-Hall Tunnel operated by Cascade Mining Corp. Because of completion of the Interstate 70 highway project west of Idaho Springs, sand and gravel and stone production dropped to only 20,000 tons and 3 tons, respectively.

Late in the year, Cotter Corp. began constructing a sink-float mill at the west end of Silver Plume for obtaining base-metal concentrates. The plant, to be completed early in 1966, was to process mine-dump material washed down the gulch from several mines, largely from the old Smuggler mine.

Custer.—Output of silver, copper, lead, and zinc was from the Passiflora-Herman mine dump and ore from the Lady Franklin underground mine operated by Cotter Corp. In addition some gold was recovered from the mine dump. Both the dump material and ore were sent to the company mill at Canon City for concentration.

Persolite Products, Inc., mined crude perlite at the Rosita quarry for processing at its expanding plant in Florence. George O. Stroup mined fire clay from a pit near Wetmore; the output was used to make building brick. Paving gravel was produced by a maintenance crew of the Colorado Department of Highways. Miscellaneous stone mined by O. L. Braly was used for terrazzo amd that mined by Rocky Mountain Aggregates, Inc., for precast panels.

Delta.—Although only three mineral commodities were produced in the county, their value amounted to nearly $1.4 million. The output of coal came from six underground mines, including part of the Somerset mine extending into the county. The coal producers in order of output were United States Steel Corp. (USS) (Somerset mine), The Juanita Coal & Coke Co. (King), Green Valley Coal Co. (Green Valley No. 2), Red Canon Coal Co. (Red Canon No. 1), Emmons Bros. Coal Co. (Emmons), and States Coal Co. (Top).

Lime was produced by Holly Sugar Corp. at its Delta plant for refining sugar. Sand and gravel production, down 88,000 tons, was paving gravel produced by a maintenance crew of the Colorado Department of Highways.

Denver.—Although no mineral production was attributed to the county, Denver was the site of important mineral processing plants, mining and milling equipment manufacturers, and offices of companies engaged in mining and petroleum activity. Asarco operated the Globe smelter and recovered cadmium and thallium from byproduct materials from other smelters. Expanded perlite and exfoliated vermiculite were produced at the expanding plant of Western Mineral Products Co. General Chemical processed pyrite for making sulfuric acid and as a byproduct of the operation produced agglomerates (cinders), having a high iron content, used for making steel and as an additive for making cement.

Continental Oil Co. purchased the Empire Petroleum Co. refinery adjacent to its Denver refinery and combined operations of the two. The refinery of Oriental Refining Co. was shut down during the year. Thus at yearend only the Continental refinery and that of Tenneco Oil Co. were in operation.

PSC installed a device at its Cherokee thermal powerplant to separate extremely fine fly ash from the ash obtained by burning coal for heating the plant boilers. Company engineers estimated that the use of the fly ash saved about a full sack of cement for each cubic yard of concrete used in constructing its Cabin Creek pumped-storage hydroelectric facility near Georgetown.

Dolores.—Rico Argentine Mining Co. increased ore production such that the value of the county mineral production rose $600,000 over that of 1964. Gold, silver, copper, lead, and zinc were obtained from ore mined from the company Rico Argentine mine at Rico. The mill was operated at or near capacity throughout the year. Because of reduced demand for acid created by the stretchout uranium program, the company had not operated its sulfuric acid plant at Rico since shutdown late in 1964.

The Payroll mine, reopened by Mountain States Mining Co., also had some gold, silver, copper, lead, and zinc production. A contractor for the Federal Bureau of Public Roads produced some paving gravel and crushed miscellaneous stone for road construction. Crushed sandstone for road use was produced by a crew of the Dolores County Highway Department.

Douglas.—Each of the three mineral commodities produced in the county increased in output. Clay production, from nine operations, had an increase of 17,649 tons. Stroud Whisenhunt produced fire clay from the Madis, Stevens, and Stroh mines; the output was sold for making vitrified sewer pipe. Robinson Brick & Tile Co. obtained fire clay from the Hogback mine and miscellaneous clay from the Pioneer, Ute, and Wildcat mines for making building brick at its plant in Denver. Waterton Sand & Clay Co. sold some fire clay from its Waterton operation for use in foundries. Denver Brick & Pipe Co. obtained fire clay from its Ringenberg mine for making building brick and flue liners at its Denver plant.

Of the county value of mineral production, 64 percent was derived from sand and gravel output. Commercial operators were Hall Sand & Gravel, Inc.; Pre-Mix Concrete, Inc.; and Tower Construction Co. Crews of the Colorado Department of Highways and the Douglas County Highway Department and a contractor for the Colorado Department of Highways produced paving gravel for road construction and maintenance.

Output of stone came from eight operations, five more than in 1964. Limestone and sandstone quarried by Carl Quinn was sold as rough-construction building stone. Waterton Sand & Clay Co. produced some crushed sandstone for foundry purposes. M & S, Inc., mined and crushed sandstone and sold it as architectural aggregate. Miscellaneous stone for riprap and road con-

struction was mined by Walker's Concrete & Rock Products, Inc., and by three contractors for the Colorado Department of Highways.

Eagle.—The value of mineral production decreased compared with that of 1965. Most of the value was derived from gold, silver, copper, lead, and zinc recovered from zinc and copper ores mined by The New Jersey Zinc Co. at its Eagle mine. Because ore production was below the 1964 output, the quantity of each of the five metals recovered was below those of 1965; however, because of an increase in the price of lead, the value of recovered lead exceeded that of 1964. The Eagle mine, second only to the Idarado mine in Ouray and San Miguel Counties for production of gold and copper, was the principal source of silver and zinc.

Volcanic cinders (classified as pumice) were mined by Lava Products, Inc., near Dotsero and by Roaring Fork Pumice Co. near Carbondale. Most of the output was used as aggregate in making cinder blocks. Sand and gravel production dropped from 91,000 to 34,000 tons; the output was paving gravel produced by a maintenance crew of the Eagle County Highway Department and by a contractor for the Colorado Department of Highways. A small quantity of sandstone was quarried by R. E. Gordon for sale as dressed building stone.

El Paso.—The value of mineral production decreased $644,000. Production of sand and gravel, 376,000 tons less than in 1964, still was over 1 million tons. Eight commercial operators, collectively, produced 239,000 tons of building sand and gravel, 10,000 tons of fill sand, and 622,000 tons of paving sand and gravel. Crews for the Federal Forest Service, Colorado Department of Highways, El Paso County Highway Department, and Colorado Springs Street Department produced 155,000 tons of sand and gravel; contractors for the U.S. Army Corps of Engineers and Colorado Department of Highways produced 145,000 tons. Nearly all of the Government-and-contractor production was used for road construction and maintenance.

Clay production was less than one-half that of 1964. Fire clay produced by Standard Fire Brick Co. was used to make firebrick and vitrified sewer pipe. Robinson Brick & Tile Co. mined fire clay for making building brick and other heavy clay products. The National Clay Products Co. produced fire clay and miscellaneous clay for making building brick.

A contractor for the Federal Forest Service produced granite for concrete and road metal. Springs Silica Sand Co. produced crushed sandstone for use as refractory material, making abrasives, foundry purposes, and stone sand. Sandstone was mined and crushed by Colorado Quartz & Minerals Corp. for roofing granules and terrazzo. Contractors for the Colorado Department of Highways produced miscellaneous stone for road construction. Colorado Lime Co., Inc., quarried limestone; mostly to make lime at its lime plant near the quarry. Castle Concrete Co., Inc., produced crushed and broken limestone for use as riprap and as an aggregate for making concrete and road base. A small amount was sold for ground cover.

Fremont.—The county had the eighth highest value of mineral production of all the counties. Cement, according to value, was the principal commodity. Both portland and masonry cement were made at the Ideal Cement Co. plant at Florence.

Most of the stone production was crushed limestone quarried by Ideal Cement Co. for making cement and by CF&I for use as flux in making steel. Granite was mined from two operations for making precast panels, and marble from one operation for terrazzo. Cowan Brothers mined and sold marble from another quarry as dressed-exterior-building stone. Most of the crushed sandstone produced was used for making cement; other uses were for landscaping and making precast panels. Miscellaneous stone for terrazzo and roofing granules was mined at two operations.

Coal production came from 18 mines, 4 less than in 1964; however, the output of coal was only about 10,000 tons below that of 1964. Fifteen underground mines accounted for 248,936 tons of coal. The total output of coal from the three strip mines was 33,395 tons. Coal producers with production exceeding 20,000 tons, in order of output, were The Corley Co. (two mines), Canon Black Diamond Coal Co., Golden Quality Coal Co., and Vento Coal Co.; except for one strip mine of The Corley Co., all the mines operated by these producers were underground.

The output of clays, increasing about 1,000 tons, came from seven operations. Bentonite, for pelletizing animal feed and lining stock-pond reservoirs, was mined by Silver Rocker Bentonite Co. Fire clay was mined by Irvin Clay Co., Notaeb Development Co., and George O. Stroup (three operations); except for some fire clay sold by Irvin Clay Co. for making firebrick, the output from these operations was sold for making building brick. Harbison-Walker Refractories Co. obtained fire clay from its operation for making firebrick.

Gypsum was produced from four mines. Part of the crude gypsum mined by Fibreboard Paper Products Corp. was calcined and used for making gypsum building products at the company plant at Florence; the balance of the crude gypsum was sold for use as a portland-cement retarder. U.S. Soil Conditioning Co., Colorama Rock Products Co., and Western Soils Co. mined gypsum and sold it uncalcined for agricultural uses.

The feldspar production came from the Mica Lode mine operated by Lockhart & Sons. Climax Uranium Co. obtained uranium ore from the Dickson Lease and Thorne properties; some vanadium was recovered from the ores when processed at the Climax mill in Grand Junction.

Although there were two more operations than in 1964, the output of sand and gravel was 33 percent less than that of 1964. Graham Construction Co. produced building and paving gravel; Canyon Concrete Co., the only other commercial operation, produced building sand and gravel. The balance of the sand and gravel was produced by crews of the Colorado Department of Highways, Colorado State Penitentiary, Fremont County Highway Department, and Canon City Highway Department.

Cotter Corp. operated the uranium section of its mill at Canon City until it produced enough uranium concentrate to complete its contract with AEC. Some base-metal ores were processed in a section of the mill previously adapted for treating such ore. The New Jersey Zinc Co., at its sintering plant near Canon City, upgraded zinc concentrates from the Eagle mining operation in Eagle County.

Perlite mined by Persolite Products, Inc., in Custer County was expanded at the company plant at Florence.

Petroleum production from the old Florence-Canon City field, second oilfield discovered in the Nation, was 20,586 barrels, a very small part (less than 1 percent) of the value of minerals produced.

Garfield.—The value of mineral production rose sharply and was $1.8 million higher than that of 1964. Most of the increase came from the production of vanadium from the reopened Rifle mine of Union Carbide Corp. From the processing of vanadium ore at the company uranium mill at Rifle, a uranium concentrate also was recovered.

Output of coal, 1,259 tons less than in 1964, came from three underground mines —Four Mile (Four Mile Coal Co., Inc.), Harvey Gap No. 3 (Bradley Bros. Enterprise), and New South Canon (Bendetti Bros.). Lime output, slightly more than in 1964, was produced by Basic Chemical Corp. at its Glenwood Springs plant. In addition to mining limestone for making lime, the company produced crushed limestone for use as asphalt filler, flux, dusting coal mines, and for making mineral food. Crushed limestone produced by Frank H. Norberg Co. was used for making lime at beet-sugar mills and as aggregate for road construction. Sand and gravel production increased from 81,000 to 148,000 tons. The output was produced by three commercial operators and a crew and contractor for the Colorado Department of Highways.

Natural gas production from 21 wells in 8 fields was nearly 10 percent higher than in 1964. Garmesa and South Canyon were the largest fields. New pipeline outlets completed near yearend were to result in greater production in 1966.

Gilpin.—A large part of the county value of mineral production was derived from the molybdenum produced by Nye Metals, Inc., from its Wilma mine near Black Hawk. Robert Ray, R. F. Zacker, Stancil Couch, and Centennial Mining Co. obtained gold from placer operations; Robert Ray also recovered some silver. John B. O'Malley, Jr., recovered gold and silver from the Barnes tailings dump. Gold, silver, copper, and lead were recovered from ore mined by McFarland & Swisher.

Peat production, down 2,930 tons, was moss peat mined by Eiven Jacobson and Gus Rudolph; peat from the two operations was sold in bulk for general soil improvement. The output of sand and gravel

was 5,000 tons of paving gravel produced by a crew of the Colorado Department of Highways for road maintenance.

Gunnison.—The value of mineral production decreased $500,000. Coal production decreased 158,000 tons; however, a large part of the decrease was due to some of the output of the Somerset mine being attributed to Delta County. Output of coal came from seven underground mines: Bear (Bear Coal Co.), Black Beauty (Ellis Coal Co.), Edwards (North Fork Coal Co.), Hawk's Nest (Champion Coal Mining Co.), Nu-Mine No. 2 (Nu-Mine Coal Co., Inc.), Old Baldwin (J. M. Smith), and Somerset (USS). At the Bear mine, Bear Coal Co. placed into operation a continuous miner manufactured by Lee Norse Co. Crawler-mounted and powered by electricity, the machine digs into a coal face with 148 bits and scoops the broken coal onto a conveyor for loading shuttle cars. The machine reportedly was capable of mining over 750 tons in an 8-hour shift.

Gold, silver, and copper production was less, lead and zinc production more than in 1964. Most of the output of these five metals came from the Keystone mine operated by McFarland & Hullinger. The balance of the production came from the Micawber mine of Elk Mountain Mining & Milling Corp. and from the Ruby mine of Ruby Mining and Drilling Co.

Contractors for the Federal Forest Service produced crushed granite for road maintenance and crushed and broken miscellaneous stone for riprap. Crews and contractors of the Colorado Department of Highways produced sand and gravel and miscellaneous stone and crews of the Gunnison County Highway Department produced gravel and crushed granite for road maintenance. The only commercial sand and gravel operator was Gunnison Ready-Mix Concrete Co., Inc.

Huerfano.—Sand and gravel production dropped from 422,000 to 147,000 tons as road construction projects involving Interstate Highway 25 near Walsenburg were completed. The output of sand and gravel consisted of paving gravel produced by Kirkpatricks, Inc., and contractors for the Federal Forest Service and the Colorado Department of Highways. One of the contractors for the Colorado Department of Highways produced miscellaneous stone for riprap.

Fire clay production increased 300 tons; output was mined by Standard Fire Brick Co. for making firebrick and vitrified sewer pipe. Output of coal from four underground mines decreased 1,642 tons. The Gordon underground coal mine of Skinner Coal Co. near Walsenburg ceased operations on May 30. Since it was opened in 1907, 2.2 million tons of coal had been produced from the mine.

Jackson.—Of the value of mineral production in the county, 91 percent was from petroleum, produced from 29 wells in 4 fields. McCallum field, operated by Continental Oil Co., was the leading field with 217,000 barrels of oil; Battleship field, operated by Monsanto Co., was second with 80,000 barrels. Eleven billion cubic feet of oil-contaminated carbon dioxide was produced from the McCallum and South McCallum fields. In the McCallum field waterflood project, 140,000 barrels of water was injected into the Dakota-Lakota reservoir.

Miscellaneous stone was mined and crushed for road construction by a contractor for the Federal Forest Service. The output of sand and gravel was produced by crews of the Colorado Department of Highways and the Jackson County Highway Department; the production was used for fill and as paving gravel.

Jefferson.—With no uranium ore production reported for 1965, the county value of mineral production decreased $1 million, about the value of the uranium ore produced in 1964. One of the richest uranium mines in the Nation, the Schwartzwalder mine of Denver-Golden Corp. near Golden, under a contract agreement with AEC, completed its commitments of ore production on December 31, 1964.

Of the county value of mineral production, 78 percent was derived from the output of sand and gravel. Of the output of sand and gravel, 76 percent was produced by commercial operators, the balance by Government-and-contractor operators. Of the commercial production, 62 percent (1.1 million tons) was paving sand and gravel, 32 percent (552,000 tons) building sand and gravel, and 6 percent (95,000 tons) sand and gravel used for fill. The Government-and-contractor production consisted of 439,000 tons of paving gravel and 100,000 tons of gravel used for fill. Byprod-

uct gold and silver were obtained from four commercial operations.

The county continued to lead in clay production with 62 percent of the State output. Eighteen operations, two more than in 1964, accounted for the output, 13 percent or 46,000 tons more than that of 1964. The output of clays consisted of fire clay (9 percent) and miscellaneous clay and shale (91 percent). Of the county output, 13 percent, 50,471 tons, was mined by independent clay producers; except for some fire clay sold for making art pottery, the production from these operations was sold for making building brick and vitrified sewer pipe. The independent producers in order of output were George W. Parfet Estate, Inc.; John L. Harvey; H. M. Rubey Clay Co.; Leland Doughty; and Garnett C. Bennetts & Sons. The captive production of 343,513 tons, 87 percent of the county output, was used for making lightweight aggregate, building brick, clay crucibles, firebrick, high-alumina refractory brick, mortar, and vitrified sewer pipe. The largest producer in the State was The Idealite Co., a division of Ideal Cement Co., which mined shale adjacent to its lightweight aggregate plant on Rocky Flats. Other producers of captive clay in the county, ranked according to production, were Clalite Concrete Products, Inc., (two operations); Colorado Brick Co.; Robinson Brick & Tile Co. (three operations); Lakewood Brick & Tile Co. (two operations); Denver Brick & Pipe Co. (four operations); and Denver Fire Clay Co.

Stone production was only one-half that of 1964. Rocky Mountain Aggregates, Inc., produced crushed basalt for landscaping and crushed granite and sandstone for making precast panels. Earl Cooper, Hamilton Mining Co., and Paul E. Linstrom also produced crushed sandstone for making precast panels. Miscellaneous stone for riprap and road construction was produced by contractors for the Colorado Department of Highways. A few pounds of beryl was mined by Ben Waltz.

Kiowa.—Value of mineral fuels production was 78 percent of the total mineral output. Natural gas was the most valuable commodity; most of the production, 1.6 billion cubic feet, was from the McClave field. Oil production was mostly from the newly discovered Mississippian reservoir in the Brandon field which yielded 11,803 barrels in about 3 months. The Fleetwood Drilling Co. gas-processing plant in the McClave field, operated from May onward, treated 670 million cubic feet of gas which yielded 9,000 barrels of natural gas liquids.

Sand and gravel production decreased 87,000 tons. Output was produced by crews of the Colorado Department of Highways and Kiowa County Highway Department and a contractor for the Colorado Department of Highways.

Lake.—Lake County continued to have the highest value of mineral production. Of the county value, 97 percent was derived from the output of molybdenum by Climax Molybdenum Co. from the Climax mine, the largest underground operation in the Nation.

Gold, silver, copper, lead, and zinc were recovered from the Yak Tunnel tailings dump by Kostelic Mining & Milling Co. and from cleanup material from the Arkansas Valley smelter by Bud's Wrecking. Mt. Elbert Peat Moss Co., Inc., mined peat moss from a deposit near Leadville; the output was sold for general soil improvement; one-third shipped as bulk and two-thirds in packages.

In the fall, Asarco, in a joint venture with Newmont Mining Corp., began an extensive exploration program in the Leadville area. The Irene shaft of Resurrection Mining Co., a wholly owned subsidiary of Newmont, was to be dewatered so that exploration work could be conducted by Asarco at the 1,800-foot level, lowest of the mine.

Sand and gravel production was up 28,000 tons. Paving gravel was produced by Peter Kiewit Sons' Co. and by a crew of the Colorado Department of Highways. C. Ryan & Sons, Inc., the only other operator, produced building sand and gravel, used mostly for construction and mine-development work at the Climax operation.

La Plata.—Mineral fuels—coal, natural gas, natural gas liquids, peat, and petroleum—comprised 98 percent of the value of mineral production. The county was ranked first in marketed natural gas valued at $6.7 million. Natural gas liquids were valued at $1.6 million. The Ignacio-Blanco gasfield dominated the mineral economy of the county. With production from three pools (all Cretaceous), the field yielded nearly 36 billion cubic feet of gas. The Oil and Gas Conservation Commission report-

ed [13] production from the field as follows: Dakota pool, 67 wells, 13.3 billion cubic feet; Fruitland-Pictured Cliffs pool, 24 wells, 481 million cubic feet; and Mesaverde pool, 362 wells, 22.2 billion cubic feet. The El Paso Natural Gas Co. San Juan (Ignacio) gas plant processed 53.7 billion cubic feet of gas (some from New Mexico) and recovered 808,000 barrels of natural gas liquids.

Coal production, about the same as in 1964, came from five underground mines. Although there were only two operations compared with four in 1964, the output of peat was 2.5 times that of 1964. Art's Truck Service mined peat moss; Adrian B. Locke mined humus peat. All of the output was sold for general soil improvement.

Mineral Concentrates & Chemical Co., Inc., recovered gold and silver from the Bessie G. dump. Gold, silver, copper, and lead were recovered from ore mined from the Coppertunity mine by Kel-Sco Industries.

Sand and gravel production dropped 287,000 tons as road construction projects on U.S. Highway 550 and Colorado Highway 140 were completed. The output from five commercial companies accounted for 61 percent of the county production. Crews of the Colorado Department of Highways and La Plata County Highway Department and a contractor for the Federal Forest Service produced the Government-and-contractor production. A contractor for the Colorado Department of Highways produced miscellaneous stone for riprap.

Larimer.—The county had the sixth highest value of mineral production. More than one-half of the value was derived from portland cement produced by Ideal Cement Co. at its Boettcher plant. Limestone for making the cement was quarried adjacent to the plant by the company. Frank H. Norberg mined, crushed, and sold limestone for making cement and lime from two operations. Crushed limestone produced by Pinion Grove Lime Co. was sold for making lime. Dimension granite in the form of rough monumental stone was produced by Rocky Mountain Quarry Co. Contractors for the Colorado Department of Highways mined miscellaneous stone; some was used for riprap and some as aggregate for road construction. The output of dimension sandstone, from 14 operations, was used to make all types of building stone and flagging. The dimension sandstone producers, in order of output, were Colorado Stone Co.; Lyons Native Stone Co.; Weaver Stone Co.; Berthoud Pink Stone Co.; Arkins-Olin Stone Quarry; Jacobson-Lyons Stone Co., Inc.; Arthur Ohline; Wild's Stone Quarries; Sterling Stone Co.; Joseph M. Puckett; Colorado Quarries; and the Federal Bureau of Reclamation.

Gypsum production decreased 6,000 tons. Crude gypsum mined by Ernest W. Monroe was used as a portland-cement retarder. United States Gypsum Co. calcined crude gypsum for making building products at the company plant in Loveland until the plant was damaged by flood waters on June 17. The company did not reopen the plant. Output of lime, only three-fourths that of 1964, was produced by The Great Western Sugar Co. at its Loveland beet-sugar plant for refining sugar. With an increase in output from 730,000 tons in 1964 to 1.4 million tons, the county had the third largest output of sand and gravel of all the counties. The increase was due to road construction of Interstate Highway 25 between Loveland and Fort Collins. Of the output of sand and gravel, 71 percent was paving sand and gravel, 26 percent building sand and gravel, and 3 percent sand and gravel used for fill. Production from eight commercial operators totaled 748,000 tons. Contractors for the Colorado Department of Highways and Federal Forest Service and crews of the Larimer County Highway Department and Federal Bureau of Reclamation produced 684,000 tons of sand and gravel.

Mineral fuels contributed less than 8 percent to the value of mineral production. Loveland oilfield, with 24 wells, accounted for 57 percent of the petroleum output. Associated Oil & Gas Co. opened its Loveland gas-processing plant in May. In August, Amerada Petroleum Corp. initiated a waterflood secondary-recovery project in the Muddy sandstone reservoir at Clarks Lake field; by yearend, 142,940 barrels of water had been injected.

Las Animas.—The value of mineral production increased $600,000. Coal output, 70,000 tons more than in 1964, was the principal reason for the increase in mineral production. Output of coal came from nine

[13] Work cited in footnote 6, Part II, Oil and Gas Production, pp. 13–22.

underground mines, including the Allen mine, the largest producing coal mine in the State. Sand and gravel production increased 76,000 tons. Crews and contractors for the Colorado Department of Highways and crews of the Las Animas County Highway Department produced most of the output. Crushed miscellaneous stone, in the form of aggregate and riprap, was produced by a crew and a contractor for the Colorado Department of Highways for road construction. Clay production decreased 4,430 tons. From two pits, Empire Clay Products, Inc., mined miscellaneous clay for making building brick. Fire clay, mined by Scott Mining Co. and Harbison-Walker Refractories Co., was used for making firebrick. The small Nina View carbon dioxide field was shut in during the year.

Logan.—Although the value of mineral production decreased $92,000, the county was ranked fifth according to value, whereas in 1964 it was ranked sixth. Mineral fuels, valued at $11.4 million, accounted for 95 percent of the value of mineral output; crude oil was valued at $10.1 million. Petroleum and natural gas were produced from 348 wells in 72 fields. Many of the fields were small, 1-, 2-, or 3-well fields; however, 6 were among the 25 largest oilfields in the State, and 4 had cumulative oil production of 5 million or more barrels. Marketed natural gas, produced with oil from many of the fields, declined 28 percent in quantity and 27 percent in value. The three natural gas plants in the county processed 4.4 billion cubic feet of gas and yielded 309,000 barrels of natural gas liquids. The county had 1 gas-injection and 10 waterflood secondary-recovery projects during the year. The gas-injection project was in the "D" sandstone reservoir of the Saber field; the waterfloods were in East Atwood ("D" sandstone), Divide ("D" sandstone), Dune Ridge ("D" sandstone), Northwest Graylin ("D" sandstone), Lewis Creek ("J" sandstone), Liberty ("J" sandstone), Luft ("D" sandstone), Minto ("J" sandstone), Mount Hope ("D" sandstone), and Winston ("J" sandstone).

The Great Western Sugar Co. produced lime at its Sterling plant for making sugar from sugar beets. Sand and gravel production went from 324,000 tons in 1964 to 497,000 tons, largely because the Logan County Highway Department produced 79,000 tons more than in 1964.

Mesa.—The value of minerals increased $1.3 million over that of 1964. All mineral commodities produced in 1964 had increases in production in 1965. In addition to these commodities, some clay was produced in 1965.

Uranium ore production, 12,000 tons more than in 1964, had the greatest value, $2.5 million. The total output of 102,500 tons came from 45 operations, 5 more than in 1964, and averaged 0.29 percent U_3O_8, 0.01 less than that of 1964. The uranium ore contained 1.18 percent V_2O_5. Vanadium oxide was recovered as a coproduct in the milling of uranium ore by Climax Uranium Co. at its Grand Junction mill.

Coal production, increasing 20,500 tons, came from six underground mines, one more than in 1964. Of the production, 79 percent came from the Cameo mine of The Juanita Coal & Coke Co.; the output was used for electric-power generation at the Cameo plant of PSC.

Sand and gravel production surpassed the previous high, established in 1959, by 33,000 tons. Of the output, 71 percent was produced by contractors and crews working for Government agencies, and 29 percent by three commercial operators. One road-construction project, a stretch of Interstate Highway 70 north of Grand Junction, required 464,000 tons of sand and gravel.

Marketed natural gas increased 26 percent in quantity and 28 percent in value. New pipeline outlets contributed largely to the increase. Twelve fields, with 38 wells, accounted for this production: Divide Creek was the largest field, with Plateau field in second place. The nearly depleted Asbury Creek field was converted to gas storage on June 26. Output of natural gas liquids was from the Fruita gas plant of Continental Oil Co. which processed 4.9 billion cubic feet of gas owned by Western Slope Gas Co.

Stone production rose to 9,350 tons. Of the value, 47 percent was derived from 758 tons of dimension sandstone produced from four operations. Horsethief Canyon Natural Stone Co., Kelley Stone Co., and Western Stone Products produced dressed building stone and flagging from sandstone. Kelly Stone Co. also produced a few tons of rough construction building stone. Dressed building stone from sandstone also

was produced by William McKittrick. The Grand Junction Highway Department mined some sandstone for use as riprap. Contractors for the Colorado Department of Highways mined 8,292 tons of miscellaneous stone for use as aggregate and riprap.

Mineral.—Except for $11,706 worth of stone, the value of mineral output was derived from production of gold, silver, copper, lead, and zinc. Most of the gold, silver, and copper, and all of the lead and zinc production came from the Emperius mine of Emperius Mining Co. Some gold, silver, and copper were recovered from ore mined by Joe Cox from the Equity mine, the only other mine with production. Homestake Mining Co. continued its investigation and evaluation of the Bulldog Mountain, Inc., property, a lead-silver prospect near Creede.

The output of stone, up 7,252 tons, was granite mined for the Federal Forest Service for use in road construction.

Moffat.—Mineral fuels—coal, natural gas, and petroleum—comprised 96 percent of the value of mineral production. Natural gas, valued at $2.5 million, was the most valuable commodity; petroleum was next most valuable. The county was ranked second in the State in marketed natural gas. The principal gasfields in the county, West Hiawatha and Powder Wash, each with gas production of over 4 billion cubic feet, were ranked third and fourth in the State. Atlantic Refining Co. discovered a new gas pay zone in the Buck Peak field. The Powder Wash field, the largest oilfield with an output of 156,916 barrels, was followed by Iles field, with production of 131,359 barrels. The Moffat field waterflood project in the Dakota reservoir was continued with 1.4 million barrels of water injected.

The lack of uranium ore production was the principal cause for a drop of $1.3 million in the county value of mineral production. At the end of 1964 Union Carbide Corp. had shut down its uranium operations in the county.

Although there were seven operations compared with five in 1964, sand and gravel production decreased 174,000 tons. Crews of the Colorado Department of Highways and Moffat County Highway Department and a contractor for the Craig Municipal Airport produced 98,000 tons of paving gravel. Commercial output, 132,000 tons, was produced by four operators. Miscellaneous stone for use in road construction mined by a contractor for the Colorado Department of Highways totaled 640 tons.

The output of coal, 19,200 tons more than in 1964, came from two underground mines, the Red Wing operated by Colowyo Coal Co. and the Wise Hill No. 3 by Silengo Coal Co.

Montezuma.—A substantial increase in petroleum production resulted in an overall increase of $2.5 million in the county value of mineral production. Petroleum and natural gas contributed 91 percent to the value of mineral production in the county; petroleum was by far the main contributor, accounting for 82 percent of the total. Because of the rapid development of the Cache field, discovered in late 1964, petroleum production increased by 796,000 barrels; Cache field production more than offset the decline in older fields. Tenneco Oil Co. produced 153 million cubic feet of carbon dioxide from the Mississippian formation in the McElmo field; as in the past, it was used by Colorado Carbonics, Inc., in Cortez.

The entire output of uranium ore came from the Roberta Jean mine operated by Earl Hotz; some vanadium was recovered from the uranium ore.

Although sand and gravel production increased 52,000 tons, the value decreased $71,000 because a large quantity of lower priced material was produced for the State highway department. The only commercial operator was Nielsons, Inc., which produced building sand and building and paving gravel. Contractors for the Colorado Department of Highways and Federal Bureau of Public Roads and crews of the Montezuma County Highway Department and Colorado Department of Highways produced paving gravel for road construction and maintenance. The contractors for both agencies also mined 288 tons of miscellaneous stone for riprap.

Montrose.—The county continued to have the seventh highest value of mineral production of all counties and the greatest production of uranium and vanadium. Vanadium production, 245 tons less than in 1964, had the highest value of the six mineral commodities produced in the county. The vanadium was recovered from 262,321 tons of uranium ore containing an average grade of 1.31 percent V_2O_5, 0.19

percent higher than in 1964. The total uranium ore production was 264,584 tons, 46,566 tons below the 1964 output. Average grade of the ore was 0.24 percent U_3O_8, 0.03 higher than that of 1964. The output of uranium ore came from 135 operations, 1 more than in 1964. Uranium concentrate (yellowcake) and an intermediate vanadium product were recovered by Union Carbide Corp. at its Uravan uranium mill. The intermediate product was shipped to the plant at Rifle for further processing.

Peabody Coal Co. was the only coal producer in the county. The output of coal, 26 percent less than in 1964, was mined from the Nucla strip operation for electric-power generation at the nearby powerplant of the Colorado-Ute Electric Association.

Output of salt was contained in brine pumped from a well by Union Carbide Corp. Sand and gravel production increased 76,000 tons. Output of stone was crushed miscellaneous stone produced for road construction by a crew and contractor for the Colorado Department of Highways.

Morgan.—Petroleum, natural gas liquids, and natural gas accounted for 93 percent of the value of mineral production. The county was ranked fifth in petroleum output, fourth in marketed natural gas, and second in production of natural gas liquids from four plants. Although oil production declined 35 percent, it was the most valuable mineral commodity. Production of oil and natural gas was from 48 fields with 224 producing wells. Largest field, both in oil and gas production, was Adena, fourth largest in the State. This field accounted for 56 percent of the petroleum production and 77 percent of the cumulative production of the county. Sand River field was second largest with an output of 123,835 barrels of oil. The county had one combined gas-and-water-injection and five waterflood projects which had injected a total of 8.7 million barrels of water and 64.5 million cubic feet of gas during the year. The Adena field, site of the gas-water project, used 5.9 million barrels of the injected water. Three of the four natural gas liquids plants processed less gas and recovered less liquids, resulting in an overall 14-percent decline in production.

Sand and gravel production, 174,000 tons more than in 1964, was by three commercial operators and crews of the Colorado Department of Highways and the Morgan County Highway Deparment. Except for 49,000 tons of building sand and gravel, the county output was paving sand and gravel. The Great Western Sugar Co. produced lime for use in making sugar from sugar beets at its Fort Morgan plant.

Ouray.—Mining activity increased with seven base-metal operations compared with three in 1964. Most of the gold, silver, copper, lead, and zinc was from ore mined in that part of the Idarado mine of Idarado Mining Co. within the county. The balance of the production of these metals came from the following mines: Bachelor (Bachelor Mines Co.), Little Mike (Skyline Mining Co.), Revenue (Federal Resources Corp.), Seniorita (Willreed Mining & Milling, Inc.), Silent Friend (Cross & Sons, Inc.), and Wewissa (Kuykendall Mines, Inc.). The only other mineral production in the county was 16,000 tons of paving gravel produced by a crew of the Ouray County Highway Department for road maintenance.

In September, Camp Bird Colorado, Inc., a subsidiary of Federal Resources Corp., began startup operation at its Camp Bird mill near Ouray. The mill, with a design capacity of 650 tons per day, was built in 1960. Ore from development work at its Revenue mine was processed for recovery of gold, silver, copper, lead, and zinc.

Park.—The value of mineral production rose $110,500; decreases in output values of gold, zinc, peat, and stone did not offset increases in output values of silver, copper, lead, and sand and gravel. The Hilltop mine of Hilltop Mining Co. was the source of most of the gold, silver, copper, lead, and zinc. Small quantities of some of these metals were recovered from other underground mines, placers, and a mine dump.

Output of peat, from three operations, was sold in bulk. William T. Kemp & Harvey F. Kemp mined moss peat for general soil improvement; McCoy & Jensen mined humus peat for packaging flowers and general soil improvement; and Universal Peat Co. mined humus peat for mixed fertilizer and general soil improvement.

Sand and gravel production was slightly more than twice the 1964 output of 108,000 tons. The output was produced by crews of the Colorado Department of Highways and Park County Highway Department and contractors for the Colorado Department of

Highways. George West mined and crushed granite for making exposed concrete aggregate and for landscaping. Colorado Quartz & Minerals Corp. produced crushed sandstone for terrazzo and dimension sandstone in the form of rough architectural building stone. A crew and a contractor for the Colorado Department of Highways mined and crushed miscellaneous stone into aggregate for road construction; the contractor also produced some riprap.

Pitkin.—The county was ranked ninth in value of mineral production, whereas in 1964 it was not rated among the top 10 counties. The output of coal, the most important commodity in value, came from four underground mines—Dutch Creek mine operated by Mid-Continent Coal and Coke Co. and Thompson Creek Nos. 1, 2, and 3 operated by Thompson Creek Coal and Coke Corp. Near the end of the year, a mine disaster at the Dutch Creek mine took the lives of nine men.

Iron ore production increased substantially. The output was mined from the Cooper's Fork magnetite deposit by Morrison-Knudsen Co., Inc., for Pitkin Iron Corp.

The county led in stone production. Except for 6,750 tons of sandstone, output of 1.9 million tons was crushed granite used for construction of the Homestake Dam. Sandstone was mined by a contractor for the Federal Bureau of Reclamation for riprap.

Morrison-Knudsen Co., Inc., the prime contractor of the Homestake Dam project for the cities of Aurora and Colorado Springs, sponsors of the Homestake Transmountain Water Diversion project, produced more than 1 million cubic yards of granite rockfill near the damsite by exploding 757,800 pounds of ammonium nitrate and dynamite. For the blast, a 4-foot-diameter "coyote" hole was driven 1,430 feet into the granite mountainside and then packed with 695,000 pounds of explosive. Another 62,800 pounds of explosives was placed in ninety-one 9-inch-diameter 50- to 60-foot-deep holes. The blast provided about one-third of the rockfill needed for the job.

Sand and gravel production was more than twice that of 1964. Three commercial operators produced 191,000 tons; most of the output was building sand and gravel. Contractors for the cities of Aurora and Colorado Springs, Federal Forest Service, Federal Bureau of Reclamation and a crew for the Federal Forest Service produced 55,000 tons of paving sand and gravel.

Sunray DX Oil Co. produced 1.5 billion cubic feet of natural gas from the three-well Wolf Creek field.

Pueblo.—The value of mineral production increased $500,000 over that of 1964. Increased output of sand and gravel was the principal reason for the rise in value. The output was still 47,000 tons short of the 1963 record. Compared with the 1964 output, sand and gravel production increased 298,000 tons in quantity and $407,000 in value. Of the 1.1 million tons produced by seven commercial operators, 577,000 tons was paving sand and gravel; 431,000 tons building sand and gravel; and 45,000 tons used for fill, engine sand, filtration sand, and other purposes. Crews of the Pueblo County Highway Department and the city of Pueblo and contractors for the Colorado Department of Highways produced 157,000 tons of paving gravel for road construction.

Lime output, 5,000 tons less than that of 1964, was produced by CF&I at its steel mill in Pueblo for use in steelmaking. On August 4, a milestone was reached when CF&I poured the 50th million ton of steel. Output of clays rose from 37,134 tons in 1964 to 61,089 tons, all fire clay from seven operations, one more than in 1964. Standard Fire Brick Co., Harbison-Walker Refractories Co., Colorado Fire Clay Co., and General Refractories Co. used and/or sold their production for making firebrick. The output of Red Mountain Clay Co. was sold for making firebrick, building brick, and for lining zinc retorts. Denver Fire Clay Co. used its production for making clay crucibles, firebrick, high-alumina refractory brick, and mortar. The output of Denver Brick and Pipe Co. was used by the company for making vitrified sewer pipe. Stone production consisted of 223 tons of crushed marble produced by O. L. Braly for terrazzo and 1,349 tons of miscellaneous stone mined by contractors for the Colorado Department of Highways for aggregate in road construction and for riprap.

Gold, silver, copper, and lead were recovered by H. G. Atchison from the old Asarco smelter slag dump at Pueblo during processing of the dump material for making rock wool. Some zinc concentrate was

recovered by M. T. Currence from cleanup material of railroad cars.

Rio Blanco.—Mineral fuels, accounting for 99 percent of the value of mineral production, dominated the mineral economy of Rio Blanco County. In total value of mineral output, the county was ranked second to Lake County. It was ranked first in crude oil and natural gas liquids and third in natural gas production. At yearend, 14 producing fields contained 539 active wells. The two largest fields in the State, Rangely and Wilson Creek, produced 99.8 percent of the crude oil in the county; these two fields, at yearend, had yielded 56 percent of the cumulative oil production of the State. The Rangely Weber reservoir had a combined water-and-gas-injection project which used, during the year, 64 million barrels of water and 20.9 billion cubic feet of gas; the gas was obtained by extracting liquids from the wet gas produced with the oil and reinjecting the residual gas into the reservoir. Two secondary-recovery projects were underway in the Wilson Creek field: a waterflood in the Sundance formation into which 8 million barrels of water was injected and a combined gas-and-water-injection project in the Morrison formation. The latter project used 687,000 barrels of water and 1.5 billion cubic feet of gas. The Chevron Oil Co. natural gas liquids extraction plant at Rangely processed the wet gas from that field and recovered 1.1 million barrels of liquids before the gas was reinjected.

Output of coal, less than in 1964, came from the Rienau Nos. 1 and 2 underground mines of Jenkins & Mathis Coal Co. and the White River underground mine of Staley-Gordon Coal Co., Inc.

Sand and gravel production slightly more than tripled the 1964 output of 56,000 tons. The only commercial operator produced a few tons of building sand and gravel. Contractors for the Colorado Department of Highways and the Federal Bureau of Public Roads and a crew of the Colorado Department of Highways produced paving sand and gravel for road construction and maintenance. The contractors for both Government agencies also mined miscellaneous stone for making riprap. A crew of the county highway department produced paving gravel.

Uranium ore production, nearly triple that of 1964, came from two operations of Devereaux Bros. and one of Harry H. Harp, Jr. The ore was shipped to the uranium mill of Union Carbide Corp. at Rifle where uranium and vanadium concentrates were produced. The ore averaged 0.25 percent U_3O_8 and 1.52 percent V_2O_5.

Routt.—Coal production surpassed the 1-million-ton mark for the first time, allowing the county to retain its position as the leading coal county in the State. The increase in coal production—350,000 tons—caused a rise of $1.1 million in the county value of mineral production. The coal came from three underground and three strip mines, including the Seneca strip mine developed in 1964. The underground producers were Dry Creek Coal Co. (Cardinal mine) and Routt Mining Corp. (Apex 2 and Keystone mines). The strip mines were operated by Energy Coal Co. (Energy strip); The Pittsburg & Midway Coal Mining Co. (Edna strip); and Seneca Coals, Ltd., (Seneca strip). The output from the Energy and Edna strip mines was sent by rail to PSC powerplants in the Denver area; coal from the Seneca strip mine was used as fuel at the nearby powerplant of Colorado-Ute Electric Association at Hayden.

Scoria (classed as pumice) was mined by McCoy Aggregate Co. from a deposit near McCoy. The output, less than that of 1964, was used as concrete aggregate and for railroad ballast. Sand and gravel produced by Jake Bettger & Sons consisted of paving sand and gravel, building gravel, and sand and gravel for fill.

Petroleum and natural gas accounted for 6 percent of the value of mineral production. North Sage Creek, Grassy Creek, and Tow Creek fields were the principal producers.

Saguache.—The value of mineral output decreased $600,000 mainly because of a lack of uranium ore production. In the Marshall Pass area, the two uranium properties credited with production in 1964 had none reported for 1965. Ore from these properties had been shipped to the Cotter Corp. uranium mill at Canon City which completed its commitments with AEC early in the year.

Output of gold, silver, copper, lead, and zinc increased, although two operations had production compared with four in 1964. All the gold and most of the silver, copper, lead, and zinc were recovered from

ore mined by Rawley Metals, Inc., from the Rawley mine. The other mining operation with metal production was the Warwick mine operated by Cotter Corp.

Sand and gravel production, all by crews of the Colorado Department of Highways and Saguache County Highway Department, dropped from 110,000 to 8,000 tons. The output of stone was 1,000 tons of crushed miscellaneous stone produced by a crew of the Colorado Department of Highways.

San Juan.—The entire county value of mineral production was derived from gold, silver, copper, lead, and zinc recovered from ore mined at nine base-metal operations. Standard Metals Corp., operator of the Brenneman and Sunnyside mines, accounted for 93 percent of the county value. The Sunnyside mine had the second largest lead and the third largest gold and zinc production of all mines in the State. Beside Standard, the other producers were Calco Mining Co. (May Day); Grant G. Gifford (Mogul); Maxwell Mining & Milling Co. (Columbus); Northwood, Inc., (unknown); Silver Wing Mining Corp. (Silver Wing); T-Bird Mining Co. (T-Bird); and Two-Bit, Inc. (Graham Virginia, Inc., and Hitti & David Mining Co., joint venture, lessees) (Osceola).

San Miguel.—Mineral production increased $2.6 million in value, enough for the county to be ranked fourth in the State. Of the nine mineral commodities produced in 1964, five had increases and four had decreases in output.

The decreases in output of gold, silver, copper, and zinc resulted from a drop in ore production from the Idarado mine of Idarado Mining Co., situated in both Ouray and San Miguel Counties. All the ore was milled at its Pandora mill at Telluride. The mine was the principal source of gold, copper, and lead in the State and second for silver and zinc. In October, the company purchased some neighboring claims with related mineral and water rights. The Idarado vein was known to extend into these claims.

Gold, silver, copper, lead, and zinc were from ore mined by Silver Hat Mining, Inc., from the San Bernardo and Valley View property. Dick & George Koskinen had gold and silver production from the Courthouse-Dynamo operation. A small quantity of gold and silver from an unknown operation was attributed to D & D Mining Co. A. A. McCluskey recovered some gold from cleanup material from the Tomboy mill. Iron ore production came from two operations and a stockpile. Chas. Pfizer & Co., Inc., and a new producer, Sigma Mining Co., mined brown iron ore for use as paint pigment. Theresa B. Robinson sold some brown iron ore from her stockpile for soil amendment.

Although there were 19 fewer mining operations than in 1964, uranium ore production increased 274 tons. Production (144,320 tons) averaged 0.23 percent U_3O_8, 0.01 percent higher than in 1964. Vanadium was recovered from all except 61 tons of uranium ore. The uranium ore processed for the recovery of vanadium averaged 1.95 percent V_2O_5, 0.09 percent higher than in 1964.

Sand and gravel output was by two commercial operators and by crews of the Colorado Department of Highways and San Miguel County Highway Department, and by a contractor for the Colorado Department of Highways.

A gold medal for heroism was awarded by the Joseph A. Holmes Safety Association to Aurelio Ortiz, an ore-train motorman, at the Idarado mine. Ortiz went to the immediate rescue of a coworker who had been buried under a sudden rush of muck from an ore chute. Ortiz dug the victim free with his bare hands, knowing full well that he could easily have been buried himself if another slide occurred.

Summit.—The value of mineral production dropped to only $167,002, a decrease of $242,098 below the 1964 value; all six mineral commodities produced decreased in output. Gold, silver, copper, lead, and zinc were recovered from ore mined by Chautauqua, Inc.; Magor Mining Co.; and Monte Cristo Mining Co. Sand and gravel production was half that of 1964.

Washington.—Although the county had the largest decrease, $2.4 million, in value of mineral production of all the counties, it continued to be the county with the third highest value. The decrease resulted from a substantial decline in petroleum production. Mineral fuels accounted for 98 percent of the value of minerals produced. Petroleum, though production was 14 percent lower than that of 1964, comprised 93 percent of the value, followed by natural gas liquids valued at $626,000. Production

of oil and natural gas was from 69 fields with 372 wells at yearend. Of the 25 largest oilfields in the State, 9 were in the county; these 9 yielded 59 percent of the county oil output. The Little Beaver and Plum Bush Creek fields each had yielded a cumulative total of more than 15 million barrels of oil; the Big Beaver and Bobcat fields had cumulative production of 9.3 million and 6.5 million barrels, respectively. The county had nine active and one inactive waterflood projects. Water for these projects totaled 12.6 million barrels. The Continental Oil Co. gasoline plant at Little Beaver field processed 1.7 billion cubic feet of wet gas from nearby fields.

The county was the site of 35 percent of the exploratory drilling in the State. Two new fields, Faro and Monte, and one extension, Azure, resulted from the wildcat drilling.

Output of sand and gravel was for paving and was produced by two commercial operators and by a contractor for the State highway department. Two contractors for the Colorado Department of Highways mined 1,351 tons of miscellaneous stone for making aggregate and riprap.

Weld.—Mineral production, $2.2 million below that of 1964, caused the value to drop below the $10 million mark. Of the seven mineral commodities produced, only natural gas and petroleum had increases in output. Sand and gravel production significantly dropped 2 million tons in quantity and $2.1 million in value because of reduction in road construction in the county. Coal, lime, natural gas liquids, and stone also had decreases in output.

Mineral fuels comprised 94 percent of the value of mineral production; petroleum was ranked first, with 55 percent, followed by coal, natural gas, and natural gas liquids. Petroleum and natural gas production was from 140 wells in 43 fields. Two of the principal Colorado oilfields, Black Hollow and Pierce, having cumulative production of more than 5 million barrels each, were in the county; a third, Saber, was partly in Logan County. Output of natural gas liquids from the plant at Southwest Roggen was 29 percent below that of 1964. Four waterflood secondary-recovery projects were in operation. Total water injected was 2.1 million barrels; most of it, 1.4 million, was used in the Black Hollow field.

Coal production, from six underground mines, decreased 61,000 tons. Coal producers, according to output, were The Imperial Coal Co. (Eagle and Imperial), Clayton Coal Co. (Lincoln and Washington), Boulder Valley Coal Co. (Boulder Valley No. 3), and McNeil Coal Corp. (Sterling). On July 1, after 45 years of continuous operation during which 3.5 million tons of coal was produced, the Sterling underground mine of McNeil Coal Corp. was closed.

Lime was produced by The Great Western Sugar Co. at its sugar plants in Eaton, Greeley, and Windsor; the production, 22 percent below that of 1964, was used for refining sugar. The output of sand and gravel was produced by Goodell Brothers, the only commercial operator; by contractors of the Colorado Department of Highways; and by a crew of the Weld County Highway Department. Riprap and aggregate were produced from miscellaneous stone mined by three contractors for the Colorado Department of Highways.

Yuma.—Discovery of the Eastward field gave Yuma County its first oil production since 1962 when the Laird field was abandoned. Although relatively small, the Eastward field discovered by Stuarco Oil Co., Inc., et al, was significant as the easternmost oilfield in the Colorado part of the Denver-Julesburg basin.

The Mineral Industry of Connecticut

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the Connecticut Geological and Natural History Survey for collecting information on all minerals except fuels.

By Joseph Krickich [1]

Value of mineral production in Connecticut decreased 3 percent below the record high year 1964. Lower unit values for stone and sand and gravel were the major contributing factors. In addition, feldspar, mica, and peat output and value were below that of 1964. In contrast, lime and clay production and value increased. Hartford County led the value of mineral production, followed in descending order by New Haven, Litchfield, and Middlesex Counties.

The continuing program of geologic mapping by the Connecticut Geological and Natural History Survey in cooperation with the Federal Geologic Survey resulted in numerous reports. The State published one bedrock and one surficial geologic report and the Federal Geological Survey published 11 Geologic Quadrangle maps. The Federal Geologic Survey also completed an aeromagnetic survey of most of Connecticut and published aeromagnetic maps of a series of quadrangles along the Massachusetts boundary as well as a block of 12 quadrangles in Southeastern Connecticut.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Cement.—Cement distribution terminals were operated at Bridgeport, Hartford, Middletown, New Haven, North Haven, Plainville, and Rocky Hill. Shipments of portland cement into Connecticut totaled 4.9 million barrels; masonry cement shipments were 142,000 barrels. Most of the cement was shipped from Pennsylvania and New York. Limited quantities came from Maine and Maryland.

Clays.—Greater demand for building brick resulted in higher clay production in the State. Output of clay, used for

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Table 1.—Mineral production in Connecticut [1]

Mineral		1964 Quantity	1964 Value (thousands)	1965 Quantity	1965 Value (thousands)
Clays	short tons	211,621	$262	237,251	$322
Gem stones		NA	8	NA	8
Lime	short tons	38,574	689	W	W
Sand and gravel	thousand short tons	10,088	9,437	9,940	9,106
Stone	do	5,864	10,764	5,871	10,444
Value of items that cannot be disclosed: Feldspar, mica (scrap), peat, and items indicated by symbol W		XX	690	XX	1,354
Total		XX	21,850	XX	21,234

NA Not available.
W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed."
XX Not applicable.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Value of mineral production in constant 1957–59 dollars

(Thousands)

Year	Value
1956	$11,495
1957	16,316
1958	13,245
1959	12,738
1960	15,243
1961	16,601
1962	19,835
1963	r 20,935
1964	r 22,207
1965	21,607

r Revised.

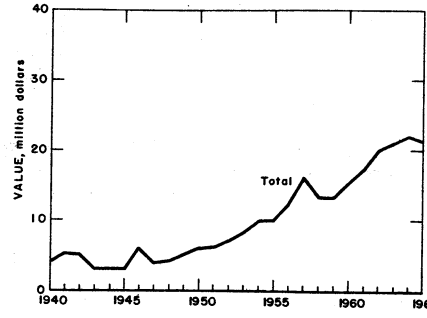

Figure 1.—Value of mineral production in Connecticut.

manufacturing lightweight aggregate, remained stable. Some miscellaneous clay was used in manufacturing flowerpots; production increased slightly above that of 1964. Clay was recovered in Hartford, Middlesex, and New Haven Counties.

Feldspar.—Production of crude feldspar from two mines in Middlesex County was below that of 1964. Output from one mine was concentrated by flotation; quartz and flake-mica were recovered as byproducts. Crude feldspar from the other mine was processed by dry grinding. The ground feldspar was sold to glass and ceramic producers. In addition, another dry grinding plant operated using purchased material; output was used in sweeping compounds. Ground feldspar was shipped chiefly to consumers in New Jersey and Pennsylvania. Limited quantities were exported.

Gem Stones.—Mineral collectors and amateur lapidarists visited quarries, pegmatite deposits, and abandoned mine dumps throughout the State to recover mineral specimens. Value of recovered material was estimated as about the same as in 1964.

Gypsum.—National Gypsum Co. produced calcined gypsum at New Haven for use in manufacturing finished building products. The company used crude gypsum shipped from out of the State.

Lime.—Production and value of lime increased compared with that of 1964. Lime output was from one producer in Litchfield County. Most of the quicklime was used in manufacturing calcium and magnesium metal at a nearby plant. Hydrated lime was sold mostly for use in masonry construction. The company utilized two rotary kilns and one continuous hydrator for manufacturing lime.

Table 3.—Employment and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1964:								
Nonmetal and peat	112	277	31	235	----	4	17.00	191
Sand and gravel	657	231	152	1,233	1	21	17.84	8,938
Stone	367	251	92	794	1	16	21.41	8,075
Total	1,136	242	275	2,262	2	41	19.01	7,727
1965: p								
Nonmetal and peat	141	270	38	289	----	2	6.92	104
Sand and gravel	655	228	150	1,223	----	25	20.44	266
Stone	435	253	110	957	1	12	13.58	6,672
Total	1,231	242	298	2,469	1	39	16.20	2,730

p Preliminary.

Mica.—A feldspar flotation plant in Middlesex County recovered scrap mica (flake mica) as a byproduct. The mica was ground for use as a roofing material.

Sand and Gravel.—Production of sand and gravel declined for the second consecutive year from the record high, 10.5 million tons recorded in 1963. Although increased production by Government-and-contractor operations was reported, total output and value decreased 1 and 4 percent, respectively, compared with that of 1964. The average price of commercial sand and gravel dropped from $1.14 per ton in 1964 to $1.10 in 1965. Commercial operators processed 81 percent of their output compared with 78 percent in 1964. Nearly 6 million tons of the commercial production was used for building and highway construction and maintenance. Of the 89 active commercial operations only 5 were classified as portable.

Output exceeding 300,000 tons was reported at two operations, and five operations produced between 200,000 and 300,000 tons. Over 2.7 million tons were produced by operations in the 100,000 to 200,000 ton range. Deliveries of sand and gravel continued to be principally by truck. Over 38

Table 4.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1964		1965	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Structural	2,106	$2,484	1,975	$2,309
Paving	1,255	1,268	1,578	1,497
Fill	243	100	302	152
Other [1]	208	190	208	161
Total	3,812	4,042	4,063	4,119
Gravel:				
Structural	1,566	2,674	1,380	2,336
Paving	977	968	1,064	1,055
Fill	742	388	622	306
Other	280	303	191	251
Total	3,565	4,333	3,257	3,948
Total sand and gravel	7,377	8,375	7,320	8,067
Government-and-contractor operations:				
Sand:				
Paving	112	43	108	38
Fill	(2)	(2)	(2)	(2)
Other	17	7	18	13
Total	129	50	126	51
Gravel:				
Building	----	----	7	3
Paving	2,575	1,008	2,438	955
Other [3]	7	4	49	30
Total	2,582	1,012	2,494	988
Total sand and gravel	2,711	1,062	2,620	1,039
All operations:				
Sand	3,941	4,092	4,189	4,170
Gravel	6,147	5,345	5,751	4,936
Total	10,088	9,437	9,940	9,106

[1] Includes molding, filter, grinding and polishing, and other sand.
[2] Included with other sand.
[3] Includes fill gravel.

percent of the commercial tonnage was produced in Hartford County; other leading producing areas were New Haven and Fairfield Counties.

Stone.—A slight increase in total stone production was reported, but value was below that of 1964. Lower unit values were reported for crushed and broken basalt (traprock), limestone, and sandstone, the principal types of stone produced. Output of basalt totaled 5.4 million tons, an increase of 151,000 tons above that of 1964. The average price per ton dropped from $1.63 in 1964 to $1.60 in 1965. Ninety-eight percent of the basalt was used for aggregates and roadstone, some was sold for riprap and railroad ballast. Quarries were active chiefly in New Haven and Hartford Counties. Four limestone quarries operated in Litchfield County. Most of the limestone was sold for agricultural stone (agstone) and used for manufacturing lime. Both dimension and crushed and broken granite were produced in New London County for riprap and aggregate. Dimension granite was produced in Hartford, New Haven, and Windham Counties. Quartz was mined in New London County and sold principally for glass manufacturing and other uses. Quartz also was recovered as a byproduct of feldspar beneficiation in Middlesex County and was marketed exclusively for glass manufacturing. A small quantity of dimension sandstone was produced in Windham County.

MINERAL FUELS

Coke.—Connecticut Coke Co., New Haven, operated a merchant coke plant consisting of 70 slot-type ovens. In addition to coke, the company produced ammonium sulfate, coal tar, crude light oil, and intermediate light oil.

Peat.—Peat production was limited to Middlesex County and was below that of 1964. Output was of the reed-sedge variety and was shredded and sold in bulk for soil conditioning uses.

METALS

Connecticut continued as an important area for smelting and processing primary and secondary nonferrous metals. Foundries throughout the State produced nonferrous castings as well as ferrous metal products. Research was conducted on some of the rarer metals as well as on the common nonferrous metals and alloys. Carpenter Steel of New England, Inc., operated two electric furnaces at Bridgeport. Iron and steel scrap was collected, separated, and processed by many dealers for the domestic steel industry and for the export market.

Nelco Metals, Inc., a subsidiary of Chas. Pfizer & Co., Inc., at Canaan, Litchfield County, continued as the only domestic producer of calcium metal in the United States. The company operated a magnesium and calcium reduction and redistillation plant. Annual rated capacity of calcium metal was 600,000 pounds and for primary magnesium was 5,000 tons.

Table 5.—Stone sold or used by producers, by uses

Use	1964		1965	
	Short tons	Value	Short tons	Value
Dimension stone	17,538	$156,928	12,297	$104,826
Crushed and broken stone:				
Concrete, roadstone	5,413,486	8,762,155	5,416,531	8,659,408
Undistributed [1]	432,541	1,844,699	442,626	1,679,333
Total	5,863,565	10,763,782	5,871,454	10,443,567

[1] Includes flux, agstone, ground quartz, railroad ballast, riprap, and other stone.

REVIEW BY COUNTIES

Government-and-contractor sand and gravel was produced by four municipalities in Hartford County and one each in Litchfield, New Haven, and New London Counties. Sand and gravel produced under contract for the Connecticut State Highway Department was not assigned to specific counties. Most of the Government-and-

contractor sand and gravel was used for highway construction and maintenance; some sand was used for controlling icy highways. Value of mineral specimens (gem stones) was not assigned to specific counties.

Fairfield.—Output of sand and gravel totaled 741,000 tons, 5 percent less than that of 1964. Production was from 10 operations. Most of the material was processed for use chiefly in building and highway construction. Quantities of fill material and sand for controlling icy highways also were produced. Leading producers were as follows: John Lamazzo & Sons Corp., Weston; Daddario Sand & Gravel, Newton; and Grasso Construction Co., Shelton.

Hartford.—The county replaced New Haven County as the leading mineral producing area. Nearly 2.5 million tons of crushed basalt (traprock) was produced compared with 2.1 million tons in 1964. The bulk of the material was sold for use as concrete aggregate and roadstone; limited quantities were sold for railroad ballast and riprap. Output was from six quarries; The Edward Balf Co., Newington, was the leading producer. Other quarries were operated by Roncari Industries, Inc., East Granby; The New Haven Trap Rock Co., Plainville; Sherman-Tomasso Concrete, Inc., Plainville; and Arborio-Tomasso, Inc., Farmington. Tower Hill Granite Co. and P. A. Armando, both near Glastonbury, produced dimension granite.

Commercial production of sand and gravel totaled 2.8 million tons, 7 percent greater than that of 1964. Output from Government-and-contractor operations increased from 203,000 tons to 239,000 tons. Most of the commercial output was construction material and came from 25 operations. Leading commercial producers were Dunning Sand & Gravel Co., The Edward Balf Co., Chapman Sand & Gravel, Costello Construction Corp., and Connecticut Sand & Stone Corp. Commercial producers processed 72 percent of their material and utilized truck transportation for marketing materials.

Clay and shale was mined near Suffield and used exclusively for manufacturing brick by Kelsey Ferguson Brick Co. Miscellaneous clay was mined at South Windsor by Carpenter Brick & Clay Products Corp. Most of the output was sold to Plasticrete Corp., for manufacturing expanded-clay lightweight aggregate at an adjacent plant. The remainder was used by Carpenter for manufacturing brick. Keller Pottery Co., Kensington, produced clay for manufacturing flowerpots. The Windsor clay mine of Edward W. Mack & Son was idle.

Litchfield.—Quicklime and hydrated lime were produced at Canaan by Minerals, Pigments, and Metals Division, Chas. Pfizer & Co., Inc., from limestone quarried nearby. Most of the quicklime was used in manufacturing high-purity calcium and magnesium at the nearby Nelco Metals, Inc., plant. The hydrated lime was used chiefly for construction; some was sold as agricultural lime. In addition to manufacturing lime, the company used limestone for agstone, filler material, and stucco. Limestone used exclusively as agstone was produced by Conklin Limestone Co., Inc., Canaan, and Allyndale Corp., East Canaan.

Table 6.—Value of mineral production in Connecticut, by counties

County	1964	1965	Minerals produced in 1965 in order of value
Fairfield	$1,169,000	$1,104,000	Sand and gravel.
Hartford	6,276,579	6,844,409	Stone, sand and gravel, clays.
Litchfield	2,769,911	2,801,319	Stone, lime, sand and gravel.
Middlesex	1,183,689	1,129,523	Feldspar, sand and gravel, clays, mica, stone, peat.
New Haven	7,379,980	6,603,902	Stone, sand and gravel, clays.
New London	923,031	807,008	Stone, sand and gravel.
Tolland	W	W	Sand and gravel.
Windham	W	W	Sand and gravel, stone
Undistributed [1]	2,147,950	1,944,175	
Total	21,850,000	21,234,000	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] Includes sand and gravel and gem stones that cannot be assigned to specific counties, and values indicated by symbol W.

United States Gypsum Co. produced limestone for flux, agstone, filler material, stucco, and for other uses. Building Materials, Inc., quarried basalt for concrete aggregate at Woodbury and produced sand and gravel from two operations near Torrington. Another principal sand and gravel producer was Sega Sand & Gravel Co., Inc., at New Milford. Other production was principally from operations near Torrington, Lime Rock, and Lakeside. Output by commercial producers totaled 557,000 tons, slightly below that of 1964. Most of the output was used in construction and paving. Some sand was used for controlling icy highways.

Middlesex.—The Feldspar Corp., Middletown, produced feldspar for use in manufacturing glass and pottery products. Crude material was beneficiated by flotation at its nearby mill; scrap mica and quartz were recovered as byproducts. The scrap mica was further processed by dry grinding for use as roofing material. The quartz was sold for manufacturing glass. Eureka Feldspar Mining & Milling Co., Inc., mined and processed crude feldspar at Portland for use in ceramic applications. Ground feldspar, used for sweeping compounds, was produced by R. & S. Enterprises, Inc., Cobalt, from purchased crude material.

Production of sand and gravel dropped to 275,000 tons compared with 339,000 tons in 1964. Principal producers were Charles W. Blakeslee & Son, Inc. (formerly Shore Line Washed Sand & Stone Co., Inc.), Killingworth, and Shoreline Concrete Co., Inc., Clinton. Michael Kane Brick Co., Middletown, produced building brick from miscellaneous clay mined nearby. Reed-sedge peat was recovered from a bog near Saybrook by Cedar Swamp Peat Co.

New Haven.—Compared with 1964, the county dropped from first to second rank as a mineral-producing area. Output of both sand and gravel and stone declined. Although output of stone dropped, the county was still the leading stone-producing area. Basalt production totaled 2.7 million tons compared with 2.9 million tons in 1964. Quarries were operated by The New Haven Trap Rock Co., North Branford and Wallingford; York Hill Traprock Quarry Co., Meriden; Charles W. Blakeslee & Sons, Inc., Hamden, and A. N. Farnham, Inc., New Haven. Output was primarily used for concrete aggregate, but some riprap, railroad ballast, and roofing granule stone also were produced. Granite for architectural work was quarried at Stoney Creek by Castelluccia & Sons, Inc.

Commercial sand and gravel production dropped from nearly 2 million tons in 1964 to 1.6 million tons in 1965. Government-and-contractor output increased. Twelve commercial operations were active, producing mostly processed material for paving, construction, and as fill material. Some sand was produced for use in manufacturing concrete masonry units and for controlling icy highways. Principal producers were Beard Sand & Gravel Co., Inc., Milford; The D. J. Carten Sand & Gravel Co., Devon; Cinque Bros. Co., North Branford; Meriden-Wallingford Sand & Stone Co., Inc., Wallingford; and Waterbury Sand & Gravel Co., Waterbury. Eighty-two percent of the commercial production was washed, screened, or otherwise prepared material. Stiles Brick Division, Plasticrete Corp., mined miscellaneous clay at Hamden for manufacturing building brick.

New London.—Quartz used chiefly for manufacturing glass was produced by Connecticut Silica Co., at North Stonington. The quartz also was processed for use as foundry abrasive, and plaster sand, as well as for roofing granules, exposed aggregate, and filler material. Barrett Division, Allied Chemical Corp., quarried granite at Montville for concrete aggregate and riprap. Limited quantities of granite for riprap were produced at the Niantic quarry of Golden Pink Granite Quarry. Stone had been depleted and the quarry was closed down. Both commercial and Government-and-contractor production of sand and gravel increased. Output by commercial operation totaled 310,000 tons compared with 247,000 tons in 1964. Principal producers were John J. Doyle Sand & Gravel Co., Inc., Lavoie Brothers, Inc., Machnik Bros., Inc., all near Montville; The Westerly Ready-Mixed Concrete Co., Inc., Pawcatuck; and Seymour Adelman, Fitchville.

Tolland.—Production of sand and gravel increased compared with that of 1964. Construction sand and gravel was produced by E. Foster Hyde, Ellington, and Richard Lee, Andover. No stone was quarried in the county as in previous years.

Windham.—Output of sand and gravel decreased compared with that of 1964. Production was processed primarily for

use in construction. Dunning Sand & Stone Co., Inc., Wauregan, and R. A. Rawson Sand & Gravel, Inc., Putnam, were the principal producers. Dunning Sand & Stone Co., Inc., was purchased by The New Haven Trap Rock Co. The company also recovered and crushed oversize basalt boulders at its sand and gravel pit; the material was sold for aggregate and railroad ballast. Dimension sandstone was produced by Helene Stone Corp., Sterling, and Robert V. Olson and Hughes Stone Co., both near Killingly. Sandstone output was used primarily as rubble. R. B. Marriott & Sons produced dimension granite at Oneco for curbing and rubble.

The Mineral Industry of Delaware

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the Delaware Geological Survey for collecting information on all minerals except fuels.

By Samuel A. Gustavson [1]

Miscellaneous clay, sand and gravel, stone, and a small quantity of mineral specimens were produced from mines in Delaware in 1965. The total value of these crude minerals was about $1.9 million, an increase of 9 percent over the 1964 figure.

[1] Physical science administrator, Bureau of Mines, Pittsburgh, Pa.

Table 1.—Mineral production in Delaware [1]

Mineral	1964		1965	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays—thousand short tons	11	$11	11	$11
Gem stones	NA	1	NA	1
Sand and gravel—thousand short tons	1,282	1,280	1,545	1,441
Stone—do	180	450	180	450
Total	XX	1,742	XX	1,903

NA Not available. XX Not applicable.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Value of mineral production in constant 1957–59 dollars
(Thousands)

Year	Value	Year	Value
1956	$1,205	1961	$1,055
1957	1,059	1962	1,543
1958	1,152	1963	1,368
1959	1,255	1964	r 1,779
1960	982	1965	1,946

r Revised.

Table 3.—Employment and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1964:								
Nonmetal and stone	11	182	2	21	-------	-------	-------	-------
Sand and gravel	54	204	11	89	-------	1	11.27	338
Total or average	65	200	13	110	-------	1	9.09	273
1965: p								
Nonmetal and stone	25	240	6	53	-------	-------	-------	-------
Sand and gravel	55	241	13	102	-------	1	9.80	39
Total or average	80	238	19	155	-------	1	6.45	26

p Preliminary.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Clays.—Miscellaneous clay was produced by the Delaware Brick Co. from an open pit mine near New Castle. All production was used by the company in the manufacture of common red building brick. Output was about the same as in 1964.

Gem Stones.—A variety of mineral specimens were collected by individuals and members of mineral clubs. Sources were the seashore and rock outcrops. The estimated value of $1,000 credited each year since 1963 to gem stone production is based on a consensus of several local dealers and the Bureau of Mines.

Sand and Gravel.—Sand and gravel continued to be the principal mineral of value produced in the State. Sand was used chiefly for building and paving purposes. Reports in 1965 indicated that about 349,000 tons of sand was sold for building purposes, 207,000 tons for highway use, and the remainder for other uses—principally for fill and as engine traction sand. A total of 579,000 tons of sand was sold in 1965, compared with 557,000 tons in 1964, an increase of about 4 percent. The average overall value, f.o.b. plant, was $1.08 per ton, compared with $0.99 in the previous year. Values again ranged from $1.00 to $1.50 per ton for building and paving uses to a low of 35 cents per ton for fill. Most of the sand was processed, and sand was sold as "pit run" was used as fill or engine traction. Virtually all the sand, except that sold for engine traction, was trucked to its destination.

Gravel production in the State was about 34 percent greater in 1965 than in the previous year, because its use for highway construction and paving increased; use for building and fill purposes declined, while demand for other uses was virtually unchanged. Gravel sold for building use totaled 87,000 tons; paving use 815,000 tons; and fill and other uses 64,000 tons in 1965, compared with 133,000, 485,000, and 107,000 tons respectively, in the previous year, The average overall value of gravel in 1965 was $0.85 per ton, 16 cents per ton less than in 1964. The decline reflected a continued increase in sales of lower valued pit-run material. Washed gravel ranged in price from about $1.60 to $3.50 per ton, while pit-run material ranged from $0.35 to $0.80 per ton, f.o.b. plant. Production was reported for 12 operations, compared with 13 in the previous year. Most of the gravel was shipped by truck to consumers. Of the total sand and gravel produced, 752,000 tons was processed and 793,000 tons was unprocessed.

Stone.—Demand for crushed stone for highway use was about the same as in 1964. Stone was produced from gabbro deposits in New Castle County, which have been classified as granite for statistical purposes. Most of the production was crushed and sized for use as a concrete aggregate on highways or as stone sand. About 5 percent of the tonnage produced, the same as in the previous year, was sold for riprap.

In addition to State sources, a substan-

tial tonnage of crushed stone, chiefly for highway construction, was purchased from quarry operators in Maryland and Pennsylvania.

REVIEW BY COUNTIES

Kent.—Sand and gravel was the only mineral produced in the county. The sand and gravel was used as building, paving and fill material. Demand for building material, the principal use, decreased about 40 percent from the previous year. The demand for paving use was down slightly and use of fill material less than half that of 1964. Virtually all material was used in either building or highway construction. All sand and gravel for building and paving use was washed and sized while all fill sand and gravel was pit-run material. Producers included St. Jones River Gravel Co. at Dover, Clough & Caulk Sand & Gravel at Wyoming, and Barber Sand & Gravel at Harrington. All producers operated stationary plants.

New Castle.—Clay, stone, and sand and gravel were the mineral commodities produced in the county. The production of stone, chiefly crushed granite (gabbro), and clay were virtually unchanged from 1964. Sand production was 352,000 tons valued at $438,000 in 1965, compared with 255,000 tons valued at $304,000 in 1964. Gravel production was 870,000 tons valued at $712,000 in 1965, compared with 533,000 tons valued at $462,000 in 1964. The increases in production of sand and gravel from New Castle County more that offset declines in Kent County.

Miscellaneous clay was mined at an open pit near New Castle by the Delaware Brick Co. for the manufacture of common building brick. Granite (gabbro) was quarried and crushed chiefly for aggregate and road use near Wilmington. Producers of sand and gravel included the following: Delaware Sand & Gravel Co. and Parkway Gravel, Inc., near New Castle; Whittington Sand & Gravel Co. at Bear; John C. Green, Jr., at Middletown; and Petrillo Bros, Inc., at Wilmington.

Production by Parkway Gravel, Inc., and John C. Green, Jr., was all pit-run material; the other operators had portable or stationary processing plants. Most of the sand and gravel was used for building and paving or highway construction. A relatively minor tonnage was reported for fill and miscellaneous uses. All was trucked to point of use.

Sussex.—Sand and a relatively minor tonnage of gravel were the mineral products of the county. Sand production was slightly greater than the previous year; gravel output was unchanged. Lewes Sand Co. produced bank-run sand for engine traction use from a pit near Lewes. Railroad demand for traction sand was down about 21 percent. Henry G. Graves & Sons, Inc., operated a stationary wash plant at its pit near Georgetown that produced sand chiefly for building construction. Atkins Brothers operated a stationary wash plant and pit near Millsboro producing sand and a small tonnage of gravel, a ratio of about 15 to 1, for building and paving use.

The Mineral Industry of Florida

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the Geological Survey of Florida for collecting information on all minerals except fuels.

By Lawrence E. Shirley [1] and Robert O. Vernon [2]

Florida established a new high in the production of mineral commodities in 1965 with a total value of $249 million. Production was 12 percent higher than in 1964, continuing an upward trend which has been consistent since 1962. Phosphate rock production in Florida was 73 percent of the national total, and both output and value were at an alltime high.

During the year tonnage and value increases were recorded for kaolin, fuller's earth, magnesium compounds, phosphate rock (land pebble), crushed limestone, dimension limestone, crude petroleum, and exfoliated vermiculite. Decreases were noted in output of cement (masonry and portland), miscellaneous clay, lime, peat, phosphate rock (soft and hard rock), rare earth concentrates (monazite), sand and gravel, staurolite, crushed oystershell, titanium concentrates, and zirconium concentrates.

Leading companies in value of mineral production were International Minerals and Chemical Corp., Mobil Chemical Co. Division of Socony-Mobil Oil Co., and General Portland Cement Co.

[1] Mining engineer, Area II Mineral Resource Office, Bureau of Mines, Knoxville, Tenn.
[2] Director, Division of Geology, Florida Board of Conservation, Tallahassee, Fla.

Table 1.—Mineral production in Florida [1]

Mineral	1964		1965	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays---thousand short tons	627	$8,405	651	$9,752
Lime---do	117	1,814	101	1,558
Natural gas---million cubic feet	40	5	107	14
Peat---short tons	19,813	102	19,253	109
Petroleum (crude)---thousand 42-gallon barrels	620	W	1,464	W
Phosphate rock---thousand long tons	17,108	119,667	19,253	141,258
Sand and gravel---thousand short tons	7,420	6,427	7,298	6,377
Stone---do	33,157	38,362	35,730	41,148
Value of items that cannot be disclosed: Cement, magnesium compounds, natural gas liquids, rare-earth metal concentrates, staurolite, titanium concentrates, zirconium concentrates, and values indicated by symbol W	XX	48,627	XX	49,104
Total	XX	223,409	XX	249,320

W Withheld to avoid disclosing individual company confidential data. XX Not applicable.
[1] Production as measured by mine shipments, sales or marketable production (including consumption by producers).

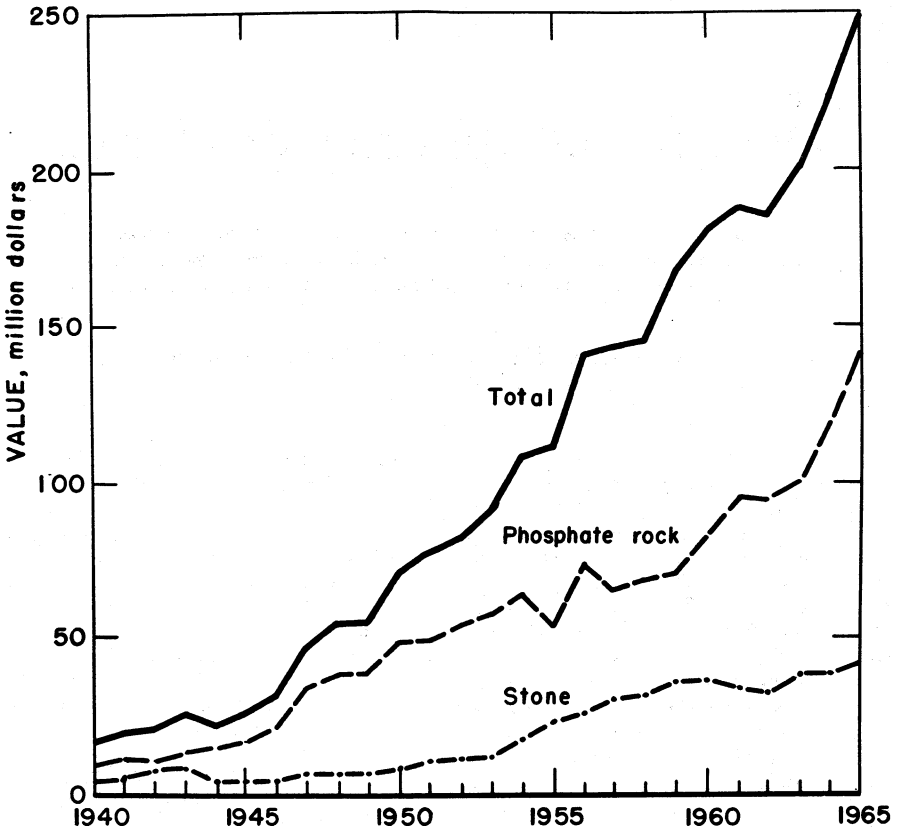

Figure 1.—Value of phosphate rock, stone, and total value of mineral production in Florida.

Table 2.—Value of mineral production in constant 1957-59 dollars

(Thousands)

Year	Value
1956	$141,692
1957	139,193
1958	145,989
1959	166,311
1960	180,228
1961	191,887
1962	185,282
1963	199,829
1964	r 218,658
1965	p 243,986

p Preliminary. r Revised.

Consumption, Trade, and Markets. — Shipments through Florida ports of mineral commodities continued to increase. The increases were reflected in new port developments and the provision of new facilities to handle the growing export market, particularly in the handling of phosphate rock and other bulk commodities for overseas shipment. Plans were announced for a new $14 million port facility at Port Manatee, near Bradenton, to serve both ocean-going and coastal vessels. The first phase of the construction at the 2,000-acre-site will include a modern terminal for loading phosphate rock aboard the vessels; the completed facilities will be leased to the Atlantic Coast Line and Seaboard Air Line railroads for a 40-year period with the lines having an option for another 40-year term. Early in the year the $5 million Port Sutton phosphate terminal in Hillsborough County was reported to be 80 percent complete. The huge terminal will eventually handle about one-third of the total phosphate going through the port.

It is owned by Florida Phosphate Terminal Corp., a subsidiary of International Minerals & Chemical Corp., and covers about 90 acres of land. Port improvements valued at $18 million were underway at Port Everglades as part of a $30 million expansion program which began late in the year. The port of Pensacola announced at yearend a $2.5 million facilities expansion, to begin early in 1966, that will assist in keeping pace with accelerating demand for shipping services through the Gulf States area.

Trends and Developments. — Florida's industrial development program continued to move forward; during the year, 528 new plants or major industries were announced for all industries in the State. One of the more important developments was the beginning of phosphate mining operations in North Florida by Occidental Corp. of Florida.

Kerr-McGee Oil Industries announced that it would start mining and construct a new plant in the Polk-Hillsborough complex in 1966.

Many new developments in the land pebble phosphate district of Polk and Hillsborough Counties were announced. At least three companies began new mine and plant construction programs. Exploration of new properties and land acquisition programs were in progress in Hardee and Manatee Counties south of the existing field, which has formerly been considered as containing low-grade prosphates.

The Division of Geology, Florida Board of Conservation, continued studies of mineral resources throughout the State, and at yearend was conducting an integrated study in a three-county area in northwest Florida, designed to help in the economic development of the area. During the year, the division published results of several studies on water and mineral resources.

Growing electric energy requirements placed new demands on the three principal suppliers of electric power in the State. Florida Power and Light Co., the largest of Florida's electric utilities and serving both the East and West coasts, had under construction 1.7 million kilowatts of new generating capacity costing $75 million per year, to be completed in a 3-year period ending in 1966. Tampa Electric Company, serving an area that includes most of the Polk-Hillsborough Counties phosphate complex, budgeted $105 million for new construction between 1964 and 1968; it expected sales to increase by 10 percent annually until 1970. Florida Power Corp., with a generating capacity of 1.15 million kilowatts, had under construction, near the Gulf terminus of the Cross Florida Barge Canal, a new plant ultimately scheduled to generate 2 million kilowatts.

Road construction continued at a high level. At yearend, Interstate Highway construction had been completed on 471.5 miles of the total designated system mile-

Table 3.—Employment and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1964:								
Peat	21	190	4	34	-------	-------	-------	-------
Metal	262	332	87	702	-------	5	7.12	165
Nonmetal	3,109	318	988	7,931	1	73	9.33	2,152
Sand and gravel	470	260	122	1,069	1	20	19.64	6,580
Stone	2,420	284	687	5,909	8	80	14.89	9,943
Total	6,282	301	1,888	15,645	10	178	12.02	4,920
1965: p								
Peat	22	227	5	42	-------	-------	-------	-------
Metal	245	290	71	572	-------	-------	-------	-------
Nonmetal	3,480	338	1,175	9,432	4	52	5.94	2,770
Sand and gravel	430	260	112	984	-------	15	15.24	945
Stone	2,615	287	751	6,473	2	102	16.07	3,323
Total	6,792	311	2,114	17,503	6	169	10.00	2,775

p Preliminary.

age of 1,151.4 miles. Interstate work in progress or underway consisted of 337.3 miles, and 342.6 miles was in a preliminary status or not yet in progress. State Road Department bridge and road construction, and maintenance programs on existing State road networks continued but at a reduced rate from 1964 which was one of the largest programs in the State's history.

Legislation and Government Programs.—Construction of the Cross Florida Barge Canal project continued throughout the year. The Inglis Lock project, on the western end of the canal, was begun and work was in progress on the St. Johns Lock near Palatka. Dredging and excavation on both the east and west ends of the canal were underway to provide quickest flood-control benefits. The project was estimated to cost $158 million. It was part of a national project, administered by the U.S. Corps of Engineers, to tie the principal inland waterway systems of the United States into one unified system.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Nonmetals accounted for 93 percent of the total mineral production value of the State. Principal nonmetals, listed in order of value, were phosphate rock, stone, cement, and sand and gravel.

Cement.—Shipments of masonry and portland cement decreased 2 percent, but value decreased less than 1 percent. Masonry cement shipments and value declined 5 percent, the sixth consecutive year of decline. Portland cement shipments decreased 2 percent, but value was only slightly below that of 1964.

Four plants operated during part of the year; three plants operated throughout and one plant was closed late in the year. General Portland Cement Co. operated two plants—one at Tampa and the other at Miami; combined annual capacity of the two plants was 9.5 million barrels. Lehigh Cement Co. operated its Miami plant throughout the year but announced in the last quarter that it was closing its Bunnell plant in Flagler County. The Bunnell plant, built in 1952, had a capacity of 3 million barrels of cement per year. Lehigh, however, acquired three large cement users in the State during the year representing a market of about 1 million barrels per year. They were Acme Concrete Co., Miami; Materials Service Corp., Orlando; and ABC Concrete Co., Jacksonville. This acquisition was, reportedly, a part of the program to realign Lehigh's competitive position in the State as a result of closing down the Bunnell plant and concentrating production at its Miami plant. Distributing plants were also being built at Orlando and Jacksonville to serve those areas.

Clays.—Florida produced more than 50 percent of the total domestic fuller's earth output. Fuller's earth production increased 18 percent in tonnage and 16 percent in value and again established an alltime high record for the State. Three companies operated four mines in Gadsden County; producers listed in order of output were Minerals and Chemicals Phillip Corp. (two mines) and Floridin Co., Inc., and Magnet Cove Barium Corp., both operating one mine each. The principal uses of the material were for absorbents and insecticides; other uses included drilling mud, filtering, decolorizing and clarifying agents for oils and fats; chemicals, soil conditioner, and other uses. Some material was exported.

Minerals and Chemicals Phillip Corp. had a new mine under development with production planned for 1966. The Attapulgite segment of the Minerals and Chemical Division of the Company reported growth in all markets served by the company with the exception of grades used in agricultural dust formulations. Petroleum uses grew sharply during the year as well as use for pet litter. The company also announced that six major league baseball parks were using the material as a soil conditioner. A plant expansion program to meet growing markets will be completed in 1966.

Kaolin output and value increased considerably over 1964 figures. Only two companies reported production. Cyprus Mines Corp., Los Angeles, Calif., announced plans for the formation of a new industrial minerals division—The United Sierra Division—through consolidation of its Sierra Talc and Chemical Division with

the United Clay Mines Corp. purchased in September. United Clay Mines Corp. had produced kaolin in the State for several years. The only other kaolin producer in the State was Edgar Plastic Kaolin Co.

Miscellaneous clay output and value were lower than in 1964. The Edgar Plastic Kaolin Co. announced the installation of a new brick plant near Edgar which will utilize both red and buff clays mined by the company in Putnam County.

Gypsum.—U.S. Gypsum Co. and Kaiser Gypsum Co., Inc., the latter company reporting for the first year, calcined gypsum at plants near Jacksonville. National Gypsum Co., calcined gypsum from Nova Scotia at its plant near Tampa. National, in operation about 2 years in the State, manufactured a complete line of gypsum building products.

Lime.—Chemical Lime Inc., Hernando County, and Dixie Lime & Stone Co., Marion County, produced primary lime. Regenerated quicklime was produced by five companies and one municipality for use in manufacturing paper and related products and for water purification. Total production was 425,000 tons valued at $6.5 million, a slight increase in both tonnage and value over 1964 figures.

Magnesia. — Michigan Chemical Corp., Port St. Joe, Gulf County, produced magnesium compounds from sea water. The company announced during the year that a $2.5 million expansion and modernization program would be started within the year to increase production to 200 tons per day; the project was to be completed in mid–1966. The company produced high purity refractory and chemical grade magnesium oxide.

Perlite.—Expanded perlite was processed by three companies from ore mined in Colorado. Producers were W. R. Grace, Inc., Dade County, formerly Perlite, Inc.; Chemrock Corp., Duval County; and Airlite Processing Corp. of Florida, Indian River County. The expanded material was used for plaster, concrete aggregate, soil conditioning, insulation, filler material, and other uses.

Phosphate Rock.—Florida led the nation for the 72nd consecutive year in marketable phosphate rock production and accounted for 73 percent of the National tonnage and value. Marketable production was at its highest level in the State's history, accounting for 57 percent of the total State mineral production value—3 percentage points more than in 1964. New mining and processing facilities, expansion of old facilities, and exploration of adjoining areas by many companies characterized the industry in 1965.

Mine production of land-pebble crude dry ore was 64.4 million tons with a P_2O_5 content of 10.3 million tons. Total marketable production sold or used was 19.2 million long tons valued at $139.6 million. Land-pebble for agricultural uses totaled 9.1 million long tons, or 48 percent; for industrial uses 4.7 million tons, or 24 percent; and for export 5.3 million tons, or 28 percent. Agricultural uses were divided as follows: 53 percent in the manufacture of ordinary superphosphate, 42 percent in triple superphosphate, and the remaining 5 percent in nitraphosphate, direct application to the soil, and stock and poultry feed. Phosphate for industrial uses included the manufacture of elemental phosphorus, ferrophosphorus, and phosphoric acid. Total exports were 5.7 million tons valued at $43.3 million.

The trend toward processing phosphate rock near the mines and shipping liquid fertilizer materials to the plants throughout the country continued. Consumers Cooperative Association (CCA) completed construction of its Green Bay chemical plant to produce phosphoric acid and granular triple-superphosphate for its plants in the Midwest. CCA did not mine rock but purchased it from local companies. Central Phosphates, Inc., a subsidiary of Cherokee Chemical Co., announced early in the year that it would begin construction of a $20-million plant north of Plant City to process low-grade phosphate rock for the manufacture of phosphoric acid and triple superphosphate fertilizer. Sulfuric acid will be produced for processing rock purchased from mining companies in the area.

Sulfuric acid manufacture using molten sulfur continued to increase, and it was reported that practically all of the sulfur coming into the Polk-Hillsborough phosphate complex was molten. About midyear, Pan American Sulphur Co.'s new liquid sulfur carrier completed its initial trip from Mexico to Tampa with a cargo of 15,000 tons of liquid sulfur. Acid Inc., a joint sulfuric acid venture of In-

ternational Minerals & Chemical Corp. and Wellman-Lord Engineering, Inc., located adjacent to the Bonny Plant of International, changed its name to Chemicals, Inc. It was reported that sulfuric acid (100 percent) production by phosphate companies for use in their own plants exceeded 5 million tons.

Land-pebble phosphate rock was produced at 18 mines operated by 12 companies in three counties. Leading producing companies were International Minerals & Chemical Corp., American Agricultural Chemical Co., Mobil Chemical Co., Division of Socony-Mobil Oil Co., American Cyanamid Co., and Swift & Co.

Soft-rock phosphate was produced at five mines by four companies. Total production was 28,000 long tons with a P_2O_5 content of 6,000 long tons, valued at $221,000. All of the material was used for direct application to the soil and for stock and poultry feed. The leading producer, operating two mines, was Loncala Phosphate Co. in Gilchrist and Marion Counties.

Hard-rock phosphate was produced by Kibler-Camp Phosphate Enterprise in Marion County. The material was used for both agricultural and industrial uses.

The leading producer of land-pebble phosphate rock was again International Minerals and Chemical Corp. (IMC). The company operated the Achan, Noralyn and Dredge mines all in Polk County. The company announced that a new mine and washer would be placed in operation in 1966; the mine and plant will be named the Kingsford complex and will have an estimated capacity of 2 to 3 million tons per year. The plant will be highly automated with computerized process controls among its special design features. The company also announced that it would build in 1965 one of the world's largest feed phosphate plants at its Bonnie operation. The new 200,000-ton unit will manufacture both diammonium phosphate and two feed calcium phosphates. Other expansion during the year included additions to the phosphoric acid plant at Bonnie, increasing phosphoric acid output by 165,000 tons per year, a $4 million expansion of the defluorination plant to increase capacity by 50,000 tons per year. A new 42-cubic-yard dragline, with a 275-foot length boom, was under construction for IMC at yearend; the new machine was to be placed in operation early in 1966.

Agrico Chemical Co., Division of Continental Oil Co., the second largest land-pebble producer, continued to expand its operations. The Payne Creek mine was being developed for production early in 1966. Its capacity will be 2 to 3 million tons per year; the mining will be done by two 40-cubic-yard draglines. Other additions included an upgrading plant under construction at its Pierce complex for completion during the first half of 1966. The capacities of the company's sulfuric acid, phosphoric acid, and triple superphosphate plants were enlarged during 1965. Agrico began construction of new offices at Pierce and announced that its New York Headquarters would be moved to Memphis, Tenn., by July 1966.

Mobil Chemical Co. Division of Socony-Mobil Oil Co. ranked third in output of land-pebble phosphate. The company continued production at its Clear Springs and Homeland mines. A mine with a capacity of 1.5 million tons, was being developed north of Ft. Meade and was scheduled to begin operations late in 1966. Mining will be done by a 40-cubic-yard capacity dragline. The company completed expansion of its diammonium phosphate plant near the end of the year, increasing capacity to 100,000 tons per year. The company continued operation of its electric furnace throughout the year.

American Cyanamid Co. ranked fourth in land-pebble output and continued to expand its Florida operations at a rapid pace. The company announced that the new Chicora mine and processing facility being developed would be placed in operation early in 1967. Initial capacity of the Chicora mine was to be 1.6 million tons per year and designed capacity of the flotation plant was 450 tons per hour. A 40-cubic-yard dragline with a boom length of 220 feet was being constructed for use at the mine. The company completed expansion of its diammonium phosphate plant late in the year, and modification of its sulfuric and phosphoric acid plants, increasing capacities about 10 percent, was also completed. The company continued operation of its Orange Park and Sydney mines and washers throughout the year.

Swift & Company ranked fifth in land-pebble output and continued operation of

its Silver City and Watson mines and plants. Plans were announced, late in the year, to double the capacity of the Silver City mine, with completion scheduled for early in 1967. The new expansion will cost about $10 million and will increase capacity for mining, and upgrading, and refining the crude rock. The company had acquired sufficient additional phosphate reserves in the area which will enable it to continue operation for more than 30 years.

W. R. Grace & Co., Davison Chemical Division, also a major land-pebble producer, continued to expand its operations. It was reported that the company had abandoned plans for a mine in the South Ridgewood area, but would probably develop a 3-million-ton-per-year capacity mine early in 1968 on its Hookers Prairie tract. Expansion of the company's phosphoric acid plant by 180,000 tons per year and construction of a new diammonium phosphate plant was completed during the year.

Smith-Douglass Co., Inc., acquired by Borden Chemical Co. in 1964, announced that it would construct a new $15-million phosphate complex on a 500-acre tract near Port Manatee. The company originally had planned to build the plant on a site adjoining its existing operations at Coronet, but objection of nearby residents concerning potential air pollution caused the company to change its plans. Triple superphosphate and diammonium phosphate are to be produced from rock mined and processed at Tenoroc. The plant was scheduled for completion early in 1966. It will have a sulfuric acid plant with a capacity of 385,000 tons per year, and a phosphoric acid plant with a capacity of 140,000 tons per year. Enlargement of the company's defluorination plant and washer facility at Tenoroc, by 50 percent each, was completed during the year.

Occidental Corp. of Florida, a subsidiary of Occidental Petroleum Corp. began mining phosphate rock in the last half of the year at the Suwannee mine in Hamilton County. Capacity of the mine was estimated at 1.5 million tons per year. The company announced before yearend that it would double the capacity of the mine, purchase a new 33-cubic-yard dragline, and construct a large fertilizer chemical complex consisting of a sulfuric acid plant, phosphoric and superphosphoric acid plants, a diammonium phosphate plant, and a granular triple superphosphate operation. The company was constructing a phosphate ship-loading terminal on the St. Johns River near Jacksonville. The terminal was to have a loading capacity of 3,000 tons of rock per hour when it becomes operative in 1966.

Kerr-McGee Oil Industries, Inc., actively acquiring phosphate properties in 1963 and 1964, announced that it would open a large mine in the vicinity of American Cyanamid Co.'s new Chicora mine. The new Kerr-Mac mine and plant will have a capacity of 1.5 million tons per year and will become operational in 1967. A 40-cubic-yard dragline will be placed in service late in 1966. Plant construction, in addition to the washer, will include a 1-million-ton fluidbed dryer.

Other companies actively mining in the land-pebble field include Hydromines, Inc., and Minerals Recovery Corp., both processing tailings from past operations. New Concept Co. closed its operation during the first half of the year.

U.S. Phosphoric Products Division of Cities Service Co. near Tampa continued to be one of the largest processors of phosphate rock. The company had purchased all of its raw material in the past, but it was reported that it had purchased a large dragline and probably will begin mining phosphate in 1967. The company ac-

Table 4.—Marketable production of phosphate rock

Type	1964		1965	
	Long tons	Value	Long tons	Value
Soft	29,734	$239,554	29,216	$226,844
Hard	70,120	681,000	69,900	693,000
Land pebble	17,008,398	118,746,365	19,153,835	140,337,900
Total	17,108,252	119,666,919	19,252,951	141,257,744

Table 5.—Phosphate rock sold or used by producers, by uses

Use	1964			1965		
	Long tons	Value		Long tons	Value	
		Total	Average per ton		Total	Average per ton
Ordinary superphosphate	4,853,171	$32,838,382	$6.77	4,796,391	$33,854,742	$7.06
Phosphoric acid (wet process)	3,131,163	25,084,095	8.01	3,605,012	27,109,690	7.52
Triple superphosphate	2,154,644	17,804,346	8.26	3,794,135	27,654,467	7.29
Elemental phosphorus, ferrophosphorus, and phosphoric acid	685,055	2,731,590	3.99	748,095	5,222,078	6.98
Direct application to the soil [1]	446,645	3,492,351	7.82	534,501	2,465,842	4.60
Exports	5,086,000	34,533,940	6.79	5,717,000	43,341,990	7.59
Total	16,356,678	116,484,704	7.12	19,195,134	139,648,809	7.27

[1] Includes nitraphosphate and stock and poultry feed.

quired phosphate reserves near Ft. Meade during 1965.

Several other companies were acquiring phosphate properties in North Florida and in counties south of the Polk-Hillsborough complex.

Sand and Gravel.—Sand and gravel output decreased for the second consecutive year. Most of the sand and gravel was used for construction purposes and the remaining small percentage for industrial uses. Construction sand and gravel was used for building, paving, fill, railroad ballast, and other uses; industrial sand was used for glass, blasting, filtration, and other purposes.

Sand and/or gravel was mined in 24 counties compared with 26 counties in 1964. The three leading counties in output were Polk, Lake, and Clay. Most of the material was processed (washed) at stationary plants. Sixty-seven percent of the material was transported by truck, 32 percent by rail, and less than 1 percent by water. The raw material, processing techniques, and manpower utilization of the sand operation of Melbourne Sand and Supply Co., Eau Gallie, was published.[3] The sand operation of Gall Silica Mining Co., Inc., was described.[4] Gall announced in September it had purchased 1,000 acres of nearby land from Algoma Corp., increasing its reserves considerably.

[3] Bergstrom, John H. Radical Techniques Highlight Florida Sand Plant. Rock Products, v. 68, No. 7, July 1965, pp. 77–78.

[4] Trauffer, Walter E. Florida Sand Producer. Pit and Quarry, v. 58, No. 2, August 1965, pp. 86–90.

Table 6.—Sand and gravel sold or used by producers, by uses

(Thousand short tons and thousand dollars)

Use	1964			1965		
	Quantity	Value		Quantity	Value	
		Total	Average per ton		Total	Average per ton
Sand:						
Structural	5,647	$4,413	$0.78	5,650	$4,373	$0.77
Fill	335	170	.51	485	277	.57
Paving	747	588	.79	465	390	.84
Other sands [1]	339	660	1.95	385	746	1.94
Total sand	7,068	5,831	.82	6,985	5,786	.83
Gravel [2]	352	596	1.69	313	591	1.89
Total sand and gravel	7,420	6,427	.87	7,298	6,377	.87

[1] Includes glass, molding (1965), blast, engine (1965), filtration, and other uses.
[2] Includes structural and paving gravel.

Table 7.—Sand and gravel sold or used by producers, by counties

(Thousand short tons and thousand dollars)

County	1964		1965	
	Quantity	Value	Quantity	Value
Bay	81	$69	W	W
Brevard	44	53	21	$26
Broward	305	232	328	320
Dade	240	178	W	W
Escambia	562	573	439	420
Gadsden	W	W	245	512
Indian River	25	25	28	28
Lake	1,548	1,143	1,382	974
Liberty	5	4	------	------
Marion	W	W	13	32
Orange	150	129	152	103
Palm Beach	170	87	130	72
Pinellas	7	5	6	5
Polk	2,411	1,996	2,369	2,125
Putnam	487	380	527	378
St. Lucie	128	103	W	W
Wakulla	42	36	20	17
Washington	14	11	------	------
Other counties [1]	1,201	1,403	1,638	1,365
Total	7,420	6,427	7,298	6,377

W Withheld to avoid disclosing individual company confidential data.
[1] Includes Clay, Franklin, Glades, Hendry, Hillsborough, Leon, Volusia, and Walton Counties, and counties indicated by symbol W.

Staurolite.—E. I. du Pont de Nemours & Co., Inc., recovered staurolite as a byproduct of ilmenite at its Highland and Trail Ridge plants in Clay County. Most of the material was used for abrasive purposes.

Stone. — Total stone output included crushed limestone, crushed oystershell, and a small tonnage of dimension limestone. Crushed limestone output was 34.3 million tons valued at $39 million, and crushed oystershell accounted for most of the remainder.

Crushed limestone was quarried at 77 locations in 22 counties, compared with 81 locations in 23 counties in 1964. The three leading producing counties again were Dade, Hernando, and Broward; these counties accounted for 61 percent of the total output and value. The principal use of crushed stone was for concrete and roads; other important uses included agstone, railroad ballast, cement, lime, asphalt filler, fill, riprap, and others. Crushed limestone was transported 62 percent by truck, 36 percent by railroad, and the remaining 2 percent by waterway.

Oystershell was dredged in five counties on State leases; five companies operated, one less than in 1964. Total output was 1.4 million tons valued at $2.2 million, decreases of 16 percent in tonnage and 10 percent in value compared with 1964 figures. Producers listed in order of output were Benton & Co., Pinellas County; Bay Dredging & Construction Co., Hillsborough County; Radcliff Materials, Inc., Walton County; Houdaille-Duval-Wright Co., Duval County; and Ft. Myers Shell and Dredging Co., Lee County. Most of the material was used for roadstone and concrete; a small tonage was sold for poultry grit. Sixty-eight percent of the oystershell was transported by truck, 31 percent by waterway, and less than 1 percent by railroad.

Seminole Rock Products, Inc.'s Seminole quarry, near Miami, was described.[5] Late in the year, Florida Limestone Corp., Palmetto, was purchased by Rinker Materials Corp., West Palm Beach. This was Rinker's first venture on the State's West Coast; the company serves the construction industry in the Miami, Orlando, and Lake Okeechobee areas. Meekins, Inc., Fort Lauderdale, purchased Coral Aggregates Co. and Samson Co., both of Miami and will be operated as Meekins-Samson, a subsidiary. Meekins operated crushed limestone quarries, and aggregate and concrete products plants in Dade and Broward Counties. Dixie Lime & Stone Co. was

[5] Excavating Engineer. Draglines Dig Stockpiles Better. V. 59, No. 10, October 1965, pp. 12–17.

Table 8.—Crushed limestone sold or used by producers, by counties

County	1964		1965	
	Short tons	Value	Short tons	Value
Alachua	1,408,583	$1,071,464	1,744,237	$1,310,445
Broward	4,250,747	4,549,278	4,615,924	5,103,206
Collier	564,931	737,756	606,052	532,475
Dade	10,161,681	9,742,079	9,431,795	9,858,759
Hendry	9,350	10,846	6,600	5,000
Hernando	6,658,103	9,352,879	6,786,076	8,930,339
Jackson			20,200	60,700
Levy	299,731	426,735	355,872	673,899
Marion	1,423,327	1,509,273	1,721,432	1,764,671
Monroe	325,000	297,500	W	W
Palm Beach	669,719	491,993	W	W
Pasco	39,171	33,295		
Sumter	W	W	3,876,241	2,966,103
Volusia	6,250	6,000		
Other counties [1]	5,659,128	7,714,419	5,160,294	7,767,249
Total	31,475,721	35,943,517	34,324,723	38,972,846

W Withheld to avoid disclosing individual company confidential data.
[1] Includes Brevard (1965), Citrus, Columbia, Flagler, LaFayette, Lee, Manatee, Pinellas (1964), Sarasota, Suwannee, and Taylor Counties, and counties indicated by symbol W.

reorganized during the year, and also acquired most of the Cummer Lime and Manufacturing Co. lime products facilities in Marion County. Key Largo Rock Quarry, Inc., purchased the quarry operation lease of Marble Corp. of America, Miami, covering the Windley Key quarry. The new company will quarry the rock and cut, polish, and ship the rock to northern areas. Consolidation of management and operations of Houdaille-Duval Co., and R. H. Wright, Inc., was completed early in the year. Houdaille-Duval-Wright's had quarries in several counties within the State.

Vermiculite.—Exfoliated vermiculite was produced by three plants of Zonolite Division of W. R. Grace in Duval, Hillsborough, and Palm Beach Counties and by Surco Manufacturing Co., formerly Verlite Co., at a plant near Tampa, Hillsborough County. Principal use of the material was for concrete aggregate; other uses included building plaster, loose fill insulation, and agricultural purposes. Crude vermiculite was obtained from South Carolina, Montana, and the Republic of South Africa.

METALS

Metals accounted for 4 percent of the State's total mineral production value. Total output of all metals was 321,000 tons valued at $10.3 million, decreases of 14

Table 9.—Crushed limestone sold or used by producers, by uses

Use	1964			1965		
	Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per ton
Concrete and roads	27,269,652	$30,590,247	$1.12	30,258,300	$33,405,119	$1.10
Agstone	679,368	1,795,706	2.64	660,970	2,136,057	3.23
Fill	W	W	W	576,381	294,887	.51
Railroad ballast	427,133	670,986	1.57	508,700	785,849	1.54
Riprap	1,000	2,500	2.50	W	W	W
Other uses [1]	3,098,568	2,884,078	.93	2,320,372	2,350,934	1.01
Total	31,475,721	35,943,517	1.14	34,324,723	38,972,846	1.14

W Withheld to avoid disclosing individual company confidential data.
[1] Includes asphalt filler (1964), cement, lime, other uses, and uses indicated by symbol W.

percent in tonnage and 10 percent in value compared with 1964 figures. Rare-earth minerals, titanium concentrates, and zirconium concentrates, all recovered from sands, constituted primary metal production. Ferroalloys were produced by two companies, but tonnage and value are not included in State totals. Florida ranked first in the Nation in rutile and zirconium concentrate production, and second in ilmenite and rare-earth concentrates.

Ferroalloys.—Mobil Chemical Co., Division of Socony-Mobil Oil Co. at Nichols, and Agrico Chemical Co., a subsidiary of Continental Oil Co., at Pierce produced ferrophosphorous as a byproduct of the electric-furnace process of smelting phosphate rock in the manufacture of elemental phosphorous. Both plants operated steadily throughout the year.

Rare-Earth Minerals.—Output and value of rare-earth metal concentrates from the Skinner mine decreased considerably. The mine was operated by Humphrey Mining Company. It was closed during the year.

Titanium Concentrates.—Florida ranked second in the nation in production of titanium concentrates, accounting for 26 percent of the National output and 39 percent of the value. Combined shipments of ilmenite and rutile decreased 17 percent below those of 1964. Output and value of ilmenite production decreased 17 and 9 percent, respectively, compared with 1964 figures. Companies producing or shipping concentrates, listed in order of total shipments, were E. I. du Pont de Nemours & Co., Inc. from its Highland and Trail Ridge mines, Humphrey Mining Company, Skinner mine; and Florida Minerals Co., Vero mine. Florida Minerals co. announced that its operation would close late in the year; only shipments were recorded during 1965. Humphrey Mining Company closed the Skinner mine near Jacksonville and moved its operations to Folkston, Ga.

Florida accounted for 73 percent of domestic rutile output and 35 percent of the total value. Humphrey Mining Company, Skinner mine reported shipments during the year but no production; Florida Minerals Co., Vero mine, reported production and shipments. Combined shipments of both companies decreased 6 percent and value was considerably lower.

Zirconium Concentrates.—Florida was responsible for 99 percent of the U.S. zircon output and value. Zirconium concentrate shipments in the State decreased 5 percent in tonnage and 6 percent in value below 1964 figures. Producers, listed in order of output, were E. I. du Pont de Nemours & Co., Inc. (Trail Ridge Plant), Titanium Alloy Manufacturing Division of National Lead Co. (Skinner plant), and Florida Minerals Co. (Vero plant); Florida Minerals announced that its operation would close late in the year.

MINERAL FUELS

Mineral fuels accounted for 8 percent of the State's total mineral production value. Mineral fuels production consisted of natural gas, crude petroleum and its derivatives, and peat. Increased petroleum production and exploration in the State was at an alltime high.

Natural Gas.—All natural gas production came from the Humble Oil Co., Sunniland Field, Collier County, and was used in company operations for pumping crude petroleum. Production reports indicate a substantial increase in output above the 1964 figures. Florida Gas Transmission Co. announced a $42.7 million expansion program about midyear that would boost the line's average sales delivery capacity to 444 million cubic feet per day. The company planned to build 210 miles of 30-inch loops between Eunice, La., and Brooker, Fla., 22 miles of 6- and 8-inch sales laterals in Florida, and 30,700 horsepower in new and existing stations. Florida Gas also announced it would build an $89 million natural gas pipeline through the State to supply six major Florida Power and Light Co. plants on the East Coast; the electric utility company signed a contract to buy natural gas fuel for the next 20 years and this was reported to be the largest single energy contract in Florida history. The gas will be used exclusively for fuel for Florida Power and Light plants at the proposed Turkey Point site and at Cutler Ridge, Miami, Port Everglades, Riviera Beach, and Cape Kennedy.

Peat.—Seven companies in five counties produced humus and reedsedge peat principally for soil improvement purposes. A small quantity of moss peat was also produced in Hillsborough County. Most of the material was shredded and shipped in bulk by trucks to the local markets. Leading producing Counties were Hillsborough and Orange; leading producers were F. E.

Stearns Peat Co., near Sydney, Daetwyler Peat Co., near Orlando, and Traxler's Peat Co., near Florahoma. Although classified as a fuel, none of the peat in Florida was used for this purpose.

Petroleum.—Crude petroleum production from the State's two oil fields more than doubled over that of 1964. Humble Oil Co.'s Sunniland field in Collier County and Sun Oil Co.'s Sunoco-Felda field in Hendry County produced 1,464,000 barrels of oil during the year. Cumulative production from the Sunniland Field exceeds 9-million barrels of low gravity oil. Production in 1965 came from 15 wells. Each of two new wells completed in the field late in the year was producing about 500 barrels of oil per day.

Drilling activity in the Sunoco-Felda field about 18 miles north of the Sunniland field increased rapidly after its discovery in late 1964. The Sun Oil Co. reportedly spent $5 million in developing the field and drilled 281,450 feet in 28 wells, 26 of which were drilled during 1965. This drilling resulted in 21 oil wells, three of which were being completed, and 4 dry holes. At yearend, three new wells were being drilled. Yields from the better wells in the field range from 320 to 370 barrels of oil per day; estimated monthly production of oil from the field at yearend was about 100,000 barrels.

Exploration activity for oil in Florida increased; during 1965, six exploratory wells were plugged and abandoned and a total of 36,144 feet drilled in these holes. Two of the tests were in Citrus County, two in Columbia County, one in Lafayette County, and one in Dade County. The State Board of Conservation, Florida Geological Survey, Oil and Gas Section, reported more permits issued for geophysical work in 1964 and 1965 than during any other 2-year period in the State's history. Geophysical surveys to a water depth of 600 feet, were planned for the next several years of most of the west coast of the State. Mobil Oil Co. was conducting an exploration program off the west coast counties of Collier, Lee, and Sarasota and received a permit during the year to drill in a lease block of 100,000 acres in Citrus County, near Homosassa Springs. Mobil was also exploring in Charlotte and Lee Counties on the Babcock Ranch which comprises about 90,000 acres.

The Division of Geology published [6] a preliminary study of the South Florida basin to assist in oil exploration in the southern area of the State. The report contains a series of maps, descriptive sections and drilling results of wells in the Basin.

REVIEW BY COUNTIES

Mineral production was recorded in 45 of the 67 counties, 1 county less than in 1964. Polk, Hillsborough, and Dade Counties, as in 1964, were again the three leading counties in mineral production value and furnished 71 percent of the State's total value. Eleven counties had values of over $3 million, and the leading 10 counties furnished 89 percent of the total value. Phosphate rock, the major mineral commodity in the State, was produced principally in Polk, Hillsborough, and Hamilton Counties.

Alachua.—Five companies crushed limestone for roadstone and concrete uses; total output was 1.7 million tons valued at $1.3 million. Sixty-one percent of the stone was transported by railroad and the remainder by truck. The three leading producers were Houdaille-Duval-Wright Co. (Haile Quarry), Limestone Products Co. (Haile Quarry), and Ocala Lime Rock Co. (Haile Quarry). Peacock Lime Rock Corp. did not report production.

Edgar Brick Co. mined a small quantity of miscellaneous clay at its Edgar mine and reported it for use in manufacturing building brick at its plant in Putnam County. This was Edgar's first full year of kiln operation; initially production began with two kilns each capable of firing 85,000 brick at 2,000 degrees in 12-day cycles; two more kilns were added boosting capacity from 4 million to 10 million brick annually.

Bay.—Calloway Sand Co. (Silver Creek mine) and Cato Sand Co. (Mill Bayou mine) mined building and paving sand for local markets; all of the sand was transported by truck. International Paper Co. produced regenerated lime at its Panama

[6] Oglesby, Woodson R. Folio of South Florida Basin—A Preliminary Study. Florida Geological Survey, Map Series No. 19, 1965, 3 pp., 10 maps.

Table 10.—Value of mineral production in Florida, by counties [1]

County	1964	1965	Minerals produced in 1965 in order of value
Alachua	$1,071,464	W	Limestone, miscellaneous clay.
Bay	69,000	W	Sand and gravel.
Bradford	----------	W	LP gas and natural gasoline.
Brevard	53,000	W	Sand and gravel, limestone.
Broward	4,781,278	$5,423,206	Limestone, sand and gravel.
Citrus	W	W	Limestone, miscellaneous clay, phosphate rock.
Clay	W	W	Ilmenite, zircon, sand and gravel, staurolite, miscellaneous clay, peat.
Collier	W	W	Petroleum, limestone, natural gas.
Columbia	W	W	Limestone.
Dade	W	W	Cement, limestone, sand and gravel.
Duval	W	W	Oystershell, zircon, ilmenite, rutile, monazite.
Escambia	586,130	450,000	Sand and gravel, miscellaneous clay.
Flagler	W	W	Cement, limestone.
Franklin	W	W	Sand and gravel.
Gadsden	W	W	Fuller's earth, sand and gravel, miscellaneous clay.
Gilchrist	W	W	Phosphate rock.
Glades	W	W	Sand and gravel.
Gulf	W	W	Magnesium compounds, lime.
Hamilton	----------	W	Phosphate rock.
Hendry	W	W	Sand and gravel, limestone.
Hernando	W	W	Limestone, lime.
Hillsborough	25,508,388	27,344,444	Phosphate rock, cement, oystershell, sand and gravel, peat.
Indian River	W	W	Sand and gravel, rutile, ilmenite, zircon.
Jackson	----------	60,700	Limestone.
LaFayette	W	W	Do.
Lake	1,143,000	974,000	Sand and gravel.
Lee	W	W	Limestone, oystershell.
Leon	W	W	Sand and gravel.
Levy	426,735	673,899	Limestone.
Liberty	4,000	----------	
Manatee	W	W	Do.
Marion	W	W	Limestone, phosphate rock, lime, sand and gravel.
Monroe	297,500	W	Limestone.
Orange	W	W	Sand and gravel, peat.
Palm Beach	578,993	W	Limestone, sand and gravel.
Pasco	33,295	----------	
Pinellas	W	W	Oystershell, sand and gravel.
Polk	108,851,765	127,241,900	Phosphate rock, sand and gravel.
Putnam	W	W	Kaolin, sand and gravel, peat.
St. Lucie	103,000	W	Sand and gravel.
Sarasota	W	W	Limestone.
Sumter	W	2,966,103	Do.
Suwannee	W	W	Do.
Taylor	W	W	Do.
Volusia	W	W	Sand and gravel, peat.
Wakulla	36,000	17,000	Sand and gravel.
Walton	W	W	Oystershell, sand and gravel.
Washington	11,000	----------	
Undistributed [2]	79,854,452	84,168,748	
Total	223,409,000	249,320,000	

W Withheld to avoid disclosing individual company confidential data.
[1] The following counties are not listed because no production was reported: Baker, Calhoun, Charlotte, De Soto, Dixie, Hardee, Highlands, Holmes, Jefferson, Madison, Martin, Nassau, Okaloosa, Okeechobee, Osceola, St. Johns, Santa Rosa, Seminole, and Union.
[2] Includes value of natural gas liquids, and counties indicated by symbol W.

City plant for use in the manufacture of paper.

Bradford.—Florida Hydrocarbons Co., a subsidiary of the Houston Corp., produced natural gasoline and liquified petroleum gases at its plant near Brooker. The plant in operation since mid–1962 has reported capacity to treat 330 million cubic feet of gas per day to recover petroleum products.

Brevard.—Valkaria Sand Co., Inc. (Valkaria mine), mined building sand for local consumption; all of the sand was transported by truck. F & M Trenching Co. (F M quarry) crushed limestone for use in concrete and roadstone, and transported the material by truck.

Broward.—The County ranked seventh in mineral production value. Limestone was crushed at 10 quarries by 7 companies, compared with 12 quarries in 1964; total crushed limestone output was 4.6 million tons valued at $5.1 million. Essentially all of the stone was used for roadstone and in concrete and was transported by truck. The three leading producing companies were Houdaille-Duval-Wright Co.

(Deerfield, Wright and Green quarries), Maule Industries, Inc. (Prospect quarry), and Hollywood Quarries, Inc. (Broward County quarry).

Sand for building and fill uses was mined by four companies; total output was 328,000 tons valued at $320,000.

Citrus.—General Portland Cement Co. crushed limestone at its Citrus County quarry and also mined miscellaneous clay at its county mine for use in manufacturing cement at its Tampa plant; output and value increased over 1964 figures. Florida Lime Works, Inc. (Dunnellon quarry), formerly Middleton Mining Co., Inc., and Crystal River Quarries, Inc. (Crystal River quarry) crushed limestone for agricultural purposes. Of the total crushed stone produced, including that used for cement, 13 percent was transported by railroad and the remainder by truck. Soft-rock phosphate was mined by three companies; total marketable production was 19,000 tons valued at $163,000, a slight increase over 1964 figures. Most of the material was used for agricultural purposes.

Clay.—The county was fourth in value of mineral production. E. I. du Pont de Nemours & Co., Inc. (Trail Ridge and Highland mines) mined ilmenite, zircon, and staurolite; zircon output increased, but ilmenite and staurolite shipments decreased below 1964 levels. All-Florida Sand Co. (Keystone Heights mine) mined building sand; output and value increased considerably over 1964 figures. Florida Solite Corp. (Russell mine), near Green Cove Springs, mined miscellaneous clay for use in manufacturing lightweight aggregate products; output and value decreased markedly. Tomes Peat Humus Co. mined humus peat at its mine near Keystone Heights; output and value was about the same as in 1964. The material was used principally for soil improvement purposes.

Collier.—The County ranked tenth in mineral production value. Humble Oil and Refining Co. produced crude petroleum from its Sunniland Field; production and value more than doubled compared with 1964 figures. Natural gas production, reported as a preliminary figure, increased only slightly over that of 1964. Limestone was crushed at four quarries; total output was 606,000 tons valued at $532,000. Most of the material was used for roadstone and concrete, but a small quantity was used for agricultural purposes.

Dade.—The county ranked third in value of mineral production. Total shipments of cement decreased slightly below 1964 figures. General Portland Cement Co. (Everglades mill) and Lehigh Portland Cement Co. (Miami mill) shipped both masonry and portland cement and crushed limestone for use in its manufacture; output and value increased. Lehigh acquired a large user of cement, Acme Concrete Co. of Miami and was concentrating production at its Miami plant as a result of closing another of its mills in Flagler County. Thirteen quarries crushed limestone compared with 16 in 1964. Total output was 9.4 million tons valued at $9.9 million, compared with 10.1 million tons valued at $9.7 million in 1964. Most of the stone went into concrete and roadstone uses; more than 1 million tons went into "other uses" and a small tonnage was used for railroad ballast. About two-thirds of the total tonnage was transported by truck and the remainder by railroad. The three leading quarries were Seminole Rock Products, Inc. (Medley quarry), Lehigh Portland Cement Co. (Dade County quarry), formerly Ideal Crushed Stone Co., and Maule Industries, Inc. (Pennsuco quarry), formerly listed as Ponce Products Corp. All three quarry outputs established new records.

Sand and gravel was mined by three companies for fill, paving, lawn dressing, and building uses; most of the sand was transported by truck. W. R. Grace & Co., formerly Perlite, Inc., expanded perlite at its plant near Hialeah, for use in building plaster, insulation, concrete aggregate, soil conditioning, and filler. The City of Miami (Hialeah limekiln) produced 28,000 tons of regenerated lime valued at $416,000 for use as a water softening and purification agent in its municipal water plant.

Duval.—Titanium Alloy Manufacturing Division of National Lead Co. (Skinner mine) produced ilmenite, rutile, zircon, and monazite; shipments and value of all commodities decreased. The company reported that the mine closed during the year; Humphreys Mining Co., mining contractor, had mined the Skinner tract for National Lead Company since 1944. Houdaille-Duval-Wright Co. dredged oystershell and crushed shell at its White Shell

plant near Jacksonville; the material was used in concrete and roadstone and crushed for poultry grit. Kaiser Gypsum Co. calcined crude gypsum ore from Nova Scotia at its new Dames Point plant near Jacksonville. The company reported for the first year. Use of the material was principally in the manufacture of wallboard, building plaster, and other building products. Chemrock Corp. expanded crude perlite at its plant near Jacksonville, for use in building plaster, concrete aggregate, soil conditioning, and filler. Zonolite Co. exfoliated vermiculite at its Jacksonville plant for use as loose-fill insulation, building plaster, concrete aggregate, and other uses; most of the raw material was shipped into the State from South Carolina. Owens-Illinois Glass Co. produced 60,000 tons of regenerated lime for use in the manufacture of paper at its Jacksonville plant.

Escambia.—Sand and gravel was produced at six mines; output was 352,000 tons of sand valued at $311,000 and 87,000 tons of gravel valued at $109,000. Total tonnage mined was 439,000 tons compared with 562,000 in 1964. The three leading producers were Escambia County Highway Department (Escambia mine), Clark Sand Co. (Pensacola mine), and Edward M. Chadbourne, Inc. (Pensacola mine). Most of the material was used for building and paving purposes and was transported principally by truck. Miscellaneous clay was mined by Taylor Brick and Tile Co. at its Barth mine for use in the manufacture of building brick and other heavy clay products.

Flagler.—The county ranked eighth in mineral production value. Lehigh Portland Cement Co. produced masonry and portland cement at its Bunnell plant; the company crushed limestone from its Coquina mine for use in manufacturing the cement; output and value was only slightly below 1964 figures. Near yearend the company announced that it would close its Bunnell plant and concentrate cement production at its Miami plant. This company was the only mineral producer in the county, and output was substantial.

Gadsden.—The county ranked sixth in value of mineral production and was the only county that produced fuller's earth. Total output and value of fuller's earth was at an alltime high. Producers, listed in order of output, were Minerals and Chemicals Phillip Corp. (Midway and La-Camelia mines), Floridin Co. (Quincy mine), and Magnet Cove Barium Corp. (Havana mine). Minerals and Chemicals Phillip announced a new mine under development during the year that would begin production in 1966. Florida Gravel Co. (Chattahoochee mine) mined sand and gravel; output and value increased over 1964 figures. Most of the sand was used for building purposes and the gravel for paving uses. Appalachee Correctional Institute (Chattahoochee mine) mined a small quantity of miscellaneous clay for use in the manufacture of building brick; output and value continues to decrease.

Gilchrist. — Loncala Phosphate Co. (Mona mine) mined soft-rock phosphate for agricultural uses; output and value increased over 1964 figures. The company also has a soft-rock phosphate mine and plant in Marion County.

Gulf.—The county ranked ninth in value of mineral production. Michigan Chemical Corp. recovered magnesium compounds from sea water and produced primary lime for use in its recovery plant at Port Saint Joe. Port Saint Joe Paper Co. produced regenerated quicklime at its Port Saint Joe plant for use in paper manufacture; output was 75,000 tons valued at $1.1 million, a substantial increase over that of 1964. Michigan Chemical Corp. announced a $2.5 million expansion and modernization program to increase output of magnesium compounds to 200 tons per day and also announced the installation of a new rotary kiln for calcining oystershell in the manufacture of lime, an important commodity in the company process.

Hamilton.—Occidental Corp. of Florida, a subsidiary of Occidental Petroleum Corp. placed its new land-pebble phosphate mine into operation and reported production for the first year. Near the end of the year, the company announced that mine capacity would be doubled to 3 million tons per year, with corresponding new plant capacity. The company was constructing a loading terminal on the St. John River near Jacksonville for barge and ship transportation of phosphate rock.

Hendry.—Ortona Sand Co. Inc. (Labelle mine) mined building and paving sand; output and value increased over 1964 figures. Most of the sand was transported by truck. Hendry County Highway De-

partment crushed limestone for use in its road maintenance program; all of the material was transported by truck.

Hernando. — Hernando County ranked fifth in value of mineral production. The county, with nine quarries, was also one of the leading crushed stone producing counties in the State; total output was 6.8 million tons valued at $8.9 million, an increase in output over that of 1964. The three leading quarries, listed in order of output, were Florida Rock Products Corp. (Diamond Hill quarry), the largest single producing quarry in the State, Camp Concrete Rock Co. (Gay quarry), and Brooksville Rock Co. (Broco quarry). Coastal Rock Co. (Sasser quarry) reported for the first year. Principal use of the stone was for roadstone and concrete; a small percentage was used for railroad ballast; and other uses. Fifty-four percent of the stone was transported by railroad and the remainder by truck. Chemical Lime, Inc. (Brooksville limekiln) produced primary lime from crushed limestone supplied by Camp Concrete Rock Co.'s Gay quarry; output and value decreased below 1964 figures.

Hillsborough.—The county ranked second in value of mineral production. Marketable production of phosphate rock increased over that of 1964; two companies, American Cyanamid Co. (Sydney mine) and Agrico Chemical Co. division of Continental Oil Co. (Boyette mine), mined and processed land-pebble phosphate. General Portland Cement Co. produced masonry and portland cement at its Tampa mill; raw materials for the manufacture of the cement were shipped from other counties. Bay Dredging and Construction Co. dredge and crushed oystershell from State lease No. 1703; most of the shell was used for concrete and roadstone. Edgar Plastic Kaolin Co. (Plant City mine) mined sand for construction and industrial uses; output and value increased considerably above 1964 figures, establishing a record year for the operation. J. E. Stearns Peat Co. and A. J. Stearns produced humus peat for soil improvement purposes; output and value remained about the same as in 1964. National Gypsum Co. calcined gypsum at its Tampa plant for the second year; most of the Nova Scotia crude ore was processed for use in wallboard, plaster, and other building products. Jim Walter Corp., Tampa, obtained the Celotex Corp. and announced that main offices and research facilities of Celotex would be concentrated in Tampa. Zonolite Division of W. R. Grace & Co. exfoliated vermiculite at its Tampa plant for use in building plaster, insulation, concrete aggregate, and other uses; the crude vermiculite was from South Carolina. Surco Manufacturing Co., formerly Verlite Co., also exfoliated vermiculite at its Tampa plant for use in building products; output and value increased over 1964 figures.

Indian River. — Florida Minerals Co. produced ilmenite, rutile, and zircon from beach sands at its Vero mine; both output and value decreased below 1964 figures. The company reported late in the year that its operation would close. Airlite Processing Corp. of Florida expanded perlite at its processing plant near Vero Beach for use in building plaster and concrete aggregate; raw material for the operation was from out-of-State sources. Indian River County Highway Department mined 28,000 tons of paving sand valued at $28,000, for use in its road maintenance program.

Jackson. — Green Valley Lime Co. crushed limestone for agricultural purposes; the material was ground at the company's plant near Marianna. All of the material was transported by truck and applied directly to the soil.

LaFayette. — Williston Shell Rock Co. (Chancey quarry) and LaFayette County Highway Department crushed limestone for use in concrete and roadstone; output and value increased considerably over 1964 figures. All of the material was transported by truck.

Lake.—Sand was mined by five companies; total output was 1.4 million tons valued at $974,000, compared with 1.5 million tons valued at $1.1 million in 1964. The sand was used for building and paving purposes and was transported principally by truck.

Lee. — Limestone was crushed by two quarries for use in concrete and roadstone; output and value increased over 1964. West Coast Rock Co. (Fort Myers quarry) and Harper Bros. (Estero quarry) crushed limestone and transported it by truck. Fort Myers Shell Co. dredged oystershell from State lease No. 1917 for use in concrete and roadstone; output and value increased

over 1964 figures. All of the material was transported from dock to markets by truck.

Leon. — Roberts Sand Co. (Norfleet mine) and Middle Florida Sand Co. (Tallahassee mine) mined building, paving, and fill sand for local consumption; output and value increased slightly over 1964 figures. All of the sand was transported by truck.

Levy.—Limestone was crushed at three quarries compared with four in 1964. Total output was 356,000 tons valued at $674,000, an increase over 1964 figures. Producers, listed in order of output, were Dixie Lime & Stone Co. (Lebanon No. 4 quarry), W & M Construction Co. (Raleigh quarry), and Connell & Shultz (Williston quarry). Ralph Swiney did not report production of agricultural limestone from the Miller quarry and was assumed out of business during the year. Dixie Lime & Stone crushed stone for agricultural purposes, and the other two companies crushed stone for concrete and roadstone uses. About 70 percent of the material was transported by truck and the remainder by railroad.

Manatee. — Florida Southern Dolomite, Ltd. (Palmetto quarry) crushed limestone for agricultural purposes; the material was ground at a nearby plant. Output and value decreased below 1964 figures. Lee A. Thorpe Construction Co. (Bradenton quarry), reporting for the first year, crushed limestone for use in concrete and roadstone. Fifty-three percent of the combined output of the two companies was transported by truck, and the remainder by railroad.

Marion.—Eight quarries crushed limestone; total output was 1.7 million tons valued at $1.8 million. Most of the material was used for concrete and roadstone, and a small percentage was produced by one company for agricultural purposes. About 90 percent of the stone was transported by truck and the remaining 10 percent by railroad and waterway. Dixie Lime & Stone Co., the largest producer in the county, operated the Lehigh, Reddick and Bellview quarries. Output from the Lehigh quarry was the largest in the county; all three quarries reported for the first year. The next two leading quarries were Cummer Lime and Manufacturing Co. (Kendrick quarry) and Ocala Lime Rock Corp. (No. 7 Kendrick quarry). Dixie Lime & Stone announced during the year that it had purchased most of the lime rock facilities of Cummer Lime and Manufacturing Co., excluding the concrete block facilities which was sold to other interests. The City of Ocala and the Marion County Highway Department operated one quarry each and produced 126,000 tons of limestone valued at $97,000 for use in concrete and roadstone; output was about the same as in 1964. Kibler-Camp Phosphate Co., the only hard-rock phosphate producer in the State, mined 70,000 tons of marketable product valued at $693,000. Loncala Phosphate Co. mined soft-rock phosphate at its Minehead mine and processed the material at a nearby plant for agricultural uses; output and value decreased below 1964. Loncola also mined soft-rock phosphate in Gilchrist County and was the largest producer of this material in the State. National Silica Corp. (Lynn mine) mined industrial sand at about the same rate as in 1964. Dixie Lime & Stone Co. produced primary lime at its No. 1 Limekiln only during a part of the year. The company announced that its old limekiln would be closed, and a new modern 200-ton-per-day kiln would be constructed near the company's Coleman No. 2 quarry near Sumterville, Sumter County. The new kiln was scheduled to become operational in 1966.

Monroe.—Charley Toppino & Sons, Inc. (Stock Island quarry) and Alonzo Cothron, Inc. (Cothron quarry) crushed limestone for use in concrete and roadstone and other uses; output and value increased considerably over 1964 figures. All of the stone was transported by truck. Key Largo Quarries, Inc., obtained the old dimension stone quarry near Windley Keys from a Miami-based concern and reactivated the operation during the year. The new company planned to quarry, polish, and ship dimension limestone to northern markets.

Orange.—Orange County Highway Department mined paving sand for use in its highway maintenance program; total output was 152,000 tons valued at $103,000. All of the sand was transported by truck. Daetwyler Peat, Orlando, and Raymond Johnson, Plymouth produced peat for general soil improvement and earthworn cul-

ture purposes. Output and value was about the same as in 1964.

Palm Beach.—Belle Glade Rock Co. (Belle Glade quarry) crushed limestone for roadstone and concrete; output and value increased considerably over 1964 figures. All of the stone was transported by truck. Palm Beach County Highway Department crushed 156,000 tons of limestone valued at $125,000 and 130,000 tons of paving sand valued at $72,000, both for use in its road maintenance program; both materials were transported by truck. Zonolite Division of W. R. Grace & Co. exfoliated crude vermiculite at its Boca Raton plant; the crude vermiculite was shipped from South Carolina and was processed for use in concrete aggregate, building plaster, insulation, and other building uses. Output and value increased over 1964 figures.

Pinellas.—Benton and Co., Inc., dredged oystershell from State lease No. 1788 for use in concrete and roadstone; output and value decreased below 1964 figures. The shell was transported from dock to markets principally by truck. Florida Washed Sand Co. mined sand at its St. Petersburg mine; output and value decreased below 1964 figures. The sand was used for building purposes and was transported by truck.

Polk.—Polk County was again, as in 1964, the leading county in value of mineral production. The county was the principal phosphate producing county and led the State in sand and gravel output. The phosphate industry, both mining and processing, continued to grow at a rapid pace. New mines and new facilities to handle increased production were announced durin the year. The County and industry continued to lead the State in land reclamation measures through its organization of phosphate producers, and new programs were in progress. The phosphate industry was primarily responsible for the high economic level in the county, making it one of the most heavily industrialized areas in the State. Land-pebble phosphate rock was produced at 15 mines by 11 companies; 1 company operated 3 mines, and 2 companies operated 2 mines each. Total marketable production was 17.0 million tons valued at $125.1 million, compared with 15.2 million tons valued at $106.9 million in 1964. Leading producers in the county, listed in order of total company output, were International Minerals & Chemical Corp. (Achan, Noralyn and Dredge mines), Mobil Chemical Co. Division of Socony-Mobil Oil Co., and Agrico Chemical Co. Division of Continental Oil Co. American Cyanamid Co. and Agrico Chemical Co. also operated mines and plants in adjoining Hillsborough County.

Sand was mined at 10 mines compared with 11 mines in 1964; total output was 2.4 million tons valued at $2.1 million, a decrease in both output and value compared with 1964 figures. One company mined sand for industrial uses and the other mine produced construction sand. The three leading producers, listed in order of output, were Standard Sand and Silica Co. (Standard mine), Oak Ridge Sand Co. (Achan mine), and Mammoth Sand Co. (Lake Wales mine).

Putnam.—Sand was mined at four mines compared with five mines in 1964; total output was 527,000 tons valued at $378,000, compared with 487,000 tons valued at $380,000 in 1964. Both industrial and construction sand was produced; 75 percent of the sand was transported by truck and the remainder by railroad. Edgar and Cyprus mines recovered kaolin at an increased rate. Peat was produced by Traxler's Peat Co. at Florahoma; the material was used for general soil improvement purposes. Hudson Pulp and Paper Co. (Palatka limekiln) produced 87,000 tons of regenerated lime valued at $1.3 million, for use in paper manufacture.

St. Lucie.—Ft. Pierce Sand & Materials, Inc., operated two sand mines and produced material for building and fill purposes. Most of the sand was unprocessed and transported by truck. Combined output and value decreased below 1964 figures.

Sarasota.—Venice Dolomite Co, formerly West Coast Dolomite Division of West Coast Rock Co., crushed limestone for agricultural purposes; the limestone was processed at the company's plant near Venice. Ninety-nine percent of the stone was transported by truck.

Sumter.—Limestone was crushed at six quarries by three companies, three quarries more than in 1964. Dixie Lime & Stone Co. (St. Catherine quarry) and St. Catherine Rock Co. reported output for the

first year. The Coleman No. 1 and Mabel quarries of Dixie Lime was reported closed during the year.

Suwannee.—Four quarries crushed limestone for roadstone, concrete, railroad ballast, agricultural purposes, and other uses; total output and value increased slightly over 1964 figures. Sixty-one percent of the stone was transported by railroad, and the remainder by truck. The Dixie Lime & Stone Co. (Mulkey quarry) was reported closed during the year.

Taylor.—Williston Shell Rock Co. (Perry quarry) crushed limestone for concrete and roadstone uses; output and value decreased below 1964 figures. All of the stone was transported by truck. Buckeye Cellulose Corp. (Foley limekiln) produced 100,000 tous of regenerated lime for use in the manufacture of alkalies and paper. Output and value decreased below 1964 figures.

Volusia.—White Sand & Materials Corp. (New Smyrna Beach mine) mined sand for fill purposes; output and value remained about the same as in 1964. Tamoka Peat & Rock Co., Inc., mined a small tonnage of peat for soil improvement purposes; output and value decreased considerably below 1964 figures.

Wakulla. — The Forest Service of the U.S. Department of Agriculture mined 20,000 tons of sand valued at $17,000 for paving purposes from its Wakulla County mine; output and value decreased considerably below 1964 figures.

Walton.—Radcliff Materials, Inc., a Division of Southern Materials Corp., Mobile, Ala., dredged and crushed oystershell from State lease No. 1718 for use in roadstone and concrete; output and value decreased below 1964 figures. Adams Sand Co., Inc. (Mossy Head mine) mined sand for building uses; output and value increased considerably over 1964 figures. All of the sand was transported by truck.

The Mineral Industry of Georgia

This Chapter has been prepared under a cooperative agreement for the collection of mineral data, except mineral fuels, between the Bureau of Mines, United States Department of the Interior, and the Department of Mines, Mining and Geology, Georgia.

By James L. Vallely [1] and A. S. Furcron [2]

Georgia's mineral production value continued its long steady upward trend in 1965 and reached $135.2 million, 6 percent above the 1964 record. Increases were noted in most minerals; exceptions were coal, peat, sand and gravel, and crushed slate. Initial production of titanium and zircon concentrate, and higher production values for cement, kyanite, bauxite, and iron ore contributed to the record high production. Nonmetallics made up almost 98 percent of the value of the State's mineral production, and metals and mineral fuels 2 percent.

Georgia ranked first among the States in output of kaolin, with 78 percent of the national total, second in fuller's earth, with 31 percent, third in bauxite, third in scrap mica with 11 percent, third in barite, and fifth in feldspar. Georgia also was first in output of crushed granite, with 29 percent of the national total, crushed marble, dimension marble, and second in output of dimension granite, with 24 percent.

Leading companies in the mineral industries were Minerals & Chemicals Philipp Corp. (kaolin and fuller's earth), Georgia Marble Co. (marble, granite, and feldspar),

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Table 1.—Mineral production in Georgia [1]

Mineral	1964 Quantity	1964 Value (thousands)	1965 Quantity	1965 Value (thousands)
Barite thousand short tons	109	$2,022	W	W
Clays do.	4,365	58,899	4,607	$63,158
Coal (bituminous) do.	4	15	------	------
Iron ore (usable) thousand long tons, gross weight	354	1,752	424	2,170
Mica:				
Scrap thousand short tons	W	W	13	W
Sheet pounds	------	------	2,793	([2])
Sand and gravel thousand short tons	r 3,588	r 3,594	3,675	3,588
Stone do.	r 22,822	r 46,428	23,421	48,265
Talc short tons	40,400	135	44,800	313
Value of items that cannot be disclosed: Bauxite, cement, feldspar, kyanite, peat, titanium concentrate (1965), zircon concentrate (1965), and values indicated by symbol W	XX	14,292	XX	17,688
Total	XX	r 127,137	XX	135,182

r Revised. XX Not applicable.
W Figure withheld to avoid disclosing individual company confidential data.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Less than ½ unit.

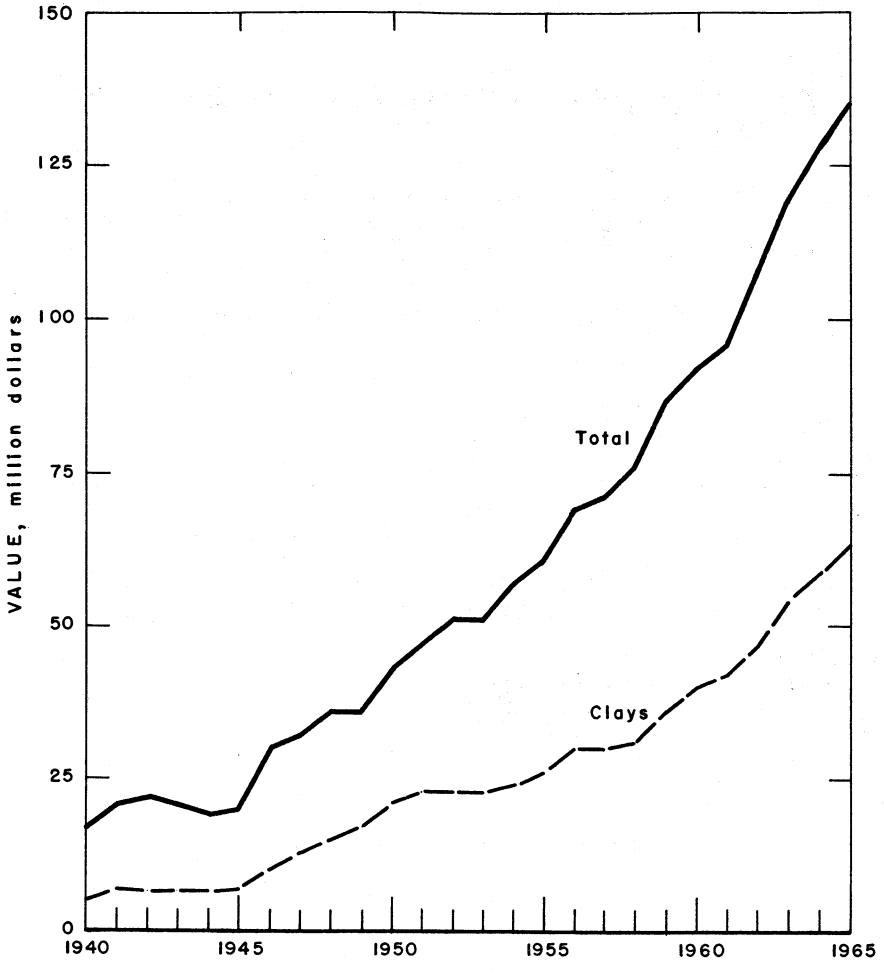

Figure 1.—Value of clays, and total value of mineral production in Georgia.

J. M. Huber Corp. (kaolin), Freeport Kaolin Co. (kaolin), and Vulcan Materials Co. (granite).

Trends and Developments. — Record-breaking production of construction materials continued in 1965. Many new quarries and plants were placed in production during the year. Burns Brick Co. constructed a new plant and increased its capacity to 85 million bricks per year. The new addition, the first European style plant in America, featured "souring" of the clay and soft extrusion.[3] Cherokee Brick Co. constructed a new addition to its plant, increasing its production 33⅓ percent. Flintkote Co. began production of wallboard and other building products at its new gypsum mill at Savannah. Georgia Marble Co. acquired three granite quarrying companies: Continental Granite Co., Inc., Elberton City Quarries, Inc., and Hoover Granite Quarries, Inc., together with the

[3] Brick and Clay Record. First European Style Plant in America Underway in Macon, Ga. V. 147, No. 4, October 1965, pp. 36-37.

finishing plant of Granite Manufacturers, Inc., all in the Elberton granite district. The companies will operate as the Continental Granite Division.

Table 2.—Value of mineral production in constant 1957–59 dollars

(Thousands)

Year	Value
1956	$70,275
1957	71,648
1958	76,575
1959	86,007
1960	90,817
1961	93,686
1962	101,528
1963	118,410
1964	r 120,063
1965	126,681

r Revised.

Six new granite quarries, three each of dimension and crushed stone, reported initial production. A new titanium mining operation with byproduct zircon, the first in the State, began production in Charlton County in south Georgia. Bituminous coal production, of decreasing importance for many years, ceased completely in 1965.

Legislation and Government Programs.—Exploration for phosphate rock and other minerals, under the direction of the Georgia Department of Mines, Mining and Geology, has been started in southern Georgia with a special appropriation of $250,000 from the State Legislature.

Reports relating to the State's minerals were published by the Bureau of Mines and the Geological Survey.[4]

[4] Callahan, J. T., L. E. Newcombe, and J. W. Geurin. Water in Georgia. U. S. Geol. Survey Bull. 1762, 1965, 88 pp.

LeVan, H. P., E. G. Davis, and F. E. Brantley. Extraction of Manganese From Georgia Umber Ore by a Sulfuric Acid-Ferrous Sulfate Process (In Two Parts). I. Countercurrent Decantation Extraction and Agglomeration of Leached Residue Tests. BuMines Rept. of Inv. 6692, 1965, 21 pp.

O'Neill, James F. Brown Iron Ore Resources: Quitman County, Ga. BuMines Inf. Circ. 8264, 1965, 29 pp.

United States Geological Survey. Bauxite Deposits of the Southeastern United States: F. Springville District, Ga.; G. Andersonville District, Ga.; H. Areas Adjacent to and Between the Springvale and Andersonville Districts, Ga.; I. Warm Springs District, Meriwether Co., Ga.; and J. Irwinton District, Ga. U. S. Geol. Survey Bull. 1199, 1965, 231 pp.

Table 3.—Employment and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-day worked (thousands)	Man-hours worked (thousands)	Number of injuries: Fatal	Number of injuries: Nonfatal	Injury rates per million man-hours: Frequency	Injury rates per million man-hours: Severity
1964:								
Metal	97	165	16	127	----	1	7.89	134
Nonmetal, coal, peat	3,591	307	1,103	8,860	3	221	25.28	2,811
Sand and gravel	425	245	104	875	----	21	23.99	7,219
Stone	2,613	254	663	5,514	1	122	22.31	3,092
Total	6,726	280	1,886	15,376	4	365	24.00	3,141
1965: p								
Metal	255	145	37	301	----	----	----	----
Nonmetal	3,110	314	977	7,856	2	183	23.55	3,041
Sand and gravel	370	195	72	678	1	8	13.27	9,074
Stone	2,910	260	756	6,297	2	125	20.17	2,973
Total	6,645	277	1,842	15,132	5	316	21.21	3,223

p Preliminary.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Barite.—Primary barite was used for well drilling and barium chemicals; crushed and ground barite was used for well drilling, paint and rubber filler. Four producers were active in Bartow County in 1965; the leading producer was Paga Mining Co.

Cement.—Cement ranked third in value in the State's mineral production. Shipments of portland cement increased 2 percent in quantity and 3 percent in value. Masonry cement shipments were also 2 percent higher but increased 4 percent in value. Portland cement producers were: Penn-Dixie Cement Corp., Marquette Cement Manufacturing Co., and Southern Cement Co. Marquette Cement Manufacturing Co. was the only producer of masonry cement. Eighty percent of the portland cement was shipped to Georgia destinations. Out-of-State shipments were principally to Florida (10 percent). Smaller tonnages went to Alabama, North Carolina, South Carolina, and Tennessee. Portland cement shipments went to the following: Ready-mixed concrete plants (61 percent), concrete-product manufacturers (11 percent), highway contractors (5 percent), other contractors (13 percent), building materials dealers (8 percent), and government agencies and other users (2 percent).

Clays.—Clay comprised 47 percent of the total value of mineral production; kaolin alone accounted for more than 42 percent. Kaolin production increased 5 percent in tonnage and value; fuller's earth production increased 29 percent and 38 percent, respectively, in tonnage and value; and miscellaneous clay production increased 3 percent and 7 percent, respectively, in tonnage and value.

Georgia continued to lead the Nation in kaolin production and ranked second in fuller's earth. Kaolin was mined by 17 companies from 28 mines in 8 counties. 6 companies produced fuller's earth from mines in 4 counties, and 11 companies mined miscellaneous clay in 7 counties. In all, clay was produced by 32 companies, with 47 operations in 16 counties. United Clay Mines Corp. was purchased by Cyprus Mines Corp. and became part of its Sierra United Division. M & M Clays was purchased by General Refractories Corp., and Diversey Corp. was sold to General Reduction Corp. General Portland Cement Co. opened a new kaolin pit in Sumter County to supply part of its requirements for the Tampa, Fla. cement plant. J. M. Huber Corp. was building a processing plant at a new kaolin mine near Wrens in Jefferson County. Brief descriptions of the two kaolin processing plants were published.[5] Leading kaolin producers were Minerals & Chemicals Philipp Corp., J. M. Huber Corp., Freeport Kaolin Co., and Georgia Kaolin Co. Principal producers of fuller's earth were Minerals & Chemicals Philipp Corp., Waverly Petroleum Products Co., and Georgia-Tennessee Mining & Chemical Co. Principal producers of miscellaneous clay were Burns Brick Co., Chattahoochee Brick Co., Cherokee Brick & Tile Co., Merry Bros. Brick & Tile Co., Oconee Clay Products Co., and Southern Cement Co.

Feldspar.—The Feldspar Corp. produced feldspar flotation concentrate at its Monticello mill from feldspathic rock mined in Jasper County. Consolidated Quarries Division of Georgia Marble Co. produced a feldspar-quartz flotation concentrate, a by-product of fines from granite-crushing operations.[6] Production and value of feldspar were higher than in 1964; the flotation concentrate was used for manufacture of glass and pottery.

Gypsum.—Imported crude gypsum was calcined at two plants in Savannah, Chatham County, and one at Brunswick, Glynn County, for use in manufacturing wallboard and other gypsum products. The calcined production was 431,000 tons valued at $9.25 million.

Kyanite.—Aluminum Silicates, Inc., continued to increase production of kyanite at Graves Mountain, near Lincolnton. Its principal use was in refractories.

[5] Mineral Processing. Handling Kaolin. V. 6, No. 4, April 1965, pp. 32–33.
———. One Plant Serves Five. V. 6, No. 8, August 1965, pp. 32–33.
[6] Pit & Quarry. Georgia Crushed Granite Firm Makes Feldspar-Quartz Mixture. V. 58, No. 2, August 1965, pp. 97–100.

Lime.—Six companies produced regenerated lime; 352,000 tons valued at $6.7 million, an increase of 5 percent in tonnage and 3 percent in value. This lime was produced and reused principally by pulp and paper companies, by burning calcium carbonate sludge in rotary kilns. Data on regenerated lime are not included in table 1 of this chapter.

Mica.—Scrap mica was produced in Cherokee, Hart, and Jasper Counties. Grinding plants were operated by the Ruberoid Co. at Hartwell and Thompson-Weinman Co. at Cartersville. The dry ground mica was used in the paint, roofing, and rubber industries. A small quantity of sheet mica, 2,800 pounds of punch and circle, also was mined.

Perlite.—Crude perlite shipped into the State was expanded by Zonolite Division of W. R. Grace & Co. at its plant at Atlanta. Production and value were substantially lower than in 1964.

Table 4.—Kaolin sold or used by producers, by counties

County	1964		1965	
	Short tons	Value	Short tons	Value
Twiggs	1,201,922	$27,562,292	1,146,656	$27,259,132
Washington	1,004,184	22,451,656	1,145,865	25,154,331
Wilkinson	W	W	188,337	3,213,509
Other counties [1]	378,049	4,505,931	240,384	1,783,838
Total	2,584,155	54,519,879	2,721,242	57,410,810

W Withheld to avoid disclosing individual company confidential data; included with "Other counties."
[1] Includes Baldwin, Floyd, Houston (1965), Richmond, and Sumter Counties, and counties indicated by symbol W.

Table 5.—Kaolin sold or used by producers, by uses

Use	1964			1965		
	Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per ton
Pottery and stoneware:						
Whiteware	92,488	$1,992,174	$21.54	119,624	$2,515,100	$21.03
Refractories: Firebrick and block	173,548	1,468,777	8.46	221,309	1,567,182	7.08
Fillers:						
Paper filling	685,654	14,788,464	21.56	618,338	11,617,715	18.79
Paper coating	1,027,597	24,455,922	23.80	1,162,026	31,171,875	26.83
Rubber	105,833	1,506,807	14.24	83,128	904,350	10.88
Paint	61,761	1,442,945	23.36	77,758	1,815,900	23.35
Fertilizers	6,203	122,848	19.80	9,718	172,000	17.70
Insecticides and fungicides	6,825	85,280	12.49	W	W	W
Plastics, organic	W	W	W	29,137	535,300	18.37
Portland and other hydraulic cements	W	W	W	46,803	78,666	1.68
Chemicals	15,332	331,740	21.64	16,942	366,600	21.64
Exports	136,102	3,255,295	23.92	142,186	3,401,200	23.92
Other uses [1]	272,812	5,069,627	18.58	194,273	3,264,922	16.81
Total	2,584,155	54,519,879	21.10	2,721,242	57,410,810	21.10

W Withheld to avoid disclosing individual company confidential data; included with "Other uses."
[1] Includes stoneware; art pottery, flowerpots, and glaze slip (1964); enameling; floor and wall tile; mortar; glass refractories; foundries, steelworks; sagger, pins, stilts and wads; other refractories; linoleum and oilcloth; plaster and plaster products (1964); other fillers; catalysts; other uses; and uses indicated by symbol W.

Table 6.—Miscellaneous clay sold or used by producers, by counties

County	1964		1965	
	Short tons	Value	Short tons	Value
Fulton	323,730	$168,700	344,946	$207,000
Gordon	29,598	14,500	28,851	17,300
Other counties [1]	1,267,935	790,621	1,305,521	819,657
Total	1,621,263	973,821	1,679,318	1,043,957

[1] Includes Bibb, Columbia (1965), Floyd, Houston (1964), Polk, and Richmond counties.

Sand and Gravel.—Sand and gravel production, ranking fourth in the State's minerals, increased 2 percent. Production of structural and paving sands together increased 9 percent in tonnage and 12 percent in value; production of industrial and other sands decreased 35 percent in tonnage and 27 percent in value.

Twenty-one companies produced sand only from 24 pits in 21 counties, and 5 companies mined both sand and gravel in 4 counties. The principal producing counties were Muscogee, Thomas, Crawford, Effingham, and Bibb. Atlantia Sand & Supply Co. (Crawford County), Dawes Silica Mining Co., Inc. (Dougherty, Effingham, Long, and Thomas Counties), Taylor County Sand Co. (Taylor County), Howard Sand Co. (Taylor County), and Brown Bros. (Talbot County) were the principal producers. Of the 29 sand and gravel plants, 1 produced more than 600,000 tons, 6 between 200,000 and 400,000 tons, 6 between 100,000 and 200,000 tons and 16 less than 100.000 tons.

Stone.—Stone ranked second in value in the State's mineral production. Total crushed stone production increased 3 percent in tonnage and 3 percent in value; crushed granite production was up 2 percent in both tonnage and value; crushed limestone and crushed marble production decreased 3 percent and 6 percent, respectively, in tonnage but increased 2 percent and 6 percent, respectively, in value. Crushed sandstone production increased 40 percent in tonnage and 44 percent in value while crushed slate production decreased 9 and 10 percent respectively in quantity and value.

Dimension granite production increased 13 percent in tonnage and 12 percent in value; dimension marble production, although considerably higher in quantity, was relatively little changed in value. Only small quantities of dimension limestone and sandstone were quarried; output of dimension sandstone was equal to that of 1964 but dimension limestone production was only one-fourth of that produced the previous year.

Table 7.—Sand and gravel sold or used by producers, by counties

(Thousand short tons and thousand dollars)

County	1964		1965	
	Quantity	Value	Quantity	Value
Brooks	35	$21	----	----
Cherokee	1	2	1	$1
Cook	111	127	137	106
De Kalb	19	27	W	W
Dougherty	168	158	142	133
Montgomery	30	22	38	56
Richmond	40	35	W	W
Telfair	15	15	8	9
Ware	19	15	W	W
Undistributed [1]	r 3,150	r 3,172	3,349	3,283
Total	r 3,588	r 3,594	3,675	3,588

r Revised.
W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] Includes Bibb, Chatham, Crawford, Effingham, Evans, Fulton, Glynn, Greene, Long, Muscogee, Talbot, Taylor, and Thomas Counties, and counties indicated by symbol W.

Table 8.—Sand sold or used by producers, by uses

(Thousand short tons and thousand dollars)

Use	1964			1965		
		Value			Value	
	Quantity	Total	Average per ton	Quantity	Total	Average per ton
Sand:						
Structural	2,634	$1,998	$0.76	2,854	$2,231	$0.78
Paving	273	233	.85	304	263	.87
Fill	55	32	.58	32	14	.44

Stone was produced at 85 quarries in 35 counties by 52 companies and 2 Government-and-contractor operations. Dimension granite was produced in 5 counties and 35 quarries by 26 companies; crushed granite in 18 counties from 24 quarries by 11 companies, and crushed limestone in 8 counties by 11 companies and 2 Government-and-contractor operations. Crushed and dimension marble was produced in Pickens County and crushed marble only in Chattooga and Gilmer Counties. Crushed slate was mined in Bartow and Polk Counties, quartzite in Richmond County, by-product quartz in Jasper County, crushed sandstone in Polk County, and dimension sandstone in Pickens County.

Leading producers of crushed granite were Vulcan Materials Co. (six quarries), Weston & Brooker Co. (two quarries), Dixie Lime & Stone Co. (four quarries), and Hitchcock Corp. (two quarries). Leading producer of dimension granite for building stone and curbing and flagging was Davidson Granite Co., Inc.; for monumental stone, Coggins Granite Industries, Inc., Comolli Granite Co., and Georgia Marble Co. Marble Products Co. produced crushed marble and Georgia Marble Co. produced both crushed and dimension marble. Excluding the cement companies, the principal producers of crushed limestone were Dalton Rock Products Co., Lambert & Lambert Stone Co. Inc., Southeastern Highway Contracting Co., and Patton Rock Products Corp. Superior Stone Co. was the only producer of quartzite. Ruberoid Co. mined and crushed slate for roofing granules. Georgia Lightweight Aggregate Co. quarried slate for the manufacture of lightweight aggregates.

Roofing Granules.—Natural roofing granules were produced in Bartow County (slate) and Gilmer and Pickens Counties (marble). Total production was 69,000 tons valued at $700,000.

Talc.—Georgia Talc Co., Murray County, the only producer, mined and ground talc for asphalt, insecticides, roofing, rubber, paint, paper, and miscellaneous uses. Output of ground talc was unchanged from that of 1964.

Vermiculite.—W. R. Grace & Co., Zonolite Division, at its Atlanta plant, exfoliated crude vermiculite shipped into the State. Production was little changed from that of 1964, but value was 5 percent higher.

Table 9.—Dimension granite sold or used by producers, by counties

County	1964			1965		
	Cubic feet	Short tons (equivalent)	Value	Cubic feet	Short tons (equivalent)	Value
DeKalb	890,504	73,911	$1,157,951	845,637	69,284	$1,178,685
Elbert	639,829	53,107	1,625,514	766,409	63,612	1,860,080
Hancock	36,160	3,001	56,160	17,924	1,488	26,886
Other counties [1]	455,087	37,772	843,760	659,537	54,741	1,040,988
Total	2,021,580	167,791	3,683,385	2,289,507	189,125	4,106,639

[1] Includes Madison and Oglethorpe counties.

Table 10.—Crushed granite sold or used by producers, by uses

Use	1964			1965		
		Value			Value	
	Short tons	Total	Average per ton	Short tons	Total	Average per ton
Concrete and roadstone	r 14,844,836	r $20,299,543	$1.37	15,132,245	$21,151,919	$1.40
Railroad ballast	W	W	W	1,167,099	1,449,195	1.24
Riprap	278,241	512,955	1.84	249,502	405,702	1.63
Other uses [1]	1,699,709	2,378,944	1.40	636,438	669,916	1.05
Total	r 16,822,786	r 23,191,442	1.38	17,185,284	23,676,732	1.38

r Revised.

W Withheld to avoid disclosing individual company confidential data; included with "Other uses."

[1] Includes stone sand, poultry grit, filter stone, fertilizer filler, other uses, and uses indicated by symbol W.

Table 11.—Dimension granite sold or used by producers, by uses

Use	1964			1965		
		Value			Value	
	Cubic feet	Total	Average per cubic foot	Cubic feet	Total	Average per cubic foot
Rough monumental	944,547	$1,669,308	$1.77	1,368,896	$2,583,586	$1.89
Rubble	512,662	109,377	.21	546,337	120,496	.22
Curbing and flagging	293,309	551,030	1.88	280,000	576,076	2.06
Dressed monumental	100,139	712,200	7.11	W	W	W
Rough construction	29,482	45,044	1.53	------	------	------
Other uses [1]	141,441	596,426	4.22	94,274	826,481	8.77
Total	2,021,580	3,683,385	1.82	2,289,507	4,106,639	1.79

W Withheld to avoid disclosing individual company confidential data; included with "Other uses."

[1] Includes architectural stone and uses indicated by symbol W.

Table 12.—Crushed limestone sold or used by producers, by uses

Use	1964			1965		
		Value			Value	
	Short tons	Total	Average per ton	Short tons	Total	Average per ton
Concrete and roadstone	2,396,150	$2,958,201	$1.23	2,139,537	$2,929,238	$1.37
Agstone	W	W	W	189,155	331,457	1.75
Other uses [1]	1,048,147	1,699,632	1.62	1,014,960	1,517,261	1.49
Total	3,444,297	4,657,833	1.35	3,343,652	4,777,956	1.43

W Withheld to avoid disclosing individual company confidential data; included with "Other uses."

[1] Includes cement, riprap, fluxing stone (1965), railroad ballast, other uses, and uses indicated by symbol W.

METALS

Bauxite.—American Cyanamid Co., the only bauxite producer, mined and shipped crude ore from its mines in Bartow, Floyd, and Sumter Counties to its drying plant at Adairsville (Halls Station), Bartow County, and to consumers.

Iron Ore.—Brown iron ore shipments increased 20 percent in tonnage and 24 percent in value. Ninety percent of the output was mined in the southern part of the State below the Fall Line, in Dooly, Marion, Quitman, and Stewart Counties. Fourteen operations were active in this area. Only three companies, including one producer of crude iron oxide pigments, operated in Bartow County, and one in Polk County, both in the northwestern part of the State. Leading producers were Davis Bros., Woodward Mining Co., Lumpkin Mining Co., and Dunbar and Layton, all in Stewart County. Iron ore was shipped to Birmingham and Gadsden, Alabama steel plants.

Crude iron oxide pigment production decreased 2 percent and 6 percent, respectively, in tonnage and value; however, finished pigments increased 13 percent in quantity and 18 percent in value.

Titanium.—Titanium concentrate was produced for the first time in Georgia by Humphreys Mining Co. at a new operation northeast of Folkston in Charlton County.

Zirconium.—Zircon was recovered as a byproduct in the concentration of titanium concentrate at the new Humphreys Mining Co. plant near Folkston.

MINERAL FUELS

Coal (Bituminous).—Following a steady decline in production over many years, no coal was reported from Georgia in 1965.

Peat.—Humus and reed-edge peat were produced in Lowndes County. Output declined more than 50 percent and value by 30 percent.

REVIEW BY COUNTIES

Mineral production was reported from 70 counties; 23 counties had production valued above $1 million and constituted 91 percent of the State total. Eleven counties with production of more than $3 million in descending order were as follows: Twiggs, Washington, Pickens, Fulton, Houston, Polk, Bartow, Richmond, DeKalb, Wilkinson, and Jones.

Baldwin.—General Refractories Co. mined kaolin at the Wood mine for the manufacture of firebrick and block.

Bartow.—Mineral production increased 34 percent. Barite, limestone, slate, and brown iron ore all contributed to this increase. Leading crude barite producers were Paga Mining Co. and New Riverside Ochre Co.; the latter company was also the only producer of crude and finished iron oxide pigments in the State. Thompson-Weinman & Co. operated a grinding plant at Cartersville to produce fillers and extenders from barite, kaolin, marble, mica, and other minerals. Two new quarries reported crushed limestone production, Southeastern Highway Contracting Co., and Bartow County Highway Department. Marquette Cement Manufacturing Co. also quarried limestone for use in its cement plant at Rockmart, Polk County. Ruberoid Co. mined and crushed slate at its Fairmount underground mine for roofing granules and slate flour. American Cyanamid Co. mined bauxite at the Neel mine and operated its bauxite drying plant near Adairsville throughout the year. Joe Mosteller and Southern Machine Co., a new producer, mined brown iron ore.

Bibb.—Burns Brick Co. and Cherokee Brick & Tile Co. mined miscellaneous clay at Macon for brick and other clay products. Sand Suppliers, Inc. mined sand, and Cornell-Young Co. mined sand and gravel for building and paving.

Camden.—St. Marys Kraft Corp. calcined papermill sludge to quicklime for recirculation in the mill process.

Charlton.—Humphreys Mining Co. began production of titanium and zirconium concentrates at a new mine and plant near Folkston.

Chatham.—Sayler-Morine Construction, Inc., mined building and fill sand. Con-

Table 13.—Value of mineral production in Georgia, by counties [1]

County	1964	1965	Minerals produced in 1965 in order of value
Baldwin	W	W	Kaolin.
Bartow	$3,187,986	$4,270,766	Barite, limestone, slate, iron ore, bauxite, iron oxide pigments.
Bibb	W	W	Sand and gravel, miscellaneous clay.
Brooks	21,000	------	
Charlton	------	W	Ilmenite, zircon.
Chatham	W	W	Sand and gravel.
Chattooga	W	W	Marble.
Cherokee	W	W	Mica, sand and gravel.
Clarke	W	W	Granite.
Clayton	W	W	Do.
Cobb	W	W	Do.
Columbia	------	W	Miscellaneous clay.
Cook	127,000	106,000	Sand and gravel.
Crawford	W	W	Do.
Dade	W	W	Limestone.
Decatur	W	W	Fuller's earth.
De Kalb	W	W	Granite, feldspar, sand and gravel.
Dooly	W	W	Iron ore.
Dougherty	158,000	133,000	Sand and gravel.
Douglas	W	W	Granite.
Early	W	W	Limestone.
Effingham	W	W	Sand and gravel.
Elbert	W	W	Granite.
Evans	W	W	Sand and gravel.
Fannin	W	------	
Fayette	W	W	Granite.
Floyd	W	W	Limestone, miscellaneous clay, kaolin.
Forsyth	625,000	------	
Franklin	129,000	------	
Fulton	6,111,048	7,060,700	Cement, granite, miscellaneous clay.
Gilmer	W	W	Marble.
Glynn	W	W	Sand and gravel.
Gordon	14,500	17,300	Miscellaneous clay.
Greene	W	W	Sand and gravel.
Gwinnett	W	W	Granite.
Hall	W	W	Do.
Hancock	W	26,886	Do.
Hart	W	W	Mica.
Henry	W	W	Granite.
Houston	W	W	Cement, limestone, kaolin.
Jasper	576,111	621,352	Feldspar, sandstone, mica.
Jefferson	637,520	W	Fuller's earth.
Jones	W	W	Granite.
Lamar	W	W	Do.
Lincoln	W	W	Kyanite.
Long	W	W	Sand and gravel.
Lowndes	W	W	Peat.
Madison	W	W	Granite.
Marion	W	W	Iron ore.
Mitchell	W	W	Limestone.
Monroe	------	W	Granite.
Montgomery	22,000	56,000	Sand and gravel.
Murray	134,800	313,200	Talc.
Muscogee	W	W	Granite, sand and gravel.
Oglethorpe	596,362	588,088	Granite.
Pickens	W	W	Marble, sandstone.
Polk	W	W	Cement, slate, miscellaneous clay, iron ore, sandstone.
Quitman	------	W	Iron ore.
Rabun	W	W	Granite.
Richmond	W	W	Sandstone, kaolin, miscellaneous clay, sand and gravel.
Stephens	------	W	Granite.
Stewart	684,270	1,602,800	Iron ore.
Sumter	W	W	Bauxite, kaolin.
Talbot	W	W	Sand and gravel.
Taylor	W	W	Do.
Telfair	15,000	9,000	Do.
Thomas	W	W	Fuller's earth, sand and gravel.
Twiggs	W	W	Kaolin, fuller's earth.
Walker	W	W	Limestone.
Ware	15,000	W	Sand and gravel.
Warren	W	W	Granite.
Washington	22,451,656	25,154,331	Kaolin.
Webster	W	------	
Whitfield	W	W	Limestone.

See footnotes at end of table.

Table 13. Value of mineral production in Georgia, by counties [1]—Continued

County	1964	1965	Minerals produced in 1965 in order of value
Wilkinson	W	$3,213,509	Kaolin.
Undistributed	r $91,630,147	92,009,068	
Total	r 127,137,000	135,182,000	

r Revised.

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] The following counties are not listed because no production was reported: Appling, Atkinson, Bacon, Baker, Banks, Barrow, Ben Hill, Berrien, Bleckley, Brantley, Bryan, Bulloch, Burke, Butts, Calhoun, Camden, Candler, Carroll, Catoosa, Chattahoochee, Clay, Clinch, Coffee, Colquitt, Coweta, Crisp, Dawson, Dodge, Echols, Emanuel, Glascock, Grady, Habersham, Haralson, Harris, Heard, Irwin, Jackson, Jeff Davis, Jenkins, Johnson, Lanier, Laurens, Lee, Liberty, Lumpkin, Macon, McDuffie, McIntosh, Meriwether, Miller, Morgan, Newton, Oconee, Paulding, Peach, Pierce, Pike, Pulaski, Putnam, Randolph, Rockdale, Schley, Screven, Seminole, Spaulding, Taliaferro, Tattnall, Terrell, Tift, Toombs, Towns, Treutlen, Troup, Turner, Union, Upson, Walton, Wayne, Wheeler, White, Wilcox, Wilkes, and Worth.

tinental Can Co. calcined papermill sludge to quicklime for reuse in the pulpmill. Flintkote Co. began production of gysum products at its new multimillion dollar plant 3 miles east of Savannah. National Gypsum Co. also calcined crude gypsum at its Savannah building products mill.

Chattooga.—Marble Products Co. of Georgia at Summerville increased its production of crushed marble for terrazo chips.

Cherokee.—Glenn-Ray Corp. and Thompson-Weinman & Co. mined scrap mica. Wolf Creek Sand Co. produced a small tonnage of molding sand.

Clarke.—Gainesville Stone Co. continued operation of its crushed granite quarry at Athens.

Clayton.—Tyrone Rock Division of Dixie Lime & Stone Co. quarried and crushed granite for concrete and roadstone.

Cobb.—Stockbridge Stone Division of Vulcan Materials Co. produced crushed granite for concrete and roadstone at its Kennesaw quarry.

Columbia.—Georgia Vitrified Brick & Clay Co. mined miscellaneous clay for heavy clay products at its Compania mine at Harlem.

Cook.—Scruggs Concrete, Inc., formerly Bannockburn Sand Co., produced building and fill sand at the Burneyhill mine.

Crawford.—Atlanta Sand & Supply Co. produced building, paving, blast, and railroad sands at the Rollo mine.

Dade.—Dave L. Brown quarried a small tonnage of limestone for concrete and roadstone at Morganville.

Decatur.—Milwhite Co. and Minerals & Chemicals Philipp Corp. mined and processed fuller's earth near Attapulgus for fillers in insecticides and fungicides, absorbent uses, filters for oils and greases, drilling mud, and other uses.

De Kalb.—Total value of mineral production in DeKalb County decreased 28 percent. The decrease resulted from lower production and value for crushed granite; dimension granite production showed little change from that of 1964. Producers of crushed granite were Consolidated Quarries Division of Georgia Marble Co., Davidson Granite Co. Inc., and Stone Mountain Grit Co., all near Lithonia; dimension granite producers were Davidson Granite Co., Inc., J. T. Reagan Granite Co., both of Lithonia, and Stone Mountain Granite Corp. and Coffey Granite Co. at Stone Mountain. Consolidated Quarries Division also produced a feldspar-silica mixture as a by-product from granite fines for use in glassmaking. Stamps Sand Co., Atlanta, and Sand & Gravel Pit Co., Decatur, mined building and paving sand and gravel.

Dooly.—Arrington Mining Co. produced brown iron ore for use in iron furnaces.

Dougherty.—Production of building sand was 142,000 tons valued at $133,000, a decrease of 16 percent in tonnage and value. Producers were Albany Lime & Cement Co., Dawes Silica Mining Co., and Musgrove Sand Co.

Douglas.—Consolidated Quarries Division of Georgia Marble Co. quarried and crushed granite at Douglasville for concrete and roadstone, riprap, railroad ballast, and other uses. Stockbridge Stone Division of Vulcan Materials Co. opened a new granite quarry at Lithia Springs for concrete and roadstone.

Early.—Georgia Rock Products Co. quarried and crushed limestone for concrete and roadstone.

Effingham.—Dawes Silica Mining Co., Inc., produced building, blast, molding, filter, and fertilizer filler sands at the Eden mine.

Elbert.—Production of dimension granite, principally for monumental stone, increased 19 percent in quantity and 16 percent in value. Thirteen companies operated 16 quarries for dimension granite. Coggins Granite Industries, Comolli Granite Co., and Continental Granite Division of Georgia Marble Co. were the leading producers in terms of tonnage. McLanahan Crushed Stone Co. at Elberton was the only crushed granite producer.

Evans.—Evans Concrete Products Co. mined building sand at the Daisy mine near Claxton.

Fayette.—Tyrone Rock Products Division of Dixie Lime & Stone Co. crushed granite for concrete and roadstone, riprap, and railroad ballast.

Floyd.—American Cyanamid Co. mined kaolin from the New Holland bauxite mine. Chattahoochee Brick Co. and Oconee Clay Products Co. mined shale west of Rome for use in their brick and clay products plants at Atlanta and Milledgeville respectively. Ready-Mix Concrete Co. crushed limestone for concrete and roadstone, riprap, railroad ballast, and agstone. Floyd County Highway Department crushed limestone for concrete and roadstone.

Fulton.—The county ranked fourth in the State in value of mineral production. Southern Cement Co. mined miscellaneous clay from a pit adjacent to its cement plant at Atlanta. Atlanta Brick & Tile Co. and Chattahoochee Brick Co. mined miscellaneous clay for the manufacture of brick. Hitchcock Corp. and Stockbridge Stone Division of Vulcan Materials Co. crushed granite for concrete and roadstone. W. J. Griffins and Thompson Bros. Sand Co. produced building sand for local use. Zonolite Division of W. R. Grace & Co. operated plants at Atlanta for exfoliation of crude vermiculite and expansion of perlite, both shipped in from other States.

Gilmer.—Willingham-Little Division of Georgia Marble Co. crushed marble at the Gobel and Whitestone mines for terrazzo and roadstone.

Glynn.—Gray Towing Co. mined building sand at Brunswick. Bestwall Gypsum Co. calcined imported crude gypsum for wallboard and other building materials. Brunswick Pulp & Paper Co. calcined mill sludge to quicklime for recirculation in the papermaking process.

Gordon.—Plainville Brick Co. mined shale near its brick plant at Plainville.

Greene.—L. C. Curtis & Sons, Inc. mined sand for building purposes at Watkinsville.

Gwinnett.—Clement Bros. Co. and Stockbridge Stone Division of Vulcan Materials Co. crushed granite for concrete and roadstone.

Hall.—Gainesville Stone Co. quarried and crushed granite for concrete and roadstone.

Hancock.—Middle Georgia Quarrying Co. produced dimension granite for monumental use at the Spartan quarry.

Hart.—Funkhouser Mills Division of Ruberoid Co. mined and ground mica at Hartwell for roofing, wallboard, and joint cement.

Henry.—Stockbridge Stone Division of Vulcan Materials Co. crushed granite at Stockbridge for concrete and roadstone and for railroad ballast.

Houston.—Penn-Dixie Cement Corp. mined kaolin and limestone and manufactured portland cement at Clinchfield. Georgia Limerock Division of Dixie Lime & Stone Co. crushed limestone near Perry for agricultural use.

Jasper.—The Feldspar Corp. mined feldspathic rock at several locations and produced flotation-grade feldspar and byproduct mica and quartz sand at its Monticello mill.

Jefferson.—Georgia-Tennessee Mining & Chemical Co. mined and processed fuller's earth near Wrens for absorbent uses.

Jones.—Hitchcock Corp. (Gray quarry) and Weston & Brooker (Ruby quarry) crushed granite for concrete and roadstone, riprap, and railroad ballast.

Lamar.—Tyrone Rock Division of Dixie Lime & Stone Co. quarried granite at Yatesville for concrete and roadstone.

Lincoln.—Aluminum Silicates, Inc. mined and processed kyanite near Lincolnton for use in refractories.

Long.—Dawes Silica Mining Co., Inc., mined building sand at Ludowici.

Lowndes.—Georgia Peat Moss Co. produced reed-sedge peat and Lake Park Peat Moss Co. produced moss and humus peat, for horticultural and agricultural use. Owens-Illinois Glass Co. produced and recirculated quicklime by calcining pulpmill sludge at its papermill at Valdosta.

Madison.—Continental Granite Division of Georgia Marble Co. opened a new quarry near Carlton, and Coggins Granite Industries, Inc., operated the Piedmont quarry, both companies produce rough monumental granite.

Marion.—Pope Mining Co. mined brown iron ore near Buena Vista.

Mitchell.—Bridgeboro Lime & Stone Co. crushed limestone for concrete and roads and for agstone.

Monroe.—Tyrone Rock Division of Dixie Lime & Stone Co. began producing crushed granite for concrete and roadstone at its new No. 6 quarry, 6 miles northwest of Macon.

Montgomery.—R. W. Geiger mined paving sand at Mt. Vernon.

Murray.—Georgia Talc Co., the only producer in the State, mined crude talc near Chatsworth and marketed ground talc, principally for asphalt filler, insecticides, and roofing.

Muscogee.—Brown Sand & Gravel Co. and Calhoun Sand & Gravel Co. mined sand and gravel at Columbus for building use. Stockbridge Stone Division of Vulcan Materials Co. crushed granite at the Barin quarry north of Columbus for concrete and roads and railroad ballast.

Oglethorpe.—Dimension granite principally for monumental stone was quarried by 12 companies. Leading producers were Bennie & Harvey, American Granite Quarries, Dixie Granite Co., and Continental Granite Division of Georgia Marble Co.

Pickens.—The county ranked third in value of mineral production in the State. Georgia Marble Co. quarried and manufactured dimension marble at Tate and Nelson for building and monumental uses, and crushed marble at Tate and Whitestone. Marble Products Co. of Georgia also crushed marble. The crushed marble was used for terrazzo, whiting, and roadstone. Hardy Johnson quarried sandstone for rough architectural stone and flagstone.

Polk.—Marquette Cement Manufacturing Co. produced portland and masonry cements at Rockmart. The company mined clay and sandstone in Polk County and limestone in Bartow County to supply the cement plant. Georgia Lightweight Aggregate Co. produced lightweight aggregate from slate mined near the plant at Rockmart. Albea-York Mining Co. Inc. mined brown iron ore.

Quitman.—Camellia Mining Co. and Gordon Gary Mining Co. opened new brown iron ore mines during the year.

Rabun.—Rabun Quarries, Inc., crushed granite near Dillard for concrete and roadstone.

Richmond.—Babcock & Wilcox mined kaolin for refractories, whiteware, paint, plastics, and other uses. Georgia-Carolina Brick & Tile Co., Merry Bros. Brick & Tile Co., and Georgia Vitrified Brick & Clay Co. mined miscellaneous clay for brick and other clay products. Superior Stone Division of Martin Marietta Corp. crushed quartzite at the Dan quarry north of Augusta. Speer Sand & Gravel Co. mined building sand and gravel for miscellaneous uses. Continental Can Co. calcined papermill sludge to quicklime for recirculation through its mill at Augusta.

Stephens.—McLanahan Crushed Stone Co., Inc., began operation of a new granite quarry near Toccoa for concrete, roadstone, and riprap.

Stewart.—Ten companies, five of them new operations, mined brown iron ore. Principal producers were Davis Bros.,

Woodward Mining Co., Lumpkin Mining Co., Dunbar & Layton, and Brown-Nuggett Mining Co.

Sumter.—American Cyanamid Co. mined bauxite and kaolin from the Cavender, Easterlin, and Thigpen mines, and kaolin only from the Holloway mine. General Portland Cement Co. mined kaolin from a new pit for shipment to its Florida cement plant.

Talbot.—Brown Bros. Sand Co. and Taylor Sand Co. produced sand for building purposes.

Taylor.—Butler Sand Co. and Howard Sand Co., two of the leading producers in the State, mined and processed building and paving sand.

Telfair.—Flanders Bros. mined building sand near Scotland.

Thomas.—Cairo Production Co., Inc., and Waverly Petroleum Products Co. mined and processed fuller's earth for absorbent uses. Dawes Silica Mining Co. mined and processed a variety of construction and industrial sands.

Twiggs.—The county ranked first in the State in value of mineral production. Cyprus Mines Corp. acquired United Clay Mines, which in turn had purchased the Georgia Coating Clay Co. in 1964. Other kaolin producers were Freeport Kaolin Co., Georgia Kaolin Co., and J. M. Huber Corp. General Reduction Corp. purchased the Diversey Corp., producer of fuller's earth for absorbent uses.

Walker.—Lambert & Lambert Stone Co. (formerly Rossville Stone Co.) crushed limestone for concrete and roadstone, riprap, and railroad ballast. Patton Rock Products Corp. quarried and crushed limestone for concrete and roadstone, flux, and agstone. H. R. Perry Stone Co. quarried a small quantity of dimension limestone.

Ware.—E. W. Pafford dredged building sand from the Satilla River near Waycross.

Warren.—Weston & Brooker Quarry Co. produced crushed granite at Camak for concrete, roadstone, riprap, and railroad ballast.

Washington.—The county ranked second in value of mineral production. Kaolin, the only mineral produced, was mined and processed by Minerals & Chemicals Philipp Corp., American Industrial Clay Co., Thiele Kaolin Co., Cyprus Mines Corp., Anglo-American Clays Corp., and Champion Paper & Fibre Co. The kaolin was sold principally for paper coating and filling; other uses were whiteware, tile, refractories, plastics, paint, rubber, fertilizer, and catalysts.

Wayne.—Rayonier, Inc., calcined sludge and recirculated the resulting quicklime in its cellulose plant at Jesup.

Whitfield.—Dalton Rock Products Co. crushed limestone for concrete, roadstone, and agricultural purposes.

Wilkinson.—Kaolin was mined by Minerals & Chemicals Philipp Corp., Evans Clay Co., Oconee Clay Products Co., D. C. Hardie Clay Co., and General Refractories Co., principally for rubber, paint, firebrick and block, and other refractories.

The Mineral Industry of Hawaii

This chapter has been prepared under a cooperative agreement for the collection of mineral data between the Bureau of Mines, U.S. Department of the Interior, and the Hawaii Department of Land and Natural Resources.

By Roy Y. Ashizawa [1]

Record demand for construction materials lifted Hawaii's mineral output above $20 million for the first time. Increased consumption was reported for portland cement, asphalt, crushed stone, sand and gravel, and volcanic cinder.

Shipments of lime to sugar mills were above those in 1964.

Declines were reported for output of black coral, clay, and solar-evaporated salt.

Table 1.—Mineral production in Hawaii [1]

Mineral		1964 Quantity	1964 Value (thousands)	1965 Quantity	1965 Value (thousands)
Cement	376-pound barrels	1,717,040	$8,877	1,564,385	$8,297
Clays	short tons	2,555	W	W	W
Lime	do	8,737	321	8,820	305
Pumice, pumicite, volcanic cinder	do	365,475	603	379,729	624
Sand and gravel	do	407,000	979	751,000	2,237
Stone	do	5,281,714	8,765	5,171,769	9,353
Value of items that cannot be disclosed: Gem stones, salt, and values indicated by symbol W		XX	60	XX	19
Total		XX	19,605	XX	20,835

W Withheld to avoid disclosing individual company confidential data. XX Not applicable.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

REVIEW BY MINERAL COMMODITIES

NONMETALS

Cement.—Two plants on Oahu produced 1,584,000 barrels of portland cement and shipped 1,564,000 barrels to the following customers: 70 percent to ready-mixed concrete companies, 12 percent to building material dealers, 12 percent to concrete product manufacturers, and 6 percent to contractors, government agencies, and miscellaneous customers. Nearly 1,291,000 barrels was distributed in bulk, and 273,000 barrels in paper bags.

Shipments were 153,000 barrels less than in 1964, because a 376,000-barrel decrease in exports was only partly offset by a 223,000-barrel increase for use in Hawaii. Consumption of domestic cement, including white and other premium types received from the U.S. mainland, was a record high 1,518,000 barrels. Imports of foreign cement from Japan and Denmark, amounted to 2,100 barrels.

Nearly 368,000 tons of coral limestone and 60,000 tons of basalt and trachyte from quarries on Oahu, and 41,000 tons of imported gypsum, silica sand, and other raw materials and grinding aids were used for making cement. The plants also consumed 42.9 million kilowatt-hours of electrical energy.

Clays.—Hawaii Clay Products, Inc., the sole producer of clay brick and pipe, suspended operation of its Barbers Point plant

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Table 2.—Value of mineral production in constant 1957–59 dollars
(Thousands)

Year	Value [1]
1956	$6,848
1957	6,049
1958	6,369
1959	7,472
1960	9,302
1961	15,019
1962	14,963
1963	15,614
1964	r 20,016
1965	p 21,301

r Revised.
p Preliminary.
[1] The years 1960–65 include the value of portland cement shipments (in thousand dollars), as follows: 1960, $567; 1961, $5,585; 1962, $6,104; 1963, $7,270; 1964, $9,067; 1965, $8,484.

on Oahu early in the year because of technical difficulties in producing clay products of uniform strength and quality. The raw clay used at the plant came primarily from the old Wilson pit near Waimanalo.

Gem Stones.—An increasing number of tourists, more than 600,000 in 1965, continued to create a favorable market for Hawaiian jewelry made with polished black coral. The volume of black coral gathered from the deep waters off the islands, however, was less than in 1964 because of an oversupply of raw material at local jewelry manufacturers and the growing reluctance of divers to sell raw black coral for less than $6.00 per pound.

Lime.—Hydrated lime was produced at plants on Oahu and Maui for use at sugar and pineapple canneries, in masonry mortars, and for the treatment of water and sewage. Lime sales to sugar mills, for use in clarifying cane juice, reflected a record yield of cane sugar in 1965.

Pumice and Volcanic Cinders.—Nearly 380,000 tons of pumice and volcanic cinders was mined for use as lightweight concrete aggregate and for surfacing roads and subdivision lands. Interisland shipments to Oahu consisted of substantial tonnages of pumice from Hawaii Island and cinders from Molokai for use in concrete and some cinders from Hawaii Island for decorative landscape and garden use. The latter included the bright rust-colored cinder from along the Koae Road near Kapoho, sold on Oahu for 6 cents per pound. Another potential source of decorative material is the blue cinders at the Iilewa pit near Pahoa, also on Hawaii Island.

Salt.—Commercial salt was produced on Oahu by solar evaporation of sea water from Keehi Lagoon. Poor weather conditions during April and May adversely affected the year's output. The crude product was bagged and sold undried to local grocers.

Apparent consumption of crude and refined salt in Hawaii, including receipts from mainland producers, amounted to 3,787 tons.

Sand and Gravel.—Production of sand and gravel was 751,000 tons, an alltime high. Accessible beach and dune deposits were worked extensively by producers who needed to maintain sufficient plant stockpiles of sand for concrete and mortar uses. Large tonnages of sand and streambed gravel also were used as fill and landscape material on resort and subdivision lands.

Stone.—Nearly 5.2 million tons of stone was quarried, of which 4.6 million tons was processed for use as concrete aggregate and roadstone. The remaining 600,000 tons was mainly decorative lava slabs, riprap, roofing

Table 3.—Employment and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1964:								
Nonmetal	90	100	9	76	---	1	13.18	119
Sand and gravel	64	109	7	55	---	1	18.24	766
Stone	445	270	120	991	---	29	29.27	665
Total	599	227	136	1,122	---	31	27.63	633
1965: p								
Nonmetal	115	78	9	72	1	---	13.89	83,333
Sand and gravel	60	100	6	51	---	---	---	---
Stone	510	251	128	1,061	---	35	32.99	621
Total	685	209	143	1,184	1	35	30.41	5,624

p Preliminary.

granules, and coral limestone used for agricultural liming and for making cement and lime.

Quarries yielded 3,556,000 tons of basalt, 947,000 tons of coral limestone, and 668,000 tons of miscellaneous stone. Of the total stone production 77 percent was produced on Oahu Island, 17 percent on Hawaii Island, and 6 percent on Kauai, Lanai, Maui, and Molokai Islands. The quarries on Oahu accounted for over 700,000 tons of the record 800,000-ton gain in output of basalt. Production of coral limestone declined 125,000 tons due mainly to decreased use of dredged coral on Hawaii Island. The 786,000-ton drop in output of miscellaneous stone also occurred on Hawaii Island where less aa was quarried.

Vermiculite.—Crude Montana vermiculite was expanded at a facility on Oahu to produce lightweight aggregate for fireproofing, insulation, and acoustical plaster.

MINERAL FUELS

Standard Oil Co. of California continued to operate its refinery on Oahu at near capacity. The facility utilized crude oil imported from foreign oilfields to produce a variety of products including asphalt, various grades of fuel oil, motor and aviation gasoline, jet fuel, and liquefied gas.

Demand for petroleum products increased appreciably compared with 1964. The largest gains were for jet fuel for civilian use and for asphalt for paving.

REVIEW BY ISLANDS

Hawaii (Hawaii County).—The total volume of mineral materials handled was less than in 1964 when exceptionally large quantities of aa from the 299th pit near Hilo and dredged coral from the Kawaihae stockpile were used for fill in the Hilo and Mauna Kea resort areas. Demand for concrete aggregate and roadstone, however, continued to increase.

A record quantity of basalt was produced at the quarry and stationary crusher operation of James W. Glover, Ltd., at Hilo. The company utilized its portable crusher to process volcanic rock for the Chain of Crater road and for subdivision roads at Naalehu. Kuwaye Bros., Inc., and Yamada & Sons, Inc., were the principal suppliers of pit-run and crusher-run aa from Hilo and coral from Kawaihae. Island Trucking Service, Inc., also worked the dredged coral stockpile at Kawaihae to produce a variety of products including stone sand for concrete and fines for mortar and agricultural liming. About 6 miles southeast of Kona, J. M. Tanaka Contractors, Inc., quarried basalt and aa rock for use in asphalt and portland cement concrete.

Volcanite, Ltd., produced lightweight aggregate from a pumice deposit at Puuwaawaa. The material was used on the island and also shipped by barge from Kawaihae Harbor to Oahu. Large quantities of volcanic cinder and rock were quarried on sugar plantation lands near Honokaa, Pepeekeo, Pahala, and Naalehu. The Kapoho and Pahoa cinder deposits were worked, primarily by Kuwaye and James Kuwana, for base material, and by Glover, for lightweight concrete block. Kuwana produced decorative stone with slabs pried loose from a lava flow near Pahoa. Public works crews mined several thousand tons of cinder from the Keaumoku and Kohala Mountain pits near Kamuela for road maintenance. A small quantity of sand and gravel was produced from streams along the northeast section of the island.

Kauai (Kauai County).—Increased building and road construction resulted in increased output of mineral materials. Grove Farm Co., Ltd., quarried and processed a substantial tonnage of basalt rock at its Bluestone quarry near Puhi, and produced decomposed basalt at the Kahili quarry near Kilauea for road base and coral limestone at its Koloa quarry for concrete.

Miscellaneous stone deposits, including those near Moloaa, Hanamaulu, and at Kapaia Valley, were sources of aggregate for the Lihue Plantation Co., Ltd., sugarcane haul roads and residential subdivisions. Volcanic cinder was quarried at the McBryde Sugar Co. Kapeku hill near Eleele, and at the Olokele Sugar Co. pit near Kaumakani. Various producers obtained coral sand and basaltic sand and gravel from beach and streambed deposits for concrete and road repairs.

Lanai (Maui County).—Dole Corp. pur-

Table 4.—Value of mineral production in Hawaii, by counties

County	1964	1965	Minerals produced in 1965 in order of value
Hawaii	$2,644,000	$1,860,000	Stone, pumice and volcanic cinder, sand and gravel.
Honolulu	15,450,000	16,983,000	Cement, stone, sand and gravel, lime, salt, clays.
Kauai	409,000	831,000	Stone, sand and gravel, volcanic cinder.
Maui	1,102,000	1,161,000	Sand and gravel, stone, volcanic cinder, lime, gem stones.
Total	19,605,000	20,835,000	

chased crushed rock from Oahu and produced local beach sand for construction projects at its pineapple plantation. Appreciable quantities of large field boulders, removed from plantation lands, were used as armor and core stone for the breakwater at Manele Bay. Kahului Railroad Co. shipped its portable crusher from Maui to Lanai and processed basalt rock, mainly for extending and widening the airfield.

Maui (Maui County).—Hawaiian Commercial & Sugar Co., Ltd., operated a rotary kiln and a continuous hydrator near Lower Paia to produce hydrated lime. Coral sand from the adjacent beach was used as raw material for the lime plant.

The foothills near Waikapu was the source of alluvial gravel processed by Maui Concrete & Aggregates, Inc. Kahului Railroad Co. operated a basalt rock quarry and a stationary crusher near Puunene, to produce aggregate for asphalt and portland cement concrete. The company's portable crusher was shipped to Lanai. A & B Commercial Co. mined volcanic cinder at the Puuhele pit near Maalaea for use in the manufacture of concrete products. At year-end, the quarry and plant operations of Kahului Railroad Co. and A & B Commercial Co. were acquired by Concrete Industries, Inc., a newly formed subsidiary of HC&D, Ltd.

Volcanic cinder for road maintenance was produced near Honokohau, Makawao, Kanaio, and other locations by plantation and ranch operators, contractors, and public works crews. Various producers removed beach sand from near Kahului and Kaanapali and dune sand from the Wailuku area for use in concrete and road patching.

Molokai (Maui County).—HC&D, Ltd., mined large quantities of lightweight volcanic cinder and coral sand at Waieli and Papohaku beach, respectively, and shipped the material by barge from Lono Harbor to Oahu. Molokai Aggregates, Inc., operated a basalt quarry and crusher at Manawainui gulch near Kaunakakai and supplied much of the concrete aggregate and roadstone used on the island. Sand and volcanic cinder used by local contractors and public works road crews were obtained primarily from the Moomomi sand dunes and Puuluahine cinder pit.

Oahu (Honolulu County).—Demand for mineral aggregate for concrete and roadstone on Oahu was at an alltime high. Stone producers quarried a record 3.1 million tons of basalt, 844,000 tons of coral limestone, and 11,000 tons of miscellaneous stone, a total of nearly 4.0 million tons.

Basalt rock was quarried and processed by Hawaiian Bitumuls & Paving Co., Ltd., at the Kaena quarry near Camp Erdman, and by HC&D, Ltd., at the Kapaa quarry near Kailua. HC&D also sold or used coral sand and lightweight volcanic cinder which it barged to Oahu from the company's Molokai operation. Pacific Cement & Aggregates, Inc., produced basalt at the Halawa quarry near Aiea and limestone at the Lualualei quarry. The Puu Palailai basalt quarry near Ewa and a limestone quarry near Kailua were operated by Pacific Concrete & Rock Co., Ltd. Coral limestone also was produced at the Ewa and Kahuku sugar plantations for road maintenance; at Waianae and Barbers Point, primarily for use in making cement; and near Maile for base material. Nanakuli Paving & Rock Co., Ltd., quarried limestone at its Testa quarry until August. Joe's Moss Rock Co. was the principal supplier of decorative rock gathered in the Waianae Range. Coral sand was removed from beach and dune deposits along the northern and eastern coastal areas for concrete and fill.

GasprO, Ltd., utilized purchased limestone to produce lime at its plant near Waianae. A 6- by 90-foot rotary kiln and a 4- by 15-foot continuous hydrator were operated to calcine and hydrate lime. Solar-evaporated salt was produced near Keehi Lagoon by Tamotsu Tanaka. Vermiculite of Hawaii, Inc., operated a small furnace in Honolulu to expand Montana vermiculite for lightweight aggregate uses.

The Mineral Industry of Idaho

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the Idaho Bureau of Mines and Geology for collecting information on all minerals except fuels.

By Ronald P. Collins,[1] Richard W. Knostman,[2] and Norman S. Petersen [2]

Idaho's 1965 record-setting mineral production, valued at $105 million, was dominated by increased values for lead, zinc, sand and gravel, stone, silver, phosphate rock, and vanadium. These commodities accounted for nearly 88 percent of the $19-million increase over the 1964 total. The value of 1965 lead and zinc production, primarily from the Coeur d'Alene region, increased to $37.7 million. Slightly higher prices for both commodities offset decreased output and provided incentives for producers to augment exploration and development activities. Sand and gravel contributed $13.2 million to the total value of mineral production; output was up 27 percent, largely due to increased demands of highway construction and heavy engineering projects. The value of silver production increased $2.6 million, owing to the rising industrial demand for the metal. Underground mining developments in 1965 resulted in silver production that approached the record highs of 1937 and 1938. The leading three domestic silver mines were in the Coeur d'Alene region of Shoshone County. The Sunshine mine (Sunshine Mining Co.), the leading domestic silver source, accounted for 90 percent (1.8 million ounces) of the 2-million-ounce net increase over the 1964 output. Expansion-minded silver producers announced numerous commitments for extensive exploration and development projects. The multimillion-dollar deep-level development begun in 1964 by American Smelting and Refining Company, referred to as the "Coeur Project," continued during the year. The results of this project could strongly influence future investments by lending institutions to the silver producers in the Coeur d'Alene region.

Rapid expansion of the phosphate industry was highlighted by a 45-percent increase in production value over that of 1964. Investments by major producers were extensive. J. R. Simplot Co. completed a $10-million expansion at the Pocatello fertilizer works and in early 1965 announced a $7-million expansion program for the same site. Monsanto Company, continuing a 1964 expansion program at its Soda Springs plant, started constructing a 70,000-kilovolt-ampere elemental phosphorus furnace; plans called for a duplicate furnace within 3 years. The Bunker Hill Co. completed an ammonium phosphate plant at its Kellogg complex, and production was begun in December. El Paso Products Co. initiated phosphate operations in Caribou County when a strip-mining operation began supplying rock for the firm's recently completed fertilizer complex north of Soda Springs.

Consumption, Trade, and Markets.—The continued economic upswing enjoyed by the Nation in 1965 was quite apparent in the specific measures of Idaho business activity shown in table 3. All changes from 1965 were improvements except the value of highway contracts awarded. Heavy engineering construction was stimulated by two large dam projects; contracts were awarded for both the $28-million Hell's Canyon Dam on the Snake River and a $14-million dam and reservoir in Adams County. The cash flow from Idaho agricultural receipts was well above that of a year earlier. Quite possibly as a result of the interaction between rising prices and rising costs in an active business climate, the Federal Reserve

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Table 1.—Mineral production in Idaho [1]

Mineral	1964 Quantity	1964 Value (thousands)	1965 Quantity	1965 Value (thousands)
Antimony ore and concentrate—short tons, antimony content	585	W	818	W
Clays [2]—thousand short tons	29	$25	47	$33
Copper (recoverable content of ores, etc.)—short tons	4,666	3,042	5,140	3,639
Gold (recoverable content of ores, etc.)—troy ounces	5,677	199	5,078	178
Iron ore (usable)—thousand long tons	4	33	9	84
Lead (recoverable content of ores, etc.)—short tons	71,312	18,684	66,606	20,781
Mercury—76-pound flasks	83	26	1,119	639
Peat—short tons	900	8	W	W
Pumice—thousand short tons	59	100	46	79
Sand and gravel—do	9,582	8,691	12,151	13,198
Silver (recoverable content of ores, etc.)—thousand troy ounces	16,483	21,313	18,457	23,865
Stone—thousand short tons	1,144	2,773	1,831	3,440
Tungsten ore and concentrate (60 percent WO_3 basis)—short tons	11	8	------	------
Zinc (recoverable content of ores, etc.)—do	59,298	16,129	58,034	16,946
Value of items that cannot be disclosed: Barite (1964), cement, garnet (abrasive), gem stones, lime, mica (1964), perlite, phosphate rock, titanium, vanadium, and values indicated by symbol W	XX	15,231	XX	22,203
Total	XX	86,262	XX	105,085

W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed." XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes fire clay, kaolin, and bentonite; included with "Value of items that cannot be disclosed."

Bank of San Francisco reported that banks in Idaho showed the strongest gains in bank loans in a decade.

Employment.—According to monthly reports by the Idaho Department of Employment, figures for the rate of unemployment dipped to 4.4 percent, the lowest point reached since the postwar years in spite of a gain in the labor force. Nonfarm jobs were at an alltime high during 1965. Average monthly employment increased by 7,000 workers during the year. The increase in construction employment was attributed to dam construction projects, expansion at Atomic Energy Commission sites, and industrial facilities for the manufacture of phosphate fertilizers. Declining farm employment partially offset gains in nonfarm industries. Substantial job gains were recorded in manufacturing both durable and nondurable goods.

Exploration for new deposits, plus increased production in existing mines, intensified a shortage of experienced miners in the Coeur d'Alene area. Many of the largest firms were advertising for men willing to work as underground miners regardless of experience. The Idaho Employment Security Agency estimated that 300 to 400 workers could be easily absorbed by the industry in Shoshone County.

Table 2.—Value of mineral production in constant 1957-59 dollars

(Thousands)

Year	Value
1956	$64,176
1957	71,849
1958	67,666
1959	69,119
1960	55,299
1961	67,724
1962	79,351
1963	r78,507
1964	r78,563
1965	92,560

r Revised.

Legislation and Government Programs.—No contracts were signed in 1965 under the program of the Office of Minerals Exploration (OME), U.S. Department of the Interior; five previous contracts remained active. Bonneville Power Administration (BPA) cancelled its contract of April 9, 1964, with Monsanto Company to supply power to the firm's Soda Springs plant in southern Idaho. The cancellation resulted from a provision in the U.S. Senate public works appropriation bill passed in August 1965. The southern Idaho wet-acid phosphate processors had vigorously opposed the BPA-Monsanto contract.

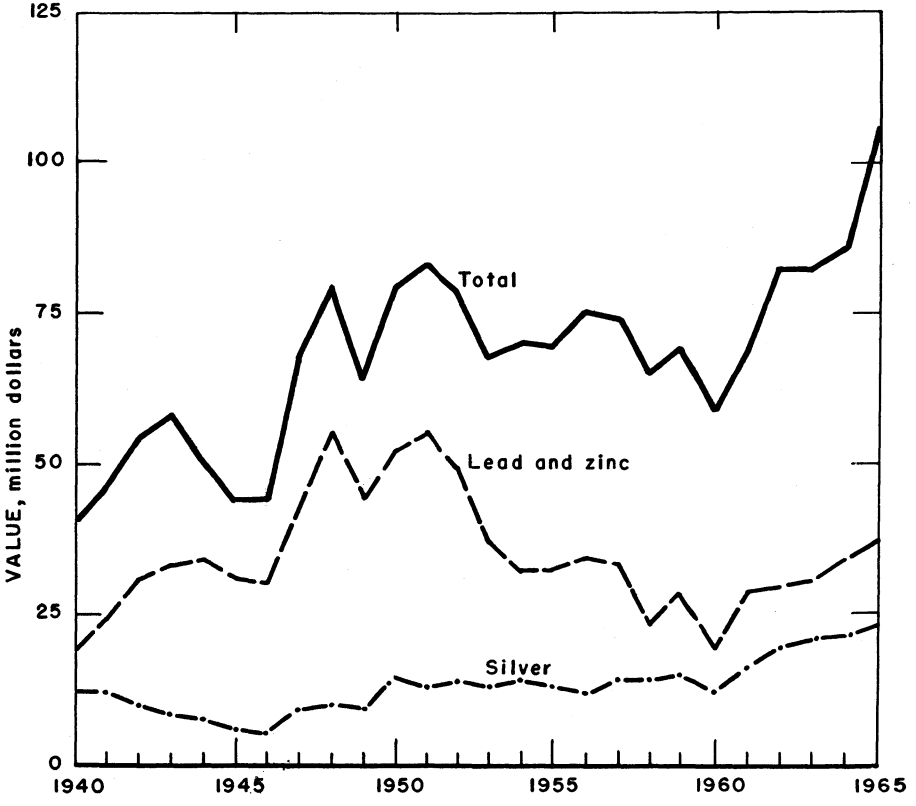

Figure 1.—Value of silver, lead and zinc, and total value of mineral production in Idaho.

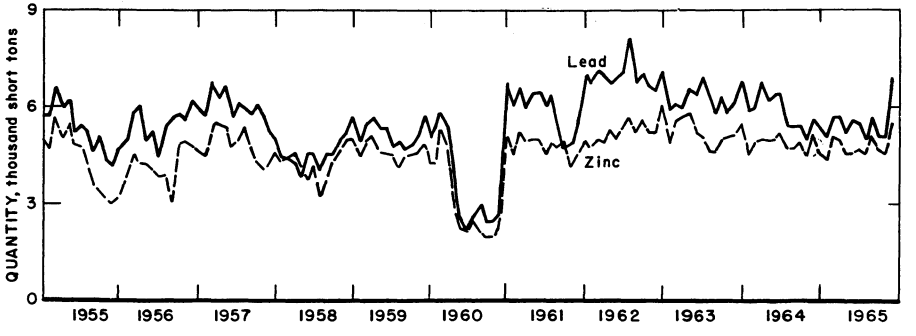

Figure 2.—Mine production of lead and zinc in Idaho, by months in terms of recoverable metals.

Table 3.—Indicators of Idaho business activity

		1964	1965 p	Change (percent)
Personal income:				
Total	millions	$1,454.0	$1,618.0	+11.3
Per capita		$2,114.0	$2,338.0	+10.6
Construction activity:				
Building permits	millions	$40.7	$47.8	+17.4
Heavy engineering awards	do	$63.4	$73.5	+15.9
State highway commission:				
Value of contracts awarded	do	$35.9	$22.6	−37.0
Value of contract work performed	do	$26.9	$35.5	+32.0
Cement shipments to and within Idaho thousand 376-pound barrels		1,140.6	1,447.5	+26.9
Cash receipts from farm marketings	millions	$462.0	$518.2	+12.2
Mineral production	do	$86.3	$105.1	+21.9
Factory payrolls	do	$164.7	$180.2	+9.4
Annual average labor force and employment:				
Total labor force	thousands	267.4	271.6	+1.6
Unemployment	do	14.0	11.5	−17.9
Employment:				
Construction	do	9.3	11.4	+22.6
Lumber and wood products	do	11.9	12.1	+1.7
Food products	do	11.7	11.8	+0.9
All manufacturing	do	31.8	33.0	+3.8
All industries	do	253.4	260.1	+2.6

p Preliminary.

Sources: Survey of Current Business, Construction Review, Pacific Builder and Engineer, Idaho State Highway Commission, The Farm Income Situation, Idaho Labor Market, Labor Force and Employment in Idaho, Distribution by Industry of Wages Paid for Covered Employment in Idaho, and Bureau of Mines.

Table 4.—Employment and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1964:								
Metal	2,738	239	658	5,258	7	214	42.03	11,640
Nonmetal and peat	460	263	121	977	--	27	27.64	835
Sand and gravel	275	233	64	514	--	8	15.57	397
Stone	175	160	28	223	--	1	4.49	54
Total	3,648	238	871	6,972	7	250	36.86	8,927
1965:p								
Metal	2,715	254	690	5,525	9	250	46.88	11,366
Nonmetal and peat	467	296	138	1,165	1	15	13.73	5,560
Sand and gravel	330	209	69	554	--	14	25.27	361
Stone	240	117	28	218	1	3	18.35	27,904
Total	3,752	247	925	7,462	11	282	39.27	10,125

p Preliminary.

Table 5.—Annual employment and wages paid in the mineral industries

Year	Mining							
	Metals		Nonmetal		Fuels		Total	
	Annual average employment	Annual payroll (thousands)	Annual average employment	Annual payroll (thousands)	Annual average employment	Annual payroll (thousands)	Annual average employment	Annual payroll (thousands)
1961	3,032	$17,607	288	$1,785	2	$5	3,322	$19,397
1962	2,996	17,336	270	1,546	--	--	3,266	18,882
1963	2,926	17,650	285	1,519	13	84	3,224	19,253
1964	2,951	18,310	327	1,901	14	82	3,292	20,293
1965 p	2,935	18,563	540	3,431	3	11	3,478	22,005

Year	Manufacturing							
	Stone and clay products		Primary metals		Phosphate fertilizers, elemental phosphorus, and sulfuric acid		Total	
	Annual average employment	Annual payroll (thousands)	Annual average employment	Annual payroll (thousands)	Annual average employment	Annual payroll (thousands)	Annual average employment	Annual payroll (thousands)
1961	677	$3,457	1,008	$5,750	1,250	$8,263	2,935	$17,470
1962	686	3,936	970	5,497	1,254	8,240	2,910	17,673
1963	823	4,369	971	5,694	1,217	8,342	3,011	18,405
1964	757	4,138	1,032	6,425	1,106	8,086	2,895	18,649
1965 p	854	5,210	1,296	8,234	1,245	9,042	3,395	22,486

p Preliminary.

Source: Idaho Employment Security Agency; employment covered by unemployment insurance. Industry groups may not correspond with those in the Bureau of Mines canvass.

Table 6.—Hours and earnings of production workers in mining

	1961	1962	1963	1964	1965 p
Annual average:					
Weekly earnings	$105.32	$107.32	$110.21	$114.91	$116.22
Hourly earnings	$2.62	$2.72	$2.79	$2.88	$3.00
Weekly hours	40.2	39.4	39.5	39.9	38.8

p Preliminary.

Source: Idaho Employment Security Agency.

Table 7.—Office of Minerals Exploration contracts active during 1965

County and contractor	Commodity	Contract		
		Date	Total amount	Government participation, percent
Custer:				
Clayton Silver Mines	Silver	Dec. 2, 1963	$90,370	50
Ivers Mining Co., Inc.	Gold	Nov. 20, 1963	46,623	50
Idaho: Clyde D. Painter	Gold and silver	Sept. 2, 1964	41,830	50
Lemhi:				
Clemens and Arthur Lombardi	Silver and gold	Dec. 24, 1963	86,670	50
J. Howard Sims	do	May 7, 1963	59,230	50

REVIEW BY MINERAL COMMODITIES

METALS

Antimony.—Output of antimony rose 40 percent over the strike-reduced 1964 total, and the value increased 54 percent because of a higher average market price. Production of the metal, a silver ore byproduct from the Sunshine mine, was the largest since the 1952 closing of the Yellow Pine property in Valley County. Sunshine Mining Co. shipped 822 tons of cathode metal containing 96.1 percent antimony from its electrolytic plant at Kellogg.

Cadmium.—Recovery of cadmium at The Bunker Hill Co. electrolytic zinc plant declined 20 percent below the 1964 total because of a lower average cadmium content of the zinc concentrates processed.

Copper.—A strong demand and a rising market price failed to induce a significant production increase, since copper output continued to be mainly a silver ore byproduct. Copper ore was mined at the Empire mine (Lost River Mines, Inc.), Custer County, and the Blackbird mine (Machinery Center, Inc.), Lemhi County, but Shoshone County silver and lead-zinc mines supplied nearly 70 percent of the State total. Exploration activity increased in Adams, Custer, and Washington Counties.

Gold.—Increasing mining costs, coupled with a static market price, resulted in further gold production declines, and the output was a record low for the third consecutive year. Only 284 ounces was recovered from ores mined primarily for the gold content. The decline resulted partly from reduced production by Gem State Consolidated Mines, Inc. (Dewey Group), in Gem County. The Lucky Friday mine, Shoshone County, and the Blackbird mine, Lemhi County, supplied the largest amounts.

Placer production was from four small-scale hand operations. Also included in the placer total was bullion taken from the Snake River area in 1947 but not sold until 1965. The largest output from any operation was 7 ounces.

Iron Ore.—Shipments of iron ore were more than double the 1964 total because production was initiated by Kenneth Steck from Iron Mountain Mining Co. deposits on Iron Mountain near Weiser. The ore was trucked from the open pit mine to the rail siding at Weiser, crushed, and shipped

Table 8.—Mine production of gold, silver, copper, lead, and zinc in terms of recoverable metals [1]

Year	Mines producing		Material sold or treated [2] (thousand short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Troy ounces	Value (thousands)	Troy ounces (thousands)	Value (thousands)
1956–60 (average)	82	23	1,758	10,804	$378	14,955	$13,535
1961	60	22	1,497	5,718	200	17,576	16,249
1962	60	13	1,586	5,845	205	17,772	19,283
1963	57	16	1,535	5,477	192	16,711	21,375
1964	55	7	1,649	5,677	199	16,483	21,313
1965	70	5	1,783	5,078	178	18,457	23,865
1863–1965 [3]	--	--	147,871	8,322,990	194,444	804,214	639,166

Year	Copper		Lead		Zinc		Total value (thousands)
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	
1956–60 (average)	7,467	$4,730	58,973	$15,524	49,923	$11,889	$46,056
1961	4,328	2,597	71,476	14,724	58,295	13,408	47,178
1962	3,861	2,378	84,058	15,467	62,865	14,459	51,792
1963	4,172	2,570	75,759	16,364	63,267	14,551	55,052
1964	4,666	3,042	71,312	18,684	59,298	16,129	59,367
1965	5,140	3,639	66,606	20,781	58,034	16,946	65,409
1863–1965 [3]	193,053	85,111	7,309,777	1,033,954	2,518,262	529,274	2,481,949

[1] Includes recoverable metal content of gravel washed (placer operations), ore milled, old tailings re-treated, and ore, old slag, and mill cleanings shipped to smelters during the calendar year indicated. Owing to rounding, individual items may not add to totals shown.
[2] Does not include gravel washed.
[3] Partly estimated for years before 1901.

Table 9.—Gold production at placer mines

Year	Mechanical and hydraulic methods [1]			Small-scale hand methods			Total [2]		
	Number of operations	Material treated (thousand cubic yards)	Gold (troy ounces)	Number of operations	Material treated (thousand cubic yards)	Gold (troy ounces)	Number of operations	Material treated (thousand cubic yards)	Gold (troy ounces)
1956–60 (average)	12	170	2,114	11	5	64	23	175	2,178
1961	8	60	488	14	9	53	22	69	541
1962	7	38	318	6	8	58	13	46	376
1963	5	8	90	11	4	54	16	12	144
1964	3	9	80	4	2	24	7	11	104
1965	--	--	--	5	3	31	5	3	31

[1] Combined to avoid disclosing individual company confidential data.
[2] Data may not add to totals shown because of rounding.

to cement plants at Lime and Oswego, Oreg. C. C. Hill and Howard Sims also mined iron ore from open pits in Benewah and Valley Counties, respectively. Porter Bros. Corp. continued shipping magnetite from its stockpile at Lowman.

Lead.—An increased average market price caused the lead output value to rise despite a production drop. Although production from the Bunker Hill mine declined for the fourth consecutive year, it remained the largest individual source in the State. Production from the Lucky Friday mine ranked second followed by output from the Star Unit area and Page mines.

The increased price of lead, coupled with relatively high silver and zinc prices, spurred exploration and development activities throughout the State. This activity was most pronounced in the Coeur d'Alene region where Day Mines, Inc., reopened the Dayrock mine and began exploring its Hunter Ranch property under a joint agreement with Hecla Mining Co. The Bunker Hill Co. continued its extensive exploration of the Bunker Hill and adjacent properties.

Bunker Hill smelter production increased to 93,753 tons, the largest since 1961. The increase was due largely to more raw material imports from Canada.

Mercury.—A continuing high mercury price, averaging $570.75 per flask (76 pounds), resulted in a significant increase over 1964 production. The increase largely was due to the 1,059 flasks produced by El Paso Products Co. at the Idaho-Almaden mine near Weiser after operations were resumed in February. Mercury also was recovered at the Hermes property, Valley County, at approximately the 1964 rate.

Silver.—Production of silver was the third largest in the history of the State. Sunshine Mining Co. accounted for most of the increase—its production rose from 4.6 million ounces in 1964 to 6.4 million ounces. Galena mine (American Smelting and Refining Company) output, the second largest individual silver source in the Nation, was about the same as in previous years. Small production declines from the Lucky Friday and Bunker Hill mines were offset by increases from the Silver Summit mine, Shoshone County, and the Silver Star-Queens mine, Blaine County.

The long-term silver demand outlook, despite elimination of silver from most coins, accelerated efforts to find and develop silver-bearing deposits. In the Coeur d'Alene region, The Bunker Hill Co. intersected high-grade ore on the 3300 level of the Crescent mine, and work was underway to check the extension of this ore shoot on the 3500 level. Hecla Mining Co. continued developing the lower levels of the Silver Summit mine. American Smelting and Refining Company (Asarco) began sinking a three-compartment rectangular shaft on Rainbow Mining Co. property, adjacent to the Galena mine, as part of the "Coeur Project" to explore possible deep ore bodies on Rainbow and Coeur d'Alene Mines Corp. claims. Four Shoshone County firms —Silver Bowl, Inc., Coeur d'Alene Silver Giant, Inc., Allied Silver, Inc., and Silver Pirate Mining Co.—were merged to facilitate developing their 300 claims. Phillips Petroleum Co. continued exploring the Rock Creek Silver-Lead Co. property near Wallace. Exploration and development of

Table 10.—Mine production of gold, silver, copper, lead, and zinc in 1965, by counties, in terms of recoverable metals

County	Mines producing		Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Troy ounces	Value (thousands)	Troy ounces	Value (thousands)
Boise	3	--	21	$1	761	$1
Bonner	7	--	W	W	W	W
Butte	2	--	--	--	1,364	2
Camas	1	--	2	(1)	5,909	8
Custer	9	--	222	8	156,382	202
Gem	1	--	384	13	929	1
Idaho	2	1	28	1	9	(1)
Jerome	--	1	3	(1)	--	--
Lemhi	14	--	W	W	4,311	6
Shoshone	21	--	2,713	95	17,917,551	23,167
Washington	1	--	--	--	52	(1)
Undistributed [2]	9	3	1,705	60	369,541	478
Total [3]	70	5	5,078	178	18,456,809	23,865

County	Copper		Lead		Zinc		Total value (thousands)
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	
Boise	--	--	1	(1)	(1)	(1)	$2
Bonner	W	W	53	$17	2	$1	63
Butte	1	$1	10	3	2	1	6
Camas	(1)	(1)	20	6	3	1	15
Custer	302	214	539	168	74	22	614
Gem	(1)	(1)	3	1	3	1	16
Idaho	--	--	--	--	--	--	1
Jerome	--	--	--	--	--	--	(1)
Lemhi	W	W	10	3	3	1	W
Shoshone	3,540	2,506	63,474	19,804	56,443	16,481	62,054
Washington	1	1	--	--	--	--	1
Undistributed [2]	1,296	917	2,496	779	1,505	438	2,637
Total [3]	5,140	3,639	66,606	20,781	58,034	16,946	65,409

W Withheld to avoid disclosing individual company confidential data.
[1] Less than ½ unit.
[2] Includes values and quantities that cannot be shown separately for Blaine, Owyhee, Twin Falls, and Valley Counties, and items indicated by symbol W.
[3] Owing to rounding, individual items may not add to totals shown.

the Sunshine and Galena properties were accelerated.

Federal Resources Corp., the largest silver producer outside Shoshone County, completed its first full year of milling operations at Bellevue, Blaine County. Clayton Silver Mines increased ore reserves and doubled milling capacity at its Clayton operation, Custer County.

Thorium.—No production was reported, but interest continued in the Lemhi Pass area thorium deposits. The Dow Chemical Corp. explored claims in the Lemhi Pass area leased in 1964 from Carroll W. Wells and Rare Metals Exploration, Inc. Lemhi Pass Thorium Corp. leased its 200 unpatented claims in the area to Adalee Enterprises, Inc., of Boise. Lemhi Minerals Co. contracted to process ore mined from 100 acres of Sawyer Petroleum Company's property, Beaverhead County, Mont., in its mill at Baker.

Titanium.—Porter Bros. Corp. continued shipping ilmenite concentrate from its mill site at Lowman; however, shrinking markets for the fine-grained material caused a reduction in the amount sold.

Vanadium.—Output of vanadium more than doubled the 1964 total because of sharply increased production from the Kerr-McGee plant at Soda Springs and the Vitro Chemical Co. facility at Salt Lake City, Utah. Kerr-McGee processed ferrophosphorus from the nearby Monsanto Company elemental phosphorus facility. Vitro Chemical Co. continued modifying its former uranium plant at Salt Lake City, Utah, to extract vanadium from ferrophosphorus produced at the FMC Corp. elemental phosphorus operation in Power County.

Zinc.—The Star Unit area, Bunker Hill, and Page mines continued to dominate zinc production statistics by accounting for

Table 11.—Mine production of gold, silver, copper, lead, and zinc in 1965, by classes of ore or other source materials, in terms of recoverable metals

Source	Number of mines [1]	Material sold or treated (short tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Ore:							
Dry gold and gold-silver [2]	9	802	288	270	--	300	--
Dry silver	19	473,404	1,125	12,634,982	5,799,800	6,959,900	3,588,700
Total	28	474,206	1,413	12,635,252	5,799,800	6,960,200	3,588,700
Copper	3	84,713	1,600	9,986	3,141,000	--	--
Lead	18	221,412	1,432	3,241,138	518,200	42,031,600	3,371,700
Lead-zinc and zinc	14	836,223	563	2,414,063	701,500	79,216,300	103,133,900
Total	35	1,142,348	3,595	5,665,187	4,360,700	121,247,900	106,505,600
Other lode material:							
Gold and silver mill cleanings, silver old tailings, copper, lead, lead-zinc mill cleanings, and assay sweeps [2]	11	123,247	39	139,597	4,000	3,596,400	930,100
Copper precipitates	1	--	--	--	8,700	--	--
Zinc slag smelted	1	43,608	--	16,768	106,800	1,407,500	5,043,600
Total lode material	70	1,783,409	5,047	18,456,804	10,280,000	133,212,000	116,068,000
Placer	5	([3])	31	5	--	--	--
Total all sources	75	1,783,409	5,078	18,456,809	10,280,000	133,212,000	116,068,000

[1] Because some mines produce more than one class of material, detail will not necessarily add to total shown.
[2] Combined to avoid disclosing individual company confidential data.
[3] 3,420 cubic yards.

nearly 86 percent of the State output. Star Unit area and Page mine production was slightly below corresponding 1964 totals, but Bunker Hill output remained about the same because a bulk mining method was developed to extract low-grade zinc ore profitably.

The Bunker Hill Co. continued to process foreign and domestic custom ore at its Kellogg concentrator. The company reported milling 627,000 tons of ore, the largest annual tonnage in its history. Custom lead-zinc ore originated chiefly from Pine Point Mines, Ltd., Northwest Territories, Canada.

The Bunker Hill electrolytic zinc plant operated at capacity throughout the year

Table 12.—Mine production of gold, silver, copper, lead, and zinc in 1965 by types of material processed and methods of recovery, in terms of recoverable metals

Type of material processed and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Lode:					
Amalgamation	256	160	--	--	--
Concentration and smelting of concentrates	4,340	18,394,363	10,058,400	131,339,400	110,905,900
Total	4,596	18,394,523	10,058,400	131,339,400	110,905,900
Direct smelting:					
Ore	434	37,790	102,100	272,700	18,200
Mill cleanings and assay rejects [1]	17	7,723	4,000	192,400	100,300
Old slag	--	16,768	106,800	1,407,500	5,043,600
Copper precipitates	--	--	8,700	--	--
Total	451	62,281	221,600	1,872,600	5,162,100
Placer	31	5	--	--	--
Grand total	5,078	18,456,809	10,280,000	133,212,000	116,068,000

[1] Combined to avoid disclosing individual company confidential data.

except when production was curtailed to repair a flash roaster. The firm announced that a new 350-ton-per-day flash roaster was to be installed and that the annual slab zinc production capacity would be increased 20 percent to 110,000 tons.

Zirconium.—A report appraising the zircon resource and market potential of Idaho and other States was published.[3]

NONMETALS

Barite.—The J. R. Simplot Co. Sun Valley mine in Blaine County remained idle; the last production from the mine was in 1959 when several thousand tons of ore was produced. There were no shipments of crude barite from stocks during the year; stockpiles at the mine had been utilized to meet Simplot requirements for crude barite for the past several years.

Cement.—Production of portland and masonry cements was continued at the Inkom plant of Idaho Portland Cement Co., Bannock County. Production and shipments of portland cement were increased 26 and 25 percent, respectively, over totals for 1964; masonry cement shipments remained substantially the same as for the previous year. Cement production went mainly to destinations within the State; quantities also were shipped to markets in other Rocky Mountain States. Limestone requirements for cement manufacture were supplied from the nearby company Inkom quarry. Shale, gypsum, and iron ore used in the manufacturing process were purchased.

Clays.—The quantity of clays sold or used by producers increased 42 percent over the 1964 total. Greater production of miscellaneous clay, kaolin, and fire clay contributed to the increase. Miscellaneous clay, used in making heavy-clay construction products, was dug from pits in Ada, Bonneville, Cassia, Elmore, Latah, and Minidoka Counties. Fire clay production, from one operation in Latah County, registered a moderate increase over that of the previous year. Bentonite, mined in Owyhee and Gem Counties, was used in oilwell-drilling muds, for sealing irrigation canals and reservoirs, and as a binder for livestock feed pellets. Output of bentonite remained substantially the same as in 1964.

J. R. Simplot Co. continued producing paper-filler clay (kaolin) at the firm's Miclasil operation near Bovill, Latah County. Clay from the firm's Stanford pit northwest of Deary supplied the plant.

The Anaconda Company early in the year dropped its remaining lease-options on high-alumina clay deposits in Latah County. The firm had been investigating the technical and economic feasibility of using these high-alumina clay resources as a source of alumina.

Garnet.—Garnet production and shipments by Idaho producers increased sharply compared with totals for the previous year. Garnet-bearing material recovered from two dragline operations near Fernwood, Benewah County, registered a 77-percent increase over the 1964 total; production and shipments of refined garnet concentrates also were increased but not as sharply as was the crude mine production. Output went mainly to west coast markets for use as an airblast abrasive material.

Gem Stones.—The value of gems and gem materials collected in the State was estimated at $150,000. This estimate was based largely on a U.S. Forest Service visitor-day count (18,500) at the Emerald Creek star garnet deposit near Fernwood, Benewah County. It was estimated that an average of 3 pounds of gem materials was collected per visitor-day. The average price assigned to garnet was $2.50 per pound.[4] The value estimated for gem garnet ($140,000) was the highest for any gem material collected. Other materials, such as metallic ore specimens and many varieties of quartz, also were eagerly sought by the collectors.

Gem materials were gathered in small amounts by a large number of amateur collectors. The recreation-mining industry was served by 17 gem and mineral clubs and 16 commercial dealers. An article describing the Emerald Creek garnet deposit was published.[5]

Gypsum.—Gypsum for agricultural (land plaster) use was shipped from stocks at the Rock Creek mine near Weiser by Rock Is-

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[3] Kauffman, A.J., Jr., and Dean C. Holt. Zircon: A Review, With Emphasis on West Coast Resources and Markets. BuMines Inf. Circ. 8268, 1965, 69 pp.

[4] Gems and Minerals. A Catalog of Gem Materials Values—1965. October 1965, pp. 21–27.

[5] Agee, Leon M. Asterism in Garnets. Lapidary J., November 1965, pp. 910–916.

land Gypsum Co. The quantity shipped was greater than in 1964.

Kyanite.—Kyanite deposits in northcentral Idaho were under investigation by private firms and the Federal Bureau of Mines during the year. Sunshine Mining Co. in October negotiated a 10-year lease with the State of Idaho for 1,760 acres of kyanite-bearing lands near Kooskia in northwestern Idaho County. The firm announced plans for constructing a mill for upgrading the kyanite-bearing material, if the economics and the market potential proved favorable.

An extensive investigation to appraise kyanite resources in the Goat and Woodrat Mountain areas was begun by the Federal Bureau of Mines in 1964. A program of sampling, drilling, and reconnaissance mapping was carried out in 1964–65; a report of field investigations was being prepared. As a followup to the field resource evaluation, the Bureau in July initiated petrographic and beneficiation studies of samples from the Woodrat and Goat Mountain areas in northwestern Idaho County to determine the feasibility of recovering kyanite concentrates.

Lime.—Limestone was calcined to lime at beet-sugar refineries in Bonneville, Canyon, Minidoka, and Twin Falls Counties. Captive production of quicklime, used in beet-sugar refining, was 7 percent greater than in 1964. In addition, lime was regenerated from calcium-carbonate sludge precipitated in the chemicals recovery system at a kraft-pulp plant in Nez Perce County.

Mica.—The scrap mica operation of Non-Metallics, Inc., Deary, Latah County, was closed in 1965. The operation, during the previous 2 years, had produced small tonnages of scrap mica which were recovered by processing dumps at the Muscovite mine site.

Peat.—Shipments of peat by producers registered a sharp increase over the 1964 total. Reed-sedge peat was produced and shipped by Idaho Peat, Inc., from an operation near Downey, Bannock County, at a greatly accelerated rate. A small tonnage of humus peat was shipped from stocks by Soil Specialties, Inc., from an operation near Victor, Teton County. The peat was sold for horticultural and general soil improvement uses.

Perlite.—The quantity of perlite mined by Oneida Perlite Corp. at its open pit operation north of Malad, Oneida County, increased over twofold compared with the 1964 total. The tonnage, however, remained relatively small compared with Western States production. The crude material, after crushing and sizing, was shipped to the firm's storage and expanding facilities at Malad. Expanded perlite produced at the Malad plant was shipped to markets in the Western States for use as lightweight-plaster and concrete aggregate, as loose-fill insulation, and for soil conditioning.

Phosphate Rock.—Production of both crude and marketable phosphate rock increased sharply over totals for 1964. Mine production of crude phosphate rock totaled 3.7 million long tons. Output of marketable phosphate rock was 39 percent greater. Increased production from established operations and initial output from a mine in Caribou County were factors contributing to the increase.

Phosphate rock production also was greater than in 1964. Elemental phosphorus manufacture continued to require the largest tonnage, and requirements for this use exceeded the 1964 demand by 33 percent. Other uses registering gains were phosphate fertilizer and wet-process phosphoric acid manufacture, which increased 16 and 37 percent, respectively.

Phosphate rock was mined at four operations in two counties. J. R. Simplot Co. continued producing from the Gay and Conda mines in Bingham and Caribou Counties, respectively, and Monsanto Company mined phosphate rock at the Ballard property in Caribou County. El Paso Products Co. reported production from the firm's newly opened Mabie Canyon mine in Dry Valley north of Soda Springs, Caribou County. Most of the El Paso production was stockpiled for future use at the firm's newly constructed fertilizer plant near Conda.

Phosphate rock was reduced to elemental phosphorus at plants of Monsanto Company, Soda Springs, and FMC Corp., Mineral Products Division, at Pocatello. The elemental phosphorus furnace at El Paso Products Co., Georgetown, Bear Lake County, remained idle throughout the year.

J. R. Simplot Co. continued producing phosphate fertilizer products at the firm's fertilizer manufacturing complex near Po-

catello. Placed on productive stream at the Pocatello works in October was a 100-ton-per-day ammonium sulfate plant which rounded out a $10-million expansion program initiated in 1963. In January, the firm announced plans for additional expansion at the Pocatello works—the third major investment in plant and facilities at the site within the past 2 years. Cost of the program was $9 million, $7 million of which was allotted for construction at the Pocatello fertilizer complex. Scheduled for Pocatello were an additional 1,200-ton-per-day sulfuric acid plant, additions to the phosphoric acid production facilities, and an addition to the fume-scrubbing systems to remove fluorine and stack gases generated in manufacturing fertilizer products. The raw materials handling systems, and the raw material and finished products storage facilities were to be enlarged, and the plant's supporting utilities were scheduled for necessary additions. Also scheduled in the firm's overall investment program was $1.5 million for a new beneficiating plant at the Conda mine in Caribou County.

Monsanto Company continued an expansion program begun in 1964 at the firm's Soda Springs elemental phosphorus plant. Work was completed on modifying two existing furnaces for higher capacity operation, and construction was begun on a third furnace rated at 70,000 Kilovolt-amperes. The new furnace was scheduled for completion by early 1966. Announced plans called for a second 70,000-Kilovolt-ampere furnace to be built within 3 years.

The Bunker Hill Co. continued producing fertilizer-grade phosphoric acid at Kellogg, Shoshone County. Construction work was completed on an ammonium phosphate fertilizer plant, started in 1964 at Kellogg. The plant, which was constructed adjacent to the present Bunker Hill phosphoric acid plant and smelter complex at Kellogg, was to be operated by Bunker Hill with marketing and distribution of the fertilizer products to be handled by Stauffer Chemical Co. Production of ammonium phosphate fertilizers was initiated in December. Also scheduled for construction as part of announced plans for expanding the electrolytic zinc refining capacity at Kellogg, was a second 350-ton-per-day sulfuric acid facility. The acid was to be used in manufacturing phosphate fertilizers at the Kellogg site.

El Paso Products Co. late in the year began producing phosphoric acid and phosphate fertilizers at a newly constructed fertilizer complex north of Soda Springs, Caribou County. Phosphate rock requirements were supplied from the firm's mine in Dry Valley, 20 miles from the plant site.

Pozzolan.—El Paso Products Co. in July began constructing a pozzolan plant adjacent to the firm's mercury operation near Weiser, Washington County. Calcined opalite, a waste product from furnacing mercury ore, was to be used as a raw material feed for the pozzolan plant. Production, which was to be used as a concrete additive at dam construction projects, was scheduled to begin in 1966.

Pumice.—The quantity of pumice and volcanic cinder sold or used declined 22 percent compared with similar totals for 1964. Reduced market demand for pumice as a lightweight-concrete aggregate caused the decline. Pumice was produced in Bonneville, Caribou, Oneida, and Twin Falls Counties; a small quantity of volcanic cinder was mined in Canyon County. Pumice and cinder output was used chiefly as lightweight-concrete aggregate; the State highway department used crude pumice for road surfacing in Caribou County.

Sand and Gravel.—Sand and gravel production for all purposes increased 27 percent over the 9.6-million-ton total in 1964. Greater demand for sand and gravel at State highway department projects (5.9 million tons versus 2.3 million tons in 1964) was the principal reason for the increase; increased requirements for these commodities by the Bureau of Public Roads and the U.S. Forest Service also contributed. Production by commercial firms (2.8 million tons) remained substantially the same as in the previous year. Government-and-contractor production (largely contractor production for Federal, State, county, and municipal agencies) advanced 39 percent (table 13). Plants producing over 100,000 tons accounted for 67 percent of the commercial sand and gravel total compared with 62 percent in 1964. Bannock County was the principal producing area, with output exceeding 1.6 million tons. Production exceeded 500,000 tons each in Bonneville, Canyon, Clark, Franklin, and Twin Falls Counties. Sand and gravel production was reported from operations in 40 of the 44 counties in the

Table 13.—Sand and gravel sold or used by producers, by classes of operations and uses
(Thousand short tons and thousand dollars)

Class of operation and use	1964		1965	
	Quantity	Value	Quantity	Value
Commercial operations:				
Building	609	$978	629	$1,100
Road material	2,120	1,985	1,920	2,063
Fill	48	52	161	192
Other [1]	94	96	101	165
Total	2,871	3,111	2,811	3,520
Government-and-contractor operations:				
Building	505	288		
Road material	4,146	4,025	8,470	9,137
Fill	2,059	1,266	865	539
Other [1]	1	1	5	2
Total	6,711	5,580	9,340	9,678
All operations:				
Building	1,114	1,266	629	1,100
Road material	6,266	6,010	10,390	11,200
Fill	2,107	1,318	1,026	731
Other [1]	95	97	106	167
Grand total	9,582	8,691	12,151	13,198

[1] Includes special sands, railroad ballast, and sand and gravel used for miscellaneous purposes.

State. Significant tonnages also were produced which could not be assigned to a specific county of origin.

Universal Lumber & Supply Co. (Del Monte Properties Co.) continued producing quality sand for plaster, glass, foundry, abrasives, and other specialty uses from an operation near Emmett, Gem County. The sand was shipped by rail and truck to markets throughout the Pacific Northwest.

Stone.—Production of stone increased 60 percent over the 1.14-million-ton total for 1964. Increased production for commercial markets and greater demand by Federal, State, county, and municipal agencies for roadstone accounted for the sharp rise. Commercial operations produced 1.1 million tons, an advance of 49 percent over the 738,000-ton total in 1964. Government-and-contractor tonnage (largely contractor production for Federal, State, county, and municipal agencies) advanced 81 percent over the 406,000-ton total for the previous year.

Basalt continued to be the principal stone quarried. Output, which increased 91 percent compared with the previous year's total, was used mainly as a road base and surfacing material; smaller quantities were used as riprap. Limestone production, principally from quarries in Bannock and Lewis Counties, advanced 18 percent, because demands by the cement and sugar-refining industries increased. Sandstone and quartzite, produced from quarries in Bannock and Caribou Counties, respectively, declined 27 percent. Reduced output of quartzite used as furnace flux at elemental phosphorus plants caused the decline. Stone was quarried in 13 counties; however, significant tonnages also were produced which could not be assigned to a specific county of origin.

REVIEW BY COUNTIES

Mineral production was recorded from 42 of the 44 counties. Shoshone County accounted for 60 percent of the total mineral-output value. Sand and gravel and stone were the principal or only products from 30 counties. Selected counties with significant metal and nonmetal developments are discussed in the following review.

Adams.—After concluding a drilling program at the Peacock open pit mine in the Seven Devils area, Copper Ridge Mining Co., Ltd., relinquished the property to Idaho Exploration Co., a firm organized during the year. The new company began modifying the former Alaska tungsten mill at Cuprum to process Peacock mine copper oxide ore by a leach-precipitation method.

Table 14.—Value of mineral production in Idaho, by counties

(Thousand dollars)

County	1964	1965	Minerals produced in 1965 in order of value
Ada	W	$882	Sand and gravel, clays.
Adams	$43	---	
Bannock	W	W	Cement, sand and gravel, stone, peat.
Bear Lake	223	280	Sand and gravel.
Benewah	248	W	Abrasive garnet, stone, sand and gravel, iron ore.
Bingham	W	W	Phosphate rock, vanadium, sand and gravel, stone.
Blaine	738	W	Lead, zinc, silver, sand and gravel, gold, copper.
Boise	14	2	Silver, gold, lead, zinc.
Bonner	132	117	Sand and gravel, silver, lead, gold, zinc, copper, stone.
Bonneville	880	1,020	Sand and gravel, lime, pumice, clays.
Boundary	59	283	Sand and gravel, stone.
Butte	81	14	Sand and gravel, lead, silver, zinc, copper.
Camas	W	21	Silver, lead, sand and gravel, zinc, copper, gold.
Canyon	868	1,247	Sand and gravel, lime, pumice.
Caribou	W	W	Phosphate rock, stone, vanadium, sand and gravel, pumice.
Cassia	W	W	Sand and gravel, clays.
Clark	112	758	Sand and gravel.
Clearwater	198	328	Stone, sand and gravel.
Custer	538	783	Copper, silver, sand and gravel, lead, zinc, gold.
Elmore	139	116	Sand and gravel, clays.
Franklin	842	528	Sand and gravel.
Fremont	117	---	
Gem	W	238	Sand and gravel, gold, silver, lead, zinc, clays, copper.
Gooding	47	185	Sand and gravel.
Idaho	501	155	Sand and gravel, stone, gold, silver.
Jefferson	76	125	Sand and gravel.
Jerome	---	173	Sand and gravel, gold.
Kootenai	345	121	Sand and gravel.
Latah	W	W	Clays, stone, sand and gravel.
Lemhi	W	W	Copper, gold, sand and gravel, silver, lead, iron ore, zinc.
Lewis	408	W	Stone.
Lincoln	298	W	Sand and gravel.
Madison	615	21	Do.
Minidoka	545	481	Sand and gravel, lime, clays.
Nez Perce	563	616	Stone, sand and gravel.
Oneida	29	100	Sand and gravel, pumice, perlite.
Owyhee	6	200	Sand and gravel, clays, gold, lead, silver.
Payette	49	55	Sand and gravel.
Power	26	13	Do.
Shoshone	57,565	62,910	Silver, lead, zinc, copper, antimony, sand and gravel, gold, stone.
Teton	--	202	Sand and gravel, peat.
Twin Falls	686	1,260	Sand and gravel, lime, pumice, gold.
Valley	83	134	Stone, mercury, sand and gravel, iron ore, ilmenite, gold, silver.
Washington	32	1,226	Mercury, sand and gravel, iron ore, copper, silver.
Undistributed [1]	19,156	30,491	
Total	86,262	105,085	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] Includes value of mineral production that cannot be assigned to specific counties and values indicated by symbol W.

Idaho Mining & Smelting Co. postponed indefinitely plans to construct a small copper smelter at Oxbow Dam.

Bannock.—The value of nonmetal minerals produced advanced 69 percent compared with that of 1964 owing to increased production of cement, sand and gravel, stone, and peat. Production of 1.7 million tons of sand and gravel, an increase of 140 percent over the previous year's output, ranked the county first in output of these commodities. Greater demand for sand and gravel at State highway department projects was the principal reason for the sharp rise. Limestone was quarried at an increased rate from the Inkom quarry of Idaho Portland Cement Co. to supply requirements of the firm's cement plant at Inkom. Reed-sedge peat was produced and shipped by Idaho Peat, Inc., from an operation near Downey.

Benewah.—Production from the McCleary Butte property was curtailed because of reduced iron ore requirements at the Ideal Cement Co. plant at Irvin, Wash.

Garnet concentrates were produced and shipped by Idaho Garnet Abrasive Co. and Emerald Creek Garnet Milling Co. from operations near Fernwood. Shipments from both operations increased compared with those of the previous year. The Emerald Creek garnet area near Fernwood also

served as a rich source of gem-quality garnet for collectors and hobbyists. Much of the digging for garnet specimens was on gravel tailings areas which resulted from previous industrial garnet mining operations. Garnets larger than ½-inch had not been recovered for industrial garnet, and these specimens were sought by collectors. Sand and gravel and stone for road construction and surfacing uses were produced.

Bingham.—J. R. Simplot Co. continued mining phosphate rock and phosphatic shale at the Gay mine near Fort Hall. Production of both phosphate rock and phosphatic shale was increased significantly compared with output in the previous year. The higher-grade rock went for manufacturing phosphate fertilizer products at the firm's fertilizer plant near Pocatello, and the lower-grade phosphatic shale was reduced to elemental phosphorus at the Pocatello plant of FMC Corp. Sand and gravel output increased 161 percent owing largely to increased needs at county and State road projects.

Blaine.—Federal Resources Corp. increased lead, zinc, and silver production from the Silver Star-Queens mine at Bellevue. The ore, richer than that mined in 1964, was processed at the adjacent 250-ton-per-day concentrator, along with ore from several smaller mines in the area and tailings from previous operations at the Minnie Moore mine.

Boise.—Silver Bullion Mining Co. purchased 15 claims in the Placerville area after exploration had exposed a promising silver-bearing vein on the 200 level of the Silver King mine.

Bonner.—Gold, silver, and lead production from the Weber mine was far larger than that from any of the other six metal mines operated.

The geologic setting and history of the Pend Oreille Lake region were described.[6]

Bonneville.—Despite a drop in tonnage, the county continued as the principal pumice-producing area in the State. Output was from operations of Idaho Falls Pumice Co. and Idaho Concrete Products, Inc., near Idaho Falls and Ammon, respectively. Limestone was processed to lime by the Utah-Idaho Sugar Co. for use at the firm's Idaho Falls sugar refinery. Clay mined near Idaho Falls was used in producing heavy clay construction products by Idaho Falls Brick and Tile Co.

Camas.—Nearly 2,000 tons of ore from the Buttercup mine yielded 5,900 ounces of silver, 10 tons of lead, and 3 tons of zinc.

Caribou.—Mine production of phosphate rock increased 35 percent compared with output in 1964. Output from both the Ballard (Monsanto Company) and the Conda (J. R. Simplot Co.) mines was increased sharply, and production was initiated from the Mabie Canyon mine of El Paso Products Co. A portion of the increased production from the Ballard mine was stockpiled to supply the expanded phosphorus productive capacity being installed at Monsanto's Soda Springs plant. A second nodulizing kiln and additional rock-handling equipment were installed as part of a program for expanding elemental phosphorus productive capacity at the Soda Springs site. Construction was begun on the first of two 70,000-Kilovolt-ampere furnaces scheduled for installation. Conda mine output was beneficiated and shipped to the Simplot fertilizer-manufacturing complex at Pocatello. Quartzite, used as a flux in elemental phosphorus furnaces, was quarried near Soda Springs. A quantity of crude pumice was mined and used at State highway department projects. Sand and gravel output rose 88 percent, owing to greater demand at Federal and county road projects.

Custer.—Lost River Mines, Inc., purchased the Empire mine, Alder Creek district, in February. While development was in progress, copper ore from old stopes was extracted and milled in a 175-ton-per-day concentrator originally constructed in 1961. Eight-ton ore cars and a diesel loader were placed in use on the main 1100 haulage level.

Silver ore (26,658 tons) from the Clayton mine yielded 31 ounces of gold, 130,877 ounces of silver, 18.5 tons of copper, 429 tons of lead, and 63 tons of zinc. The Clayton Silver Mines annual report to stockholders stated that mining costs totaled $124,284, and milling costs were $72,991; total operating expenses were $232,058. An ore block containing nearly 200,000 tons above the 800 level was prepared for mining. Diamond drilling completed in April

[6] Savage, C.N. Geologic History of Pend Oreille Lake Region in North Idaho. Idaho Bureau of Mines and Geology Pamphlet 134, July 1965, 24 pp.

disclosed an ore body between the 800 and 1300 levels estimated to contain 600,000 tons. As a result of the reserve increase, the mill capacity was raised to about 180 tons per day by installing a new ball mill, new and reconditioned flotation cells, two cyclone classifiers, and new jaw and gyratory crushers.

Part of the Bayhorse dump was shipped by L & B Investment Co. Federal Resources Corp. trucked silver ore from the Phi Kappa mine in the Alto district to the company mill at Bellevue.

Gem.—Rising costs caused production by Gem State Consolidated Mines, Inc., to decline to 384 ounces of gold and 929 ounces of silver. Concentrate from the 40-ton-per day flotation mill was shipped to both the U.S. Assay Office, San Francisco, Calif., and the lead smelter at East Helena, Mont.

Latah.—Production of paper clay at the Miclasil plant of J. R. Simplot Co. near Bovill, in terms of value, continued as the principal mineral industry activity in the county. Fire clay was mined near Helmer by A. P. Green Firebrick Co. and used at the firm's Troy plant for manufacturing refractory products. The scrap mica recovery operation of Non-Metallics, Inc., was idle throughout the year.

Lemhi.—Machinery Center, Inc., Salt Lake City, Utah, accounted for most of the metal production by operating the Blackbird copper mine at approximately the 1964 rate. Eight gold and silver mines and five lead and zinc mines also yielded small quantities of ore.

Adalee Enterprises, Inc., Boise, completed surface work and drilling on the Lemhi Pass Thorium Corp. property in the Lemhi Pass area. One purpose of the work was to determine the ore's rare-earth content.

Oneida.—Crude perlite mined at the open pit operation of Oneida Perlite Corp. was processed to expanded perlite at the firm's Malad plant. Mine production of crude perlite and output of expanded perlite both were greater than for the previous year. Pumice, mined by South Idaho Construction Co. from the Wrights Creek deposit near Malad, was used as lightweight-concrete aggregate. Output declined substantially compared with production for the previous year. Sand and gravel output increased sharply, owing to greater demand by the State highway department.

Owyhee.—Sidney Mining Co. continued exploring 48 optioned claims in the Silver City area.

Power.—Phosphate rock from mines in Bingham and Caribou Counties was supplied in greater quantities to the growing phosphate processing industry centered at Pocatello. J. R. Simplot Co. processed phosphate rock from the company mines in Bingham and Caribou Counties to phosphate fertilizer products. The Simplot firm continued to add productive capacity during the year and announced plans for additional plant expansions. FMC Corp. at Pocatello increased phosphorus production to meet expanded requirements of its phosphorus conversion plants in the Western and Midwestern States. Phosphatic shale mined in Bingham County suppiied the facility.

Sulfur from recovery plants in the Western United States and Western Canada was converted to sulfuric acid by J. R. Simplot Co. for use in manufacturing phosphate and ammonium phosphate fertilizers at Pocatello.

Shoshone.—Nineteen mines supplied 95 percent of the State's base- and precious-metal production value. The increased value of metal production resulted from larger silver output and higher average copper, lead, and zinc market prices. Dividends paid to stockholders of Coeur d'Alene region mining companies were $6.47 million, compared with $5.6 million in 1964.

The Bunker Hill Co. scheduled a $13-million expansion of its electrolytic zinc plant and related facilities. The expansion, to include expanding slab zinc production facilities to 110,000 tons annually, installing a second 350-ton-per-day sulfuric-acid plant, and modernizing operating procedures, is to be completed in 1967.

Although production exceeded that of 1964, delayed foreign lead concentrate deliveries forced curtailment of The Bunker Hill Co. lead smelter operations during the first quarter. The plant was operated at capacity during the remainder of the year.

An extensive treatise on the geology of the Coeur d'Alene district was published.[7]

Beaver District.—The Day Mines, Inc., annual report to shareholders stated that

[7] Hobbs, Warren S., Allen B. Griggs, Robert E. Wallace, and Arthur B. Campbell. Geology of the Coeur d'Alene District, Shoshone County, Idaho. U.S. Geol. Survey Prof. Paper 478, 1965, 139 pp.

Table 15.—Mine production of gold, silver, copper, lead, and zinc, in the Coeur d'Alene region, Shoshone County, in terms of recoverable metals

Year	Mines producing		Material sold or treated [1] (thousand short tons)	Gold, lode and placer (troy ounces)	Silver, lode and placer (thousand troy ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)	Total value (thousands)
	Lode	Placer							
1956–60 (average)	26	1	1,425	2,304	14,519	3,306	56,536	48,638	$41,735
1961	15	1	1,434	3,279	17,369	3,673	70,651	58,184	46,313
1962	17	1	1,537	3,962	17,578	3,435	83,339	62,713	51,085
1963	16	--	1,463	3,427	16,523	3,332	74,794	63,118	53,980
1964	18	--	1,482	2,952	16,122	3,336	69,586	58,054	57,146
1965	21	--	1,592	2,713	17,918	3,540	63,474	56,443	62,054
1884–1965	--	--	[2] 112,589	444,323	703,340	116,016	6,833,505	2,385,309	2,089,630

[1] Does not include gravel washed.
[2] Complete data not available: 1904–1965.

company production from the Monitor mine was 25,813 tons, averaging 0.6 ounce of silver per ton, 1.6 percent lead, and 4.9 percent zinc. Monitor ore was concentrated at the Dayrock mill until underground reserves were exhausted. Kennedy and Zanetti produced 70,262 tons of ore averaging 0.5 ounce of silver per ton, 1.1 percent lead, and 2.1 percent zinc from a leased subdivision of the Monitor mine. Of this, 19,600 tons was mined by conventional methods and the remainder came from the Interstate gob and a surface dump.

Evolution District.—The Sunshine mine continued to be the leading silver mine in the Nation with a production of 6.44 million ounces from ore assaying 38.8 ounces per ton. Nearly 200 ounces of gold, 1,200 tons of copper, 340 tons of lead, and 200 tons of zinc also were recovered from 168,763 tons of ore. According to the Hecla Mining Co. annual shareholders report, exploration and development, concentrated on the 4400 and 4600 levels of the Sunshine Unit area, blocked out more ore than was mined. Deepening the No. 10 shaft to provide access for developing the 4800 and 5000 levels was begun late in the year. Sunshine Mining Co. gained control of Bismarck Mining Co. preparatory to expanding operations into part of the 48 claims comprising the Bismarck property located southwest of the Sunshine mine.

Hecla Mining Co. extracted 34,764 tons of ore averaging 19.4 ounces of silver per ton and 0.5 percent copper from the Silver Summit mine. Drifting on the 3600 level of the mine exposed four ore shoots in addition to the two developed previously, but 1,200 feet of drifting on the 3800 level exposed considerably less ore. Yearend ore reserves were 35,000 tons, compared with 31,000 tons on January 1.

Hunter District.—According to The Bunker Hill Co. annual report to stockholders, 240,197 tons of ore from the Star Unit area yielded 628,506 ounces of silver, 10,617 tons of lead, and 24,050 tons of zinc. Exploration and development results, particularly on the 7100 level, were sufficiently encouraging to warrant a 2.5-year project to deepen the Noonday shaft to the 9000 level, 7,000 feet below the main tunnel level. Yearend reserves were increased to 1,140,155 tons.

Production from the Nation's third largest silver property—the Lucky Friday mine—was 181,260 tons of ore yielding 1,404 ounces of gold, 3.15 million ounces of silver, 19,602 tons of lead, and 1,387 tons of zinc. The Lucky Friday shaft was deepened to a point 155 feet below the 3650 level, and stope preparation was begun on the 3450 level. Yearend ore reserves declined to 607,000 tons, compared with 671,000 tons on January 1.

Hecla and Day Mines, Inc., agreed to explore Day Mines' Hunter Ranch property, located adjacent to Lucky Friday ground. The cost of driving two laterals westward from the Lucky Friday shaft, and diamond drilling was to be shared equally by the firms. A lateral from the Lucky Friday 2800 level had penetrated 480 feet into Hunter Ranch property by yearend.

Lelande District.—Lead-zinc mill cleanings were shipped from the Haywire, Hercules, and Sherman mills. Small quantities of ore were extracted at the Mace and Sherman mines.

Placer Center District.—Day Mines, Inc., a 25-percent participator in the Galena mine operation, reported to shareholders that 4.36 million ounces of silver and 1,543 tons of copper were recovered from 147,656 tons of ore averaging 30 ounces of silver per ton and 1.1 percent copper. Drifting and crosscutting totaling 11,826 feet and 12,300 feet of diamond drilling developed more ore than was mined. Sinking of the No. 3 shaft from the 3000 to the 3700 level was begun. American Smelting and Refining Company, operator of the property, also planned to increase the Galena mill capacity about 50 percent to 750 tons per day.

Asarco planned to sink the "Coeur Project" shaft to the 3,500-foot point before starting a 3000-level crosscut to intersect a lateral Hecla Mining Co. drove into Rainbow ground from the Silver Summit mine in previous years.

Day Mines, Inc., resumed production from the Dayrock mine, closed since 1962, and developed a 1250 level while rehabilitating two upper levels. Ore milled aggregated 5,367 tons containing 2.4 ounces of silver per ton and 3.0 percent lead, according to the Day Mines, Inc., annual report. Development, consisting of 1,751 feet of drifting and crosscutting and 88 feet of raising, indicated reserves sufficient for 2 years of operation at a 150-ton-per-day rate.

Smelter District.—The Bunker Hill Co. continued to smelt dump slag for its metal content and its value as a fluxing agent.

Summit District.—A small amount of gold ore came from the Mountain Lion group.

Yreka District.—Development of the Bunker Hill mine continued at a high rate, but production declined. The 17,000-foot-long crosscut to connect the 23 level of the Bunker Hill mine and the 3100 level of the Crescent mine, begun in 1959, was completed in midyear, thus providing access for drilling and other exploration of a large area owned by Bunker Hill and Yreka-United, Inc. Reserves of high-grade lead-silver ore declined to 1.09 million tons, but development of a bulk mining method, making possible the profitable extraction of low-grade zinc ore bodies, added 1.79 million tons of this material to the firm's ore reserves. The bulk procedure involved using trackless mining equipment and a horizontal checkerboard extraction pattern in which one-third of the ore was left as roof support pillars. The Bunker Hill annual report to shareholders stated that 366,837 tons of Bunker Hill mine ore yielded 1.589 million ounces of silver, 25,631 tons of lead, and 16,885 tons of zinc.

The Bunker Hill concentrator at Kellogg was operated on a 7-day-week schedule beginning in March due to increased custom ore receipts. The 627,000 tons processed was larger than in any other year. Milling old Bunker Hill mill tailings remained profitable because of favorable lead and zinc market prices.

At the Crescent mine, Bunker Hill drifted 600 feet along a high-grade silver zone averaging 5.5 feet wide and assaying almost 75 ounces per ton. A small prospect shaft was sunk to the 3500 level, and drifting was begun to check the high-grade ore shoot's downward extension. The company reported to shareholders that 664,211 ounces of silver was recovered from 20,217 tons of ore averaging 34 ounces per ton. The 3300-level development increased year-end ore reserves fourfold to 162,352 tons averaging 70 ounces per ton.

Valley.—Antimony Gold Ores Co. produced a small quantity of concentrate containing 53 percent antimony from stockpiled ore at its mill near Yellow Pine, but the concentrate was not sold. Mercury was recovered at the Hermes property at approximately the 1964 rate. The open pit mine ore was concentrated by flotation in a 20-ton-per-hour mill prior to furnacing in a D–retort.

A mercury-bearing antimony deposit located between Big Creek and Yellow Pine was described.[8]

Washington.—Copper ore was shipped from a small open cut at the Railroad mine in the Heath mining district. Copper Ridge Mines, Ltd., subleased the IXL property to American Exploration Co. Copper Ridge held a lease on the property from Idaho Mining & Smelting Corp. American Exploration conducted an extensive drilling program to determine the feasibility of developing a profitable open pit copper operation. Kismet Mining Co., Ltd.,

[8] Leonard, B.F. Mercury-Bearing Antimony Deposit Between Big Creek and Yellow Pine, Central Idaho. Paper in Geological Survey Research 1965: Chapter B. U.S. Geol. Survey Prof. Paper 525–B, 1965, pp. B23–B28.

dropped its option on a copper-tungsten property on Cuddy Mountain after completing a drilling program begun in 1964. Kismet also reopened old workings on the Nixon Ranch and planned further development.

El Paso Products Co. employed approximately 15 men at the Idaho-Almaden mercury mine. Ore extracted from three pits contained from 1.9 to 2.2 pounds of mercury per ton. The company began constructing a plant addition to produce pozzolan as a byproduct.

Gypsum was shipped from stocks at the Rock Creek mine of Rock Island Gypsum Co. for agricultural use. Sand and gravel output rose owing to sharply increased demand at State and county road projects.

The Mineral Industry of Illinois

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the Illinois Geological Survey, for collecting information on all minerals except fuels.

By Richard E. Dawes [1]

Illinois mineral production in 1965 was valued at $593 million, slightly higher than in 1964. Increases in total value of clays, coal, flourspar, lead, lime, liquefied petroleum (LP) gases, peat, sand and gravel, stone, tripoli, and zinc offset decreases in portland and masonry cement, natural gas, natural gasoline and cycle products, and petroleum. Mineral fuels comprised over 71 percent of the State total value. Nonmetals comprised over 27 percent and metals over 1 percent.

In 1965, the State led in fluorspar production, ranked fourth in bituminous coal output, and was among the leading States in the production of construction materials —cement, clays, lime, sand and gravel, and stone. Illinois also ranked high in the processing of mineral raw materials.

[1] Mining engineer, Bureau of Mines, Minneapolis, Minn.

Table 1.—Mineral production in Illinois [1]

Mineral	1964 Quantity	1964 Value (thousands)	1965 Quantity	1965 Value (thousands)
Cement:				
Portland—thousand 376-pound barrels	9,790	$32,191	9,358	$30,622
Masonry—thousand 280-pound barrels	596	2,038	615	1,907
Clays [2]—thousand short tons	2,007	4,358	2,169	4,601
Coal (bituminous)—do	55,023	208,448	58,483	218,972
Fluorspar—short tons	127,454	6,452	159,140	7,861
Lead (recoverable content of ores, etc.)—do	2,180	571	3,005	938
Natural gas—million cubic feet	7,824	905	7,396	865
Natural gas liquids:				
Natural gasoline and cycle products—thousand gallons	14,109	1,030	W	W
LP gases—do	312,173	13,758	W	W
Peat—short tons	W	W	36,774	453
Petroleum (crude)—thousand 42-gallon barrels	70,168	205,592	63,708	186,664
Sand and gravel—thousand short tons	34,880	39,966	36,228	40,480
Stone—do	42,987	56,553	47,066	61,294
Zinc (recoverable content of ores, etc.)—short tons	13,800	3,754	18,314	5,348
Value of items that cannot be disclosed: Fuller's earth, gem stones, lime, peat (1964), and tripoli	XX	15,520	XX	33,020
Total	XX	591,136	XX	593,025

W Withheld to avoid disclosing individual company confidential data. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes fuller's earth, included with "Value of items that cannot be disclosed."

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Table 2.—Value of mineral production in constant 1957–59 dollars
(Millions)

Year	Value	Year	Value
1956	$597	1961	$577
1957	571	1962	605
1958	582	1963	605
1959	581	1964	r 609
1960	598	1965	p 611

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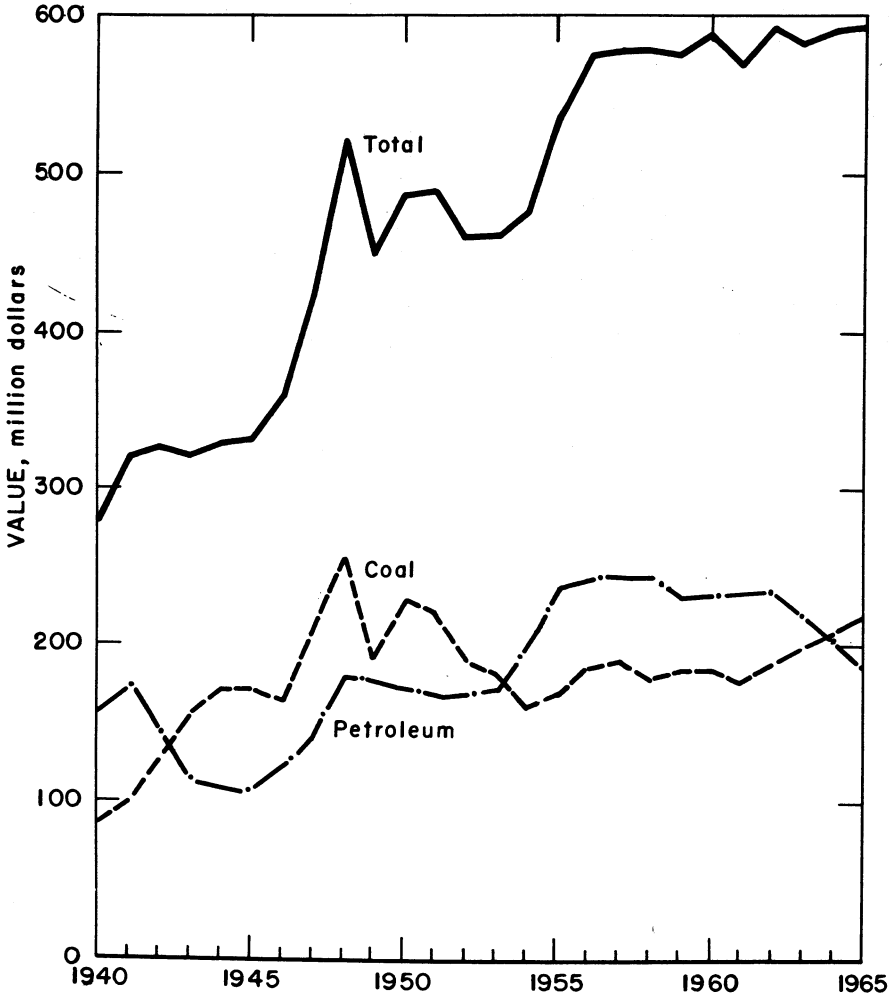

Figure 1.—Value of coal, petroleum, and total value of mineral production in Illinois.

Table 3.—Employment and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1964:								
Coal	8,386	242	2,032	15,811	10	675	43.33	5,682
Peat	17	118	2	18	---	---	---	---
Metal	51	255	13	104	---	5	48.07	1,634
Nonmetal	1,382	234	324	2,598	1	100	38.88	3,895
Sand and gravel	1,877	208	390	3,307	1	62	19.05	2,860
Stone	3,290	264	870	7,066	---	128	18.12	704
Total	15,003	242	3,631	28,904	12	970	33.97	3,963
1965: p								
Coal	8,600	244	2,101	16,590	14	725	44.54	6,986
Peat	24	83	2	18	---	---	---	---
Metal	30	267	8	65	---	---	---	---
Nonmetal	1,425	253	360	2,884	1	84	29.47	4,613
Sand and gravel	1,980	224	443	3,757	---	80	21.29	2,262
Stone	3,370	270	909	7,403	1	124	16.89	1,664
Total	15,429	248	3,823	30,717	16	1,013	33.50	4,884

p Preliminary.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Coal (Bituminous).—Illinois ranked as the fourth largest bituminous-coal-producing State in the Nation with an output of 58.5 million tons. A 6-percent increase in tonnage and 5-percent increase in value in 1965 were attributed to a 3.1-million-ton increase in coal consumption by electric utilities. Most of the increase was utilized by in-State consumers.

Over 58 percent of the State coal production was utilized in Illinois. Nearly two-thirds of the coal mined in the State was used in producing electric energy. Total shipments to general manufacturing and processing industries increased about 420,000 tons to 16.1 million tons; and to coke and gas plants, 250,000 tons to 1.6 million tons. Shipments to retail dealers decreased 370,000 tons to 2.6 million tons. Railroad fuel consumption decreased to about 220,000 tons.

The total value of bituminous coal production was the greatest of any single commodity group within the State in 1965, nearly 37 percent of the total value of minerals produced. Coal consumption in Illinois increased nearly 7 percent; almost 77 percent of the 44.4 million tons of bituminous coal consumed was produced within the State. Average mine value was $3.74 per ton, down from $3.79 per ton in 1964.

Production, excluding mines producing less than 1,000 tons annually, was reported from 90 mines in 29 counties.

Counties producing over 1 million tons of coal in order of rank were Fulton, Perry, Franklin, Williamson, St. Clair, Christian, Saline, Randolph, Jefferson, Montgomery, Knox, Jackson, and Peoria. Production from these counties represented over 93 percent of the State total.

Ten companies each produced over 1 million tons of coal to account for nearly 95 percent of the State total. These companies were Bell & Zoller Coal Co., Freeman Coal Mining Corp., Old Ben Coal Corp., Peabody Coal Co., Sahara Coal Co., Inc., Southwestern Illinois Coal Corp., Stonefort Coal Mining Co., Inc., Thunderbird Collieries Corp., Truax-Traer Coal Division (Consolidation Coal Co., Inc.), and The United Electric Coal Cos. Peabody Coal Co. No. 10 underground mine in Christian County ranked as the largest producing bituminous coal mine in the Nation. Two other Illinois mines were among the seven largest producing mines in the Nation.

Strip mines supplied nearly 56 percent of the total production and underground mines provided the remainder. Output from strip mines increased nearly 9 percent

from the 1964 output, whereas production from underground mines increased over 3 percent.

Forty-nine plants cleaned 82 percent of the State total coal output. All but a minor fraction of a percent of the underground production was cut and loaded by machines. Loading equipment included 83 mobile loaders, 54 continuous miners, and 2 duckbills or self-loading conveyors. Stripping and loading equipment at strip mines included 161 power shovels, draglines, and wheel excavators. Among the new equipment was a 180-cubic-yard stripping shovel added at the Southwestern Illinois Coal Corp. Captain mine near Cutler. Over 83 percent of the total State output was shipped to consumers by rail, less than 10 percent by truck, and nearly 7 percent by waterways. A small quantity was consumed at the mines.

The Old Ben No. 24 underground mine near Benton reported initial production in midyear.

Coke.—Approximately 2.5 million tons of coke, valued at $49.2 million, was produced at six plants, representing an increase of 9 percent in quantity and 13 percent in value from the 1964 figures. Consumption of coke by producing companies increased 3 percent to nearly 2.4 million tons. During 1965, 568 ovens were operated, the same number as in 1964.

Producing plants recovered 200,000 tons of coke breeze valued at over $1.3 million, representing a 14-percent increase in quantity and a 6-percent decrease in value from the 1964 figures. More than 122,000 tons of coke breeze was used by producers in agglomerating iron ore, compared with 102,000 tons in 1964. Other products of coke oven plants included coke oven gas, tar, ammonia, crude light oil, and light-oil derivatives.

Peat.—Peat was produced by six companies in Cook, Kane, Lake, and Whiteside Counties. Increased survey coverage resulted in a substantial increase in reported production. Moss, reed-sedge, and humus types were sold in bulk for general soil conditioners. Moss and reed-sedge were also sold in packaged form.

Table 4.—Coal (bituminous) production in 1965, by counties

(Excludes mines producing less than 1,000 short tons)

County	Number of mines operated		Production (short tons)			Value
	Underground	Strip	Underground	Strip	Total	
Adams	--	1	-------	26,520	26,520	$183,990
Christian	1	--	5,404,196	-------	5,404,196	W
Douglas	1	--	646,201	-------	646,201	W
Franklin	4	--	6,182,282	-------	6,182,282	W
Fulton	--	7	-------	7,282,709	7,282,709	28,677,031
Gallatin	3	1	45,185	50,243	95,428	255,338
Greene	--	1	-------	5,550	5,550	20,918
Grundy	--	1	-------	350,822	350,822	W
Henry	1	--	16,769	-------	16,769	W
Jackson	1	2	356,872	970,710	1,327,582	W
Jefferson	1	--	2,682,787	-------	2,682,787	W
Johnson	--	1	-------	1,939	1,939	W
Knox	--	2	-------	2,260,205	2,260,205	W
Logan	1	--	15,882	-------	15,882	79,410
Macoupin	1	--	378,979	-------	378,979	1,569,041
Menard	1	--	5,255	-------	5,255	W
Mercer	1	--	23,685	-------	23,685	123,162
Montgomery	2	--	2,352,395	-------	2,352,395	W
Peoria	1	3	15,454	1,286,725	1,302,179	6,154,668
Perry	--	3	-------	6,503,838	6,503,838	21,179,525
Randolph	1	2	818,762	2,045,441	2,864,203	W
St. Clair	4	2	1,291,802	4,430,117	5,721,919	19,969,665
Saline	3	9	1,894,759	2,783,528	4,678,287	17,455,603
Schuyler	--	1	-------	435,216	435,216	W
Stark	--	1	-------	533,166	533,166	W
Vermilion	3	3	46,479	788,348	834,827	W
Washington	1	--	31,262	-------	31,262	W
Will	--	1	-------	496,869	496,869	W
Williamson	10	8	3,604,619	2,417,637	6,022,256	22,558,292
Total	41	49	25,813,625	32,669,583	58,483,208	218,972,345

W Withheld to avoid disclosing individual company confidential data; included in total.

Petroleum, Natural Gas, and Natural Gas Liquids.—Crude petroleum production decreased 9 percent in both quantity and value to comprise over 31 percent of the State total value of mineral production. Most of the production came from oilfields in the southeastern part of the State. Waterflood oil production accounted for about two-thirds of the total output.

As reported by the Illinois State Geological Survey, Fayette County accounted for approximately 10.9 million barrels of petroleum valued at $31.9 million, or over 17 percent of the State total petroleum production and value. Other counties each producing over 5 million barrels of crude petroleum in order of rank were Marion, Lawrence, White, and Wayne. Production from these four counties represented 42 percent of the total State crude petroleum production and value. Nearly 25 percent of the crude petroleum production in the State came from the Louden and Salem fields.

The Illinois State Geological Survey reported the completion of 1,245 wells in 1965, of which 574 were producing oil wells, 11 were gas wells, 367 were dry holes in pools, and 293 were unsuccessful wildcats. Total footage drilled was 2,608,415, of which 50 percent was in producing wells. Data do not include service wells, natural gas storage wells, and old wells worked over.

Table 5.—Crude petroleum production, by counties

(Thousand 42-gallon barrels and thousand dollars)

County	1964		1965	
	Quantity	Value [1]	Quantity	Value [1]
Adams	10	$29	8	$23
Bond	149	437	135	396
Brown	6	18	2	6
Christian	934	2,737	887	2,599
Clark [2]	865	2,534	776	2,274
Clay	2,702	7,917	2,703	7,920
Clinton	1,536	4,500	1,105	3,238
Coles	999	2,927	802	2,350
Crawford	3,561	10,434	3,473	10,176
Cumberland	(2)	(2)	(2)	(2)
DeWitt	245	718	269	788
Douglas	148	434	104	305
Edgar	60	176	57	167
Edwards	1,230	3,604	969	2,839
Effingham	433	1,269	441	1,292
Fayette	12,961	37,976	10,903	31,946
Franklin	1,646	4,823	1,360	3,985
Gallatin	1,263	3,701	1,057	3,097
Hamilton	3,148	9,224	2,978	8,726
Hancock [2]	43	126	44	129
Jasper	768	2,250	741	2,171
Jefferson	1,856	5,438	1,411	4,134
Lawrence	7,127	20,882	6,908	20,240
McDonough	(2)	(2)	(2)	(2)
Macon	36	105	25	73
Macoupin	8	23	7	21
Madison	320	938	283	829
Marion	8,916	26,124	7,827	22,933
Montgomery	3	9	2	6
Moultrie	5	15	5	15
Perry	56	164	43	126
Randolph	145	425	122	357
Richland	1,985	5,816	1,961	5,746
Saline	609	1,784	700	2,051
Sangamon	157	460	219	642
Shelby	100	293	77	226
Wabash	2,474	7,249	2,528	7,407
Washington	615	1,802	570	1,670
Wayne	5,682	16,648	5,643	16,534
White	7,324	21,459	6,515	19,089
Williamson	43	126	48	141
Total	70,168	[3] 205,592	63,708	[3] 186,664

[1] County values calculated by using State average value per barrel, $2.93, for both years.
[2] Value of production in Cumberland County included with Clark County, and McDonough County with Hancock County because actual source of production cannot be identified.
[3] Data do not add to total shown because of rounding.

Source: Illinois Geological Survey.

According to the American Petroleum Institute [2], proved crude oil reserves on December 31 totaled over 371 million barrels, a 20-million barrel decrease from the reserves of the previous year.

Proved reserves of natural gas on December 31 totaled approximately 210,000 million cubic feet, according to the American Gas Association.[3] This represents an increase of about 30 million cubic feet over 1964 estimates.

Proved-recoverable reserves of natural gas liquids totaled 3 million barrels on December 31, according to the American Gas Association [4].

NONMETALS

Cement.—Portland and masonry cements were produced by four companies with plants in La Salle, Lee, and Massac Counties. Total production of portland cement was over four-fifths of the annual finished portland cement capacity in the State. More than 96 percent of the production was of types I and II (general-use and moderate-heat); the remainder was high-early-strength and special-use types.

Over 91 percent of the total portland cement shipments was in bulk; the remainder in bags. About two-thirds of the shipments were by truck, over 31 percent by rail and, except for minor quantities used at the plant, the remainder by waterways.

Over 62 percent of the portland cement and about 29 percent of the masonry cement shipments were distributed within the State. Portland cement shipments to Wisconsin accounted for over 13 percent of the State output.

Approximately 34 percent of the masonry cement shipments went to Wisconsin. Tennessee received about 6 percent of the portland cement shipments and almost 27 percent of the masonry cement shipments. Shipments were also made to Alabama, Arizona, Arkansas, Indiana, Iowa, Kentucky, Michigan, Minnesota, Mississippi, and Missouri.

Over 2.7 million tons of limestone was used for the manufacture of portland cement. About 343,000 tons of other raw materials such as clay, gypsum, iron ore, sand, shale, and slag were also consumed.

Approximately 267 million kilowatthours of electric energy was used. About five-eighths of this electric energy was purchased, and the remainder was home-generated. All four plants in the State used the dry process of production.

Clays.—Total production of fire clay, fuller's earth, miscellaneous clay, and shale increased both in quantity and value. Fire clay production increased over 1 percent. Miscellaneous clay and shale output increased over 9 percent. Consumption of miscellaneous clay and shale for lightweight aggregate increased nearly 74 percent. Fire clay consumption increased about 3 percent for heavy-clay product manufacture and remained essentially the same for refractories. Production of fuller's earth for absorbent uses increased.

Production was reported from 22 counties. Fire clay was produced by 10 companies operating in Greene, Grundy, La Salle, McDonough, Marshall, and Scott Counties.

Fluorspar.—Illinois supplied 66 percent of the total domestic output of fluorspar and ranked first among the six fluorspar-producing States. Sales of acid-grade fluorspar increased 5 percent in quantity and 4 percent in value to account for approximately 56 percent of the total sales. Sales of ceramic-grade fluorspar increased over 64 percent in quantity and nearly 69 per-

[2] Oil and Gas Journal. 1965 Reserves Showing Near Oil's Best. V. 64, Mar. 28, 1966, p. 107.
[3] Work cited in footnote 2.
[4] Work cited in footnote 2.

Table 6.—Finished portland cement produced and shipped

(Thousand barrels and thousand dollars)

Year	Active plants	Production	Shipped from mills	
			Quantity	Value
1956–60 (average)	4	9,176	8,838	$27,642
1961	4	8,757	8,595	28,301
1962	4	9,081	9,145	30,205
1963	5	9,465	9,281	30,577
1964	4	9,978	9,790	32,191
1965	4	9,235	9,358	30,622

cent in value to represent approximately 42 percent of total sales. Metallurgical-grade fluorspar increased in both quantity and value but accounted for less than 2 percent of total sales.

Production of crude ore came from Hardin and Pope Counties. All finished fluorspar was produced in Hardin County. No Kentucky ore was processed in 1965. Nearly 601,000 tons of crude ore was milled to produce about 168,000 tons of finished fluorspar. Byproduct lead and zinc concentrates were also produced.

Principal producers were Aluminum Company of America, Minerva Oil Co., Ozark-Mahoning Co., Greene Mining Co., and J. W. Patton & Sons. Several other producers removed material from stockpiles during the year.

Aluminum Company of America terminated mining operations at its mine near Rosiclare near midyear. The company continued to operate the mill using stockpiled ore.

Lime.—Total production of quicklime and hydrated lime increased over 11 percent in quantity and 5 percent in value. About half of the total production was for chemical and industrial uses, approximately 46 percent for refractory purposes, and 5 percent for construction use. About 44 percent of the shipments went to Indiana destinations. Approximately 31 percent of the State production was distributed within the State.

Perlite.—Crude perlite mined outside the State was expanded at plants operated by eight companies in Champaign, Cook, DeKalb, Kankakee, Lake, and Will Counties. Processed material sold or used increased about 28 percent in value and 23 percent in quantity. Use of processed perlite for roof insulation accounted for about 67 percent of the total output. Loose fill insulation and concrete aggregate uses each comprised approximately 9 percent of the total production.

Sand and Gravel.—Illinois ranked seventh in the Nation in quantity of sand and gravel produced and fourth in value. Production was reported in 78 counties from 241 commercial and 108 Government-and-contractor operations. Commercial operations accounted for over 97 percent of the total State production. Sand and gravel for paving use decreased 7 percent in quantity and 12 percent in value. The use of sand and gravel for building purposes increased over 11 percent in quantity and 5 percent in value. Building and paving uses represented over 80 percent of the total tonnage produced. Sales of unground industrial sands for glass and molding increased approximately 12 percent to nearly 8 percent of the total sand and gravel output. Approximately seven-eighths of the total shipments were by truck and the remainder by railway and waterway.

Production of over 1 million tons each in Cook, Grundy, Kane, Lake, La Salle, McHenry, Peoria, Tazewell, Will, and Winnebago Counties represented nearly 67 percent of the total State output. Major producers included Chicago Gravel Co., Concrete Materials Division (Martin Marietta Corp.), Consumers Co. (Division of Vulcan Materials Co.), Crystal Lake Trucking & Excavating Co., Elmhurst-Chicago Stone Co., Material Service Division (General Dynamics Corp.), Ottawa Silica Co., C. A. Powley Co., Road Materials Corp., and Wedron Silica Co.

Concrete Materials Division (Martin Marietta Corp.) purchased the facilities and assets of McGrath Sand & Gravel Co., Inc., Lincoln, Ill.

Stone.—Illinois ranked second in the Nation in limestone production and in total stone production. Total production consisted primarily of limestone, with some sandstone produced in Alexander County for refractory purposes and slate produced in St. Clair County for industrial use.

Limestone was produced in 60 counties in 1965. Crushed and broken limestone was produced in all of these counties, whereas dimension stone was produced in three counties.

Over 93 percent of the crushed and broken stone was shipped by truck, over 5 percent by rail, and the remainder by water.

Nearly 61 percent of the State total crushed and broken limestone production came from 10 counties—Cook, Kankakee, La Salle, Lee, Livingston, Randolph, Rock Island, St. Clair, Union, and Will. Each of these counties had more than 1 million tons of production. Production from Cook County represented approximately 29 percent of the total State production. Leading

Table 7.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1964		1965	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	6,527	$5,850	6,149	$5,532
Paving	5,550	5,084	5,184	4,583
Glass (unground sand only)	1,609	3,295	1,861	4,041
Molding (unground sand only)	975	3,115	1,029	3,075
Ground [1]	202	2,224	W	W
Other [2]	2,039	2,811	2,843	6,141
Total	16,902	22,379	17,066	23,372
Gravel:				
Building	5,437	5,457	7,185	6,360
Paving	10,099	10,512	9,667	9,302
Railroad ballast	175	158	52	39
Fill	735	486	1,257	773
Other	121	102	33	34
Total	16,567	16,715	18,194	16,508
Total sand and gravel	33,469	39,094	35,260	39,880
Government-and-contractor operations:				
Sand:				
Building	2	1	----	----
Paving	325	177	293	165
Total	327	178	293	165
Gravel:				
Paving	1,064	683	675	435
Fill	20	11	----	----
Total	1,084	694	675	435
Total sand and gravel	1,411	872	968	600
All operations:				
Sand	17,229	22,557	17,359	23,537
Gravel	17,651	17,409	18,869	16,943
Grand total	34,880	39,966	36,228	40,480

W Withheld to avoid disclosing individual company confidential data; included with "Other."

[1] Includes abrasive, chemical, enamel, filler, foundry, glass, pottery, porcelain, tile and other ground sand.

[2] Includes blast, engine, fill, filtration, grinding and polishing, oil (hydrafrac), railroad ballast, other construction and industrial sands, and items indicated by symbol W.

producers in the State were Columbia Quarry Co.; Consumers Co. (Division of Vulcan Materials Co.); Dolese & Shepard Co.; Elmhurst-Chicago Stone Co.; Lehigh Stone Co.; Marquette Cement Manufacturing Co.; Material Service Division (General Dynamics Corp.); Medusa Portland Cement Co.; Rein, Schultz & Dahl, Inc.; and Solvay Process Division (Allied Chemical Corp.). Production from these Companies represented nearly half of the total State production.

General Stone & Materials Corp., Roanoke, Va. purchased the Lutz Marble Co., Inc., Anna, Illinois. Lutz Marble Co., Inc., has been the leading producer of dimension limestone in Illinois.

Sulfur.—Shipments of elemental sulfur increased nearly 9 percent in quantity and over 14 percent in value. The Anlin Company of Illinois recovered sulfur by the Amine-Gas-Purification and Modified-Claus processes, at its Hartford plant in Madison County. The Pure Oil Co. (Division of Union Oil Co. of California) recovered sulfur by the Modified-Claus process at its Lemont plant in Will County.

Tripoli (Amorphous Silica).—Production of crude material increased more than 2 percent in quantity but only slightly in value. Sales of prepared material increased less than 2 percent in quantity and 1 percent in value. Prepared material was used for abrasives, filler, and other purposes. Material was produced in Alexander County by Illinois Minerals Co., near Elco, and by Tamms Industries Co., near Tamms. Both companies operated under-

Table 8.—Limestone sold or used by producers, by uses

Use	1964		1965	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Dimension:				
Rubble—thousand short tons	2	$18	2	$17
Sawed—thousand cubic feet	W	W	24	102
House stone veneer—do	W	W	5	5
Flagging—do	W	W		
Total—approximate thousand short tons [1]	5	141	4	[2] 123
Crushed and broken:				
Riprap—thousand short tons	586	860	724	1,071
Concrete aggregate and roadstone—do	31,615	41,524	35,399	45,984
Railroad ballast—do	370	390	558	528
Agriculture—do	4,661	6,904	4,755	7,053
Cement—do	2,895	2,235	2,716	2,009
Other [3]—do	2,854	4,492	2,908	4,517
Total—do	42,981	56,405	47,060	61,162
Grand total—do	42,986	[2] 56,547	[2] 47,065	61,285

W Withheld to avoid disclosing individual company confidential data; included in "Total."
[1] Average weight of 170 pounds per cubic foot used to convert cubic feet to short tons.
[2] Data do not add to total shown because of rounding.
[3] Includes limestone for asphalt filler, chemical uses, dust for coal mines, fertilizer, lime, metallurgical uses, mineral food, poultry grit, stone sand, whiting or whiting substitute, and other uses.

Table 9.—Mine production of silver, lead, and zinc, in terms of recoverable metals

Year	Mines producing	Materials sold or treated [1] (short tons)	Silver		Lead		Zinc		Total value
			Troy ounces	Value	Short tons	Value	Short tons	Value	
1956–60 (average)	22	930,762	316	$286	2,796	$744,502	25,506	$6,122,543	$6,867,331
1961	20	965,541	---	---	3,430	706,580	26,795	6,162,850	6,869,430
1962	17	970,900	---	---	3,610	664,240	27,413	6,304,990	6,969,230
1963	13	750,930	---	---	2,901	626,616	20,337	4,677,510	5,304,126
1964	14	537,141	---	---	2,180	571,160	13,800	3,753,600	4,324,760
1965	[2] 8	681,130	---	---	3,005	937,560	18,314	5,347,688	6,285,248

[1] Data include flourspar ore from which lead and/or zinc were recovered as follows: 1956—336,635 tons; 1957—360,406 tons; 1958—401,562 tons; 1959—297,252 tons; 1960—380,395 tons; 1961—368,283 tons; 1962—399,742 tons; 1963—400,283 tons; 1964—359,247 tons; and 1965—495,686 tons.
[2] Includes 1 boulder pile.

ground mines. Ozark Minerals Co. and Star Silica Co. merged at the start of the year to form Illinois Minerals Co.

Vermiculite.—Production of exfoliated vermiculite increased nearly 5 percent. Shipments increased less than 1 percent in quantity and over 8 percent in value. Material was used primarily for insulation, concrete and plaster aggregate, masonry fill, and agricultural purposes. Plants of Zonolite Division of W. R. Grace & Co. in Cook County, Mica Pellets, Inc., in DeKalb County, and International Vermiculite Co. in Macoupin County, processed crude material, all of which was mined outside the State.

METALS

Lead and Zinc.—Major producers of lead and zinc were The Eagle-Picher Co. in northern Illinois and Aluminum Company of America, Minerva Oil Co., and Ozark-Mahoning Co. in southern Illinois. Southern Illinois producers recovered lead and zinc as byproducts of fluorspar operations. Increased fluorspar production and increased prices for lead and zinc stimulated the increase in lead and zinc production.

Average weighted yearly prices used to calculate total values of lead and zinc production were 15.6 cents per pound for lead and 14.6 cents per pound for zinc. Prices in

Table 10.—Mine production of lead and zinc in 1965, by months, in terms of recoverable metals

(Short tons)

Month	Lead	Zinc
January	210	1,460
February	280	1,510
March	365	1,715
April	410	1,715
May	275	1,490
June	220	1,620
July	265	1,705
August	160	1,640
September	145	1,465
October	270	1,330
November	215	1,330
December	190	1,334
Total	3,005	18,314

1964 were 13.1 cents for lead and 13.6 cents for zinc.

Aluminum Company of America closed its mine in midyear but will continue to operate a mill, using stockpiled material.

The Eagle-Picher Co. reopened the Blackjack Mine southeast of Galena early in the year. Ore from the mine was milled at the company's Graham mill north of Galena. Zinc was the primary metal recovered with lead recovered as a byproduct.

American Zinc, Lead & Smelting Co. expanded and modernized its electrolytic zinc refinery at Monsanto.

Pig Iron and Steel.—More than 6.4 million short tons of pig iron, a 15-percent increase from that of 1964, was shipped from Illinois blast furnaces or consumed by producing companies. Estimated total value of production was $361.8 million. Five companies operated blast furnaces in Chicago and Granite City. Of the 22 blast furnaces in the State, 7 were inactive the entire year, 8 were out of blast part of the year, and 7 operated throughout the year.

Approximately 3.1 million short tons of iron ore was consumed in Illinois agglomerating plants. About 78 percent of the iron ore was from domestic sources. Nearly 4.5 million short tons of domestic iron and manganiferous ores, about 3.7 million short tons of sinter, and over 2.2 million short tons of pellets were consumed in Illinois blast furnaces. Pellet consumption was 54 percent greater than in 1964. In addition to the foreign iron ore consumed in the agglomerating plants, a small quantity was consumed directly in the State blast furnaces.

Over 1.8 million tons of limestone and dolomite was consumed in Illinois agglomerating plants and blast furnaces. About 4.5 million tons of coke was consumed in the State blast furnaces. Data for nonintegrated steel plants are not included.

According to the American Iron & Steel Institute, steel production in Illinois was 11,180,923 short tons, an increase of 6 percent over 1964 totals.

Construction started on the Granite City Steel Co. modernization program, which includes a 220-ton basic oxygen furnace plant and an 80-inch computer-controlled continuous hot strip rolling mill.

Other Metals.—The American Zinc Co. of Illinois recovered cadmium and germanium as byproducts of domestic zinc ores at its Fairmont City zinc refinery plant. American Potash & Chemical Corp. processed concentrates bearing thorium, rare-earth elements, and yttrium at its West Chicago plant. United Refining & Smelting Co. produced bismuth, cadmium, and some low-melting alloys at its Franklin Park plant.

REVIEW BY COUNTIES

Mineral production in 1965, excluding natural gas and natural gas liquids, was reported in 100 of the 102 counties. Of this group, Cook County led in value of mineral output with $33.4 million. Total value of mineral production increased in 50 counties and decreased in 49 counties.

Adams.—Limestone was produced by Black White Limestone Co., Marblehead Lime Co. (Division of General Dynamics Corp.), and Menke Stone & Lime Co. from underground mines and by Missouri Gravel Co. and Western Illinois Stone Co. from quarries. Missouri Gravel Co. operated a portable plant, all others operated stationary plants. Limestone production increased nearly 2 percent in value and over 6 percent in quantity.

Marblehead Lime Co. and Menke Stone & Lime Co. also produced quicklime and hydrated lime near Marblehead and Quincy, respectively. Marblehead began producing quicklime at its new Quincy plant early in 1965.

Blick's Sand Co. and Quincy Sand Co. produced sand and gravel near Quincy. Production decreased 16 percent in value and 15 percent in quantity.

Triple S Mines, Inc., produced about 27,000 tons of coal from a strip mine near Augusta. Output decreased 6 percent in value and quantity. Approximately three-fourths of the production was cleaned by jigging.

Crude petroleum was produced from fields in the southeast part of the county. Production decreased about 20 percent in quantity.

Alexander.—Tripoli (amorphous silica) was produced by Illinois Minerals Co. and Tamms Industries Co. from underground mines near Elco and Tamms. Prepared material was used for abrasives, filler, and other miscellaneous uses. Ozark Minerals Co. and Star Silica Co. merged to become Illinois Minerals Co. Sand and gravel was produced by H. H. Halliday Sand Co. near Cairo and by the county highway department. The material was used for building, fill, and engine sand.

Sandstone was mined by Western Fire Brick Co. (Division of A. P. Green Fire Brick Co.) from an underground mine near Elco. The material was shipped by rail to the company plant at Granite City for processing into refractory material.

Bond.—Crude petroleum was produced from fields throughout the county. Production decreased over 9 percent in quantity. Sand and gravel was produced by Greenville Gravel Co., Inc., Munie Gravel Pit, and Pruitt Sand Pit. Stationary plants were operated by all companies. Munie Gravel Pit also operated a portable plant near Keyesport. Other operations were near Greenville. Output decreased 10 percent in value and 15 percent in quantity. About 65,000 tons of clay and shale was produced near New Douglas by Richards Brick Co. and used for manufacturing heavy clay products at its plant near Edwardsville, Madison County.

Brown.—Hollembeak Gravel Co. produced sand and gravel near Mt. Sterling at a stationary plant. Production was used for paving and fill. Frederic Brick & Tile Co. produced shale near Mt. Sterling for use in the manufacture of draintile. Pea Ridge Stone Co. operated a stationary plant near Mt. Sterling to produce agricultural limestone.

Crude petroleum decreased 67 percent from 1964 production. Output came from the southwestern part of the county.

Christian.—About 5.4 million tons of coal was mined by Peabody Coal Co. at its No. 10 underground mine near Pawnee, the largest bituminous coal mine in the United States. The county was second in underground production and sixth in total output of coal in the State. Nearly 96 percent of the total output was shipped by rail. About 46 percent of the production was cleaned by jigging.

Tri-County Stone Co. produced limestone at a stationary plant near Nokomis for concrete aggregate, roadstone, and agricultural purposes.

Crude petroleum production decreased more than 5 percent in quantity. Production came from fields in the northern and eastern portions of the county.

Cook.—Mineral production value increased to over $33.4 million. This represented the highest county value of mineral production (excluding natural gas and natural gas liquids) in the State. Limestone led in quantity and value with over 13.6 million tons and $17.1 million, nearly 2 percent greater than in 1964. The county was first in the production of limestone in the State. Producers were Consumers Co. (Division of Vulcan Materials Co.) with quarries near Hillside, Lemont, and McCook; Dolese & Shepard Co. with a quarry near Hodgkins; R. P. Donohoe Co., Inc., with a quarry near Lemont; and Material Service Division (General Dynamics Corp.) with quarries near Chicago, Lyons, McCook, and Thornton. Processed material was used as concrete aggregate and roadstone, railroad ballast, agricultural limestone, flux, refractory material, and in lime manufacturing.

Marblehead Lime Co. produced quicklime and hydrated lime at plants near South Chicago and Thornton. Standard Lime & Refractories Co. (Division of Martin Marietta Corp.) produced quicklime at its plant near McCook. Total county lime production increased in quantity and value.

Nearly 1.1 million tons of sand and gravel was produced for building, paving, and fill purposes by Chicago Gravel Co. near Elgin; Doetsch Bros. near Schaumburg; Material Service Division (General Dynamics Corp.) near Wheeling; and Worth Sand

Table 11.—Value of mineral production in Illinois, by counties [1]

County	1964 [2]	1965	Minerals produced in 1965 in order of value
Adams	$1,940,799	$2,176,597	Stone, lime, coal, sand and gravel, petroleum.
Alexander	246,325	247,210	Tripoli, sand and gravel, stone.
Bond	788,570	721,300	Petroleum, sand and gravel, clays.
Boone	339,328	438,276	Stone, sand and gravel.
Brown	W	37,860	Sand and gravel, clays, stone, petroleum.
Bureau	1,543,332	592,000	Sand and gravel.
Calhoun	W	21,720	Stone.
Carroll	307,049	372,634	Stone, sand and gravel.
Cass	2,000	2,000	Sand and gravel.
Champaign	450,000	W	Do.
Christian	W	W	Coal, petroleum, stone.
Clark [3]	3,261,367	3,156,625	Petroleum, stone, sand and gravel.
Clay	W	W	Petroleum, stone.
Clinton	W	W	Petroleum, stone, sand and gravel.
Coles	W	W	Do.
Cook	32,342,102	33,400,798	Stone, lime, sand and gravel, clays, peat.
Crawford	W	W	Petroleum, sand and gravel.
Cumberland [3]	W	W	Sand and gravel.
DeKalb	506,782	736,450	Sand and gravel, stone.
De Witt	W	W	Petroleum, sand and gravel.
Douglas	W	W	Coal, petroleum, stone.
Du Page	W	W	Stone, sand and gravel.
Edgar	175,800	169,010	Petroleum, sand and gravel.
Edwards	3,603,900	2,839,170	Petroleum.
Effingham	1,268,690	W	Petroleum, sand and gravel.
Fayette	38,188,545	W	Petroleum, stone, sand and gravel, clays.
Ford	244,000	222,000	Sand and gravel.
Franklin	W	W	Coal, petroleum.
Fulton	29,702,022	29,296,031	Coal, sand and gravel.
Gallatin	4,104,813	3,556,348	Petroleum, coal, sand and gravel.
Greene	436,659	512,446	Stone, clays, coal.
Grundy	5,378,853	4,947,057	Coal, sand and gravel, clays.
Hamilton	9,223,600	8,725,540	Petroleum.
Hancock [3]	533,529	765,150	Stone, petroleum.
Hardin	10,648,425	13,630,187	Fluorspar, zinc, stone, lead, sand and gravel.
Henderson	460,040	715,794	Stone, sand and gravel.
Henry	573,448	355,975	Stone, coal, sand and gravel.
Iroquois	W	W	Sand and gravel.
Jackson	W	W	Coal, stone, sand and gravel.
Jasper	2,250,240	2,171,130	Petroleum.
Jefferson	W	W	Coal, petroleum, stone, sand and gravel.
Jersey	269,331	172,972	Stone, sand and gravel.
Jo Daviess	1,773,215	1,945,763	Zinc, stone, sand and gravel, lead.
Johnson	1,140,645	1,229,019	Stone, coal.
Kane	2,542,457	2,979,703	Sand and gravel, stone, peat.
Kankakee	W	W	Stone, clays, sand and gravel.
Kendall	358,428	499,529	Stone, sand and gravel.
Knox	W	W	Coal, stone, clays, sand and gravel.
Lake	925,679	W	Sand and gravel, clays, peat.
La Salle	29,670,332	30,574,721	Cement, sand and gravel, clays, stone.
Lawrence	21,265,110	20,451,440	Petroleum, sand and gravel.
Lee	W	W	Cement, stone, sand and gravel, clays.
Livingston	2,494,052	2,656,587	Stone, clays, sand and gravel.
Logan	776,115	717,710	Stone, sand and gravel, coal.
McDonough [3]	W	W	Stone, clays.
McHenry	3,503,360	4,069,662	Sand and gravel, stone.
McLean	578,000	W	Sand and gravel.
Macon	W	W	Sand and gravel, petroleum.
Macoupin	1,438,075	1,589,551	Coal, petroleum.
Madison	3,050,449	2,676,161	Stone, petroleum, sand and gravel.
Marion	W	W	Petroleum, stone.
Marshall	304,302	452,780	Sand and gravel, clays.
Mason	19,000	32,000	Sand and gravel.
Massac	W	W	Cement, stone, sand and gravel.
Menard	W	W	Stone, coal, clays.
Mercer	527,947	320,706	Do.
Monroe	W	W	Stone.
Montgomery	W	W	Coal, stone, petroleum, sand and gravel.
Moultrie	26,650	27,650	Petroleum, sand and gravel.
Ogle	2,146,106	1,740,657	Sand and gravel, stone.
Peoria	8,567,567	8,852,974	Coal, sand and gravel, stone.
Perry	W	21,305,515	Coal, petroleum.
Pike	761,011	758,854	Stone, sand and gravel.
Pope	3,000	2,000	Sand and gravel.
Pulaski	W	W	Stone, clays, sand and gravel.
Putnam	9,000	11,000	Sand and gravel.
Randolph	9,652,449	11,383,178	Coal, stone, petroleum, sand and gravel.
Richland	5,816,050	5,745,730	Petroleum.
Rock Island	2,177,850	1,847,331	Stone, sand and gravel.
St. Clair	24,692,686	24,525,879	Coal, stone, sand and gravel, clays.
Saline	16,827,820	19,506,603	Coal, petroleum.
Sangamon	1,713,180	1,649,327	Sand and gravel, petroleum, clays.

See footnotes at end of table.

Table 11.—Value of mineral production in Illinois, by counties [1]—Continued

County	1964 [2]	1965	Minerals produced in 1965 in order of value
Schuyler	W	W	Coal, stone, sand and gravel.
Scott	$231,848	W	Stone, clays, sand and gravel.
Shelby	W	$411,610	Petroleum, stone, sand and gravel.
Stark	W	W	Coal, sand and gravel.
Stephenson	489,776	615,343	Stone, sand and gravel.
Tazewell	1,173,000	1,387,500	Sand and gravel, clays.
Union	1,264,140	W	Stone, sand and gravel.
Vermilion	6,323,395	5,583,216	Coal, stone, clays, sand and gravel.
Wabash	7,418,337	7,579,040	Petroleum, sand and gravel.
Warren	W	W	Stone.
Washington	2,327,694	2,255,170	Petroleum, stone, coal.
Wayne	16,648,260	16,533,990	Petroleum.
White	21,693,320	19,271,950	Petroleum, sand and gravel.
Whiteside	552,092	883,904	Peat, stone, sand and gravel.
Will	8,162,042	7,966,685	Sand and gravel, coal, stone.
Williamson	24,680,760	22,698,932	Coal, petroleum.
Winnebago	2,460,543	2,209,924	Sand and gravel, stone.
Woodford	W	W	Sand and gravel.
Undistributed [4]	206,355,709	228,093,426	
Total	591,331,000	593,025,000	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] Data for natural gas, and natural gas liquids are not available on a county basis; however, values for these commodities are included with "Undistributed." Morgan and Piatt Counties are not listed because no production was reported.
[2] Some county totals for 1964 revised to include value of petroleum production.
[3] Value of petroleum production in Cumberland County included with Clark County, and McDonough County with Hancock County because actual source of production cannot be identified.
[4] Includes value for natural gas, natural gas liquids, some sand and gravel that cannot be assigned to specific counties, and values indicated by symbol W.

& Gravel Co., Inc., near Worth. Road Materials Corp., closed its operation near Arlington Heights. Production from the county increased nearly 36 percent in value and more than 23 percent in quantity.

Miscellaneous clay was produced for use in manufacturing building brick. Producers included Brisch Brick Co. near Stickney, Carey Brick Co. near Chicago, Chicago Brick Co. near Riverdale, and Illinois Brick Co. near Blue Island. Production increased about 6 percent in quantity and value.

Humus peat was mined near Barrington by Henry Frenzer, Inc., and sold in bulk for general soil improvement.

Blast and steel furnaces were operated in the South Chicago area. Pig iron producers included Interlake Steel Corp., Republic Steel Corp., United States Steel Corp., and Wisconsin Steel Division (International Harvester Co.).

Perlite imported from outside the State was expanded by Research Sales Division, ITT Bell & Gossett Hydronics near Dolton; and by Silbrico Corp. near Chicago. Finished material was used for building plaster, concrete aggregate, filter aid, loose fill insulation, soil conditioning, and traction material.

Vermiculite from outside the State was exfoliated by Zonolite Division of W. R. Grace & Co., at its Franklin Park plant for use in agriculture, concrete and plaster aggregate, and loose fill insulation. U.S. Mica Co., Inc., produced ground mica at its Forest Park plant for various uses.

American Potash & Chemical Corp. processed concentrates bearing thorium, rare-earth elements, and yttrium at its West Chicago plant.

Crawford.—Crude petroleum production decreased 2 percent in quantity from the 1964 production. The Main Consolidated field was the principal producing area in the county. The county was the sixth largest crude-petroleum-producing county in the State.

Bowman Gravel Co., Wm. J. Wyke, and the county highway department produced sand and gravel for paving and fill. Stationary plants were operated by the two companies near Palestine and Hutsonville, respectively. County production increased substantially from the 1964 production.

Douglas.—Moffat Coal Co. produced 646,000 tons of coal from its underground mine near Murdock. Approximately 72 percent of the output was shipped by rail. The entire production was cleaned by jigging.

Crude petroleum production decreased nearly 30 percent in quantity. Production

was principally from fields in the southwestern part of the county.

Stockpiled limestone originally produced from an underground mine near Tuscola was sold by Material Service Division (General Dynamics Corp.) for use as concrete aggregate and roadstone.

Fayette.—The county led in production of crude petroleum with output of 10.9 million barrels, representing 17 percent of the State total. However, production decreased 16 percent in quantity in 1965. The principal producing field was the Louden field in the eastern part of the county. The county also ranked second in total value of mineral production (excluding natural gas and natural gas liquids).

Crushed limestone was produced by Winter Stone Quarry at its stationary plant near Ramsey. Output was used principally for roadstone and agricultural purposes.

Sand and gravel was produced by Dugan Sand & Gravel near Hagarstown and Lutz Sand Co. near Mulberry Grove. Both operations were stationary plants. Production was used for building, paving, and molding purposes.

The State highway department contracted for paving sand and gravel. County sand and gravel production increased 58 percent in quantity and 28 percent in value. Diller Shale Products Co. produced 13,000 tons of miscellaneous clay for use in manufacturing heavy-clay products at its St. Elmo plant.

Franklin.—The county ranked first in output of coal from underground mines in the State. Production increased nearly 5 percent to about 6.2 million tons. Coal was produced by Freeman Coal Mining Corp. from its Orient No. 5 underground mine near Benton and by Old Ben Coal Corp. No. 9 underground mine near West Frankfort and its Nos. 21 and 24 underground mines near Sesser. Production from the latter mine began in midyear. Over 81 percent of the coal production was cleaned at three plants. Approximately 98 percent of the output was shipped by rail.

Crude petroleum production decreased 17 percent in quantity. Production came from fields throughout the county. The Benton Field in the central part of the county was a principal producing area.

Fulton.—The county ranked first in total coal output in the State in 1965. Nearly 7.3 million tons of coal, a decrease of 2 percent in quantity from the 1964 figure, was produced from seven strip mines. Producers included Little Sister Coal Corp., Midland Electric Coal Corp., Peabody Coal Co., Thunderbird Collieries Corp., Truax-Traer Coal Division (Consolidation Coal Co., Inc.), and The United Electric Coal Cos. Coal was cleaned at seven plants. Of the total, nearly 66 percent was shipped by rail, over 27 percent by water, and the remainder by truck.

Duck Island Sand & Gravel Co., Glasers Gravel, Holle Building Service Co., and Otter Creek Sand & Gravel Co. produced a total of 524,000 tons of sand and gravel for building, road construction, fill, and other purposes. Output decreased 4 percent in quantity but increased 3 percent in value. Plants were operated near Canton, Enion, Havana, and London Mills.

Gallatin.—Crude petroleum production decreased 16 percent in quantity. Production came from the northeastern part of the county.

Coal production increased 64 percent to 95,000 tons. Output was from three underground mines and a strip mine. Wenzel Coal Co., Inc., opened an underground mine near Shawneetown and Marshall Equipment Co. a strip mine near Harrisburg in September. B. & W. Coal Co. suspended operations at its underground mine late in the year. Blu-Blaz-Bloc Coal Co. changed ownership in midyear but retained the same company name.

Sand and gravel production decreased slightly to 202,000 tons. Delta Materials Co. and the county and State highway departments produced sand and gravel for building and road construction.

Greene.—Crushed limestone production increased substantially in quantity and value. Orton Quarry, Inc., Raid Quarries, Inc., and Martin Valstad produced limestone for riprap, concrete aggregate, road construction, and for agricultural purposes. American Vitrified Products Co. produced miscellaneous clay near White Hall for use in manufacturing vitrified sewer pipe. Ruckels Potteries, Inc., sold a small quantity of stockpiled stoneware clay.

Birch Creek Coal Co. produced coal from its strip mine near Roodhouse for local consumption.

Grundy.—Coal was produced by Peabody Coal Co. from its strip mine near South Wilmington. Production increased over 3 percent. The mine extends into Kankakee and Will Counties, but production was reported from only Will and Grundy Counties. The entire output was cleaned at the company plant in Kankakee County. About 45 percent of the total output was shipped by rail.

The county ranked fifth in the production of sand and gravel in the State. Production decreased 22 percent in quantity and nearly 20 percent in value. Material Service Division (General Dynamics Corp.) and Penoyer Gravel Co. produced material near Morris for use in building and road construction.

Illinois Clay Products Co. (Division A. P. Green Fire Brick Co.) produced over 100,000 tons of plastic fire clay near Coal City for use in manufacturing refractories.

Hardin.—Finished fluorspar shipments increased nearly 25 percent in quantity and about 22 percent in value. Major producing companies were Aluminum Company of America, Minerva Oil Co., and Ozark-Mahoning Co. Each company produced lead and zinc concentrates as byproducts of their fluorspar operations. Aluminum Company of America closed its Fairview-Blue Diggings mine in midyear but continued to operate its mill throughout the year on stockpiled material. Tamora Mining Co., Rosiclare Lead & Fluorspar Mining Co., and several other companies sold stockpiled fluorspar. Some Illinois crude ore was processed in Kentucky.

Production of crushed limestone decreased 6 percent to about 974,000 tons. Output was used for riprap, building and road construction, and cement manufacture. Producers were Denny & Simpson Stone Co., Missouri Portland Cement Co., Rigsby & Barnard Quarry, and Williams Quarry. The State highway department contracted for paving sand.

Henry.—Crushed limestone was produced by Cleveland Quarry, Inc., at its stationary plant near Cleveland. Output was used chiefly for road construction and agricultural purposes.

Sand and gravel for paving and molding was produced by Collinson Bros. near Kewanee and by Oberlaender Sand Co. near Colona. The State highway department contracted for paving sand.

Shuler Coal Co. produced coal from its underground mine near Alpha. Operations were abandoned early in the year. Nearly 92 percent of the total output was shipped by rail. All the output was crushed and treated.

Jackson.—Coal production decreased nearly 5 percent to 1.3 million tons. Truax-Traer Coal Division (Consolidation Coal Co., Inc.) produced from its Burning Star No. 1 slope mine and its Burning Star No. 1 strip mine. The No. 1 slope mine was closed late in the year. Fabco, Inc., produced from a strip mine near De Soto, but the operation was abandoned in September. The entire county coal production was shipped by rail. Of the total output 77 percent was cleaned.

Illinois Quarry Co. produced limestone at its stationary plant near Ava for building, road construction, and agricultural purposes. Sand and gravel for building, paving, and fill was produced by Lawder Sand Co. near Grand Tower.

Jefferson.—Freeman Coal Mining Corp. produced coal from its Orient No. 3 underground mine near Waltonville. Production increased nearly 7 percent in quantity. The entire output was cleaned and more than 95 percent of the coal was shipped by rail.

Belle Rive Mining Co., Inc., and Randall Stone Co. operated stationary plants near Dix and Mt. Vernon, respectively, and produced crushed limestone for aggregate material and agricultural purposes. The State highway department contracted for paving gravel.

Crude petroleum production decreased 24 percent to 1.4 million barrels. Production came from fields throughout the county.

Jo Daviess.—The Eagle-Picher Co. was the principal producer of lead and zinc concentrates. Output was from the Blackjack mine, the Graham group, and the Dinsdale boulder pile. All ore was concentrated at the Graham mill. The Blackjack mine was reopened during the year.

Over 532,000 tons of crushed limestone was produced by seven companies in the county, principally for building, road construction, and railroad ballast. Portions of the material were lead-zinc jig tailings.

Production increased nearly 13 percent in quantity from that of the previous year.

Dubuque Sand & Gravel Co. operated a stationary plant near East Dubuque and produced sand and gravel for building and fill purposes.

Johnson.—Nearly 952,000 tons of crushed limestone was produced by Charles Stone Co., Ramona Stone Co., and the Southern Illinois Stone Co. Output was used for riprap, aggregate, railroad ballast, and agricultural purposes. Quarries were operated near Buncombe, Cypress, and Goreville.

Herod Mining Corp. produced coal from its strip mine near Herod. Operations began in May but were later suspended. The entire output was shipped by rail.

Kane.—The county was the third largest sand and gravel producing county in the State with output of 3.1 million tons. Output increased 15 percent from that of 1964. Eleven companies operated plants near Algonquin, Big Rock, Carpentersville, Dundee, Elgin, Hampshire, Montgomery, North Aurora, and St. Charles.

Conco-Western Stone Co., Fox River Stone Co., Elmer Larson, Inc., and Rein, Schultz & Dahl, Inc., produced limestone at portable plants near North Aurora, South Elgin, Big Rock, and Elgin. Output was used for concrete aggregate, roadstone, agricultural purposes, rubble, and flagging.

Reed-sedge peat was produced by Batavia Soil Builders near Batavia for general soil improvement purposes. Material was sold in bulk.

George B. Smith Chemical Works, Inc., produced iron oxide pigments at its plant at Maple Park.

Kankakee.—The county ranked third in production of limestone in the State, with an increase of 16 percent in quantity and 13 percent in value from the 1964 figures. Lehigh Stone Co. and Manteno Limestone Co. operated stationary plants near Kankakee and Manteno, respectively. Output was used for concrete aggregate, roadstone, railroad ballast, and agricultural purposes.

Clay was produced by Eastern Illinois Clay Co. and St. Anne Brick & Tile Co. near St. Anne and Kankakee Clay Products Co. near Kankakee for use in manufacturing brick and other heavy-clay products. Production decreased 11 percent in quantity.

Peabody Coal Co. cleaned coal produced in its adjacent operations in Grundy and Will Counties at its Northern Illinois cleaning plant. No coal was produced from the Kankakee County portion of the mine.

Sand and gravel for road construction was produced by Engelman Trucking near Kankakee. The State highway department contracted for paving sand.

U.S. Perlite Corp. produced expanded perlite from imported material at its Momence plant for use in acoustical tile.

Knox.—Midland Electric Coal Corp. produced coal from its Mecco and Middle Grove strip mines near Victoria and Farmington, respectively. Output from the Middle Grove mine was cleaned at the company plant in Fulton County. Production from the Mecco mine was cleaned and crushed at the company plant at the mine site. About 98 percent of the county output was shipped to consumers by rail.

Abingdon Rock Co., Inc., produced limestone from its stationary plant near Abingdon for use as aggregate and agricultural limestone.

Galesburg Brick Co., formerly Alton Brick Co., produced about 27,000 tons of miscellaneous clay for the manufacture of building brick at its East Galesburg plant.

Lawrence Downin produced gravel at a portable plant near London Mills for use in road construction.

Briggs Manufacturing Co. produced ground feldspar at its Abingdon plant for use in potterymaking. Crude material was mined outside the State.

Lake.—Sand and gravel production decreased nearly 8 percent in quantity to about 1.2 million tons. Eight companies operated plants near Antioch, Barrington, Gurnee, Half Day, Libertyville, Prairie View, Wadsworth, and Wauconda. Material was used for building and road construction, railroad ballast, and fill. The State highway department contracted for road construction material.

National Brick Co. produced clay near Deerfield for the manufacture of building brick. Output decreased to 14,000 tons.

Peat moss was produced by Joseph W. Grenus near Millburn and Marvin J. Walker near Lake Villa for general soil improvement. Material was sold in bulk.

National Gypsum Co. produced calcined gypsum at its Waukegan plant. Crude material came from out-of-State sources. The company also produced expanded perlite for use as building plaster. Filter Materials Corp. produced expanded perlite at its Lake Zurich plant for use as a filter aid. Crude perlite was from outside the State.

La Salle.—Mineral production increased 3 percent in value to $30.6 million. The county ranked third in the State in total mineral production value (excluding natural gas and natural gas liquids).

Alpha Portland Cement Co. and Marquette Cement Manufacturing Co. produced portland and masonry cements at plants near La Salle. Each company also produced clay or shale and limestone for use in cement manufacture.

Over 1.7 million tons of crushed limestone was produced for cement manufacture, concrete aggregate, roadstone, and agricultural uses. Output increased nearly 4 percent. Producers were Alpha Portland Cement Co. near La Salle; H. & F. Stone Co. near Sheridan; Marquette Cement Manufacturing Co. near Oglesby; Troy Grove Stone Co. near Troy Grove; and Utica Stone Co. near Utica.

Nearly 4.3 million tons of sand and gravel was produced by 14 companies to make this county second in the State for sand and gravel production. Production increased over 12 percent in quantity. Material was used for building, paving, railroad ballast, and industrial purposes. Industrial sand producers included The American Silica Sand Co., Inc., near Utica; Arrowhead Silica Corp. and Pure Silica Co. near Troy Grove; Bellrose Silica Co. and Ottawa Silica Co. near Ottawa; and Wedron Silica Co. near Wedron. Pure Silica Co. completed construction on its silica-sand plant and made initial shipments of industrial sand early in the year.

Illinois Valley Minerals Co. and La Salle Canyon Quarry produced plastic fire clay for use in manufacturing refractories. Hydraulic-Press Brick Co. and Ristokrat Clay Products Co. produced clay for use in manufacturing building brick. Material Service Division (General Dynamics Corp.) produced shale for use in manufacturing lightweight aggregate and cement.

Lawrence.—The county ranked third in production of crude petroleum with output of 6.9 million barrels, a 3-percent decrease from the 1964 figure. The county supplied 11 percent of the State total petroleum production. The Lawrence field was the predominate producing field in the county.

Sand and gravel production decreased 30 percent to 257,000 tons, chiefly because of lesser demand for road construction material. Output was used for road construction and other purposes. Producing companies, all operating plants near Lawrenceville, included Ambraw Gravel Co., Gregory Gravel Co., H. & B. Gravel Co., Inc., and Vincennes Gravel Co., Inc. The county highway department produced paving sand for its own use.

Lee.—Portland and masonry cements were produced near Dixon by Medusa Portland Cement Co., which mined limestone and clay for use in manufacturing cement.

Limestone was also produced by Frank N. Butler Co. near Ashton, Lee Center, and Dixon; Oregon Stone Quarries near Aston and Dixon; Laurde Renner Limestone Co. near Dixon; Stoneridge Limestone Co. near Steward; and Wastone, Inc., near Dixon. Material was used for aggregate, railroad ballast, and agricultural purposes. Total county limestone output decreased 4 percent in quantity.

Sand and gravel produced by C. C. Macklin, Nelson Sand & Gravel Co., and Rock River Ready Mix, Inc., was used for building, road construction, fill, and industrial purposes. Plants were operated near Dixon, Nelson, and Steward. Output increased from that of the previous year.

Livingston.—Crushed limestone production increased 17 percent to nearly 1.7 million tons. Output came from stationary plants near Chenoa, Fairbury, and Pontiac. Material was used for concrete aggregate, roadstone, agricultural purposes, riprap, asphalt filler, and dust for coal mines.

Miscellaneous clay and shale were produced by Diller Tile Co., Inc., near Chatsworth; and Hydraulic-Press Brick Co. and Streator Clay Pipe Co. near Streator. Output was used in manufacturing building brick, vitrified sewer pipe, and other heavy-clay products. Production decrease over 4 percent.

Rowe Construction Co. and Valley View Dirt & Gravel Co. produced sand and grav-

el for road construction and fill. The State highway department contracted for paving sand.

Logan.—About 250,000 tons of sand and gravel was produced, a 22-percent decrease from the 1964 tonnage. Producers were Allsopp's Sand & Gravel near Mt. Pulaski, Chestnut Sand & Gravel Co. near Chestnut, R. A. Cullinan & Son, Inc., near Atlanta, and Lincoln Sand & Gravel Co. near Lincoln. Material was used for building, road construction, and engine sand. Chestnut Sand & Gravel Co. closed its pit in midyear.

Rocky Ford Limestone Co. produced crushed limestone near Lincoln for roadstone and agricultural use.

About 16,000 tons of coal was produced from an underground mine near Lincoln. Logan County Coal Mine, Inc., operated the mine until September, when it was acquired by El-B Coal Co., Inc. Output was for local consumption.

McDonough.—Crushed limestone was produced near Colchester by Colchester Stone Co. and McClure Quarries, Inc. Output was for riprap, roadstone, and agricultural purposes.

Plastic fire clay, stoneware clay, and miscellaneous clay was produced near Colchester by Booz & Co., Colchester Brick & Tile Co., and Martin's Clay Pits. Material was used in manufacturing building brick, other heavy-clay products, pottery, and refractories.

Crude petroleum was produced, although actual county production data were not available. Petroleum production data for McDonough County and adjoining Hancock County are combined and shown under Hancock County in table 5.

McHenry.—The county ranked first in sand and gravel production, supplying 16 percent of the State total quantity. Output increased 36 percent to 5.9 million tons. Production was used for building and road construction, railroad ballast, and fill. Thirteen companies operated plants near Alden, Algonquin, Cary, Crystal Lake, Griswold Lake, Huntley, Island Lake, Marengo, McHenry, and Woodstock. The county highway department produced road construction gravel for its own use. Paving material was produced under contract for the State and Lake County Highway Departments. Garden Prairie Stone Co., Inc., produced 33,000 tons of limestone near Marengo for roadstone, agricultural purposes, and flagging.

Macoupin.—Approximately 379,000 tons of coal was produced by Little Dog Coal Co. from its underground mine near Gillespie. The entire output was cleaned by jigs and concentrating tables. About two-thirds of the production was shipped by rail.

Crude petroleum production, from fields in the east-central part of the county near Gillespie and Carlinville, decreased 12 percent to 7,000 barrels.

International Vermiculite Co. exfoliated vermiculite from material produced outside the State at its Girard plant. Processed material was used for insulation purposes.

Madison.—C. M. Lohr, Inc., Mississippi Lime Co., and Reliance Quarry, Inc., produced crushed limestone for roadstone, agricultural purposes, and riprap. Mississippi Lime Co. operated an underground mine; the others operated quarries. Production increased 23 percent in quantity and 19 percent in value. County sand production increased 8 percent in quantity and 7 percent in value. Paving sand was produced by C. E. Baker Trucking Service, Inc., at its stationary plant near Granite City. Mississippi Lime Co. produced sand for building, paving, engine, and other uses. The State highway department contracted for paving sand.

Crude petroleum production decreased 12 percent to 283,000 barrels. Producing fields are located in the eastern part of the county.

The Anlin Co. of Illinois recovered sulfur by Amine-Gas-Purification and Modified-Claus processes at its Hartford refinery.

Granite City Steel Co. operated coke ovens, and blast and steel furnaces at Granite City. Construction started on the company's modernization program. Included in the program are a 220-ton basic oxygen furnace plant and an 80-inch computer-controlled continuous hot strip rolling mill.

Marion.—The county ranked second in crude petroleum production. Output was 7.8 million barrels, representing 12 percent of the State total production.

Shoots Stone Quarry operated a quarry near Iuka and produced limestone for

roadstone, agricultural purposes, and riprap.

Marshall.—About 397,000 tons of sand and gravel was produced for road construction and fill. Vernon Henry and Wilson's Gravel Co. operated portable plants near La Rose and Lacon, respectively. The county highway department contracted for road construction gravel. Hydraulic-Press Brick Co. produced plastic fire clay near Sparland for use in manufacturing building brick.

Massac.—Missouri Portland Cement Co. produced portland and masonry cements near Joppa. Limestone for the plant was quarried and crushed near Cave-in-Rock, Hardin County, and then barged on the Ohio River to the plant.

Crushed limestone was produced by Columbia Quarry Co. near Mermet for riprap, roadstone, and agricultural purposes. Total county production of sand and gravel was 94,000 tons. Sand and gravel for road construction and fill was produced by Delta Materials Co. near Joppa, and Metropolis Ready Mix Concrete Co. near Metropolis. Road construction gravel was produced by the Massac and Pope County Highway Departments and under contract for the State highway department.

Menard.—Coal for local consumption was produced by New Salem Mining Corp. from its underground mine near Petersburg. Operations were suspended in April.

Crushed limestone was produced near Athens by Athens Stone Quarry and D-P Indian Point Limestone Products, Inc. Output was used for riprap, roadstone, and agricultural purposes. Petersburg Clay Products Co., Inc., produced clay near Petersburg for use in manufacturing building brick and other heavy-clay products.

Mercer.—Hazel Dell Coal Corp. produced about 24,000 tons of coal from its underground mine near New Windsor. Approximately 61 percent of the shipments were by rail.

Crushed limestone for road use was produced by Viola Materials, Inc., from its stationary plant near Viola. The company also produced less than 1,000 tons of coal from a strip mine near Viola.

Hydraulic-Press Brick Co. produced shale near Aledo for use in manufacturing building brick.

Montgomery.—Approximately 2.4 million tons of coal was produced from two underground mines—the Crown mine of Freeman Coal Mining Corp. near Farmersville and the Hillsboro mine of Truax-Traer Coal Division (Consolidation Coal Co., Inc.) near Coffeen. The former company operated a cleaning plant, utilizing jigging and pneumatic methods. The latter company shipped its entire output by conveyor to a nearby powerplant.

Limestone production decreased slightly to 744,000 tons. Central Illinois Stone Co., Inc., Nokomis Quarry, Inc., and Rein, Schultz & Dahl, Inc., produced crushed limestone for roadstone and agricultural purposes. Fournier Stone Co. discontinued operations. The State highway department contracted for paving sand.

Crude petroleum production decreased about one-third to 2,000 barrels.

Peoria.—Coal production increased about 17 percent to 1.3 million tons. Producers included Peabody Coal Co., Sherwood-Templeton Coal Co., Inc., The United Electric Coal Cos., and Zaborac Coal Co. The first three producers operated strip mines and the last producer operated an underground mine. Big Bear Coal Co. and Layne's Coal Co. each produced less than 1,000 tons.

About 1.4 million tons of sand and gravel was produced, a 12-percent decrease from 1964 production. Production was used for building and road construction and fill purposes. Concrete Materials Division (Martin Marietta Corp.) purchased the Chillicothe, Oak Hill, and Pottstown operations of McGrath Sand & Gravel Co., Inc.

About 957,000 tons of crushed limestone was produced by three companies near Princeville. Production was used for roadstone and agricultural purposes.

Perry.—The county ranked second in coal production. Over 6.5 million tons, an increase of over 60 percent from the 1964 tonnage, was produced by three companies operating near DuQuoin and Percy. Southwestern Illinois Coal Corp., Truax-Traer Coal Division (Consolidation Coal Co., Inc.), and The United Electric Coal Cos. operated strip mines. Southwestern Illinois Coal Corp. added a new 180-cubic-yard stripping shovel at its Captain Mine. Nearly 98 percent of the county output

was shipped to consumers by rail. Cleaning plants were operated by each company. Truax-Traer Coal Division (Consolidation Coal Co., Inc.) also cleaned coal mined by the company in Jackson County.

Crude petroleum production was 43,000 barrels, a decrease of 23 percent from the 1964 production. Producing fields were located in the northern part of the county.

Pope.—Ozark-Mahoning Co. produced crude fluorspar-lead-zinc ore from its Barger, Loyd-Gibson, Parkinson, and Barnett properties. The ore was processed at the company plant in Hardin County. Stockpile shipments of fluorspar ore were made by other producers to processors in Hardin County and in Kentucky. The county highway department produced road construction gravel for its own use. The State highway department contracted for road construction gravel.

Pulaski.—Crushed limestone was produced by Columbia Quarry Co. near Ullin for roadstone, railroad ballast, agricultural purposes, and riprap. Star Enterprises, Inc., produced fuller's earth near Olmsted and sold it for absorbent uses. Delta Materials Co. and Mize Gravel Pit produced sand and gravel near Olmsted for road construction.

Randolph.—Nearly 2.9 million tons of coal, an increase of 21 percent over the 1964 figure, was produced by Eden Mining Corp., Southwestern Illinois Coal Corp., and Zeigler Coal & Coke Co. The latter two companies operated cleaning plants, utilizing jigging methods. Over 94 percent of the county total production was cleaned. More than 95 percent of the shipments were by rail. Truax-Traer Coal Division (Consolidation Coal Co., Inc.) began preliminary work on a new strip mine near Sparta. Production is expected to begin in 1966.

Chester Quarry Co., Randolph Quarries, Inc., Solvay Process Division (Allied Chemical Corp.), and Stotz Quarry Co. produced limestone for riprap, roadstone, agricultural purposes, and chemical uses. Output increased over 10 percent in quantity from the 1964 output. All operations were underground except Randolph Quarries, Inc. Sand for building, road construction, and engine use was produced by Southern Illinois Sand Co. near Chester. The State highway department contracted for paving sand.

Crude petroleum production decreased nearly 16 percent to 122,000 barrels. Output came from fields in the northeastern part of the county.

St. Clair.—The county ranked fifth in total coal output and third in output from strip mines. Output decreased 1 percent to about 5.7 million tons. Over 77 percent of the production was from two strip mines; the remainder came from four underground mines. Strip mines were operated by Peabody Coal Co. near Freeburg and Millstadt. The River King mine of Peabody Coal Co. was ranked in the top 10 producing bituminous coal mines in the Nation. Underground mines were operated by Belle Valley Coal Co., Inc., and Shiloh Valley Coal Co. near Belleville, Midland Electric Coal Corp. near Marissa, and Peabody Coal Co. near Millstadt. Peabody Coal Co. abandoned its Midwest underground mine near Millstadt early in the year. Almost the entire county coal production was cleaned at five preparation plants.

Limestone production increased nearly 11 percent to 2.7 million tons. The county ranked second in limestone production. Output was used for riprap, roadstone, railroad ballast, stone sand, and agricultural purposes. Producers were Columbia Quarry Co. near Dupo and Columbia, East St. Louis Stone Co. near East St. Louis, Quality Stone Co., Inc., near Hecker, and The Casper Stolle Quarry & Contracting Co. near Dupo. Missouri-Illinois Material Co. produced sand near East St. Louis for building, road construction, engine use, and fill. The State highway department contracted for paving sand. Hill Brick Co. produced clay near Fairview for use in manufacturing building brick. Hydraulic-Press Brick Co. produced clay near East St. Louis for use in manufacturing lightweight aggregate. Belle Valley Coal Co. produced slate as a byproduct of coal mining. The slate was ground to flour fineness.

Chas. Pfizer & Co., Inc., produced finished iron oxide pigments and ground barite at its East St. Louis plant. Ground barite was used for paint filler, rubber filler, and pharmaceutical purposes.

Saline.—Coal production increased 16 percent to nearly 4.7 million tons. Output was from nine strip mines and three underground mines. The strip mines were near Carrier Mills, Harrisburg, Herod, and Stonefort; the underground mines were

near Harrisburg. Three cleaning plants were operated. Herod Mining Corp. opened a strip mine near Herod late in the year. Marshall Equipment Co. and New Gallatin Coal Co. abandoned their strip mines near Harrisburg around mid-year. New Gallatin Coal Co. underground mine and Youngs Coal Corp. strip mine, both near Harrisburg, were abandoned late in the year. Other producers were Houston Coal Co., J. W. Coal Co., Inc., Sahara Coal Co., Inc., Shawnee Coal Co., and Stonefort Coal Mining Co., Inc. Over 89 percent of the shipments were by rail, the remainder by water.

Crude petroleum production increased 15 percent to 700,000 barrels. Production was from the northern part of the county.

The State highway department contracted for road construction gravel.

Sangamon.—No coal was produced in the county in 1965. Eddy Coal Co. and R & S Coal Mine, Inc., underground mines near Cantrall were abandoned.

A total of 739,000 tons of sand and gravel was produced by Buckhart Sand & Gravel Co., Inc., Clear Lake Sand & Gravel Co., and Springfield Sand & Gravel Co. County output increased 17 percent in quantity and 9 percent in value. Production was used for building, road construction, and fill. The city of Springfield contracted for road construction sand and gravel.

Clay Products Co. and Poston Brick & Concrete Products Co. produced clay near Springfield for use in manufacturing building brick, other heavy-clay products, and lightweight aggregate.

Crude petroleum production increased 39 percent to 219,000 barrels. Producing fields were southeast of Springfield.

Tamms Industries Co. produced iron oxide pigments at its Lyons plant.

Schuyler.—Peabody Coal Co. produced coal from its Key strip mine near Rushville. The entire tonnage was cleaned by jigging. About 96 percent of the production was shipped by barge on the Illinois River.

Limestone was produced by Elas Quarry and Missouri Gravel Co. near Pleasant View and Damon, respectively. Production was used for roadstone and agricultural purposes. Princeville Stone Co. produced paving sand near Frederick. The State highway department contracted for road construction gravel.

Scott.—Krueger Quarry and Thomas Quarry, Inc., produced limestone near Winchester for use as riprap, concrete aggregate and roadstone, and agricultural purposes. The State highway department contracted for paving sand. Sterling Shafer produced clay near Alsey for use in manufacturing building brick.

Stark.—Stonefort Coal Mining Co., Inc., produced coal from its strip mine near Wyoming. The entire output was shipped by rail.

R. A. Cullinan & Son, Inc., produced gravel near Castleton for road construction.

Tazewell.—Nearly 1.4 million tons of sand and gravel was produced for use in building, road construction, railroad ballast, and fill. Output increased 15 percent in quantity and nearly 18 percent in value. Producers were Concrete Materials Division (Martin Marietta Corp.), R. A. Cullinan & Son, Inc., Peoria Concrete Construction Co., and C. A. Powley Co. Concrete Materials purchased McGrath Sand & Gravel Co., Inc., operations at Mackinaw and Pekin. Peoria Concrete Construction Co. purchased Hoffer Construction Co., Inc., operation at East Peoria. Peoria Brick & Tile Co. produced clay near East Peoria for manufacturing building brick.

Vermilion.—Coal production decreased 25 percent to 835,000 tons. Three strip mines supplied 94 percent of the county output; the remainder was from three underground mines. Sixty percent of the shipments were by rail, the remainder was for local consumption. Lee Coal Co. reopened its strip mine near Oakwood after nearly 3 years of inactivity. Fairview Collieries Corp. and The United Electric Coal Cos. operated strip mines near Danville. Underground mines were operated near Catlin by Blue Lake Coal Co., Inc., and near Danville by Deep Valley Coal Co. and V-Day Coal Co. The United Electric Coal Cos. Mary Moore No. 25 mine and Blue Lake Coal Co., Inc., mine were closed early in the year.

Material Service Division (General Dynamics Corp.) produced limestone near Fairmount for use as concrete aggregate, roadstone, and refractory material. Eight companies produced 229,000 tons of sand and gravel. Output was for road construction and fill. Western Brick Co. (Division Illinois Brick Co.) produced shale near Danville for use in manufacturing building brick and lightweight aggregate.

Wabash.—Crude petroleum production increased 2 percent to 2.5 million barrels. Producing fields located entirely or partly within the county are Allendale, Mt. Carmel, and New Harmony Consolidated.

Sand and gravel production increased 2 percent to 181,000 tons. Output was for building, road construction, fill, and other uses. Producers were Allendale Gravel Co., George Aulvin Sand & Gravel Co., DunBar Sand & Gravel Co., and Mt. Carmel Sand & Gravel Co. The State highway department contracted for paving sand.

Allendale Coal Co. abandoned its strip mine near Allendale; no coal was produced in the county in 1965.

Washington.—Venedy Coal Co. produced coal from its underground mine near Venedy. Output was primarily for local consumption.

Limestone was produced by Covington Stone Co. near Okawville, Nashville Stone Co. (Division Five Star Exploration & Development Corp.) near Nashville, and Pitts Quarry, Inc., near Radom. Output was for roadstone and agricultural purposes. Total production increased 12 percent in quantity and 14 percent in value.

Crude petroleum production decreased 7 percent to 570,000 barrels. Producing fields are located throughout the county.

Wayne.—The county ranked fifth in petroleum production with output of 5.6 million barrels, or nearly 9 percent of the State total. Production decreased less than 1 percent from that of 1964. A portion of the Clay City Consolidated field is in the county.

The county highway department contracted for road construction gravel.

White.—The county ranked fourth in crude petroleum production. Output in 1965 was 6.5 million barrels, 10 percent of the State total. Production decreased 11 percent from that of 1964. Portions of New Harmony Consolidated and Roland Consolidated fields are in the county.

About 183,000 tons of sand and gravel was produced, a 23-percent decrease from the 1964 tonnage. Material was produced by Eastwood Sand & Gravel Works near Grayville, Halley Sand & Gravel near Carmi, and Mt. Carmel Sand & Gravel Co. near Crossville. Output was used for building, road construction, and fill. The State highway department contracted for road construction sand and gravel.

Whiteside.—Limestone production decreased 17 percent to about 244,000 tons. Output was for riprap, roadstone, and agricultural purposes. Producers were Alldritt Bros., Cordova Quarry, Inc., Johnson Coal Co., and Rein, Schultz & Dahl, Inc. Collinson Bros. and McCue Bros., Inc., operated sand and gravel plants near Prophetstown and Sterling, respectively. Output was used as road construction material. The Jordan Township Highway Department produced gravel for its own use.

Anderson Peat Co. produced moss peat and Markman Peat Co. produced reed-sedge peat at operations near Morrison. Material was sold in bulk and packaged form.

Will.—Nearly 497,000 tons of coal was produced from the Will County portion of the Northern Illinois strip mine operated by Peabody Coal Co. near South Wilmington. Some coal was also produced from the Grundy County portion of the mine. All production was cleaned by jigging methods at the company plant in Kankakee County.

The county ranked as the fourth largest sand and gravel producing county in the State in 1965 with output of 2.9 million tons, over 8 percent of the State total. Production decreased 11 percent from that of 1964 in quantity and value. Producers were Avery Gravel Co., Chicago Gravel Co., Elmhurst-Chicago Stone Co., Material Service Division (General Dynamics Corp.), C. H. Monk, and Turner Stone, Inc. Plants were operated near Joliet, Lemont, Lisle, Lockport, and Plainfield. The State highway department contracted for road construction material.

The county ranked fourth in limestone production. Output was nearly 2 million tons, 4 percent of the State total and a 12-percent increase from the 1964 total. Producers were Lincoln Stone Quarry, Inc., Material Service Division (General Dynamics Corp.), National Stone Co. (Division of Dolese & Shepard Co.), Wm. D. Tierney & Son (formerly Navajo Stone Co.), and the Illinois State Penitentiary.

Johns-Manville Perlite Corp. expanded perlite from outside the State at its Joliet plant for uses as filler and filter aid, and at its Rockdale plant for use as roof insulation. The Pure Oil Co. (Division of Union Oil Co. of California) recovered sulfur by the Modified-Claus process at its Lemont refinery.

Williamson.—Approximately 6 million tons of coal was produced, a 6-percent decrease from the 1964 tonnage. The county dropped from second to fourth in coal production. Nearly 60 percent of the total county output was from 10 underground mines and the remainder from 8 strip mines. Major underground mine producers were Bell & Zoller Coal Co. and Freeman Coal Mining Corp. Major strip mine producers were Big Muddy Coal Corp., Forsyth-Energy Co., Peabody Coal Co., and Thunderbird Collieries Corp. About 6.1 million tons, including coal mined outside the county, was cleaned at 11 plants. Over 88 percent of the total county shipments were by rail. Strip mines were opened by Liberty Coal Co. and Menow Coal Co., Inc., near Crab Orchard and Marion, respectively. Liberty Coal Co. and Wenzel Bros. Coal Co. abandoned strip mines during the year. No production came from the Williamson County portion of Stonefort Coal Mining Co., Inc., Will Scarlet mine. Company production from the Saline portion of the mine was cleaned in Williamson County.

The Mineral Industry of Indiana

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the Geological Survey, Indiana Department of Natural Resources, for collecting information on all minerals except fuels.

By Donald F. Klyce [1] and Mary B. Fox [2]

In 1965 the value of mineral production in Indiana reached $218.6 million, about 3 percent greater than in 1964. Value of cement, coal, natural gas, petroleum, sand and gravel, and stone shipments increased while that of abrasives, clays, gypsum, and peat declined.

Nonmetals accounted for 57 percent of the value of the State mineral production. The remainder represented the value of mineral fuels as no metallic minerals were produced in the State.

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Table 1.—Mineral production in Indiana [1]

Mineral	1964		1965	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Abrasives (whetstones)—short tons	5	$16	5	$15
Cement, portland—thousand 376-pound barrels	15,038	48,695	14,925	48,797
Clays—thousand short tons	1,545	2,264	1,459	2,160
Coal (bituminous)—do	15,075	57,246	15,565	59,927
Natural gas—million cubic feet	199	47	239	56
Peat—short tons	66,568	543	53,873	511
Petroleum (crude)—thousand 42-gallon barrels	11,283	32,157	[2] 11,429	[2] 32,458
Sand and gravel—thousand short tons	24,416	21,811	24,867	22,220
Stone—do	22,318	39,978	24,574	42,124
Value of items that cannot be disclosed: Masonry cement and gypsum	XX	9,026	XX	10,299
Total	XX	211,783	XX	218,567

XX Not applicable.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Final figure; supersedes figure in Volume II Petroleum chapter because of late revision.

Table 2.—Value of mineral production in constant 1957–59 dollars
(Millions)

Year	Value	Year	Value
1956	$201	1961	$206
1957	199	1962	209
1958	202	1963	212
1959	209	1964	219
1960	213	1965	[p] 226

[p] Preliminary.

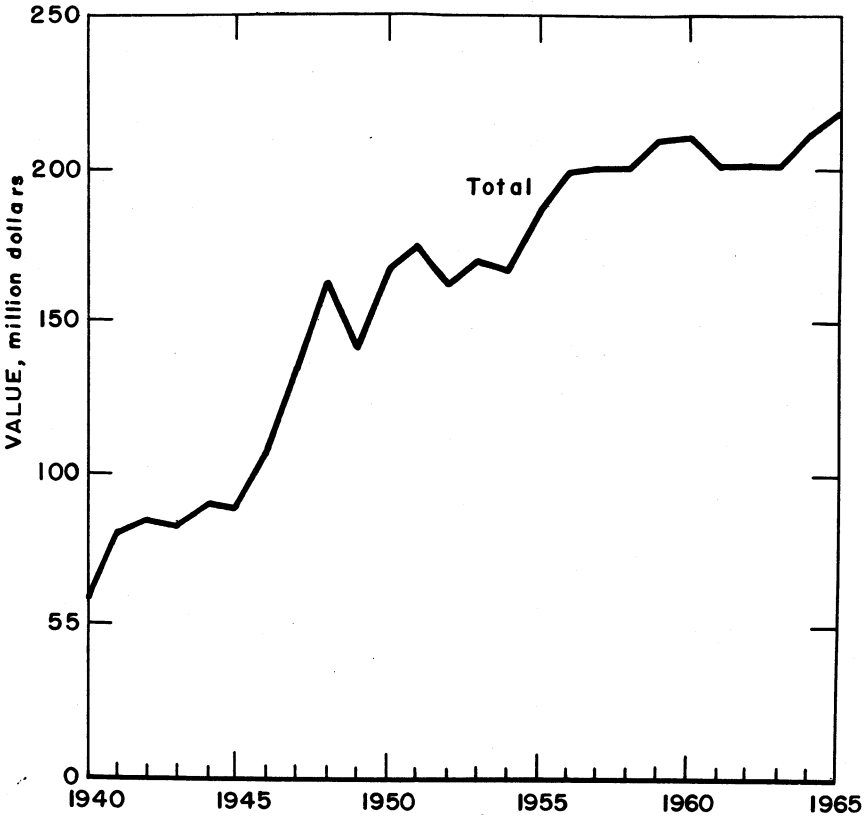

Figure 1.—Total value of mineral production in Indiana, 1940–65.

Table 3.—Employment and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1964:								
Coal	2,679	219	586	4,496	1	161	36.03	2,547
Peat	36	194	7	58	-------	-------	-------	-------
Nonmetal	818	247	202	1,611	1	20	13.03	4,146
Sand and gravel	1,188	238	283	2,421	-------	32	13.22	4,096
Stone	3,372	263	886	7,297	3	144	20.15	3,450
Total	8,093	243	1,964	15,883	5	357	22.79	3,351
1965: [p]								
Coal	2,500	238	595	4,328	-------	195	45.06	1,532
Peat	41	171	7	62	-------	2	32.52	3,740
Nonmetal	840	260	218	1,743	-------	32	18.36	962
Sand and gravel	1,200	262	315	2,692	1	26	10.03	4,272
Stone	2,935	277	813	6,718	3	137	20.84	3,624
Total	7,516	259	1,948	15,543	4	392	25.48	2,855

[p] Preliminary.

Table 4.—Clays sold or used by producers, by kinds
(Thousand short tons and thousand dollars)

Year	Fire clay		Miscellaneous clay		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
1956–60 (average)	414	$734	1,268	$2,229	1,682	$2,963
1961	334	588	1,028	1,858	1,362	2,446
1962	347	569	1,103	1,686	1,450	2,255
1963	448	724	1,098	1,623	1,546	2,347
1964	376	644	1,169	1,620	1,545	2,264
1965	329	526	1,130	1,634	1,459	2,160

REVIEW BY MINERAL COMMODITIES

NONMETALS

Abrasive Materials. — Whetstones were fabricated from sandstone quarried in the area by Hindostan Whetstone Co. at a mill near Orleans, in Orange County. In 1965 output was the same in quantity as reported in 1964, although the value was slightly less.

Cement.—Portland and masonry cements were produced at plants in Lake County by Universal Atlas Cement Division of United States Steel Corp., in Lawrence County by Lehigh Portland Cement Co., in Putnam County by Lone Star Cement Corp., and in Cass and Clark Counties by Louisville Cement Co.

The average mill values of both portland and masonry cements increased. In 1965, portland cement was valued at $3.27 per barrel compared with $3.24 in 1964, while masonry cement was $3.06 and $2.63, respectively. A small decline in portland cement shipments was offset by an increase in sales of masonry cement. Year-end stocks of portland cement were 1.5 million barrels compared with 1.8 million barrels in 1964. About 40 percent of the cement shipped was used in Indiana. Principal out-of-State consumers were in Illinois, Kentucky, and Wisconsin. Shipments also went to 14 other States. Nearly 3.6 million tons of limestone and 865,000 tons of slag, clays and shale, sand, gypsum, grinding aids, and air-entraining compounds were used in manufacturing cement. Approximately 362 million kilowatt-hours of electrical energy was used at the plants. Three plants used the dry process of manufacture, and two used the wet process. Annual finished-cement capacity of Indiana plants was 19.7 million barrels.

Louisville Cement Co. announced plans for a multimillion-dollar expansion program that included a second kiln (450- by 12-foot) and storage silos at the Logansport plant, Cass County, which will double production capacity. A modernization program at the Speed plant, Clark County, is also planned.

Clays.—Clay output was down nearly 6 percent from 1964. Much of the loss resulted from a decreased demand for materials for building brick and other heavy clay products. Clay was used in the manufacture of cement, lightweight aggregate, heavy clay products (building brick, pipe, draintile), and miscellaneous uses including pottery and stoneware. Fire clay was mined in 7 counties, and miscellaneous clay in 21 counties.

Figures compiled by the Indiana Geological Survey indicated that the value of products manufactured from clay and shale was $37 million.

Areas of thin drift in Jasper and La Porte Counties were mapped in detail by the Indiana Geological Survey.[3] Two cores of the New Albany Shale were sampled for laboratory investigation to determine its potential as a raw material for expanded shale aggregate in northern Indiana.

Gypsum.—Output of crude gypsum declined about 15 percent, reflecting a decreased demand for building materials. National Gypsum Co. and United States Gypsum Co. operated underground mines and adjacent board plants in Martin County, near Shoals. Building materials, including lath, plaster, and wallboard were

[3] Rooney, L. F. and J. A. Sunderman. Lightweight Aggregate Potential of the New Albany Shale in Northwestern Indiana: 1964, Indiana Department of Conservation, Geological Survey Report of Progress 27, 40 pp.

manufactured. A report on the recently discovered gypsum deposits in northern Indiana was published.[4]

The Indiana Geological Survey took three more cores in La Porte County establishing the updip boundary of the Fish Lake deposit and extending the La Porte deposit 1 mile to the southwest of the survey's discovery.

Mineral Wool.—Mineral wool was manufactured from Lake County blast furnace slags and from small amounts of clays, gravel, and limestone. Plants were in Huntington, Madison, Wabash, and Wayne Counties.

Perlite.—Crude perlite, mined in Western States, was expanded at plants in Lake, Martin, and Scott Counties. The expanded product was used in building plaster, concrete aggregate, and for insulation.

Sand and Gravel.—Sand and gravel production increased nearly 2 percent, continuing an upward trend that began in 1961. Sand and gravel for building purposes increased by more than 500,000 tons. A 1-million-ton loss in road materials was offset by a 1-million-ton gain in sand and gravel fill. Production was reported in 68 counties from 214 commercial and 26 Government-and-contractor operations.

The largest production of sand and gravel came from Marion County. Substantial production was also reported from Allen, Cass, De Kalb, Hamilton, La Porte, Madison, St. Joseph, Tippecanoe, and Vigo Counties.

The leading commercial producers, in alphabetical order, were American Aggregates Corp., Burtzner & Wilhelm, Carter's Sand & Gravel Co., Inc., Irving Bros. Gravel Co., Inc., Irving Materials, Inc., No. 2, Rieth-Riley Construction Co., Inc., S. & L. Gravel Co., Inc., Standard Materials Corp. (Martin Marietta Corp.), and Western Indiana Aggregates Corp. A report on the Indiana sand and gravel industry was published.[5] The Indiana Geological Survey published a map showing the locations of sand and gravel deposits.[6]

Slag (Iron-Blast Furnace).—Slag, a by-product of pig iron production in Lake County blast furnaces, was used in manufacturing cement, mineral wool, and roofing granules. It was also crushed for use as an aggregate and expanded for lightweight aggregate.

Stone. — With the exception of small quantities of sandstone and calcareous marl, all stone produced was limestone, and nearly 98 percent of this limestone was crushed or broken and sold for cement, concrete aggregate, roadstone, filler, flux, agricultural limestone, mineral food, railroad ballast, and riprap. Production of crushed limestone increased 11 percent in volume and almost 12 percent in value from that of 1964. Nearly all of the gain was due to increased demand for crushed limestone for concrete aggregate and roadstone. Crushed and broken limestone was produced in 43 counties, with the largest output reported from Allen, Clark, Lawrence, and Putnam Counties.

The leading crushed stone producers were Bloomington Crushed Stone Co., Inc.; Erie Stone, Inc. (Irving Bros. Gravel Co., Inc.); Lone Star Cement Corp.; May Stone & Sand, Inc.; Mulzer Bros.; Newton County Stone Co., Inc.; Standard Materials Corp. (Martin Marietta Corp.), Utica Limestone Quarry (Louisville Sand & Gravel Co.); and Western Indiana Aggregates Corp. A map showing the locations of crushed stone producers was published by Indiana Geological Survey.[7]

The remainder of the limestone produced was for dimension purposes. Production of dimension limestone was 15 percent less than in 1964, but one category, cut stone, registered a gain of 20 percent over 1964. Leading dimension stone producers included Bloomington Limestone Corp., B. G. Hoadley Quarries, Inc., Independent Limestone Co., Indiana Limestone Co., Inc., and Texas Quarries, Inc. A report on dimension stone was published.[8]

Principal marl-producing areas were in Lagrange, La Porte, Marshall, and Steuben Counties. Six other counties reported minor production.

Sandstone was quarried in Brown, Craw-

[4] Rooney, L. F. Gypsum Deposits In Northern Indiana. Trans. AIME, v. 232 (min.), 1965, pp. 268–273.

[5] Carr, D. D. 1965, Sand and Gravel Industry of Indiana. Indiana Business Rev., August 1965, pp. 7–11.

[6] Indiana Geological Survey. Locations of Sand and Gravel Operations in Indiana. Miscellaneous Map No. 10, 1964.

[7] Indiana Geological Survey. Locations of Crushed Stone Operations In Indiana. Miscellaneous Map No. 11, 1965.

[8] Rooney, L. F. 1965, Indiana Dimension Limestone Industry. Indiana Business Rev., September 1965, pp. 3–8.

Table 5.—Sand and gravel sold or used by producers, by classes of operations and uses
(Thousand short tons and thousand dollars)

Class of operation and use	1964		1965	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	4,553	$3,847	4,933	$4,172
Paving	4,932	3,642	3,577	2,887
Fill	1,568	711	2,193	969
Other [1]	864	1,463	844	1,582
Total	11,917	9,663	11,547	9,610
Gravel:				
Building	3,625	4,153	3,793	4,409
Paving	6,274	6,494	6,615	6,623
Railroad ballast	93	77	45	35
Fill	1,574	838	1,956	1,041
Other	200	175	203	99
Total	11,766	11,737	12,612	12,207
Total sand and gravel	23,683	21,400	24,159	21,817
Government-and-contractor operations:				
Sand:				
Paving	22	10	14	6
Total	22	10	14	6
Gravel:				
Building	--------	--------	3	1
Paving	642	363	647	380
Fill	69	38	44	16
Total	711	401	694	397
Total sand and gravel	733	411	708	403
All operations:				
Sand	11,939	9,673	11,561	9,616
Gravel	12,477	12,138	13,306	12,604
Grand total	24,416	21,811	24,867	22,220

[1] Includes filler and foundry sand (1964), engine, fire or furnace, glass, molding, railroad ballast, other construction and industrial sand (1964–65), and abrasive and blast sand (1965).

ford, Lawrence, Martin, Monroe, Morgan, and Spencer Counties. The principal use was as building stone, although a quartz conglomerate, quarried in Martin County, was crushed for use in manufacturing refractories.

Overall stone production in 56 counties was 10 percent greater than in 1964.

Sulfur.—Byproduct sulfur was recovered from crude petroleum at the Whiting Refinery of American Oil Co. The Mathieson-Fluor process was used.

MINERAL FUELS

Coal (Bituminous).—The output of Indiana coal mines was more than 3 percent greater than in 1964 while the value of coal mined was nearly 5 percent more than in 1964. Sixty-one mines were operated, one more than in 1964. Of these, 20 were underground mines, and 41 were strip mines. The latter produced 85 percent of the coal. Nearly 12.4 million tons of coal was mechanically cleaned at 15 plants. About 65 percent of the coal was moved by rail, 15 percent by water, 12 percent by truck, and the remainder mostly by conveyor or tram. About 60 percent of the coal mined in Indiana was used by electric utilities.

Coal was mined in 16 counties. More than 95 percent of production came from mines in Clay, Gibson, Greene, Pike, Sullivan, and Warrick Counties.

Initial production began at the Squaw Creek Coal Co. strip mine, jointly owned by Peabody Coal Co. and Aluminum Company of America. The mine will supply fuel for power at the latter's Warrick Works. Peabody Coal Co. in June opened

Table 6.—Limestone sold or used by producers, by uses

Use	1964		1965	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Dimension:				
Rough construction thousand short tons	----------	----------	W	W
Rubble do	72	$261	W	W
Rough architectural thousand cubic feet	3,035	3,535	2,651	$3,095
Sawed do	1,701	3,989	1,167	2,889
House stone veneer do	1,051	1,781	886	1,614
Cut do	400	2,624	481	3,091
Flagging do	189	43	W	W
Total (approximate thousand short tons) [1]	534	12,233	456	10,993
Crushed and broken:				
Riprap thousand short tons	115	157	143	230
Concrete aggregate and roadstone do	15,789	20,305	18,170	23,718
Railroad ballast do	386	481	436	544
Agriculture do	2,467	3,569	2,453	3,489
Cement do	2,586	1,975	2,616	2,071
Other [2] do	321	749	207	606
Total do	21,664	27,236	24,025	30,658
Grand total do	22,198	39,469	[3] 24,480	41,651

W Withheld to avoid disclosing individual company confidential data; included in total.
[1] Average weight of 145 pounds per cubic foot used to convert cubic feet to short tons.
[2] Includes limestone for poultry grit and other uses (1964), asphalt filler, dust for coal mines, fertilizer, filter beds, mineral food, metallurgical uses, and stone sand.
[3] Data do not add to total shown because of rounding.

Table 7.—Calcareous marl production

Year	Number of producers	Shorttons	Value
1956–60 (average)	8	76,441	$49,754
1961	9	31,707	19,137
1962	16	50,952	34,657
1963	17	59,265	36,635
1964	29	86,493	52,335
1965	21	64,493	40,260

the Hawthorn mine, 4 miles northwest of Sanborn. Planned annual capacity is about 1 million tons. Facilities included a preparation plant; operating equipment included a 70-cubic-yard-stripping shovel.

In January, Ayshire Collieries Corp. acquired the Minnehaha underground mine of Fairview Collieries Corp. in Sullivan County. Ayrshire continued operating the mine but as a strip mine. The company closed the Friar Tuck mine in the same area in June. Another mine opening in 1965 was the Wasson Coal Mining Corp. strip mine in Warrick County. Mine closings included G. & F. Corp. Old Hickory strip mine, Clay County; Ditney Hill underground mine of Ingle Coal Corp., Warrick County; Airline underground mine of Peabody Coal Co., Sullivan County; and Tecumseh strip mine of Tecumseh Coal Corp., Warrick County. Equipment at the Tecumseh mine was moved to the Lynnville mine. Late in the year, Interlake Steel Corp. concluded the sale of its Enos Coal Mining Division to Old Ben Coal Corp.

Coke.—Coke was produced at five plants with 2,218 ovens. Output was 8.3 million tons, compared with 8.2 million tons in 1964. About 12.0 million tons of coal was delivered to the coke plants and carbonized. Most of the coking coal came from Kentucky and West Virginia. None was mined in Indiana. Most of the coke produced in Indiana was used in Lake County blast furnaces.

Peat.—Reed-sedge, moss peat, and humus were mined from bogs in Grant, Hamilton, Kosciusko, La Porte, Marion, Marshall, Porter, Warren, and Wells Counties. Marketed output reported was 19 percent less than in 1964. The peat was used principally for soil conditioning and horticultural use. None was sold for use as fuel.

Petroleum and Natural Gas.—Despite a fewer number of wells drilled in Indiana in 1965 than in 1964, the amount of oil produced increased, reversing the production trend of the previous 2 years. Production amounted to 11,428,802 barrels,

Table 8.—Coal (bituminous) production in 1965, by counties
(Excludes mines producing less than 1,000 short tons)

County	Number of mines operated		Production (short tons)			Value
	Underground	Strip	Underground	Strip	Total	
Clay		6		835,429	835,429	$3,276,723
Daviess		1		27,088	27,088	134,873
Dubois	1		1,360		1,360	W
Fountain		1		W	W	W
Gibson	2	1	544,733	444,851	989,584	W
Greene	1	6	2,300	1,172,000	1,174,300	4,694,341
Knox	1		65,716		65,716	W
Owen		1		W	W	W
Parke		1		7,032	7,032	41,676
Perry		1		W	W	W
Pike	3	4	71,828	1,737,169	1,808,997	6,886,788
Spencer		4		58,956	58,956	254,709
Sullivan	5	4	1,394,885	2,155,226	3,550,111	13,818,574
Vermillion	2		10,491		10,491	68,961
Vigo	1	1	58,418	486,792	545,210	W
Warrick	4	10	205,576	6,265,529	6,471,105	24,018,650
Total	20	41	2,355,307	13,210,102	15,565,409	59,927,003

W Withheld to avoid disclosing individual company confidential data; included in total.

Table 9.—Peat production

Year	Number of producers	Short tons	Value
1956–60 (average)	6	16,035	$169,150
1961	7	57,146	501,850
1962	5	47,430	272,238
1963	6	47,695	411,848
1964	8	66,568	543,046
1965	9	53,873	510,793

or 145,690 barrels over the preceding year.

During 1965, 862 holes were drilled—109 less than the number drilled in 1964. Included in the 862 wells were 503 drilled in search of oil and gas or in primary development of proved reservoirs, 203 for secondary recovery purposes, and 156 in connection with gas storage projects.

Of the 503 wells drilled for exploration or development, the 218 development holes resulted in 114 oil wells, 8 gas wells, and 96 dry holes. Exploratory drilling produced 3 new fields, 18 new pools, and 5 pool extensions in Mississippian rocks, 1 new field and 1 extension in Devonian rocks, and 1 new field in Ordovician rocks.

The southwestern section of the State continues to be the site of the greater part of the exploration and development drilling, but the discovery of oil at shallow depths in La Porte County has stimulated considerable activity in northwestern Indiana. Some interest in exploration in the eastern part of Indiana was maintained.

Although the number of wells drilled for secondary recovery purposes was 37 less than in 1964, the percentage of oil produced by waterflooding increased from slightly less than 54 percent to 55.6 percent of the total production in 1965.

Three new gas storage projects were started during 1965, bringing the total in Indiana to 30.

The proved oil reserve at the end of 1965 was 57,552,000 barrels, and the total liquid hydrocarbon reserve was 57,637,000 barrels.[9]

METALS

Aluminum. — Aluminum Company of America operated a smelter in Warrick County. In April, a second potline was opened and installation of a third potline was begun at the Warrick Works. New capacity of the aluminum smelter will be more than doubled.

Pig Iron and Steel.—Pig iron and steel were produced in Lake County, at East Chicago by Inland Steel Co. and Youngstown Sheet & Tube Co., and at Gary by United States Steel Corp. Output of pig iron was 11.1 million tons compared with 11.5 million in 1964.

The American Iron & Steel Institute reported that steel production in Indiana

[9] American Gas Association, American Petroleum Institute, and Canadian Petroleum Association. Proved Reserves of Crude Oil, Natural Gas Liquids and Natural Gas. V. 20, 1965, 35 pp.

Table 10.—Crude petroleum production in 1965, by major fields

Name of field	Year discovered	Area, acres	Location, county	Number of wells		Production (barrels)
				Producing	Completed	
Caborn Consolidated	1940	1,750	Posey	103	7	175,097
Coe South	1961	430	Pike	17	2	200,397
Evansville	1947	390	Vanderburgh	NA	------	251,573
Glezen	1952	330	Pike	NA	------	160,594
Griffin Consolidated	1938	7,200	Gibson and Posey	NA	12	2,467,397
Heusler Consolidated	1938	2,110	Posey and Vanderburgh	NA	9	391,486
Mount Vernon Consolidated	1941	2,220	Posey	171	7	545,052
Newtonville Consolidated	1943	510	Spencer	NA	1	435,899
Owensville Consolidated	1940	1,820	Gibson	NA	2	274,625
Owensville North Consolidated	1943	1,940	----do	78	2	145,234
Patoka East Consolidated	1947	1,000	----do	NA	------	121,894
Plainville	1950	350	Daviess	NA	------	111,886
Princeton North Consolidated	1943	930	Gibson	51	5	241,287
Springfield Consolidated	1946	2,420	Posey	146	3	1,301,143
Union-Bowman (New) Consolidated.	1941	14,950	Gibson, Knox, and Pike	402	9	689,569
Welborn Consolidated	1941	1,700	Posey	112	6	197,319
Welborn North Consolidated	1953	370	----do	NA	2	133,506
West Hovey	1944	450	----do	23	------	104,994
Wheatonville Consolidated	1949	1,510	Gibson	75	2	173,098
Undistributed	XX	XX		NA	112	3,306,752
Total	XX	XX		NA	181	11,428,802

NA Not available. XX Not applicable.
Source: Petroleum Section, Indiana Geological Survey.

totaled 17.1 million tons, compared with 17.5 million in 1964. About 7.3 million tons of coke and coke breeze and 3.8 million tons of limestone and dolomite were used at integrated steel plants. Bethlehem Steel Corp. officially opened its new Burns Harbor steel complex on September 21. Youngstown Sheet & Tube Co. announced a $375 million expansion at its Indiana Harbor Works that will include an 84-inch hot strip mill and a 4,000-ton-per-day blast furnace.

REVIEW BY COUNTIES

Mineral production was reported from 89 of the 92 counties; Benton, Ohio, and Tipton Counties were the exceptions. In each of 26 counties, the value of mineral production was $1 million or more. Because some oilfields extend over county lines, exact county production cannot be determined, and the value of petroleum cannot be accurately distributed to the county level. Three-fifths of the State total value of mineral production came from 10 counties: Cass, Clark, Greene, Lake, Lawrence, Monroe, Pike, Putnam, Sullivan, and Warrick, exclusive of Gibson and Posey Counties which account for about two-thirds of the State petroleum production valued at more than $21.5 million.

Only those counties with significant production or activity are discussed below. See table 11 for additional detail.

Adams.—The Krick-Tyndall Co. mined miscellaneous clay near Decatur for the manufacture of heavy clay products. Meshberger Bros. Stone Corp. operated limestone quarries and crushing plants at Linn Grove and Pleasant Mills and sold the output for concrete aggregate, roadstone, and agricultural use. John W. Karch Stone Co. operated a quarry near Geneva and crushed limestone for agricultural use and roadstone and also produced a small quantity of flagstone. About 100,000 tons of sand and gravel was produced. Lybarger Gravel Co., Geneva, and Yost Gravel Ready Mix, Inc., Decatur, operated fixed sand and gravel plants and produced building and road material. S. & L. Gravel Co., Inc., produced road gravel with a portable plant.

Allen. — May Stone & Sand, Inc., operated stone quarries and sand and gravel pits in the county. The company is modernizing and expanding the Ardmore sand plant and the Ardmore quarry and is enlarging the Woodburn plant. Mid-

Table 11.—Value of mineral production in Indiana, by counties [1]

County	1964	1965	Minerals produced in 1965 in order of value
Adams	$575,570	$733,612	Stone, sand and gravel, clays.
Allen	2,233,423	2,441,385	Stone, sand and gravel.
Bartholomew	468,800	W	Stone.
Blackford	W	W	Stone, sand and gravel, clays.
Boone	176,000	174,000	Sand and gravel.
Brown	11,830	3,245	Stone.
Carroll	W	W	Stone, sand and gravel.
Cass	W	W	Cement, stone, sand and gravel, clays.
Clark	W	W	Do.
Clay	3,923,935	3,483,715	Coal, clays.
Clinton	W	39,000	Sand and gravel.
Crawford	W	W	Stone.
Daviess	124,495	198,873	Coal, sand and gravel.
Dearborn	376,000	W	Sand and gravel.
Decatur	W	W	Stone.
De Kalb	812,000	425,000	Sand and gravel.
Delaware	1,293,003	1,408,188	Stone, sand and gravel.
Dubois	44,626	16,673	Clays, coal.
Elkhart	436,602	431,782	Sand and gravel, stone.
Fayette	W	W	Sand and gravel.
Floyd	W	W	Stone.
Fountain	W	574,410	Sand and gravel, clays, coal.
Franklin	W	W	Sand and gravel, clays.
Fulton	50,375	185,100	Sand and gravel, stone.
Gibson	W	W	Coal, sand and gravel.
Grant	W	W	Stone, sand and gravel, peat.
Greene	6,223,900	4,930,486	Coal, clays, sand and gravel.
Hamilton	1,033,668	1,443,890	Sand and gravel, stone, peat.
Hancock	50,000	83,000	Sand and gravel.
Harrison	354,385	609,900	Stone, sand and gravel.
Hendricks	W	W	Sand and gravel.
Henry	W	W	Do.
Howard	W	W	Stone, sand and gravel.
Huntington	1,079,418	W	Stone, sand and gravel, clays.
Jackson	182,998	321,854	Sand and gravel, clays.
Jasper	552,123	W	Stone, sand and gravel.
Jay	W	W	Do.
Jefferson	W	W	Stone.
Jennings	280,197	320,671	Do.
Johnson	W	W	Sand and gravel.
Knox	631,922	644,577	Sand and gravel, coal.
Kosciusko	691,658	554,949	Sand and gravel, peat, stone.
Lagrange	W	338,150	Sand and gravel, stone.
Lake	W	W	Cement, sand and gravel, clays.
La Porte	W	W	Sand and gravel, peat, stone.
Lawrence	14,882,855	14,161,373	Cement, stone.
Madison	1,531,540	1,631,264	Stone, sand and gravel.
Marion	W	W	Sand and gravel, peat.
Marshall	253,111	246,201	Sand and gravel, stone, peat.
Martin	W	W	Gypsum, clays, stone.
Miami	W	W	Sand and gravel.
Monroe	8,204,412	7,727,485	Stone.
Montgomery	52,422	68,454	Sand and gravel, clays.
Morgan	780,327	789,988	Clays, sand and gravel, stone.
Newton	W	W	Stone, sand and gravel.
Noble	346,492	216,275	Sand and gravel, stone.
Orange	648,486	763,061	Stone, abrasives.
Owen	2,663,486	826,401	Stone, sand and gravel, clays, coal.
Parke	W	408,486	Sand and gravel, clays, coal.
Perry	W	W	Stone, coal.
Pike	8,528,808	6,891,988	Coal, stone.
Porter	W	W	Sand and gravel, clays, peat.
Posey	W	73,000	Sand and gravel.
Pulaski	W	W	Stone, clays, sand and gravel.
Putnam	W	10,117,110	Cement, stone, sand and gravel, clays.
Randolph	376,518	W	Stone, sand and gravel.
Ripley	392,227	307,951	Stone.
Rush	W	309,583	Stone, sand and gravel.
St. Joseph	679,730	589,996	Sand and gravel, stone.
Scott	196,502	218,118	Stone.
Shelby	1,249,449	1,368,874	Stone, sand and gravel.
Spencer	380,907	352,059	Coal, stone, sand and gravel.
Starke	W	40,000	Sand and gravel.
Steuben	W	W	Sand and gravel, stone.
Sullivan	8,219,320	14,097,199	Coal, sand and gravel, stone.
Switzerland	121,450	131,481	Stone, sand and gravel.
Tippecanoe	W	W	Sand and gravel.
Tipton	W	----------	

See footnotes at end of table.

Table 11.—Value of mineral production in Indiana, by counties [1] — Continued

County	1964	1965	Minerals produced in 1965 in order of value
Union	----------	$9,000	Sand and gravel.
Vanderburgh	W	26,264	Clays.
Vermillion	$703,644	587,703	Sand and gravel, clays, coal.
Vigo	4,000,086	3,210,603	Coal, sand and gravel, clays.
Wabash	287,500	W	Stone, sand and gravel.
Warren	W	W	Sand and gravel, peat.
Warrick	22,878,688	24,186,580	Coal, stone.
Washington	W	W	Stone.
Wayne	727,444	645,927	Sand and gravel, stone.
Wells	W	W	Stone, sand and gravel, peat.
White	349,650	331,730	Stone.
Whitley	204,000	162,000	Sand and gravel.
Undistributed [2]	111,517,018	108,708,386	
Total	211,783,000	218,567,000	

W Withheld to avoid disclosing individual company confidential data.
[1] Data for petroleum and natural gas are not available on a county basis; however, values for these commodities are included with "Undistributed." Benton and Ohio Counties are not listed because no production was reported.
[2] Includes value for petroleum, natural gas, some sand and gravel that cannot be assigned to specific counties, and values indicated by symbol W.

west Aggregates Corp. (Division of Old Fort Supply Co., Inc.) operated a limestone quarry and crushing plant near Edgerton and produced material for concrete aggregate and roadstone.

A total of 918,000 tons of sand and gravel was produced, chiefly for building, road construction, and fill. Sand and gravel was mined and processed in two plants at Fort Wayne by Paul C. Brudi Stone & Gravel Co., Inc., and at Roanoke by W. W. Gravel Co., Inc. S. & L. Gravel Co., Inc., produced road gravel with a portable plant.

Bartholomew.—Meshberger Stone Corp. operated a limestone quarry and crushing plant near Columbus. In addition to riprap, fluxstone, roadstone, agricultural limestone, stone and filter sand, the company also produced a small amount of rough construction stone and rubble.

Blackford.—Inman Tile Co. mined clay near Hartford City for its own use in manufacturing draintile. J & K Stone Corp. operated a limestone quarry at Montpelier and crushed the output for concrete aggregate, roadstone, and agricultural use.

S. & L. Gravel Co., Inc., produced road gravel with a portable plant.

Brown.—A sandstone quarry was operated near Nashville by the Brown County Stone Co., Inc. Sawed stone, rough construction stone, and rubble were produced.

Carroll.—Limestone was quarried for riprap, concrete aggregate, roadstone, and agricultural use near Delphi by Delphi Limestone Co. Sand and gravel for building use and fill was produced in the Delphi and Flora areas. The county highway department produced road gravel.

Cass. — Portland and masonry cements were produced at Logansport by Louisville Cement Co. The company also quarried limestone and mined clay in the area for use at the cement plant. Also in the Logansport area, limestone quarries and crushing plants were operated by Cass County Stone Corp. and the France Stone Co. The output was sold for flux, roadstone, and agricultural limestone, as well as riprap. Edward Sadler produced marl near Logansport for agricultural use. Sand and gravel for building, paving, and fill were produced in the county. Producers were Carter's Sand & Gravel Co., Inc., Fred Goodier Gravel Co., and S. & L. Gravel Co., Inc.

Clark.—Louisville Cement Co. operated a cement plant at Speed and manufactured portland and masonry cements. Clays and limestone for use at the plant were mined by the company in the area. Limestone was also quarried and crushed at Jeffersonville by T. J. Atkins & Co., at Sellersburg by the Sellersburg Stone Co., Inc., and at Utica by the Utica Limestone Quarry (Louisville Sand & Gravel Co.). Total county production of limestone was about 2.5 million tons, used for cement manufacture, concrete aggregate and roadstone, agricultural use, and riprap. Sand and gravel was produced from pits near Jeffersonville and Utica and used for building, paving, and fill.

Clay.—A total of 835,000 tons of coal was produced from six strip mines. The Chinook mine of Ayrshire Collieries Corp. continued to be the largest producer in the county. The Old Hickory mine of G. & F. Corp. was shut down in February. Fire and miscellaneous clay were produced in several coal mines from underclays of of the Pennsylvanian System. The clays were used in the manufacture of brick, tile, stoneware, cement, and for other purposes.

Crawford.—Limestone was produced by Mulzer Bros. near Eckerty and Cape Sandy and by Hy-Rock Products Co. near Marengo. The latter company's operation was an underground mine. Mulzer Bros.' Eckerty operation was mined by underground and open pit methods, and its Cape Sandy operation was an open quarry. Roadstone, railroad ballast, and agricultural limestone were produced. Springs Valley Sandstone Co. of West Baden Springs operated the Westall quarry and produced sawed stone for building use.

Daviess.—The J. & H. Coal Co. produced 27,000 tons of coal from a strip mine opened during 1965. The Mize Gravel Co. produced sand and gravel near Elnora for building and road use.

Decatur.—Limestone quarries and crushing plants were operated near Greensburg by Harris City Stone Co., Inc., and by New Point Stone Co. Riprap, roadstone, and agricultural limestone were produced.

De Kalb.—Output of sand and gravel declined by more than 500,000 tons to 814,000. Producers reported that lack of road construction in the area was responsible. Producers included Auburn Sanitary Landfill, Inc., Paul C. Brudi Stone & Gravel Co., Inc., Burtzner & Wilhelm, T. W. Day, Hixson Sand & Gravel, Inc., Irving Gravel Co., Inc., May Stone & Sand, Inc., and S. & L. Gravel Co., Inc. In addition to large fixed plants, several portable plants were operated in the county.

Delaware.—Sand and gravel pits and limestone quarries in the Muncie area yielded building and road materials, as well as fill material, fluxstone, and agricultural limestone. The output of both commodities was about the same as in 1964. The principal operators were Irving Bros. Stone & Gravel, J & K Stone Corp., Muncie Stone & Lime Co., and Park Sand & Gravel, Inc.

Dubois.—About 1,000 tons of coal was produced from the underground mine of Frick Bros. Coal Co. near Jasper. Hugo H. Bartelt mined fire clay near Huntingburg and sold the material for use in stoneware. Sylvester Stenftenagel produced miscellaneous clay near Huntingburg and sold the material for use in manufacturing building brick.

Elkhart.—Marl for agricultural use was dipped from pits near Elkhart and Middlebury. About 496,000 tons of sand and gravel was produced, mostly from pits in the Elkhart and Goshen areas. The material was used for building and road construction.

Floyd.—Limestone was quarried near Greenville by Standard Materials Corp. (Martin Marietta Corp.). The material was used for riprap and was crushed for concrete aggregate, roadstone, and agricultural use.

Fountain.—Coal was produced from a strip mine near Kingman. Clay, mined near Veedersburg, was used for brick, and clay mined from a pit near West Point was used in the manufacture of inorganic plastics. Building and road materials were produced from a sand and gravel pit near Attica. Portable plants were used to produce road gravel at several sites in the county.

Franklin.—Batesville Brick & Tile Corp. mined clay near Batesville and used the material for manufacturing heavy clay products. Standard Materials Corp. (Martin Marietta Corp.) produced sand and gravel near Metamora but did not operate the New Trenton plant in 1965. The county highway department produced gravel for its own use.

Fulton.—Three pits yielded marl for agricultural use. The Zartman marl pit was not operated in 1965. A total of 231,000 tons of sand and gravel was produced by five companies near Kewanna and Rochester and used for building, paving, and fill.

Gibson.—Coal was produced from the Enos stip mine and the Somerville No. 1 and Kings Station underground mines. Pits near Owensville and Patoka yielded sand and gravel for fill material and building and road use.

Extensive oilfields in the county, along with those in adjoining Posey County, accounted for about two-thirds of the State petroleum production.

Grant.—Moss peat, sold in bulk for soil improvement, was dug from a bog near Jonesboro. Pipe Creek Stone Co. (Irving Bros. Gravel Co., Inc.) operated a limestone quarry near Sweetser and produced flagstone as well as crushed limestone for road and agricultural use. Irving Bros. Gravel Co., Inc., operated a large sand and gravel plant near Marion and produced building and road materials and fill.

Greene.—Nearly 1.2 million tons of coal was produced from one underground and six strip mines. The strip mine of Comet Collieries, Inc., was acquired by Comet Coal & Clay Co., Inc., in May. The Airline strip mine of Peabody Coal Co. extended into Sullivan County. Building brick was manufactured from fire clay mined from two pits near Switz City and from shale mined near Bloomfield. Pits near Bloomfield yielded sand and gravel for building and road materials and fill.

Hamilton.—Stony Creek Stone Co., Inc., quarried and crushed limestone near Noblesville for road and agricultural use. East Side Peat Moss Co. produced moss peat from a bog near Noblesville and sold it for soil improvement. The pit was closed in July.

About 697,000 tons of sand and gravel was produced near Carmel, Fortville, Noblesville, and Sheridan and used for building, road construction, and fill.

Harrison.—Limestone for highway and agricultural use was quarried near Corydon and Depauw. Indiana Glass Sand Corp. mined silica sand from a pit near Elizabeth. Sand and gravel for building, road use, and fill was produced near Mauckport by Lucas Corp.

Howard. — Roadstone and agricultural limestone were quarried near Kokomo by Yeoman Stone Co. Road gravel and fill material were obtained from pits operated near Alto and Kokomo by Klye Pickering Gravel Co. and Fred Goodier Gravel Co., respectively.

Huntington. — Draintile was manufactured from miscellaneous clay mined at Majenica by Majenica Tile Co., Inc.

Limestone for road use was produced at Markle by Heller Stone Co., Inc., and at Huntington, Erie Stone, Inc., (Irving Bros. Gravel Co., Inc.) produced riprap and crushed limestone for flux, concrete aggregate, roadstone, railroad ballast, agricultural limestone, and stone sand. About 138,000 tons of sand and gravel for building, road use, and fill was produced near Andrews and Huntington.

Jackson.—Clay from pits near Browntown and Medora was used in the manufacture of building brick and other heavy clay products. Lehigh Portland Cement Co. mined shale from the Brownstown pit for use in manufacturing portland and masonry cements. Sand and gravel pits in the Brownstown and Seymour areas supplied materials for building, road construction, and fill.

Jasper.—Limestone for concrete aggregate, roadstone, and agricultural use was quarried near Pleasant Ridge and Rensselaer.

The Rensselaer Sand & Gravel Co. produced building and road construction materials from a fixed plant at Rensselaer.

Jay.—Rockledge Products, Inc., quarried limestone near Portland for use as riprap, road material, and agricultural use. Road gravel was produced by S. & L. Gravel Co., Inc.

Jefferson. — Standard Materials Corp. (Martin Marietta Corp.) operated the Hanover quarry and produced riprap, road material, and limestone for agricultural use.

Jennings.—Berry Materials Corp. quarried limestone at North Vernon for riprap, road material, and agricultural use.

Knox.—Coal was produced from the White Ash underground mine. About 615,000 tons of sand and gravel was obtained from pits in the Vincennes area and near Patoka. It was used for building, road material, and fill.

Kosciusko.—Marl and peat, both used for soil improvement, were dug from pits at several sites in the county. About 638,000 tons of sand and gravel was produced from pits near Etna Green, Leesburg, Syracuse, and Warsaw. It was used as building, paving material, and fill.

Lagrange. — Marl, for agricultural use, was produced at four sites. About 345,000 tons of sand and gravel was produced. Road gravel was obtained from pits near Lagrange, and building and road materials

were mined from sand and gravel deposits near Brighton and Wolcottville.

Lake. — At Buffington, portland and masonry cements were manufactured by Universal Atlas Cement Division of United States Steel Corp. Limestone, transported by water from Michigan quarries, and slag from Lake County blast furnaces were the principal raw materials used. National Brick Co. mined clay from a pit near Munster for its own use. Sand and gravel for building, paving use, and fill was produced from pits near Lowell. Pits near Dune Park, which had yielded industrial sand, were no longer operated.

Crude perlite, mined in Western States, was expanded by Federal Cement Products, Inc., at Hammond and United States Gypsum Co. at East Chicago. Roofing granules were manufactured from blast furnace slag at Hammond by H. B. Reed & Co., Inc. Byproduct sulfur was recovered from crude petroleum at the Whiting refinery of American Oil Co. Pig iron and steel were manufactured at Gary by United States Steel Corp. and at East Chicago by Inland Steel Co. and by Youngstown Sheet & Tube Co.

La Porte.—Marl and humus peat, both used for soil improvement, were dug from deposits near La Porte and Walkerton. Manley Sand Division (Martin Marietta Corp.) utilized dune sands near Lake Michigan to produce glass, molding, and engine sands. Sand and gravel deposits near Hanna and La Porte yielded building and paving materials. The Fish Lake oilfield, the first in the county, opened in September.

Lawrence. — Dimension limestone was produced in the Bedford area by companies that operated both quarries and stone mills. Building stone was also fabricated by independent mills from stone purchased from local quarries. Bedford Ground Limestone Co. purchased material, mostly spalls from the stone mills, which they processed and sold for use in mineral food, glass manufacture, and for agricultural purposes. Crushed and broken limestone used as riprap, railroad ballast, concrete aggregate, roadstone, agricultural limestone, and cement was produced by Bloomington Crushed Stone Co., Inc., Mitchell Crushed Stone Co., Inc., (Ralph Rogers & Co., Inc.), Oolitic Ground Limestone Co., and by Lehigh Portland Cement Co., who also manufactured portland and masonry cements at Mitchell.

Sandstone was quarried and milled by Indiana Sandstone Co., Inc., Spice Valley Sandstone Co., Inc., and Springs Valley Sandstone Co. It was used for flagging and building stone.

Madison. — Standard Materials Corp. (Martin Marietta Corp.) operated the Lapel limestone quarry and produced riprap and crushed stone for road material and agricultural use. About 715,000 tons of sand and gravel was obtained from pits near Anderson and Frankton. It was used for fill, road material, and building purposes.

Marion.—The county ranked first in output of sand and gravel. Plants were operated chiefly in the Indianapolis area. Leading producers included American Aggregates Corp., Rieth-Riley Construction Co., Inc., Shannon Gravel Co., and Standard Materials Corp. (Martin Marietta Corp.). Fisher Oil & Gravel Co., Inc., and Spickelmier Industries, Inc., indicated they were phasing out their sand and gravel operations in 1965. Peat Moss, Inc., produced humus and reed-sedge peat and sold it in packaged and bulk form for soil improvement.

Marshall.—Deposits near Argos and Bremen yielded marl and peat which were sold for soil improvement. From pits in the same areas, as well as near Culver and Plymouth, sand and gravel was produced and used for building, road construction, and fill.

Martin.—Crude gypsum was mined, processed, and fabricated into building materials (wallboard, lath, plaster) near Shoals by National Gypsum Co. and United States Gypsum Co. In 1965, a second gypsum board line was added to the United States Gypsum Co.'s board plant. At both plants crude perlite, mined in Western States, was expanded for use in building plaster and loose fill insulation. Brick and draintile were manufactured from clay mined near Loogootee by Loogootee Clay Products Corp. General Refractories Co. shipped a quartz conglomerate from a site near Shoals for use in manufacturing refractories. Springs Valley Sandstone Co. operated the Sellers quarry and produced building stone.

Monroe. — Dimension limestone was produced in the Bloomington area by com-

panies operating both quarries and mills, as well as by independent mills that fabricated purchased stone. A 7-week strike at the stone mills during July and August hampered output. Leading producers included Bloomington Limestone Corp., Empire Stone Co., B. G. Hoadley Quarries, Inc., Independent Limestone Co., Indiana Limestone Co., Inc., Midwest Quarries Co., Inc., Texas Quarries, Inc., and Woolery Stone Co., Inc. Bloomington Crushed Stone Co., Inc., operated a quarry and crushing plant, west of Bloomington, and produced concrete aggregate, roadstone, and agricultural limestone. Indiana Calcium Corp. operated a fine-grinding plant at Bloomington using spalls purchased from local stone mills and produced paint and rubber filler and material for use in manufacturer's pottery. Hinkle Sandstone Co. quarried and milled sandstone near Bloomington for building use.

Montgomery.—Building brick and vitrified sewer pipe were manufactured from miscellaneous clay and shale mined near Crawfordsville. In the same area gravel deposits were mined for building and road materials, and fill.

Morgan.—Limestone for concrete aggregate, roadstone, and agricultural use was quarried and crushed near Gosport. Sandstone was quarried by High Bluff Quarry and used principally for retaining walls. Clay and shale used in the production of brick, draintile, and lightweight aggregate was produced in the Brooklyn-Martinsville areas. Also near Martinsville, about 301,000 tons of sand and gravel was mined for use as building and road materials.

Newton. — Newton County Stone Co., Inc., at Kentland, quarried and crushed limestone for agricultural use, road materials, and railroad ballast. At Morocco, the Morocco Sand & Gravel Co. produced sand and gravel for building and paving use.

Noble.—Marl was obtained from a pit near Topeka and sold for soil improvement. About 274,000 tons of sand and gravel was mined from several pits and used chiefly for building and road construction and fill.

Orange.—Sandstone quarried near Orleans was fabricated locally and sold as whetstones by the Hindostan Whetstone Co. Limestone quarried near Paoli and Orleans was used for riprap, concrete aggregate, road materials, and for agricultural purposes.

Owen.—Burcham Bros., Inc., produced coal from a strip mine near Coal City. Fire clay was produced from the Old Glory mine and sold to manufacturers of art pottery, floor and wall tile, mortar, and building brick. Limestone was quarried and crushed near Spencer for road materials and for agricultural use. A small quantity of limestone from the Ramona quarry was sold as building stone. Sand and gravel was produced near Gosport and Spencer for building and road construction.

Parke.—Coal and fire clay were produced from the S. L. Turner Coal & Clay Co., Inc., strip mine near Carbon. The clay was sold to building brick manufacturers. American Vitrified Products Co. produced miscellaneous clay for their own use. The Cayuga Brick & Tile Co. did not mine clay in 1965 because of fire damage to their plant. The company expected to resume production as soon as the plant is rebuilt. About 237,000 tons of sand and gravel was produced at several sites for fill and railroad ballast, as well as for building and road construction.

Perry.—Mulzer Bros. operated the Derby limestone quarry and produced material for concrete aggregate, road construction, and agricultural use. Coal was produced from the Foster strip mine near St. Meinrad. The Ohio Valley Co. did not operate its sand pit in 1965.

Pike.—A total of 1.8 million tons of coal was produced from four strip mines and three underground mines. The Cup Creek strip mine of Cornell Excavating, Inc., was abandoned and did not produce during the year. The county highway department quarried sandstone for its own use.

Porter.—Fire clay was mined by Charles Lorenz & Son from two pits near Portage and was sold for use in manufacturing pottery and refractories. In the same area, reed-sedge peat was produced by Good Earth Co. and sold for soil improvement. Crisman Sand Co., Inc., produced industrial (furnace) sand near Portage.

Pulaski.—Draintile was manufactured at Francesville from clay mined locally. Railroad ballast, concrete aggregate, roadstone, and agricultural limestone were produced at the Francesville quarry by the Francesville Stone Division of Western Indiana

Aggregates Corp. A small quantity of sand and gravel was mined at Star City.

Putnam.—Portland and masonry cements were produced at Limedale by Lone Star Cement Corp. Nearly 2.5 million tons of limestone was produced from six quarries located throughout the county. The material was crushed and used in manufacturing cement, and as flux, roadstone, agstone, filler, mineral food, and for other purposes. Building brick was made from clay mined at the Indiana State Farm at Greencastle. Sand and gravel was produced at Reelsville and sold for building and paving purposes and fill.

Randolph.—Limestone was quarried near Albany and Ridgeville by Portland Stone Corp. and H. & R. Stone Co., respectively. Output was used for riprap, concrete aggregate, roadstone, and agricultural limestone. Sand and gravel for road use and fill was produced by Hutchens Gravel Co., operating a fixed plant near Lynn. S. & L. Gravel Co., Inc., produced road gravel with a portable plant.

Ripley.—About 217,000 tons of limestone was produced from quarries near Napoleon, Osgood, and Versailles. The material was used for riprap, roadstone, and agricultural limestone.

Rush.—At Milroy, limestone veneer and flagging were produced by Indiana Rubble Veneer Co. In the same area, McCorkle Stone Co. and Rush County Stone Co. produced riprap, roadstone, and agricultural limestone. Three companies operated portable plants near Carthage, Mays, and Rushville and produced gravel for building use, paving, and fill.

St. Joseph.—Marl was dipped from pits near North Liberty and South Bend and used for soil improvement. About 720,000 tons of sand and gravel was produced near Mishawaka and South Bend and used for building, paving, and fill.

Scott.—Airlite Processing Corp., Vienna, expanded perlite, mined in Western States, for use in building plaster, loose fill insulation, concrete aggregate, and other purposes. Limestone was quarried by Scott County Stone Co., Inc. near Scottsburg and crushed for road and agricultural use.

Shelby. — Limestone was quarried near Flat Rock, St. Paul, and Waldron. Rubble, riprap, fluxstone, railroad ballast, roadstone, and agricultural limestone were produced. About 322,000 tons of sand and gravel was produced from pits near Fairland, Morristown, and Shelbyville. Output was used for building, road material, and fill.

Spencer.—A total of 59,000 tons of coal was produced from four strip mines. Sandstone for building use was produced by Benedictine monks of St. Meinrad's Arch Abbey. The Hardy Sand Co. produced molding sand at Richland.

Steuben.—Taylor & Son operated four marl pits and sold the output for agricultural use. About 459,000 tons of sand and gravel was produced, mostly in the Angola-Freemont area, and used for building and road construction and fill.

Sullivan.—The county ranked second in the State in coal production, with an output of nearly 3.6 million tons. Four strip mines supplied 61 percent of the total; five underground mines, the remainder. Kixmiller Bros., Inc., quarried and crushed limestone at Freelandville for roadstone and agricultural use. Sand and gravel production was reported from the Carlisle, Graysville, and Sullivan areas. The material was used mostly for building, paving, railroad ballast, and fill.

Switzerland. — Limestone was quarried and crushed near Cross Plains by Tri-County Stone Co. It was used as asphalt filler, for road material, and agricultural limestone. Road gravel was produced by the county highway department.

Vanderburgh.—Standard Brick & Tile Corp. mined shale near Evansville for its own use. The West Franklin limestone quarry of Mulzer Bros. was idle during the year.

Vermillion. — Coal was produced by Black Diamond Mining Corp. and Big Oak Coal Co., operating underground mines near Blanford. Arketex Ceramic Corp. mined fire clay from the Dana pit for use in making structural tile and other heavy clay products. Colonial Brick Corp. mined shale near Cayuga for its own use. The company purchased the pit and plant formerly operated by Cayuga Brick Corp. Sand and gravel was produced at fixed plants near Cayuga and Clinton and used for building, paving, railroad ballast, and fill.

Vigo.—Coal was produced from a strip mine operated by Peabody Coal Co. near Riley and from an underground mine operated by Mount Pleasant Mining Corp. near Terre Haute. Building brick was manufactured from clay mined by Terre Haute Vitrified Brick Works, Inc., near

West Terre Haute. About 1.1 million tons of sand and gravel was produced, mostly in the Terre Haute area, and used as building and road materials, railroad ballast, and fill.

Wabash.—Riprap, roadstone, and agricultural limestone were produced by Mill Creek Stone & Gravel Corp. at its quarry and plant near Wabash. About 242,000 tons of sand and gravel, mostly for road use and fill, was produced at several sites throughout the county.

Warren.—Moss peat was produced near Otterbein by Millburn Peat Co., Inc. It was sold both in bulk and packaged form for soil improvement. Sand and gravel was produced at a fixed plant near Covington and by the county highway department. Output was used for building, road construction, and railroad ballast.

Warrick.—Nearly 6.5 million tons of coal was mined in the county, the largest county output in the State. Coal was produced at 10 strip mines and 4 underground mines. The large Squaw Creek mine began production in July. It will furnish coal for the Warrick Works of Aluminum Company of America and is operated by Peabody Coal Co. The Ditney Hill underground mine of Ingle Coal Corp. was abandoned in May, and the Tecumseh strip mine of Tecumseh Coal Corp. was closed in June. Peabody Coal Co. quarried and crushed limestone north of Booneville for its own use.

Washington.—Crushed limestone for road and agricultural use was produced by Hoosier Lime & Stone Co., Inc., at Salem.

Wayne.—De Bolt Concrete Co., Inc. produced riprap, roadstone, and agricultural limestone from a quarry near Richmond. About 285,000 tons of sand and gravel for building and road use and fill was mined from several deposits in the county, with most of the output coming from the Richmond area.

Wells.—Moss peat, for soil improvement, was produced from a bog near Warren. Erie Stone, Inc. (Irving Bros. Gravel Co., Inc.) produced fluxstone, roadstone, and agricultural limestone from its Bluffton quarry. Road gravel was produced with a portable plant by S. & L. Gravel Co., Inc.

White.—Monon Crushed Stone Co., Inc. quarried and crushed limestone near Monon for road and agricultural use, and railroad ballast.

The Mineral Industry of Iowa

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the Geological Survey of Iowa for collecting information on all minerals except fuels.

By James H. Aase [1]

Iowa mineral production was valued at $112.8 million in 1965, a record high for the State. Slight decreases recorded in value of production for peat, portland cement, and gypsum were more than offset by increases for sand and gravel, stone, coal, and clays. Nonmetals were the major commodity group, supplying nearly 97 percent of the State total value. The remaining 3 percent was supplied by mineral fuels.

Exploration activities for metallic minerals were conducted in Lyon and Sioux Counties. No metallic mineral production was reported in the State during the year.

Exploration for oil and gas was conducted in seven counties although no production was reported.

[1] Minerals specialist, Bureau of Mines, Minneapolis, Minn.

Table 1.—Mineral production in Iowa [1]

Mineral	1964 Quantity	1964 Value (thousands)	1965 Quantity	1965 Value (thousands)
Cement:				
Portland—thousand 376-pound barrels	13,607	$46,398	13,643	$46,273
Masonry—thousand 280-pound barrels	585	1,847	608	1,867
Clays—thousand short tons	1,008	1,254	1,085	1,347
Coal (bituminous)—do	973	3,447	1,043	3,694
Gypsum—do	1,287	5,821	1,254	5,554
Sand and gravel—do	13,890	13,546	18,205	17,152
Stone—do	23,935	33,038	25,891	35,468
Value of items that cannot be disclosed: Other nonmetals and peat	XX	1,279	XX	1,428
Total	XX	106,630	XX	112,783

XX Not applicable.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Value of mineral production in constant 1957–59 dollars
(Thousands)

Year	Value	Year	Value
1956	$68,534	1961	95,424
1957	73,410	1962	97,688
1958	89,973	1963	r 100,035
1959	91,098	1964	r 109,147
1960	98,861	1965	p 115,575

p Preliminary. r Revised.

Table 3.—Employment and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1964:								
Coal and peat	337	193	65	549	1	29	54.64	17,011
Nonmetal	724	246	178	1,433	---	60	41.86	4,833
Sand and gravel	1,186	173	205	1,780	2	31	18.54	8,954
Stone	2,523	267	674	5,736	2	100	17.78	3,716
Total	4,770	235	1,122	9,498	5	220	23.69	5,635
1965: p								
Coal and peat	312	212	66	528	---	35	66.29	7,623
Nonmetal	1,095	287	316	2,538	---	33	13.00	1,339
Sand and gravel	1,330	198	264	2,286	---	50	21.87	1,619
Stone	2,530	281	712	6,056	1	81	13.54	1,524
Total	5,267	258	1,358	11,408	1	199	17.53	1,784

p Preliminary.

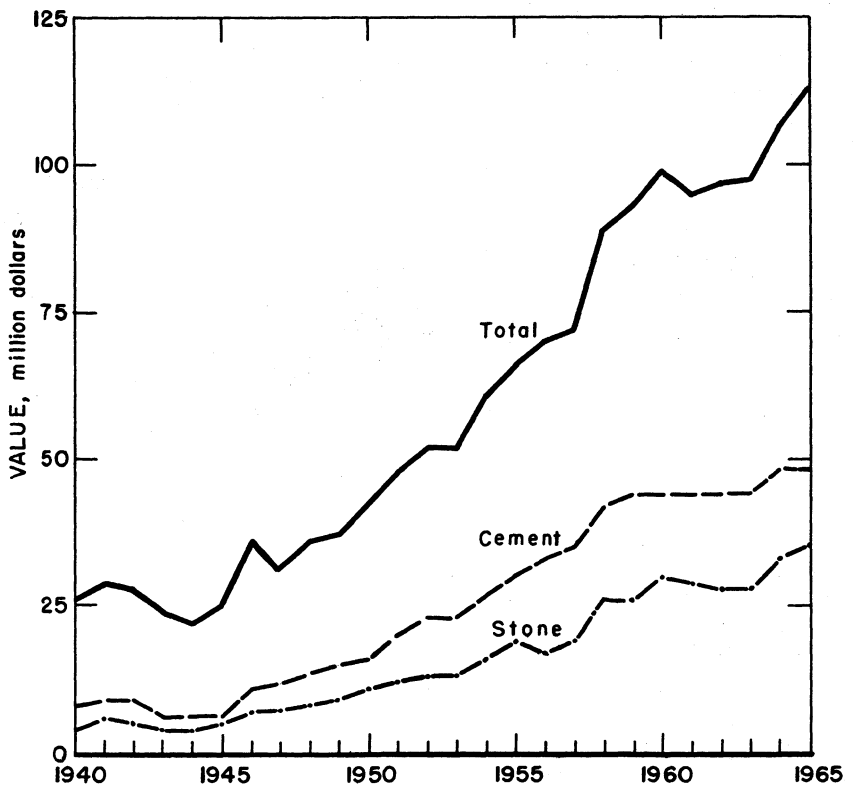

Figure 1.—Value of cement, stone, and total value of mineral production in Iowa.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Cement.—Shipments of portland cement increased slightly in quantity over that of 1964. However, total value of shipments decreased slightly because of a drop in average value per barrel to $3.39 from $3.41 in 1964. The five cement plants in the State operated a total of 28 kilns. The 13.6 million barrels of portland cement production represented approximately 90 percent of their combined capacity. The plants, operated by Lehigh Portland Cement Co. and Northwestern States Portland Cement Co. in Cerro Gordo County, Marquette Cement Manufacturing Co. and Penn-Dixie Cement Corp. in Polk County, and Dewey Portland Cement Co. in Scott County, all produced types I, II, and III cement.

Types I and II, (general-use and moderate-heat) cements, accounted for 95 percent of the total portland cement production, of which 12 percent was air-entrained and 88 percent non-air-entrained. Type III, (high-early-strength) cement, accounted for 5 percent of total portland cement production of which 57 percent was air-entrained and the remaining 43 percent non-air-entrained. Two of the plants used a dry process in manufacturing cement and three used a wet process. Total electrical energy consumed by the five plants was 327.5 million kilowatt hours; 35 percent was home generated and 65 percent was purchased. Of the portland cement shipments marketed, 83 percent were in Iowa and Minnesota. Other States, in order of shipments, were Illinois, Wisconsin, North Dakota, South Dakota, Nebraska, Indiana, and Missouri. Approximately 52 percent of the portland cement shipments were by truck and 48 percent by rail. Of the shipments, 91 percent were in bulk form and the remaining 9 percent were in packaged containers. Ready-mixed concrete companies received approximately 60 percent of the State portland cement production, followed by 17 percent to concrete product manufacturers, 14 percent to highway contractors, 7 percent to building material dealers, and the remainder to other users.

Masonry cement was produced at all of the State cement plants except Penn-Dixie Cement Corp. plant No. 8 in West Des Moines, Polk County. Shipments increased 4 percent in quantity and 1 percent in value over those of 1964. The average value per 280-pound barrel, f.o.b. mill, was $3.07, compared with $3.15 in 1964, a 3-percent decrease. The market area was similar to that of portland cement.

Clays.—Production of clay and shale increased 8 percent in quantity and 7 percent in total value compared with 1964 totals. Clay and shale pits were operated by 26 firms in 18 counties. Approximately 53 percent of the State production was used in cement manufacture, 40 percent for heavy clay products, and the remainder in lightweight aggregate, mortar mix, pozzolans, and floor and wall tile.

Fire clay production was reported by Ver Steeg Coal Co., Marion County.

Lightweight aggregate was produced by the Carter-Waters Corp. of Kansas City, Mo., from expandable shale mined from a pit near their plant at Centerville, Appanoose County. A new 8- by 125-foot gas-fired rotary kiln was added to the plant.

Sales of crude clay were reported by two companies. The other companies used their entire output in their own plants.

Gypsum.—Production of crude gypsum decreased 3 percent in quantity and 5 percent in value compared with 1964 figures. The average value per ton was $4.43, a 2-percent decrease from the 1964 value of $4.52.

In 1965, the State ranked third in the Nation for total crude gypsum production, below California and Michigan.

Gypsum deposits were mined at the United States Gypsum Co. underground mine in Des Moines County and at four open pit mines in Webster County operated by Bestwall Gypsum Division of Georgia-Pacific Corp.; The Celotex Corp.; National Gypsum Co.; and United States Gypsum Co.

A strike closed down The Celotex Corp. plant in Webster County for a 6-month period during the year.

A wide variety of gypsum products were made by all companies, including base coat plasters, premixed perlite plasters, gaging and molding plasters, prepared finishes, roof deck plasters, gypsum lath, wallboard, sheathing, tile, and other preformed items.

Lime.—Production and sales of quick-

lime and hydrated lime increased in quantity over that of 1964.

American Crystal Sugar Co. produced quicklime at Mason City, in Cerro Gordo County, for internal use in sugar refining. Purchased high-calcium limestone was burned in the company's shaft kiln with coke as fuel.

Linwood Stone Products Co., Inc., was the sole commercial producer of quicklime and hydrated lime in the State. At their plant near Buffalo in Scott County, three rotary kilns using coal and natural gas as fuel were used for burning the high-calcium limestone obtained locally from company-owned sources.

Sales of lime were made to markets principally in Iowa and Illinois, with lesser quantities sold in other surrounding States. The State lime production was used principally for water purification, steelmaking (basic oxygen converter and electric furnaces), sewage treatment, and sugar refining.

Perlite.—Crude perlite, mined outside the State, was expanded in plants operated by the gypsum producers in Webster County. The expanded perlite was used principally in manufacturing lightweight building plaster.

Sand and Gravel.—Sand and gravel production increased substantially in quantity and value from 1964. Production for paving use increased 33 percent and for building use, 17 percent. These two uses represented 89 percent of the total quantity produced in the State. Production was reported in 76 counties from 232 commercial operations and 101 Government-and-contractor operations. Overall average unit value for sand and gravel was $0.94 per ton, compared with $0.98 in 1964. Approximately 97 percent of the total shipments were by truck; the remainder were by rail and water.

Major quantity producers of sand and gravel in the State during the year, in alphabetical order, included—

Acme Fuel & Material Co.
Concrete Materials Division (Martin Marietta Corp.)
Everds Bros., Inc.
G. A. Finley, Inc.
Hallett Construction Co.
Keefner-White Materials Corp.
Maudlin Construction Co.
Peters Construction Co.
Van Dusseldorp Sand & Gravel, Inc.
Welp & McCarten, Inc.

Stone.—Quantity and value of stone production, consisting entirely of limestone, led all other commodities except cement.

Limestone was produced from 244 commercial operations and 5 government operations in 65 counties. Production increased 8 percent in quantity and 7 percent in total value, compared with that of 1964. Most of the increase was in stone used for concrete aggregate and roadstone.

Dimension limestone production increased 20 percent in value compared with that of the previous year. Quarries were operated in Dubuque and Jones Counties.

Approximately 76 percent of the State's total stone production was used in concrete aggregate and roadstone, 13 percent for cement manufacturing, 7 percent for agricultural purposes, and the remaining 4 percent for other uses.

Overall unit value of crushed and broken stone decreased to $1.36 per ton, compared with $1.37 per ton in 1964.

The five leading limestone-producing counties, listed in descending order of production quantities, were Madison, Cerro Gordo, Linn, Scott, and Black Hawk.

The five leading quantity producers reporting production of crushed and broken limestone during the year, listed alphabetically, were—

B. L. Anderson, Inc.
Concrete Materials Division (Martin Marietta Corp.)
Kaser Construction Co.
E. I. Sargent Quarries, Inc.
The River Products Co.

MINERAL FUELS

Coal (Bituminous).—Production of coal increased 7 percent in quantity and total value from the 1964 totals. Average value per ton was $3.54, unchanged from that of the previous year.

New mines opened during the year included one by the Silvers Coal Co. in Keokuk County and one by the New Lanning Coal Co., Inc., in Mahaska County. Mine closings reported in 1965 included one each by Acme Coal Co., Prothero Coal Co., Inc., and Miller Creek Coal Co. in Monroe County; and the Liter Coal Co., Inc., and Ver Steeg

Table 4.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1964		1965	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	2,094	$2,005	2,609	$2,559
Paving	2,394	2,308	2,470	2,446
Fill	743	412	1,064	632
Other [1]	187	551	262	635
Total	5,418	5,276	6,405	6,272
Gravel:				
Building	1,204	1,844	1,257	2,043
Paving	5,194	5,234	6,149	6,071
Fill	235	163	498	330
Other [2]	61	34	70	94
Total	6,694	7,275	7,974	8,538
Total sand and gravel	12,112	12,551	14,379	14,810
Government-and-contractor operations:				
Sand:				
Paving	116	66	474	248
Fill	25	18	22	8
Other	1	1	--	--
Total	142	85	496	256
Gravel:				
Building	18	10	15	8
Paving	1,593	894	3,315	2,078
Other	25	6	--	--
Total	1,636	910	3,330	2,086
Total sand and gravel	1,778	995	3,826	2,342
All operations:				
Sand	5,560	5,361	6,901	6,528
Gravel	8,330	8,185	11,304	10,624
Grand total	13,890	13,546	18,205	17,152

[1] Includes railroad ballast (1964), blast, molding, and other construction sands.
[2] Includes railroad ballast and other construction gravel.

Table 5.—Limestone sold or used by producers, by uses

Use	1964		1965	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Dimension:				
Rough construction---thousand short tons	---	---	8	$18
Rubble---do	3	$26	1	10
Sawed stone---thousand cubic feet	5	20	4	15
House stone veneer---do	12	36	14	37
Cut stone---do	48	84	72	119
Flagging---do	2	3	2	4
Total---approximate thousand short tons [1]	9	169	17	203
Crushed and broken:				
Riprap---thousand short tons	342	471	450	575
Concrete aggregate and roadstone---do	17,714	24,126	19,622	26,283
Agriculture---do	2,093	2,995	1,848	2,851
Railroad ballast---do	10	16	144	128
Cement---do	3,534	4,190	3,359	4,001
Other [2]---do	233	1,072	451	1,417
Total---do	23,926	[3] 32,869	25,874	[3] 35,266
Grand total---do	23,935	33,038	25,891	[3] 35,468

[1] Average weight of 170 pounds per cubic foot used to convert cubic feet to short tons.
[2] Includes limestone for dust for coal mines (1965), asphalt filler, fertilizer, flux, lime, mineral food, and other purposes.
[3] Data do not add to total shown because of rounding.

Coal Co. in Marion County.

Virtually all of the coal produced from the 9 underground and 19 strip mine operations was consumed within the State. About 73 percent of the production was used in electric power plants. Nearly 71 percent of the total State output was shipped to consumers by rail, and the remainder by truck.

Thickness of the coal seams mined in strip mines ranged from 32 to 72 inches, and overburden thickness ranged from 14 to 70 feet. In underground mining, the coal seams mined during the year ranged from 29 to 72 inches. No mechanical cleaning plants were operated in the State.

Peat.—Production of peat decreased about 10 percent in quantity and total value from that of the previous year. The Colby Pioneer Peat Co. and Eli Colby Co. mined peat from deposits in Worth and Winnebago Counties, respectively. Both firms operated processing plants in Hanlontown. Colby Pioneer Peat Co. produced moss, reed-sedge, and humus, and Eli Colby Co. produced moss peat only.

Petroleum, Natural Gas.—No production was reported in the State. Exploration drilling reported by the Iowa Geological Survey during the year consisted of eight oil and gas wells, seven of which were completed by yearend.

Table 6.—Coal (bituminous) production in 1965, by counties

(Excludes mines producing less than 1,000 short tons)

County	Number of mines operated		Production (short tons)			Value
	Underground	Strip	Underground	Strip	Total	
Appanoose	6	1	23,335	1,508	24,843	$153,560
Keokuk	--	2	--	6,707	6,707	15,342
Lucas	1	--	60,158	--	60,158	248,645
Mahaska	--	6	--	364,988	364,988	1,242,896
Marion	1	7	6,421	436,076	442,497	1,527,820
Monroe	1	--	106,570	--	106,570	356,000
Van Buren	--	1	--	15,240	15,240	71,245
Wapello	--	2	--	22,239	22,239	78,956
Total	9	19	196,484	846,758	1,043,242	3,694,464

Table 7.—Oil and gas exploratory wells drilled in Iowa

County	Year first well completed	Wells completed			County	Year first well completed	Wells completed		
		Through 1963	1964	1965			Through 1963	1964	1965
Adair	1947	3	--	--	Louisa	1903	1	--	--
Bremer	1903	1	--	--	Lyon	1953	1	--	--
Butler	1965	--	--	1	Mahaska	1965	--	--	1
Dallas	1923	5	--	--	Marshall	1900	1	--	--
Davis	1964	--	1	--	Mills	1943	6	--	--
Decatur	1952	1	--	--	Montgomery	1941	3	--	--
Des Moines	1963	1	--	--	Muscatine	1929	1	--	--
Fremont	1940	5	--	2	Page	1934	1	--	--
Greene	1935	1	--	--	Polk	1961	1	--	--
Grundy	1965	--	--	1	Ringgold	1944	1	--	--
Guthrie	1929	2	--	--	Sac	1928	1	1	--
Hancock	1960	1	--	--	Scott	1960	2	--	--
Harrison	1922	2	--	--	Tama	1965	--	--	1
Henry	1963	2	2	--	Taylor	1940	4	--	--
Howard	1959	4	--	--	Union	1939	1	--	--
Jackson	1907	1	--	--	Van Buren	1923	1	3	--
Jefferson	1910	2	--	--	Washington	1963	7	--	1
Keokuk	1963	2	1	--	Wayne	1926	1	--	--
Lee	1949	2	1	--	Winneshiek	1926	1	--	--

Source: Iowa Geological Survey.

REVIEW BY COUNTIES

Adair.—Schildberg Construction Co., Inc., produced limestone from three quarries near Greenfield. Production was used principally for road construction, agricultural purposes, and riprap.

Appanoose.—Crushed limestone was produced by Beryl Farnsworth, Jackson Quarries, Inc., L. & W. Construction Co., Inc., and Porter & Magnall Construction Co. from quarries located near Cincinnati and Centerville. Output was principally for roadstone and agricultural purposes.

Shale, mined by Carter-Waters Corp. from a pit adjacent to its plant near Centerville, was expanded to produce lightweight aggregate. The plant's production capacity was increased during the year with the addition of a new 8- by 125-foot gas-fired rotary kiln. The Adel Clay Products Co. mined clay near Centerville for use in manufacturing building brick and other heavy clay products.

Bituminous coal was produced at one strip and six underground mines, all in the vicinity of Centerville except for one mine near Numa. Underground mines were operated by Appanoose Coal Co., Clarke Coal Co., D. C. Coal Co., New Block Coal Co., New Gladstone Coal Co., and Number 4 Coal Co. The L. & M. Coal Co. operated the only active strip mine in the county.

The Ewing Gravel Pit was inactive throughout 1965.

Black Hawk.—Crushed limestone produced by Concrete Materials Division (Martin Marietta Corp.) from quarries near La Porte City, Janesville, and Waterloo, and by the DeWees Potthoff Stone Co. from a quarry near Raymond was used for concrete, roadstone, and agricultural purposes.

Sand and gravel was produced by six companies and the Waterloo Street Department from stationary plants near Cedar Falls, Dunkerton, La Porte City, and Waterloo. The material was used in building construction, paving, and fill. Paving sand was produced under contract for the Benton and Black Hawk County Highway Departments.

Boone.—Clay for use as a pozzolanic material in making mortar and masonry cement mix was produced from a pit near Boone by Grarok, Inc.

The Fort Dodge, Des Moines & Southern Railroad, Hallet Construction Co., and Maudlin Construction Co. produced sand and gravel from pits near Boone and Madrid. The material was used for railroad ballast, building and road construction, and fill.

Cass.—Schildberg Construction Co., Inc., produced limestone for concrete aggregate, roadstone, agricultural purposes, and riprap from portable plants located at quarries near Atlantic.

Cerro Gordo.—The county ranked first in total mineral production value, furnishing 25 percent of the State total.

Lehigh Portland Cement Co., and Northwestern States Portland Cement Co. produced portland and masonry cement at their plants near Mason City. Limestone and clay were locally produced by both companies for use in their cement manufacturing.

Mason City Brick & Tile Co. produced and used clay and shale for building brick and other heavy clay products.

Ideal Sand & Gravel Co., Lillibridge Quarries, and Welp & McCarten, Inc., produced limestone from quarries near Mason City, Rockwell, and Portland. Output was for road construction, agricultural use, and miscellaneous filler.

Three companies operating stationary and portable plants near Clear Lake, Mason City, and Portland produced sand and gravel for use in building construction, paving, and fill. The county highway department contracted for paving gravel.

Lime was produced for internal use by American Crystal Sugar Co. at its sugar plant in Mason City.

Clayton.—Approximately 137,000 tons of limestone was produced commercially by four companies and used for concrete, roadstone, and agricultural purposes.

Concrete Materials Division (Martin Marietta Corp.) mined and processed sandstone from a deposit near Clayton for use as a molding sand. Sand produced by H. Leslie Leas and Roverud Construction Co. was used for paving and other uses.

Clinton.—Crushed limestone, produced

Table 8.—Value of mineral production in Iowa, by counties [1]

County	1964	1965	Minerals produced in 1965 in order of value
Adair	W	W	Stone.
Adams	W	W	Do.
Allamakee	$257,244	W	Stone, sand and gravel.
Appanoose	968,881	$868,288	Stone, coal, clays.
Audubon	W	336,000	Sand and gravel.
Benton	W	W	Sand and gravel, stone, clays.
Black Hawk	1,198,898	1,410,082	Stone, sand and gravel.
Boone	W	W	Sand and gravel, clays.
Bremer	W	W	Stone, sand and gravel.
Buchanan	270,650	304,044	Do.
Buena Vista	144,000	211,000	Sand and gravel.
Butler	299,061	381,968	Stone, sand and gravel.
Calhoun	W	47,000	Sand and gravel.
Carroll	143,000	130,000	Do.
Cass	W	W	Stone.
Cedar	W	W	Do.
Cerro Gordo	26,680,822	28,293,014	Cement, stone, clays, sand and gravel, lime.
Cherokee	336,000	336,000	Sand and gravel.
Chickasaw	W	W	Stone, sand and gravel.
Clarke	W	W	Stone.
Clay	121,000	208,000	Sand and gravel.
Clayton	638,054	693,227	Sand and gravel, stone.
Clinton	W	582,102	Stone, sand and gravel.
Crawford	160,000	W	Sand and gravel.
Dallas	563,423	547,236	Sand and gravel, clays, stone.
Decatur	506,792	739,316	Stone.
Delaware	286,583	324,281	Stone, sand and gravel.
Des Moines	1,626,268	1,909,600	Gypsum, stone, sand and gravel.
Dickinson	W	168,000	Sand and gravel.
Dubuque	604,697	626,513	Stone, sand and gravel.
Emmet	160,000	310,000	Sand and gravel.
Fayette	532,692	726,642	Stone, sand and gravel.
Floyd	252,706	267,503	Stone, clays, sand and gravel.
Franklin	178,252	310,881	Sand and gravel, stone, clays.
Fremont	39,000	W	Stone.
Greene	W	292,000	Sand and gravel.
Grundy	53,140	W	Stone, sand and gravel.
Guthrie	W	W	Sand and gravel.
Hamilton	178,292	113,783	Sand and gravel, stone.
Hancock	291,463	406,755	Stone, sand and gravel.
Hardin	1,172,927	1,428,811	Do.
Harrison	W	W	Do.
Henry	260,000	W	Sand and gravel, stone.
Howard	152,999	W	Stone, sand and gravel.
Humboldt	W	994,442	Do.
Ida	W	10,000	Sand and gravel.
Iowa	W	W	Do.
Jackson	254,462	310,189	Stone, sand and gravel.
Jasper	W	512,732	Sand and gravel, stone.
Jefferson	W	W	Stone, sand and gravel.
Johnson	W	1,287,590	Do.
Jones	378,465	439,186	Do.
Keokuk	W	W	Stone, coal, clays.
Kossuth	204,000	271,000	Sand and gravel.
Lee	W	383,199	Stone.
Linn	2,105,621	2,714,831	Stone, sand and gravel.
Louisa	W	W	Stone.
Lucas	204,000	248,645	Coal.
Lyon	W	W	Sand and gravel.
Madison	3,043,435	3,159,307	Stone, clays.
Mahaska	1,478,472	1,537,083	Coal, sand and gravel, stone, clays.
Marion	2,203,613	2,543,155	Coal, stone, sand and gravel, clays.
Marshall	W	W	Stone, sand and gravel.
Mills	W	W	Stone.
Mitchell	427,038	489,855	Stone, sand and gravel.
Monona	W	W	Sand and gravel.
Monroe	303,412	356,000	Coal.
Montgomery	W	W	Stone.
Muscatine	817,141	1,010,000	Stone, sand and gravel.
O'Brien	114,000	171,000	Sand and gravel.
Osceola	W	212,000	Do.
Page	W	W	Stone, sand and gravel.
Palo Alto	80,000	87,000	Sand and gravel.
Plymouth	369,000	270,000	Do.
Pocahontas	W	W	Stone, sand and gravel.
Polk	15,479,771	15,572,331	Cement, sand and gravel, clays.
Pottawattamie	W	W	Stone, sand and gravel.
Poweshiek	W	W	Stone.
Sac	293,000	511,000	Sand and gravel.

See footnotes at end of table.

Table 8.—Value of mineral production in Iowa, by counties [1]—(Continued)

County	1964	1965	Minerals produced in 1965 in order of value
Scott	$14,196,628	$13,393,895	Cement, stone, lime, clays, sand and gravel.
Shelby	W	461,000	Sand and gravel.
Sioux	581,000	540,000	Do.
Story	1,172,270	W	Sand and gravel, stone, clays.
Tama	W	198,639	Stone, sand and gravel.
Taylor	W	W	Stone.
Union	W	W	Do.
Van Buren	862,387	705,776	Stone, sand and gravel, coal.
Wapello	456,640	632,487	Stone, sand and gravel, coal, clays.
Warren	W	W	Sand and gravel, clays.
Washington	W	W	Stone.
Webster	5,271,573	5,154,968	Gypsum, stone, clays, sand and gravel.
Winnebago	W	W	Peat, sand and gravel.
Winneshiek	232,715	313,987	Stone, sand and gravel.
Woodbury	177,000	257,000	Sand and gravel, clays.
Worth	W	322,752	Stone, sand and gravel, peat.
Wright	69,000	185,000	Sand and gravel.
Undistributed [2]	17,778,513	15,554,905	
Total	106,630,000	112,783,000	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] Davis, Ringgold, and Wayne Counties are not listed because no production was reported.

[2] Includes some sand and gravel and stone that cannot be assigned to specific counties and values indicated by symbol W.

at 11 quarries operated by Lowe & Eschman Construction Co., at various locations throughout the county, and at a quarry operated by Techau Limestone Co. near Grand Mound, was used for concrete, roadstone, and agricultural purposes.

Sand and gravel, produced by five companies operating stationary and portable plants near Clinton, Camanche, DeWitt, and Wheatland, was used principally for building construction, paving, and fill.

Dallas.—Gendler Stone Products Co. produced crushed limestone at a portable plant near Dexter for roadstone and agricultural purposes.

Adel Clay Products Co., Redfield Brick & Tile Co., and United Brick & Tile Co. of Iowa manufactured building brick from clay and shale of their own production.

Sand and gravel was produced commercially by six companies, operating stationary and portable plants near Adel, Booneville, Perry, Redfield, and West Des Moines. The material was used principally for building construction, paving, and fill.

Decatur.—Grand River Quarries, Inc., Jackson Quarries, Inc., and E. I. Sargent Quarries, Inc., produced limestone from quarries near Davis City, Decatur, Grand River, and Weldon. Output was for concrete, roadstone, agricultural purposes, and riprap.

Des Moines.—Kaser Construction Co. and Raid Quarries, Inc., produced limestone for road construction, agricultural purposes, and riprap. Portable plants were operated near Burlington, Danville, and Mediapolis. Kaser Construction Co. acquired the quarry formerly operated near Mediapolis by J. T. Leonhard Construction Co.

United States Gypsum Co. produced gypsum from an underground mine adjacent to its plant at Sperry.

Spring Sand & Gravel Co. produced sand and gravel at a stationary plant near Burlington for use in building construction, paving, and fill. The city of Fort Madison contracted for 1,000 tons of paving gravel.

Dubuque.—Becker Stone Co. produced limestone for architectural purposes, rough construction, and riprap from a stationary plant near Dubuque. Dubuque Stone Products Co. and L. A. Light, Inc., produced crushed limestone at stationary plants near Dubuque. Output was for road construction, railroad ballast, agricultural purposes, and riprap. The county highway department produced 34,000 tons of limestone for roadstone.

Molo Sand & Gravel Co. produced sand and gravel near Dubuque for building construction, paving, fill, and other uses. The city of Dubuque contracted for 4,000 tons of paving sand.

Fayette.—Fayette Stone Co., Inc., Paul

Niemann Construction Co., and Riverside Products Co. produced crushed limestone for concrete, roadstone, and agricultural purposes. Plants operated were near Clermont, Fairbank, Fayette, Lamont, St. Lucas, Wadena, Waucoma, and West Union. The county highway department produced 173,000 tons of limestone for roadstone.

Sand and gravel was produced commercially by six companies operating stationary and portable plants near Alpha, Clermont, Fayette, Randalia, and West Union.

Hardin.—Limestone was produced by Iowa Limestone Co. and Weaver Construction Co. which operated stationary and portable plants near Alden. Production was for concrete, roadstone, agricultural purposes, and as filler in asphalt, fertilizer, mineral food, and other materials.

Sand and gravel was produced commercially by six companies operating stationary and portable plants near Alden, Eldora, Garden City, Gifford, Hubbard, Iowa Falls, and New Providence. Production was principally for building construction, paving, and fill.

Harrison.—Clark Construction Co. and W. A. Schemmer Limestone Quarry, Inc., produced limestone at stationary plants near Logan. The stone was used for concrete, roadstone, agricultural purposes, riprap, and other uses.

Sand and gravel was produced by Maudlin Construction Co. and Schemmer Concrete Materials at plants near Logan and Woodbine for paving, fill, and other uses.

Humboldt.—Hallett Construction Co., P & M Stone Co., and Welp & McCarten, Inc., produced limestone at portable and stationary plants near Bradgate, Dakota City, Gilmore City, and Humboldt. Production was for concrete, roadstone, railroad ballast, agricultural purposes, riprap, and other uses.

Sand and gravel was produced by Humboldt Concrete Products Division (Zeidlers, Inc.), and Welp & McCarten, Inc., at stationary and portable plants near Humboldt. The material was used for building construction, paving, and other uses. The Humboldt County Highway Department contracted for 104,000 tons of paving gravel. The Pocahontas County Highway Department contracted for 14,000 tons of paving sand.

Jasper.—Limestone produced by Kaser Construction Co. at a portable plant near Sully was used for road construction and agricultural purposes.

Hallett Construction Co. and Van Dusseldorp Sand & Gravel, Inc., produced sand and gravel from sources near Mingo and Colfax, respectively. Production was for building construction, paving, fill, and other uses. The county highway department contracted for 99,000 tons of paving sand and gravel.

Johnson.—Concrete Materials Division (Martin Marietta Corp.) and The River Products Co. produced crushed limestone at portable and stationary plants near Coralville, Fairfax, and Iowa City. The stone was used for concrete, roadstone, railroad ballast, and agricultural purposes.

Sand and gravel produced near Iowa City by The River Products Co. and Stevens Sand & Gravel Co., Inc., was used for building construction, paving, and fill.

Keokuk.—Kaser Construction Co. produced limestone from quarries near Harper, Keswick, and Ollie for concrete, roadstone, and agricultural purposes.

Clay was produced near What Cheer by Oskaloosa Clay Products Co. and Silver Leaf Pipe Plant for manufacturing building brick and vitrified sewer pipe. Nelson Clay Products Co. reported no production in 1965.

Strip coal mines were operated by Lundy & Sons Coal Co. near What Cheer and Silvers Coal Co., near Oskaloosa.

Linn.—B. L. Anderson, Inc., Concrete Materials Division (Martin Marietta Corp.), Lee Crawford Quarry Co., DeWees Potthoff Stone Co., and G. W. Gaines & Son produced limestone from portable and stationary plants operated near Cedar Rapids, Center Point, Central City, Coggon, Lisbon, Paralta, and Springville. Output was for concrete, roadstone, riprap, and agricultural purposes.

Sand and gravel was produced by B. L. Anderson, Inc., Concrete Materials Division (Martin Marietta Corp.), DeWees Potthoff Stone Co., King's Concrete Co., and Frank J. Meyer Sand & Gravel Co. at portable and stationary plants near Cedar Rapids, Marion, and Mt. Vernon. Production was for building construction, paving,

and fill.

Lucas.—Approximately 60,000 tons of bituminous coal was produced by the Big Ben Coal Co. from an underground mine near Chariton.

Madison.—Concrete Materials Division (Martin Marietta Corp.), Gendler Stone Products Co., Marquette Cement Manufacturing Co., Penn-Dixie Cement Corp., E. I. Sargent Quarries, Inc., and Schildberg Construction Co., Inc., produced crushed limestone from portable and stationary plants near Earlham, Greenfield, Peru, and Winterset. Production was used for cement manufacturing, concrete, roadstone, riprap, and agricultural purposes. The county highway department produced 58,000 tons of limestone for use in roadbuilding.

Shale was produced by Marquette Cement Manufacturing Co. near Earlham for use in manufacturing cement.

Mahaska.—Approximately 365,000 tons of bituminous coal was produced from strip mines near Eddyville, Oskaloosa, and Pella. Producers were Angus Coal & Hauling Co., Lost Creek Coal Co., Mich Coal Co., New Lanning Coal Co. Inc., and Star Coal Co.

Kaser Construction Co. operated a portable plant near Oskaloosa and produced crushed limestone chiefly for road use and agricultural purposes.

Oskaloosa Clay Products Co. produced clay near Eddyville for use in manufacturing building brick.

Concrete Materials Division (Martin Marietta Corp.) produced sand and gravel at a stationary plant near Eddyville for building construction and paving.

Marion.—This county ranked first in coal production in the State, accounting for approximately 42 percent of the State total coal output. Production of 442,000 tons valued at over $1.5 million was from one underground mine operated by Walter Coal Co. and seven strip mines operated by Beard Coal Co., Hopkins Coal Co., Jude Coal Co., Inc., Newton Coal Co., Ver Steeg Coal Co., and Weldon Coal Co. The underground mine of Liter Coal Co., Inc., and the strip mine of Ver Steeg Coal Co. were closed.

Fire clay produced by Ver Steeg Coal Co. near Knoxville was sold for use in manufacturing building brick.

Durham Quarry, Inc., C. D. Hess & Son Rock Materials Co., and Pella Limestone Co. produced limestone at stationary and portable plants near Harvey, Lacona, and Pella. Production was chiefly for roadstone, agricultural purposes, and riprap.

Sand and gravel was produced at stationary plants near Knoxville, Pella, and Harvey by Knoxville Sand & Gravel, Pella Construction Co., Ltd., and Riggen Bros., respectively. Production was for building construction, paving, and fill. The county highway department produced 16,000 tons of paving gravel.

Marshall.—Concrete Materials Division (Martin Marietta Corp.), produced crushed limestone near Ferguson for concrete, roadstone, and agricultural purposes.

Sand and gravel was produced by Concrete Materials Division (Martin Marietta Corp.), Hallett Construction Co., and Maudlin Construction Co. from portable and stationary plants near Clemons, Le Grand, and Marshalltown for building construction, paving, and fill. The county highway department contracted for 49,000 tons of paving gravel.

Monroe.—Nearly 107,000 tons of bituminous coal was produced by the Lovilia Coal Co. at its No. 4 underground mine near Melrose. Corwin Hatch Coal Co. produced less than 1,000 tons of coal from a strip mine. The underground mine of Acme Coal Co., and strip mines of Miller Creek Coal Co. and Prothero Coal Co., Inc., were inactive.

Muscatine.—Wendling Quarries, Inc., produced crushed limestone at a portable plant near Atalissa for concrete, roadstone, agricultural purposes, and riprap.

Acme Fuel & Material Co., Hahn Bros. Sand & Gravel Co., Northern Gravel Co., Harold F. Storm, and Wendling Quarries, Inc., produced sand and gravel at stationary and portable plants near Lone Tree, Moscow, and Muscatine. The Louisa County Highway Department contracted for over 1,000 tons of paving sand and gravel.

Polk.—The county ranked second in the State in value of minerals produced with a value of $15.6 million.

Marquette Cement Manufacturing Co. and Penn-Dixie Cement Corp. operated cement plants in Des Moines and West Des Moines, respectively, and produced portland cement types I, II, and III. Masonry cement

was also produced by Marquette Cement Manufacturing Co.

Clay produced by Des Moines Clay Co. near Des Moines was used for building brick. Iowa Clay Pipe Co. produced shale near Des Moines for use in vitrified sewer pipe.

Sand and gravel was produced by seven companies near Des Moines and West Des Moines principally for building construction, paving, fill, and railroad ballast.

Pottawattamie.—Schildberg Rock Products Co., Inc., produced crushed limestone from quarries near Council Bluffs and Macedonia. Production was chiefly for road construction, agricultural purposes, and riprap.

The county highway department contracted for 8,000 tons of paving sand.

Poweshiek.—Crushed limestone was produced by Kaser Construction Co. at a portable plant near New Sharon and by Malcom Stone Co. at a stationary plant near Malcom. Production was for roadstone and agricultural purposes.

Sac.—Hallett Construction Co., Hosteng Sand & Gravel Co., and William Weisenborn produced sand and gravel near Auburn, Lake View, and Sac City. The material was used for building construction, paving, and fill. The Ida and Sac County Highway Departments contracted for a total of 237,000 tons of paving gravel.

Scott.—The county ranked third in mineral production in the State. Production was valued at $13.4 million.

Dewey Portland Cement Co. Division (Martin Marietta Corp.) produced types I, II, and III portland cement and masonry cement at a plant near Davenport. The company produced clay, shale, and limestone for use in manufacturing cement.

Other producers of limestone included Le Claire Quarries, Inc., Linwood Stone Products Co., Inc., and Weaver Construction Co., operating quarries near Le Claire, Davenport, and McCausland, respectively. Production was for road construction, railroad ballast, agricultural use, asphalt filler, metallurgical purposes, manufacturing lime, and other uses.

Linwood Stone Products Co., Inc., produced quicklime and hydrated lime at its plant near Buffalo.

Builders Sand & Gravel Co. operated a dredge near Princeton and produced sand for building construction.

Sioux.—Approximately 595,000 tons of sand and gravel was produced, chiefly for building construction, paving, and fill. Plants were operated near Boyden, Hawarden, Ireton, and Rock Valley.

Story.—Nevada Brick & Tile Co. produced clay near Nevada for use in making draintile.

Limestone was produced at a stationary plant near Ames operated by Ray Cook Construction Co., Inc., and at a portable plant near Roland operated by Weaver Construction Co. Production was used chiefly for roadstone and agricultural purposes.

Ray Cook Construction Co., Inc., Hallett Construction Co., and Maudlin Construction Co. produced sand and gravel at portable and stationary plants near Ames and Cambridge. Production was for building construction, paving, and fill.

Van Buren.—Approximately 15,000 tons of coal was produced by Laddsdale Coal Co., Inc., from a strip mine near Eldon.

Douds Stone, Inc., Kaser Construction Co., and Triangle Quarries, Inc., produced crushed limestone at plants near Douds, Selma, and Farmington, respectively, for roadstone, railroad ballast, agricultural purposes, and riprap. The county highway department produced 47,000 tons of limestone for use in roadwork.

Sand and gravel was produced at a stationary plant near Farmington, operated by Valley Limestone & Gravel, Inc., for building construction and paving. The city of Fort Madison contracted for 7,000 tons of paving sand and gravel. The county highway department contracted for 9,000 tons of paving sand.

Wapello.—New Lanning Coal Co., Inc., and South Iowa Coal Co. produced coal from strip mines near Kirkville and Eddyville, respectively.

Ottumwa Brick & Tile Co. produced clay and shale near Ottumwa for use in manufacturing floor tile, wall tile, and building brick.

Crushed limestone was produced at a stationary plant near Ottumwa operated by Douds Stone Inc. The stone was used for roadstone, agricultural purposes, and rip-

rap.

Concrete Materials Division (Martin Marietta Corp.) produced sand and gravel at a stationary plant near Ottumwa for building construction and paving.

Webster.—Clay was produced by Kalo Brick & Tile Co. near Coalville and by Johnston Clay Works, Inc., and Vincent Clay Products Co. near Fort Dodge. The clay was used for manufacturing building brick, draintile, building tile, other heavy clay products, and mortar mix.

Limestone obtained from an underground mine near Fort Dodge operated by Fort Dodge Limestone Co., Inc., was crushed in a portable plant and used chiefly for roadstone and agricultural purposes. Northwest Limestone Co. produced limestone for road use at a stationary plant near Fort Dodge.

The Celotex Corp.; Bestwall Gypsum Division of Georgia-Pacific Corp.; National Gypsum Co.; and United States Gypsum Co. mined gypsum by open pit methods near Fort Dodge. Processing and fabricating facilities were operated by each company. A strike closed the plant operated by The Celotex Corp. from July 1 through December 31.

Sand and gravel was produced by Scheideman Sand & Gravel and Welp & McCarten, Inc., near Barnum, Coalville, Fort Dodge, and Lehigh. Production was for building construction, paving, and fill. The Calhoun County Highway Department contracted for 16,000 tons of paving gravel.

The Mineral Industry of Kansas

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the State Geological Survey of Kansas for collecting information on all minerals except fuels.

By G. T. McIntyre,[1] A. L. Hornbaker,[2] Margaret O. Oros,[2] and R. G. Hardy [2]

Mineral production value in Kansas reached a record high in 1965. The principal mineral commodities in order of value were peroleum, natural gas, helium, natural gas liquids, and cement. Mineral output was reported from all counties. Mineral fuels and related products comprised 86 percent of the total value, nonmetals 13 percent, and metals 1 percent.

According to the Kansas Highway Commission, highway construction contracts approved during the year totaled $80.2 million. Authorized projects included 606 miles of State highway, 149 bridges, 458 miles of county secondary road, 79 county secondary bridges, and 1,615 miles of road maintenance and resurfacing. An additional 58 miles of interstate highway was opened to traffic during 1965. Since enactment of the Federal Highway Act in

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Table 1.—Mineral production in Kansas [1]

Mineral	1964		1965	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:				
Portland—thousand 376-pound barrels	8,483	$25,959	8,801	$26,972
Masonry—thousand 280-pound barrels	384	1,173	404	1,178
Clays—thousand short tons	785	935	789	953
Coal—do	1,263	5,749	1,310	6,072
Helium:				
Refined—thousand cubic feet	r 44,826	r 1,657	19,763	904
Crude—do	r 2,170,512	r 24,941	2,551,026	29,518
Lead (recoverable content of ores, etc.)—short tons	1,185	310	1,644	513
Natural gas—million cubic feet	r 764,073	96,031	793,379	105,519
Natural gas liquids:				
Natural gasoline—thousand gallons	162,725	8,713	153,485	7,791
LP gases—do	512,747	18,121	587,416	22,322
Petroleum (crude)—thousand 42-gallon barrels	106,252	310,256	104,733	305,820
Salt [2]—thousand short tons	930	11,799	1,053	12,376
Sand and gravel—do	12,968	9,108	12,544	8,473
Stone—do	14,138	18,912	15,270	20,538
Zinc (recoverable content of ores, etc.)—short tons	4,665	1,269	6,508	1,900
Value of items that cannot be disclosed: Natural cement, gypsum, pumice, and salt (brine)	XX	3,277	XX	2,642
Total	XX	r 538,210	XX	553,491

r Revised. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes salt in brine included with "Value of items that cannot be disclosed".

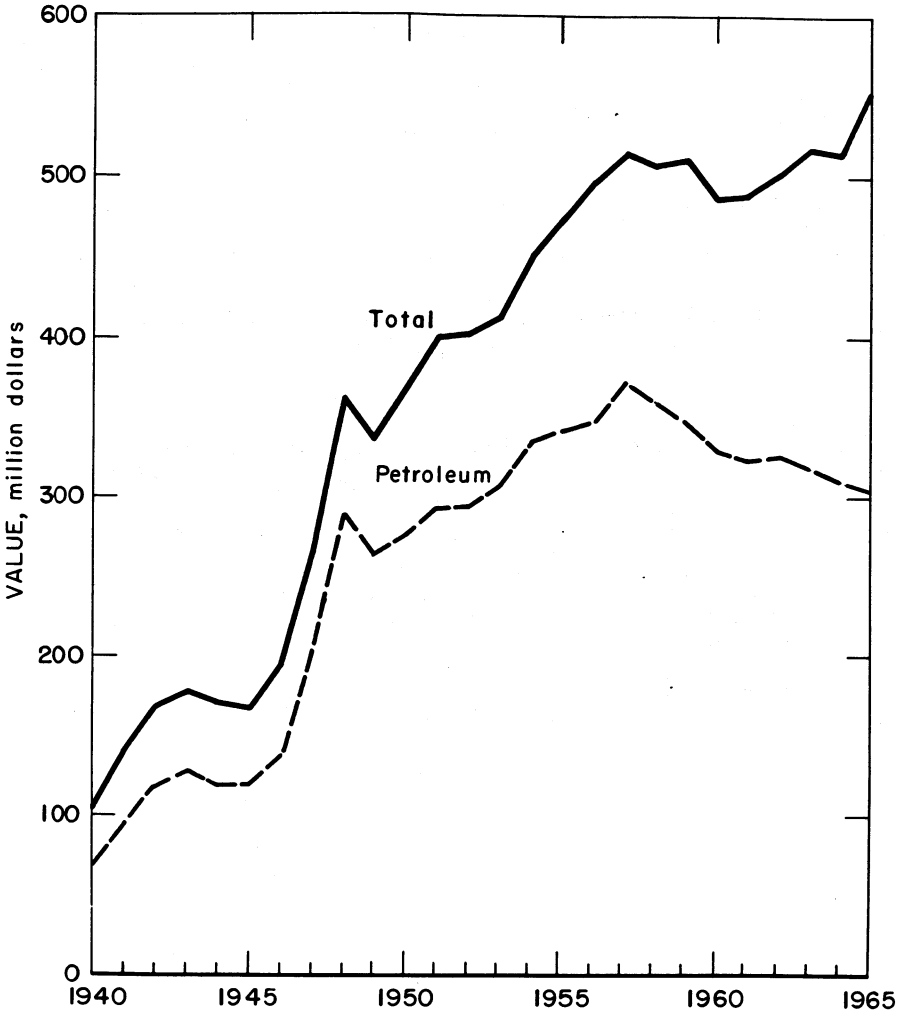

Figure 1.—Value of petroleum, and total value of mineral production in Kansas.

Table 2.—Value of mineral production in constant 1957-59 dollars

(Millions)

Year	Value
1956	$529
1957	509
1958	506
1959	516
1960	486
1961	483
1962	490
1963	r 507
1964	r 529
1965	541

r Revised.

1956, $249.3 million has been allocated to Kansas. Of this amount, $17.6 million had not been obligated at yearend.

Employment and Injuries.—According to the Employment Security Division of the Kansas Department of Labor, average annual employment in crude petroleum and natural gas industries in 1965 was 11,800, 1,100 less than in 1964. According to the Workmen's Compensation Commission, State of Kansas, 1,166 on-the-job injuries occurred in the mining industries in 1965. Sixteen injuries were fatal; 12 fatalities occurred in crude petroleum and natural gas industries, and 4 in nonmetallic mining and quarrying.

Table 3.—Employment and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1964:								
Coal	261	238	62	472	-------	15	31.80	937
Metal	49	286	14	111	-------	2	18.00	513
Nonmetal	1,087	282	306	2,451	-------	48	19.59	2,733
Sand and gravel	957	212	203	1,742	-------	28	16.07	552
Stone	2,069	217	448	3,677	4	38	11.42	6,826
Total	4,423	234	1,033	8,453	4	131	15.97	3,934
1965: p								
Coal	250	248	62	479	-------	17	35.49	1,029
Metal	55	273	15	121	-------	2	16.53	479
Nonmetal	1,185	284	336	2,682	1	53	20.13	2,563
Sand and gravel	960	203	195	1,674	-------	20	11.95	478
Stone	2,190	218	477	3,912	-------	37	9.46	609
Total	4,640	234	1,085	8,868	1	129	14.66	1,196

p Preliminary.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Total value of mineral fuels produced in 1965 was $477.9 million, $12.5 million more than that produced in 1964. Coal, helium, natural gas, and natural gas liquids gained in output and value. Petroleum decreased in output and value.

Carbon Black.—Columbian Carbon Co. produced carbon black at Hickok in Grant County, using natural gas and natural gas liquids as feedstock. Output increased in both volume and value.

Coal (Bituminous).—Six strip mines in three counties each reported output of 1,000 tons or more; production of less than 1,000 tons each was credited to three strip mines in Coffey, Linn, and Osage Counties. Overburden excavated at strip mines totaled 38.9 million cubic yards, an average of 30 cubic yards for each ton of coal strip mined. Over 98 percent of total coal mined was mechanically cleaned at three cleaning plants. Coal was shipped 67 percent by rail and 33 percent by truck.

Helium.—Four helium plants operated in Kansas throughout the year. At year-end, a fifth plant was virtually complete, but production had not commenced. Total helium production in the State was 2,570.8 million cubic feet, valued at $30.42 million.

Three of the four operating plants are privately owned; the Northern Helex Co. plant near Bushton, Ellsworth County; the Cities Service Helex, Inc., plant near Ulysses, Grant County; and the National Helium Corp. plant near Liberal, Seward County. The plants were constructed to implement the long-range helium conservation program of the Federal Government,

Table 4.—Coal (bituminous) production [1]

Year	Number of mines			Short tons (thousands)	Value (thousands)
	Underground	Strip	Total		
1956–60 (average)	------	------	------	823	$3,740
1961	1	9	10	664	3,102
1962	1	10	11	915	4,249
1963	1	9	10	1,169	5,311
1964	------	7	7	1,263	5,749
1965	------	6	6	1,310	6,072

[1] Excludes mines producing less than 1,000 short tons.

and their entire output of crude helium (purity 50 to 80 percent) is purchased by the Federal Bureau of Mines.

Under the conservation program, helium is extracted from natural gas en route to fuel markets and delivered to the Bureau of Mines pipeline extending from the Bushton plant to the Cliffside gasfield near Amarillo, Tex. At the Cliffside field, the crude helium is stored in a partially depleted natural gas reservoir. When needed to meet Federal and industrial demands, the helium will be withdrawn from storage, purified, and sold by the Bureau of Mines. The helium, in the absence of the conservation program, would be wasted when the natural gas was consumed.

The three plants produced and delivered to the Bureau of Mines 2,534 million cubic feet of helium, valued at $29.2 million, an increase of about 17 percent over the 2,171 million cubic feet delivered in 1964.

The fourth plant producing helium in 1965 was the Federal Bureau of Mines plant at Otis, Rush County. For many years the Otis plant had produced grade-A helium (purity 99.995 percent); however, beginning in July 1965, the plant was modified to produce only crude helium, at considerable savings of both money and manpower. Shipping operations were discontinued at the plant at the time of the operational changeover. During the year, the Otis plant produced 36.9 million cubic feet of helium, valued at $1.25 million. Of this total, 19.8 million cubic feet was grade-A helium, and 17.1 million cubic feet was crude helium. The grade-A helium was shipped directly from the plant to Federal and industrial customers; the crude helium was transported to the Cliffside gasfield, along with other crude helium, as part of the helium conservation program.

The Kansas Refined Helium Co. plant near Otis, Rush County, was virtually complete at yearend. Actual production had not commenced because of startup and operational problems. The plant will operate independently of the Federal helium program, marketing its output to private industrial consumers. Announced plans include the installation of a 500-liter-per-hour helium liquefier at the plant. The Air Reduction Sales Co. will operate a large-scale bulk liquid helium distribution system, as well as several liquid-to-gas installations where liquid helium will be re-gasified, re-packaged, and distributed to private consumers.

Natural Gas.—Production of natural gas reached a record high. Natural gas was produced from 8,534 wells, compared with 8,308 wells in 1964. Kansas ranked fifth in marketed production. Seventy-two percent of the State total was produced in the Hugoton gasfield area, comprising all or part of Finney, Grant, Hamilton, Haskell, Kearny, Morton, Seward, Stanton, and Stevens Counties. Exploratory drilling resulted in discovery of two important gasfields—Yellowstone North in Comanche County, and Carpenter North in Pawnee County.

Table 5.—Marketed production of natural gas

Year	Million cubic feet	Value (thousands)
1956–60 (average)	582,683	$67,427
1961	649,083	81,135
1962	694,352	86,100
1963	732,946	97,482
1964	r 764,073	96,031
1965	793,379	105,519

r Revised.

Table 6.—Marketed production of natural gas from the Kansas part of Hugoton gas area

Year	Million cubic feet
1961	467,842
1962	518,070
1963	556,067
1964	567,989
1965	574,015

Source: State Geological Survey of Kansas, Oil and Gas Division: Oil and Gas Developments in Kansas During 1965. Bull. 185.

Natural Gas Liquids.—Kansas ranked sixth in the Nation as a producer of natural gas liquids. The State's daily processing capacity was raised from 4.5 billion cubic feet to 4.7 billion cubic feet (8.1 percent of the Nation's total capacity).

During the year, Kansas-Nebraska Natural Gas Co. shut down its Deerfield plant in Kearny County. Alamo Chemical Co., subsidiary of Phillips Petroleum Co., expects to complete its 76-million-cubic-foot-

per-day gas-processing plant during the second half of 1966. The plant, located in Morton County near Elkhart, will recover 400,000 cubic feet per day of helium.

Petroleum.—Kansas ranked seventh in the Nation in volume and value of petroleum production. Petroleum producing wells totaled 47,354, compared with 46,715 wells in 1964.

At yearend, 12 refineries were operating in Kansas, 1 less than in 1964. Crude capacity decreased 21,390 barrels per stream day to a total of 350,585 barrels.[3]

Kansas had 41,662 stripper wells producing oil on January 1, 1965, 400 more than in 1964. Petroleum recovered from stripper wells totaled 69.1 million barrels in 1964, 65 percent of Kansas petroleum output, compared with 64.3 million barrels and 59 percent in 1963. Oil reserves attributed to stripper wells totaled 475 million barrels, compared with 450 million barrels as of January 1, 1964.[4]

Petrochemicals — Petrochemical plants were operated in Butler, Cherokee, Doug-

[3] Oil and Gas Journal, V. 64, No. 13, Mar. 28, 1966, p. 152.
[4] Oil and Gas Journal, V. 63, No. 45, Nov. 8, 1965, p. 88.

Table 7.—Leading gasfields [1]
(Million cubic feet)

Field	County	Discovery date	Annual production			Cumulative to Dec. 31, 1965
			1963	1964	1965	
Hugoton gas area	([2])	1930	556,067	567,989	574,015	8,150,284
Greenwood gas area	Morton	1951	33,394	42,479	37,918	460,172
Medicine Lodge-Boggs	Barber	1927	6,140	7,367	5,415	286,351
Spivey-Grabs-Basil	Harper-Kingman	1949	30,811	33,222	31,321	217,902
Rhodes	Barber	1954	6,271	3,964	2,716	84,008
Hardtner	do	1954	5,361	4,512	4,430	84,160
McKinney	Clark-Meade	1950	7,356	5,495	5,871	71,731
Boggs Southwest	Barber	1955	1,922	1,859	1,425	48,251
Sparks	Morton-Stanton	1954	4,605	5,086	4,751	51,055
Glick	Comanche-Kiowa	1957	14,160	16,050	12,478	64,118
Aetna gas area	Barber	1935	5,618	5,589	6,443	46,596
Taloga	Morton	1955	1,730	1,552	2,079	33,854
Richfield	do	1948	1,575	2,040	2,801	34,994
Liberal-Light	Seward	1951	523	502	423	30,629
Harper Ranch	Clark	1953	4,363	4,976	5,377	33,235

[1] Fields with cumulative production in excess of 30 billion cubic feet.
[2] Stevens, Grant, Kearny, Finney, Haskell, Morton, Seward, Stanton, and Hamilton Counties (in descending order of cumulative production).

Source: State Geological Survey of Kansas, Oil and Gas Division. Oil and Gas Developments in Kansas During 1965. Bull. 185.

Table 8.—Natural gas liquids production
(Thousand gallons and thousand dollars)

Year	Natural gasoline		LP gases		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
1956–60 (average)	111,741	$6,199	112,220	$5,216	223,961	$11,415
1961	132,180	5,790	135,643	5,916	267,823	11,706
1962	151,360	7,696	166,769	6,295	318,129	13,991
1963	165,370	9,811	395,877	15,481	561,247	25,292
1964	162,725	8,713	512,747	18,121	675,472	26,834
1965	153,485	7,791	587,416	22,322	740,901	30,113

Table 9.—Crude petroleum production
(Thousand 42-gallon barrels and thousand dollars)

Year	Quantity	Value	Year	Quantity	Value
1956–60 (average)	120,151	$351,063	1963	109,107	$17,501
1961	112,241	324,376	1964	106,252	310,256
1962	112,076	326,141	1965	104,733	305,820

Table 10.—Crude petroleum production, indicated demand and stocks in 1965 by months

(Thousand 42-gallon barrels)

Month	Production	Indicated demand	Stocks originating in Kansas (end of month)
January	8,826	9,078	7,292
February	8,023	7,706	7,609
March	9,077	9,477	7,209
April	8,785	8,604	7,390
May	8,750	8,840	7,300
June	8,357	8,372	7,285
July	8,880	9,448	6,717
August	8,884	9,110	6,491
September	8,569	8,934	6,126
October	9,018	7,672	7,472
November	8,695	9,391	6,776
December	8,869	9,265	6,380
Total:			
1965	104,733	105,897	XX
1964	106,252	106,279	XX

XX Not applicable.

Table 11.—Crude petroleum production by fields [1]

(Thousand 42-gallon barrels)

Field [2]	1962	1963	1964	1965	Cumulative Dec. 31, 1965
Bemis-Shutts [3]	4,024	3,812	3,594	3,371	194,535
Chase Silica [3]	2,907	2,876	2,799	2,690	235,063
El Dorado [3]	4,190	3,773	3,329	2,899	264,371
Fairport	919	1,035	1,196	1,121	37,147
Geneseo-Edwards	1,477	1,327	1,299	1,212	72,885
Gladys	893	1,135	1,065	1,177	13,340
Gorham	1,011	1,186	1,375	1,328	71,372
Hall-Gurney [3]	3,309	3,232	3,396	3,345	104,205
Kraft-Prusa [3]	2,021	2,023	1,988	1,942	99,469
Lost Springs	1,778	1,396	933	722	24,419
Marcotte	1,191	1,047	1,014	948	27,081
Morel	1,215	1,161	1,162	1,068	33,230
Pleasant Prairie	1,724	1,443	1,110	1,221	10,958
Ray	1,332	1,315	1,214	1,147	31,395
Ritz-Canton	1,013	958	817	849	56,607
Spivey-Grabs	3,915	3,731	3,457	3,168	29,912
Trapp [3]	2,494	2,540	2,758	2,772	185,627
Other fields [4]	76,663	75,117	73,746	73,753	NA
Total	112,076	109,107	106,252	104,733	NA

NA Not available.
[1] Fields with annual production in excess of 1 million barrels.
[2] Breakdown for individual fields from The Oil and Gas Journal.
[3] Giant fields.
[4] Bureau of Mines figures.

las, Grant, Sedgwick, and Wyandotte Counties. Skelly Oil Co. completed facilities at its El Dorado plant with a capacity of 50 million pounds per year of toluene, xylene, and high-solvency naphtha compounds.

NONMETALS

Total value of nonmetals produced in 1965 was $73.1 million, compared with $71.2 million in 1964, an increase of 3 percent.

Cement.—Plants in Allen, Montgomery, Neosho, Wilson, and Wyandotte Counties produced 8.9 million barrels of portland cement, utilizing an average 69 percent of total capacity. Rebuilding of the Ash Grove Lime and Portland Cement Co. plant in Neosho County was completed; maximum annual production was increased

Table 12.—Oil and gas well drilling in 1965, by counties

County	Wells drilled						Total
	Oil	Gas	Oil and gas	Service [1]	Dry	Unclassified [e]	
Allen	66			44		154	264
Anderson	31			15		14	60
Atchison					1		1
Barber	24	38	3	3	59	3	130
Barton	69	5		8	100	8	190
Bourbon	6			3		25	34
Brown					3		3
Butler	76			30	54		160
Chase	3	3		1	5		12
Chautauqua	9	1		1	14	48	73
Cheyenne					7		7
Clark	4	2		1	11	3	21
Coffey	8			3	1	8	20
Comanche		1	1		9		11
Cowley	26	1		6	55	3	91
Crawford	14			10		43	67
Decatur	1				4		5
Dickinson	1				6		7
Douglas					3		3
Edwards	1	4	1		9	2	17
Elk	1				7	4	12
Ellis	68			7	107		182
Ellsworth	14			2	21	2	39
Finney	5				7		12
Ford	1				5		6
Franklin	28			4		8	40
Geary	1				3		4
Gove	3			1	24		28
Graham	34			3	58		95
Grant	2	14		4	1		21
Gray					1		1
Greeley					2		2
Greenwood	127	1		20	51	14	213
Hamilton		36		19	8		63
Harper	6	2			15		23
Harvey	24	5		8	13		50
Haskell	18	6		2	5		31
Hodgeman	9	1		1	19		30
Jackson	1				6		7
Johnson	2			1	3	20	26
Kearny	2	1			4		7
Kingman	29	12	2		39	2	84
Kiowa	18	9	1		21	4	53
Labette	3			4		40	47
Lane	1				8		9
Leavenworth					1	3	4
Linn	11			26		60	97
Logan					1		1
Lyon	3				5		8
McPherson	25	2		2	23		52
Marion	23				18		41
Marshall					2		2
Meade		6			14	3	23
Miami	26			10	1	46	83
Montgomery	54			24	2	40	120
Morris	2			1	6		9
Morton	5	11		3	16		35
Nemaha	1				4		5
Neosho	57			48	5	80	190
Ness	47			3	60		110
Norton					16		16
Pawnee	6	2		4	33		45
Phillips	33			1	21		55
Pottawatomie					2		2
Pratt	10	3		2	22		37
Rawlins	1			1	12		14
Reno	12	2		2	29	11	56
Rice	61	4		1	76		142
Riley	1				5		6
Rooks	37			7	37	4	85
Rush	10	7		2	26		45
Russell	56	1		10	33	5	105
Saline	12			2	8		22
Scott						7	7

See footnotes at end of table.

Table 12.—Oil and gas well drilling in 1965, by counties—Continued

County	Wells drilled					Unclassified [e]	Total
	Oil	Gas	Oil and gas	Service [1]	Dry		
Sedgwick	9	------	------	3	26	------	38
Seward	11	12	3	------	9	------	35
Shawnee	------	------	------	------	2	------	2
Sheridan	------	------	------	1	12	2	15
Sherman	------	------	------	------	2	------	2
Stafford	63	------	------	2	104	4	173
Stanton	------	1	------	------	1	------	2
Stevens	1	13	------	------	5	------	19
Sumner	12	2	------	1	45	------	60
Thomas	------	------	------	------	1	------	1
Trego	19	------	------	2	38	------	59
Wabaunsee	2	------	------	1	6	------	9
Wallace	------	------	------	------	2	------	2
Wichita	------	------	------	------	2	------	2
Wilson	88	------	------	52	2	------	142
Woodson	23	------	------	13	1	80	117
Total:							
1965	1,457	208	11	425	1,505	750	4,356
1964	1,465	175	24	411	1,530	842	4,447

[e] Estimate.
[1] Service wells are waterflood wells, water-input wells, and salt water-disposal wells.

Source: State Geological Survey of Kansas. Oil and Gas Developments in Kansas During 1965. Bull. 185.

Table 13.—Estimated proved recoverable reserves of crude oil, natural gas liquids, and natural gas

Product	Proved reserves, Dec. 31, 1964	Changes in proved reserves, owing to extensions and new discoveries, in 1965	Proved reserves, Dec. 31, 1965 (production was deducted)	Changes from 1965, percent
Crude oil—thousand barrels	796,541	58,601	751,629	−5.6
Natural gas liquids [1]—do	209,986	1,142	200,317	−4.6
Natural gas—million cubic feet	17,278,142	120,381	16,596,404	−3.9

[1] Includes condensate, natural gasoline, and LP gases.

Source: American Gas Association, American Petroleum Institute, and Canadian Petroleum Association. Proved Reserves of Crude Oil, Natural Gas Liquids and Natural Gas. V. 20, Dec. 31, 1965, pp. 12–13, 24.

from 6 million sacks of cement or lime to 11 million sacks. About 63 percent of the cement was produced by the wet process and 37 percent by the dry process. Based on reports of five of the six portland cement plants, 65 percent of shipments were carried by rail and 35 percent by truck. Shipments were 89 percent in bulk and 11 percent in sacks.

Distribution of shipments by type of customer was as follows: Ready-mixed concrete companies, 67 percent; highway contractors, 14 percent; building material dealers, 9 percent; concrete product manufacturers, 6 percent; and miscellaneous customers, 4 percent.

Masonry cement was produced at all portland cement plants and at a natural cement plant in Bourbon County. Production of masonry cement increased 19 percent over that of 1964, and shipments increased 5 percent.

Clays.—The use pattern of Kansas clay and shale was 39 percent for cement; 37 percent for building brick; and 24 percent for lightweight aggregate, sewer pipe, heavy clay products, stoneware, and pottery. Lightweight aggregate was produced from shale by Buildex, Inc. Sewer pipe was produced by W. S. Dickey Clay Manufacturing Co. Brick manufacturers included Humboldt Brick & Tile Co., Kan-

Table 14.—Important oilfields discovered in 1965

Field	County	Initial production (barrels per day)
Axman Northeast	Barton	118
Mater	----do	312
Twenty	----do	189
Rosalia	Butler	50
Dechant West	Ellis	141
Gatschet	----do	88
Mixer	----do	106
Wallace	----do	210
Kootz	Ellsworth	68
Jackson Branch	Graham	86
Osgood	Ness	132
Prairie Ridge	----do	261
Riverside	----do	91
Stoneman South	Phillips	60
Schadel	Rush	161
Shultz	Saline	25
Bayer West	Stafford	104
DeMurry	Trego	25

Source: State Geological Survey of Kansas, Oil and Gas Division.

Table 15.—Portland cement production and shipments

(Thousand 376-pound barrels and thousand dollars)

Year	Production	Shipments	
		Quantity	Value
1956–60 (average)	9,204	9,067	$27,578
1961	8,329	8,028	25,605
1962	8,235	8,058	25,134
1963	8,248	8,201	25,372
1964	8,335	8,483	25,959
1965	8,877	8,801	26,972

Table 16.—Shipments of portland cement to Kansas consumers

Year	Thousand 376-pound barrels
1956–60 (average)	6,060
1961	5,770
1962	5,331
1963	5,024
1964	5,132
1965	5,041

sas Brick & Tile, Inc., Acme Brick Co., Cloud Ceramics, and Excelsior Brick Co. Stoneware was produced from Cherokee County clay by Pittsburg Pottery Co., Inc.

Gypsum.—Gypsum was mined underground by National Gypsum Co. near Medicine Lodge, Barber County, and by Georgia-Pacific Corp. at Blue Rapids, Marshall County. Kansas crude gypsum was used as a retarder in portland cement, as a soil conditioner, and as a filler in paper and paint. Principal uses of calcined gypsum were in wallboard and wall plaster.

Perlite.—Crude perlite (mined in Western States) was processed by Lite Weight Products, Inc., at its plant in Kansas City, Wyandotte County. Expanded perlite was used as a carrying agent for fertilizer, soil conditioning, building plaster aggregate, concrete aggregate, filler material, and loose-fill insulation.

Pumice.—Pumicite (volcanic ash) was mined by San Ore Construction Co. and Ernest Hanzlicek in Lincoln County and by Wyandotte Chemical Corp. in Norton County. Volcanic ash was used in cleansing and scouring compounds, hand soaps, dusting powders, and as an aggregate in asphaltic concrete. Output gained over that of 1964.

Salt.—Evaporated and rock salt were produced by six companies in Barton, Ellsworth, Reno, and Rice Counties; tonnage sold or used increased 13 percent and value increased 5 percent. One company produced rock salt, three produced evaporated salt, and two produced both rock and evaporated salt.

Meatpackers, livestock raisers, leather tanners, and feed dealers were large consumers of salt. Large amounts also were used for road stabilization and snow and ice removal.

Brine was produced in Sedgwick County by Frontier Chemical Co., a division of Vulcan Materials Co., for manufacturing chlorine and caustic soda.

The Atomic Energy Commission continued Project Salt Vault, the study of the feasibility of nuclear waste disposal in natural salt formations in the inactive Carey Salt Co. mine at Lyons in Rice County.

Sand and Gravel.—Sand and gravel was produced in 81 counties at 147 commercial

Table 17.—Clays sold or used by producers

(Thousand short tons and thousand dollars)

Year	Quantity	Value
1956–60 (average)	935	$1,210
1961	954	1,225
1962	895	1,091
1963	893	1,104
1964	785	935
1965	789	953

Table 18.—Evaporated and rock salt sold or used by producers
(Thousand short tons and thousand dollars)

Year	Evaporated salt		Rock salt	
	Quantity	Value	Quantity	Value
1956–60 (average)	377	$7,916	513	$2,625
1961	411	9,180	502	2,229
1962	432	9,446	512	2,208
1963	435	9,669	489	2,324
1964	438	9,485	492	2,314
1965	453	9,828	600	2,548

and 65 Government-and-contractor operations. Over 88 percent of total production was used for building and highway construction. Commercial operations supplied 79 percent of total tonnage and 88 percent of total value. Over 85 percent of the total production was processed. Shipments of commercial production were 96 percent by truck and 4 percent by rail. Leading producing counties in terms of value were Wyandotte, Sedgwick, Shawnee, and Johnson.

Stone.—Limestone, sandstone, and chat were quarried in 54 counties. Limestone production from 52 counties supplied 96 percent of total tonnage and 95 percent of total value. Crushed limestone was produced in 51 counties at 134 commercial and 24 Government-and-contractor operations. Dimension limestone was quarried and prepared at 11 operations in 6 counties.

Crushed sandstone was produced in Atchison, Lincoln, and Neosho Counties. Dimension sandstone was quarried in Bourbon County. Chat was produced in Cherokee County.

Principal uses for crushed stone were concrete aggregate, roadstone, cement, riprap, and agricultural stone (agstone); dimension stone was used as building stone, curbing, and flagging. Commercial producers supplied 93 percent of total stone output.

Vermiculite.—Crude vermiculite shipped from Montana was exfoliated by Dodson Manufacturing Co., Inc., at its plant at Wichita, Sedgwick County. Output was less than in 1964.

Water.—The 1965 Flood Control Act authorized the U.S. Army Corps of Engineers to spend $73.4 million on projects in Kansas. The 1965 authorization gave the Corps a backlog of Kansas projects of 12 reservoirs, 7 local protection works, and 1 wildlife refuge. Total estimated cost of the projects was $250 million.

Council Grove, John Redmond, and Wilson Dams were completed by the Corps of Engineers. The Bureau of Reclamation completed Cheney and Norton Dams. Seventy-four watershed structures were completed in 1965.

METALS

The Kansas lead- and zinc-producing area (Cherokee County) is part of the Tri-State District, which also includes northeastern Oklahoma and southwestern Missouri. Further details on Tri-State activity are given in the Oklahoma chapter.

Table 19.—Sand and gravel sold or used by producers
(Thousand short tons and thousand dollars)

Year	Commercial		Government-and-contractor		Total sand and gravel	
	Quantity	Value	Quantity	Value	Quantity	Value
1956–60 (average)	8,810	$6,294	1,834	$848	10,644	$7,142
1961	8,975	6,722	2,391	1,059	11,366	7,781
1962	9,274	6,953	2,278	1,086	11,552	8,039
1963	9,763	7,603	2,299	1,073	12,062	8,676
1964	10,227	7,788	2,741	1,320	12,968	9,108
1965	9,960	7,494	2,584	979	12,544	8,473

Table 20.—Sand and gravel sold or used by producers, by classes of operations and uses
(Thousand short tons and thousand dollars)

Class of operation and use	1964		1965	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	3,645	$2,736	4,065	$3,138
Paving	3,350	2,638	2,768	1,937
Fill	901	390	940	425
Other [1]	209	210	186	199
Total	8,105	5,974	7,959	5,699
Gravel:				
Building	438	401	494	487
Paving	1,432	1,168	1,353	1,131
Fill	66	53	36	34
Other [2]	186	192	118	143
Total	2,122	1,814	2,001	1,795
Total sand and gravel	10,227	7,788	9,960	7,494
Government-and-contractor operations:				
Sand:				
Building	17	7	65	45
Paving	1,258	637	1,314	485
Other [3]	63	25	156	48
Total	1,338	669	1,535	578
Gravel:				
Building	70	44	18	16
Paving	1,333	607	966	371
Other [4]	--	--	65	14
Total	1,403	651	1,049	401
Total sand and gravel	2,741	1,320	2,584	979
Grand total	12,968	9,108	12,544	8,473

[1] Includes railroad ballast, other construction, and industrial sand (unground).
[2] Includes other construction and miscellaneous gravel.
[3] Includes fill (1965) and other construction sand.
[4] Includes fill and other construction gravel.

Lead and zinc pigments and sulfuric acid were produced by The Eagle-Picher Co. at its plant near Galena. Feedstock for the plant was supplied by captive mines and other producers. Ozark Smelting & Mining Co., Division of the Sherwin Williams Co., operated its pigment plant at Coffeyville.

Table 21.—Sand and gravel production in 1965, by counties

(Thousand short tons and thousand dollars)

County	Quantity	Value
Barber	111	$43
Barton	239	117
Cherokee	40	16
Clark	21	6
Coffey	36	15
Comanche	34	13
Cowley	372	253
Decatur	18	18
Dickinson	147	151
Edwards	54	31
Ellis	163	98
Ellsworth	81	30
Finney	135	151
Ford	204	142
Franklin	1	(1)
Gove	58	31
Grant	24	10
Greeley	18	7
Greenwood	2	(1)
Hamilton	15	6
Harper	12	9
Harvey	167	82
Haskell	58	23
Hodgeman	101	40
Jackson	52	9
Kearny	67	59
Kiowa	140	81
Leavenworth	16	21
Linn	17	7
Logan	8	3
McPherson	45	12
Marshall	145	155
Meade	27	16
Mitchell	27	21
Nemaha	51	53
Neosho	60	75
Ness	82	35
Norton	30	23
Osborne	77	22
Ottawa	14	2
Pawnee	87	62
Phillips	89	81
Pratt	328	144
Rawlins	12	13
Reno	442	272
Republic	164	117
Rush	37	16
Russell	147	75
Saline	312	265
Sedgwick	1,910	1,053
Shawnee	565	390
Sheridan	40	16
Sherman	56	34
Stevens	132	53
Sumner	201	94
Thomas	97	100
Trego	44	54
Wallace	9	9
Washington	165	158
Wyandotte	1,820	1,507
Other counties [2]	2,918	2,074
Total	12,544	8,473

[1] Less than ½ unit.

[2] Includes Allen, Cheyenne, Clay, Cloud, Douglas, Geary, Graham, Gray, Jewell, Johnson, Kingman, Lyon, Morris, Pottawatomie, Rice, Riley, Brooks, Seward, Stafford, Wabaunsee, Wichita Counties, combined to avoid disclosing individual company data. Undistributed amounts from various counties are also included.

Lead.—Producing mines included the Grace B and Westside No. 2 mines operated by The Eagle-Picher Co. and Big John, Lucky Jew, and Wright mines operted by Mid-Continent Lead & Zinc Co. Other operators included Scotty Mining Co., 24 Mining Co., and Marlene Ann Mining Co.

Zinc.—Leading producers were Scotty Mining Co., The Eagle-Picher Co., Residue Mining Co., and Mid-Continent Lead & Zinc Co.

REVIEW BY COUNTIES

Mineral production was reported in all 105 counties, two more than in 1964. Sixty-one counties reported mineral production valued at $1 million or more. The principal mineral producing counties were Grant, Seward, Russell, Ellis, and Barton; the five counties accounted for 24.5 percent of the total value of mineral production in the State. Petroleum was produced in 83 counties, natural gas in 56, and natural gas liquids in 14.

Allen.—The county ranked first in cement production, second in value of clay output, and fifth in value of stone production. Lehigh Portland Cement Co. at Iola and The Monarch Cement Co. at Humboldt produced portland and masonry cements; limestone and clay for cement were obtained near the plant sites. Humboldt Brick & Tile Co. mined miscellaneous clay for use in heavy clay products. Limestone was quarried and crushed for concrete aggregate, riprap, and agstone by Allen County Highway Department, Nelson Brothers Quarries, The Monarch Cement Co., and Kunshek Chat & Coal Co.

Atchison.—Ralph H. Bromley & Sons Quarry and the county highway department quarried and crushed limestone for concrete aggregate, roadstone, riprap, and agstone. Mid-Continent Stone & Construction Co. produced broken sandstone for use as riprap.

Barber.—Barber County ranked first in gypsum production. Gypsum was mined and processed at Medicine Lodge by Na-

Table 22.—Stone sold or used by producers, by kinds

(Thousand short tons and thousand dollars)

Year	Limestone [1]		Other stone		Total stone	
	Quantity	Value	Quantity	Value	Quantity	Value
1961	11,948	$16,242	380	$169	[2] 12,328	[2] $16,411
1962	13,098	17,106	429	168	[2] 13,527	[2] 17,274
1963	12,904	17,600	654	883	13,558	18,483
1964	13,412	17,747	726	1,165	14,138	18,912
1965	14,673	19,566	597	972	15,270	20,538

[1] Includes diatomaceous marl, limestone for cement, and limestone for lime.
[2] Excludes crushed sandstone.

Table 23.—Stone sold or used by producers, by kinds and uses

(Short tons)

Uses	1964		1965	
	Quantity	Value	Quantity	Value
Limestone: [1]				
Riprap	857,446	$1,015,624	1,189,802	$1,081,812
Concrete aggregate and roadstone	9,291,398	12,193,799	9,927,107	13,356,196
Agriculture	466,996	760,733	521,579	850,086
Cement	2,321,089	2,457,552	2,558,595	2,686,353
Dimension	14,313	502,499	16,129	614,830
Other [2]	461,055	816,407	459,933	976,500
Total limestone	13,412,297	17,746,614	14,673,145	19,565,777
Sandstone:				
Crushed	626,414	1,076,907	W	W
Dimension	447	8,887	514	10,349
Miscellaneous stone	98,902	79,644	W	W
Total stone	14,138,060	18,912,052	15,269,846	20,537,795

W Withheld to avoid disclosing individual confidential data; included in total.
[1] Includes diatomaceous marl.
[2] Includes railroad ballast, cement rock, coal dust, whiting, and other filler.

Table 24.—Mine production of lead and zinc, in terms of concentrate and recoverable metals [1]

Year	Mines producing	Lead concentrate (galena)		Zinc concentrate (sphalerite)		Recoverable metal content [2]			
						Lead		Zinc	
		Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)
1956–60 (average)	-----	3,955	$689	19,335	$1,592	2,891	$842	10,416	$2,643
1961	9	1,910	222	4,730	311	1,449	298	2,446	563
1962	10	1,290	138	7,237	493	970	178	3,943	907
1963	8	1,402	172	6,433	514	1,027	222	3,508	807
1964	10	1,603	228	8,636	768	1,185	310	4,665	1,269
1965	9	2,304	380	12,003	1,157	1,644	513	6,508	1,900

[1] Based on Kansas ore and old tailing treated at mills during calendar year indicated.
[2] In calculating metal content of the ores from assays, allowance made for smelting losses of both lead and zinc. In comparing values of concentrate (ore) and metal, value given for concentrate is that actually received by producer, whereas value of lead and zinc is calculated from average price for all grades.

Table 25.—Value of mineral production in Kansas, by counties

County	1964 r	1965	Minerals produced in 1965 in order of value
Allen	$12,201,674	$13,006,193	Cement, petroleum, stone, clays, natural gas, sand and gravel.
Anderson	1,433,027	1,411,908	Petroleum, stone, natural gas.
Atchison	W	W	Stone, petroleum.
Barber	8,310,424	8,656,199	Natural gas, petroleum, gypsum, natural gas liquids, sand and gravel.
Barton	24,093,810	23,793,173	Petroleum, natural gas, salt, sand and gravel, clays.
Bourbon	677,818	709,974	Stone, petroleum, cement, coal.
Brown	6,392	6,301	Petroleum.
Butler	17,722,791	17,565,789	Petroleum, stone, natural gas.
Chase	379,269	406,441	Do.
Chautauqua	2,347,070	2,270,898	Petroleum, natural gas, stone.
Cherokee	5,757,313	6,426,891	Coal, zinc, lead, clays, stone, sand and gravel.
Cheyenne	W	W	Sand and gravel.
Clark	2,189,414	2,322,940	Natural gas, petroleum, sand and gravel.
Clay	126,303	541,639	Stone, sand and gravel, petroleum.
Cloud	362,850	318,712	Clays, sand and gravel, stone.
Coffey	768,011	397,894	Petroleum, stone, sand and gravel, natural gas.
Comanche	1,236,930	1,332,926	Natural gas, petroleum, sand and gravel.
Cowley	10,933,884	10,864,863	Petroleum, natural gas, stone, sand and gravel.
Crawford	1,909,099	2,385,091	Coal, petroleum, clays, natural gas.
Decatur	1,443,726	1,397,713	Petroleum, sand and gravel.
Dickinson	712,766	805,494	Stone, sand and gravel, petroleum, natural gas.
Doniphan	229,625	W	Stone.
Douglas	274,429	296,717	Sand and gravel, petroleum, stone, natural gas.
Edwards	1,217,940	1,251,643	Petroleum, natural gas, sand and gravel.
Elk	1,305,190	1,392,654	Stone, petroleum, natural gas.
Ellis	26,730,257	26,251,632	Petroleum, sand and gravel, stone.
Ellsworth	20,594,084	22,735,409	Natural gas liquids, helium, petroleum, salt, clays. sand and gravel, natural gas.
Finney	8,284,327	8,679,824	Natural gas, petroleum, natural gas liquids, sand and gravel.
Ford	402,068	389,015	Natural gas liquids, sand and gravel, petroleum, natural gas.
Franklin	943,679	1,091,411	Petroleum, stone, clays, natural gas, sand and gravel.
Geary	489,586	467,835	Stone, sand and gravel, petroleum.
Gove	628,992	633,010	Petroleum, sand and gravel.
Graham	15,168,453	14,925,185	**Petroleum, stone, sand and gravel.**
Grant	28,192,505	32,421,455	Natural gas, helium, natural gas liquids, petroleum, sand and gravel.
Gray	W	W	Sand and gravel.
Greeley	11,000	7,000	Do.
Greenwood	9,435,004	9,279,588	Petroleum, stone, natural gas, sand and gravel.
Hamilton	1,589,835	1,732,387	Natural gas, petroleum, sand and gravel.
Harper	5,072,813	4,971,024	Petroleum, natural gas liquids, natural gas, sand and gravel.
Harvey	1,871,999	1,849,265	Petroleum, natural gas, sand and gravel, natural gas liquids.
Haskell	12,652,405	13,196,066	Natural gas, petroleum, sand and gravel.
Hodgeman	6,373,149	6,294,427	Petroleum, sand and gravel.
Jackson	304,176	375,626	Petroleum, stone, sand and gravel.
Jefferson	W	W	Stone.
Jewell	846,041	1,086,242	Stone, sand and gravel.
Johnson	1,568,462	1,883,410	Stone, sand and gravel, petroleum, natural gas.
Kearny	11,158,697	12,010,967	Natural gas, petroleum, natural gas liquids, sand and gravel.
Kingman	14,752,732	14,937,449	Petroleum, natural gas, natural gas liquids, sand and gravel.
Kiowa	2,770,447	2,917,043	Natural gas, petroleum, sand and gravel.
Labette	441,736	518,503	Petroleum, stone, natural gas.
Lane	290,247	263,426	Petroleum,
Leavenworth	290,174	309,408	Stone, natural gas, petroleum, sand and gravel.
Lincoln	1,264,464	888,828	Stone, pumice.
Linn	545,934	368,416	Stone, petroleum, natural gas, sand and gravel.
Logan	45,000	3,000	Sand and gravel.
Lyon	441,919	698,438	Petroleum, sand and gravel, stone.
Marion	5,762,348	5,669,158	Petroleum, natural gas, stone, natural gas liquids.
Marshall	767,576	883,096	Gypsum, stone, sand and gravel.
McPherson	7,390,517	7,318,542	Petroleum, natural gas, clays, sand and gravel.
Meade	3,704,494	3,877,631	Natural gas, petroleum, sand and gravel.
Miami	929,062	944,537	Petroleum, stone, natural gas.
Mitchell	W	21,000	Sand and gravel.
Montgomery	6,967,027	7,379,324	Cement, petroleum, stone, natural gas, clays.
Morris	1,354,761	1,242,974	Petroleum, stone, natural gas, sand and gravel.
Morton	16,708,324	17,611,766	Natural gas, petroleum, natural gas liquids.
Nemaha	64,759	77,405	Sand and gravel, petroleum.
Neosho	8,203,635	7,924,267	Cement, petroleum, stone, sand and gravel, natural gas, clays.

See footnotes at end of table.

Table 25.—Value of mineral production in Kansas, by counties—Continued

County	1964 r	1965	Minerals produced in 1965 in order of value
Ness	$3,929,072	$4,057,672	Petroleum, stone, sand and gravel.
Norton	2,261,929	1,916,911	Petroleum, sand and gravel, stone, pumice.
Osage	W	W	Stone.
Osborne	143,627	141,888	Petroleum, sand and gravel.
Ottawa	----------	2,000	Sand and gravel.
Pawnee	3,226,818	3,192,992	Petroleum, natural gas, sand and gravel.
Phillips	6,140,319	6,122,954	Petroleum, sand and gravel.
Pottawatomie	359,273	331,967	Stone, sand and gravel.
Pratt	4,052,718	4,095,395	Petroleum, natural gas, sand and gravel.
Rawlins	2,075,582	1,998,653	Petroleum, sand and gravel, stone.
Reno	15,702,992	17,183,915	Salt, natural gas liquids, petroleum, sand and gravel, natural gas.
Republic	147,000	118,750	Sand and gravel, stone.
Rice	21,020,938	20,920,433	Petroleum, salt, stone, natural gas, sand and gravel.
Riley	655,350	721,221	Petroleum, stone, sand and gravel.
Rooks	15,054,964	14,835,953	Petroleum, sand and gravel.
Rush	2,758,778	2,369,145	Helium, petroleum, natural gas, sand and gravel.
Russell	26,684,591	26,307,768	Petroleum, sand and gravel, natural gas.
Saline	2,854,174	2,400,202	Petroleum, sand and gravel.
Scott	248,682	235,417	Petroleum, natural gas.
Sedgwick	11,481,346	11,026,506	Petroleum, natural gas liquids, salt, sand and gravel, stone, natural gas.
Seward	24,602,540	26,442,032	Helium, natural gas liquids, natural gas, petroleum, sand and gravel.
Shawnee	1,139,268	1,541,856	Stone, sand and gravel.
Sheridan	1,014,860	966,808	Petroleum, stone, sand and gravel.
Sherman	132,759	123,461	Petroleum, sand and gravel.
Smith	53,122	4,923	Stone.
Stafford	15,180,710	15,000,682	Petroleum, natural gas, sand and gravel.
Stanton	3,695,891	4,055,403	Natural gas, petroleum.
Stevens	19,718,848	21,579,222	Natural gas, petroleum, sand and gravel.
Sumner	7,942,960	7,858,630	Petroleum, natural gas, sand and gravel.
Thomas	98,000	100,000	Sand and gravel.
Trego	4,657,466	4,568,975	Petroleum, sand and gravel.
Wabaunsee	765,775	719,528	Petroleum, stone, sand and gravel.
Wallace	72,203	W	Stone, sand and gravel.
Washington	156,000	165,307	Sand and gravel, stone.
Wichita	18,194	14,148	Sand and gravel, petroleum.
Wilson	5,206,504	5,555,222	Cement, petroleum, stone, clays, natural gas.
Woodson	2,686,339	2,662,154	Petroleum, stone, natural gas.
Wyandotte	8,156,784	8,419,583	Cement, stone, sand and gravel.
Undistributed	3,461,181	4,036,282	
Total	538,210,000	553,491,000	

r Revised.
W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

tional Gypsum Co. Natural gas liquids were recovered by Skelly Oil Co. at its Medicine Lodge plant. Sand and gravel for building and paving was produced by Whitfield Sand & Gravel, Burl Gaunt, and the county highway department. Exploratory drilling resulted in the discovery of Deerhead North oilfield.

Barton.—Barton County ranked fifth in value of mineral production and third in value of petroleum production. Evaporated salt from brine wells was produced by Pawnee Salt Co. Kansas Brick & Tile Co. used fire clay in building brick. Du Bois & Stone Sand Co., Arkansas Sand Co., Klepper Sand Co., and the county highway department produced sand and gravel for building, paving, and fill uses. Three important oilfield discoveries during the year were Axman Northeast, Mater, and Twenty.

Bourbon.—Natural and masonry cement were produced near Fort Scott by Fort Scott Hydraulic Cement Co., Inc. Dimension sandstone was quarried and prepared near Redfield by Bandera Stone Co., Inc. Cullor Limestone Co., Inc., and Fort Scott Hydraulic Cement Co., Inc., quarried and crushed limestone for concrete aggregate, roadstone, agstone, mineral filler, and coal mine dusting. Coal was strip mined by Palmer Coal Co.

Butler.—The county ranked fifth in value of petroleum production. Mobil Oil Co., Inc., operated its refinery at Augusta. Mobil Chemical Co. was adding a 1,400-barrel-per-day propylene alkylation unit to its existing 2,400-barrel-per-day butylene alkylation facility. Mobil Chemical Co. produced carbon black oils and sodium cresylate solutions, using petroleum fractions as feedstock. Skelly Oil Co. operated

its refinery at El Dorado; the company also operated its aromatics complex to produce phenol acetone, benzene, toluene, and other naphtha compounds, using naphtha fractions as feedstock. Vickers Petroleum Co., Inc., produced benzene, toluene, xylenes, and other chemicals at its Potwin petrochemical plant using catalytic reformate as feedstock, its refinery at Potwin was shut down at yearend. American Petrofina Co. of Texas operated a refinery at El Dorado.

George M. Myers, Inc., Carr Rock Products Co., Starnes Excavation Co., and the county highway department quarried and crushed limestone for concrete aggregate, roadstone, agstone, and riprap.

Chase.—Dimension limestone was quarried and prepared by J. T. Lardner Cut Stone Co., Bayer Stone, Inc., and H. J. Born Stone Co. Crushed limestone was produced by Riddle Quarries, Inc., and Anderson-Oxandale. The county highway department produced limestone for riprap and gravel for paving and road maintenance.

Cherokee.—The county ranked first in coal production. Pittsburg & Midway Coal Co. and Wilkinson Coal Co. strip mined coal. The entire production of lead and zinc in Kansas was mined in Cherokee County.

Spencer Chemical Co. produced ammonia, nitric acid, fertilizers, Dry Ice, and methanol, using natural gas as feedstock at its plant near Baxter Springs.

Southwest Rock & Chat Co. furnished chat for concrete aggregate and roadstone. John J. Stark, contractor, mined and crushed limestone for concrete aggregate and roadstone. Miscellaneous clay was mined near Weir by Acme Brick Co.; stoneware clay was mined for the Pittsburg Pottery Co., Inc.

Clay. — Limestone was quarried and crushed for riprap, concrete aggregate, and roadstone by Anderson-Oxandale, Blake Stone, and Riddle Quarries, Inc. Building and paving sand and gravel and fill sand was produced by John H. Alsop Sand Co. and Clay Center Concrete & Sand Co., Inc.

Cloud.—Cloud County ranked first in value of clay production. Fire clay for building brick was mined by Cloud Ceramics. Fyfe Sand & Gravel Co. produced sand and gravel for building. Dimension limestone was quarried and prepared by Prickett, Inc.

Cowley.—The county ranked high in petroleum production. Apco Oil Corp. operated its refinery at Arkansas City. Dimension limestone was quarried and prepared by H. J. Born Stone Co., Silverdale Limestone Co., and John V. Elam. Crushed limestone for concrete aggregate, roadstone, and agstone was produced by Daniels Stone Co. Building, paving, and fill sand and gravel, railroad ballast, and engine sand were produced by seven producers; the three largest were Oxford Sand & Gravel Co., Inc., Carr Rock Products Co., and Andrews Sand & Gravel, Inc.

Crawford. — Crawford County ranked second in coal production and fifth in value of clay output. Clemens Coal Co. operated two strip mines and Cliff Carr Coal Co. operated one strip mine. W. S. Dickey Clay Manufacturing Co. and Pittsburg Pottery Co., Inc., used fire clay and miscellaneous clay for sewer pipe and stoneware. John J. Stark, contractor, quarried and crushed limestone for concrete aggregate, roadstone, and agstone.

Douglas.—Holliday Sand & Gravel Co. and Bowersock Mills & Power Co. produced sand and gravel for building, paving, and fill. Limestone was quarried and crushed for concrete aggregate, roadstone, and agstone by Killough-Clark, Inc. Cooperative Farm Chemicals Association produced ammonia, ammonium nitrate, ammonium phosphate, nitric acid, urea nitrate solutions, and fertilizers, using natural gas as feedstock, at its plant near Lawrence.

Ellis. — Ellis County ranked second in petroleum production and fourth in total value of mineral production. Hunter Ready Mix Co., Inc., Lewis C. Schmidtberger, Siebert Sand Co., Inc., and the county highway department produced sand and gravel for building, paving, and fill uses. Limestone was quarried and crushed for concrete aggregate and roadstone by Aubel Asphalt Co. and the county highway department. Dechant West, Gatschet, Mixer, and Wallace oilfields were important discoveries during 1965.

Ellsworth. — Ellsworth County ranked first in production of natural gas liquids. Northern Gas Products Co., subsidiary of Northern Natural Gas Co., operated its

natural gas liquids extraction plant at Bushton. Northern Helex Co., another subsidiary of Northern Natural Gas Co., operated its helium extraction plant adjacent to the natural gas liquids plant. Independent Salt Co. mined salt near Kanopolis. Truhlars Ready Mix Concrete, Stoppel Construction Co., and the county highway department produced sand and gravel for building, paving, and road maintenance. Acme Brick Co. and Kansas Brick & Tile Co. mined clay for building brick.

Franklin.—Buildex, Inc., expanded shale for lightweight aggregate at its plant near Ottawa; the shale was mined near the plant. Fogle Quarry, Concrete Materials Division, Martin Marietta Corp., and Killough-Clark, Inc., quarried and crushed limestone for concrete aggregate, roadstone, and agstone.

Geary.—Dimension limestone was quarried and prepared by Junction City Stone Co. Walker Cut Stone Co. and Bayer Construction Co., Inc., quarried and crushed limestone for concrete aggregate and roadstone. More Sand Co., Inc., and Junction City Sand & Gravel Co. produced sand and gravel for building, paving, fill, and other construction purposes. Milford Dam, on the Republican River, was being constructed by the U.S. Army Corps of Engineers.

Grant.—The county ranked second in value of natural gas liquids, natural gas production, and helium production, and first in value of mineral production. Four natural gasoline plants were in operation, two by Pan American Petroleum Corp., and one each by Hugoton Production Co. and Mobil Oil Co. Helium was extracted by Cities Service Helex at its Jayhawk plant near Ulysses. Columbian Carbon Co. produced carbon black at its Hickok plant. The county highway department obtained gravel for paving and road maintenance.

Jefferson.—Limestone was quarried and crushed for concrete aggregate, roadstone, riprap, and agstone by N. R. Hamm Quarry, Inc., and Roy Baker Quarry, Inc. The U.S. Army Corps of Engineers progressed in construction of Perry Dam on the Delaware River.

Jewell.—Ideal Cement Co. quarried limestone for cement at its plant near Superior, Nebr. Anderson-Oxandale and the county highway department quarried and crushed limestone for concrete aggregate, riprap, and roadstone. Gravel for paving and road maintenance was obtained by the county highway department.

Johnson.—The county ranked second in value of stone production. Union Construction Co. and Deitz-Hill Development Co. quarried and crushed limestone for concrete aggregate, roadstone, and agstone. Building, paving, and fill sand and building gravel were produced by Holliday Sand & Gravel Co. and Builders Sand Co.

Kearny.—The county ranked fourth in value of natural gas production. Natural gas liquids were recovered by Colorado Interstate Gas Co. at its Lakin plant. Kansas-Nebraska Natural Gas Co. shut down its Deerfield natural gas liquids processing plant. Popejoy Sand & Gravel Co., Kearny County Highway Department, and Grant County Highway Department produced fill and paving sand and gravel.

Leavenworth.—Limestone was quarried and crushed for concrete aggregate, roadstone, riprap, and agstone by Concrete Materials Division, Martin Marietta Corp., Geiger Construction Co., Kansas State Penitentiary, and N. R. Hamm Quarry, Inc. Sand for fill and other uses was produced by Missouri Valley Sand, Inc.

Lincoln. — Quartzite Stone Co., Inc., quarried and crushed sandstone for concrete aggregate, roadstone, riprap, railroad ballast, and filter use. Volcanic ash was produced by San Ore Construction Co. and Ernest Hanzlicek.

Marion. — Rounds & Stewart Natural Gasoline Co., Inc., recovered natural gas liquids at its plant near Marion. Riddle Quarries, Inc., Anderson-Oxandale, and The Walt Keeler Co., Inc., quarried and crushed limestone for concrete aggregate, roadstone, agstone, and riprap. The U.S. Army Corps of Engineers was constructing Marion Dam on the Cottonwood River.

Marshall.—Georgia-Pacific Corp. mined gypsum near Blue Rapids and produced plaster and plaster products. Limestone was quarried and crushed for concrete aggregate, roadstone, and agstone by Koppes Brothers, Bayer Construction Co., Inc., and Hopper Bros. Quarry. Blue River Sand & Gravel Co., Heinzelman Construction Co., and the county highway department produced sand and gravel for building, paving, and fill uses.

McPherson.—National Cooperative Refinery Association operated its petroleum refinery at McPherson. Shale was mined and expanded for lightweight shale aggregate by Buildex, Inc., at its plant near Marquette. The county highway department obtained sand for road maintenance.

Mitchell.—Haigh Sand & Gravel and Ed Hartman produced sand and gravel for paving and fill. Glen Elder Dam was being constructed on the Solomon River by the Federal Bureau of Reclamation.

Montgomery.—The county ranked third in value of clay output and fourth in value of stone output. Shale and limestone for portland and masonry cements were mined by Universal Atlas Cement, Division of United States Steel Corp. H & S Rock Co., Nelson Bros. Quarries, John J. Stark, contractor, C. W. Roweth Co., Carr Rock Products, Inc., and the county highway department quarried and crushed limestone for concrete aggregate, roadstone, railroad ballast, riprap, and agstone. CRA, Inc., formerly Cooperative Refinery Association, operated its petroleum refinery at Coffeyville. Elk City Dam was being constructed on the Elk River by the U.S. Army Corps of Engineers.

Morton. — The county ranked third in value of natural gas production. Natural gas liquids were recovered by Anadarko Production Co. at its Interstate plant near Elkhart, Kans., and Cities Service Oil Co. at its Wilburton plant. Alamo Chemical Co., subsidiary of Phillips Petroleum Co., expects to complete its 76-million-cubic-foot-per-day gas-processing plant during the second half of 1966. The plant, located near Elkhart, will recover 400,000 cubic feet of helium per day.

Neosho.—Ash Grove Lime & Portland Cement Co. completed rebuilding its plant at a cost of $10 million. Maximum annual production was increased from 6 million sacks of cement or lime to 11 million sacks. Harry Byers & Sons, Inc., O'Brien Rock Crusher, and the county highway department quarried and crushed limestone for concrete aggregate, roadstone, and agstone. Hy-Grade Construction & Materials produced sand and gravel for building, paving, fill, and filtration uses. Mid-America Refining Co., Inc., operated its petroleum refinery at Chanute.

Ness.—Siebert Sand Co., Inc., and the county highway department produced sand for paving and road maintenance. Anderson-Oxandale and the county highway department quarried and crushed limestone for concrete aggregate and roadstone. Important oilfield discoveries were Osgood, Prairie Ridge, and Riverside.

Norton.—The county highway department produced crushed limestone for concrete aggregate and roadstone. Gravel for paving and road maintenance was produced by the county highway department and Siebert Sand Co., Inc. Volcanic ash was prepared near Calvert by Wyandotte Chemical Corp.

Ottawa.—Concrete Materials Division of Martin Marietta Corp., mined and crushed limestone for the Federal Bureau of Reclamation, Glen Elder Unit project. The county highway department produced gravel for paving.

Pawnee.—Johnson Sand & Gravel Co., Larned Sand & Gravel Co., and the county highway department produced sand and gravel for building, paving, fill, and other construction purposes. The Carpenter North gasfield was discovered.

Phillips.—CRA, Inc., formerly Cooperative Refinery Association, operated its petroleum refinery at Phillipsburg. San Ore Construction Co., Inc., Siebert Sand Co., Inc., and the county highway department produced sand and gravel for paving and road maintenance.

Pottawatomie.—Bayer Stone, Inc., prepared dimension limestone. Limestone was quarried and crushed for concrete aggregate and roadstone by Anderson-Oxandale, Concrete Materials Division, Martin Marietta Corp., and Bayer Construction Co., Inc. The county highway department and Anderson-Oxandale Co. produced sand and gravel for building, paving, and fill.

Reno.—Reno County ranked first in salt production and fourth in natural gas liquids output. The Carey Salt Co., Morton Salt Co., and The Barton Salt Co. produced evaporated salt from brine wells. The Carey Salt Co. also mined rock salt. J. E. Steele Sand & Gravel, Shears Sand Plant, Hoskinson Sand & Gravel Co., and others produced sand and gravel for building, paving, and fill. Cities Service Oil Co. recovered natural gas

liquids at its fractionation plant in Hutchinson. Cheney Reservoir on the Ninnescah River was completed by the Bureau of Reclamation.

Republic.—Sand and gravel for building, paving, road maintenance, and fill was produced by John H. Alsop Sand Co., Reece-Johnson, Inc., and the county highway department. Limestone was quarried and crushed for concrete aggregate and roadstone by the county highway department.

Rice. — The county ranked fourth in value of petroleum production. American Salt Corp. produced evaporated salt from brine wells and mined rock salt near Lyons. Tobias & Birchenough, Inc., and Arensman Sand & Gravel Co. produced building and paving sand. Limestone was quarried and crushed for concrete aggregate, roadstone, agstone, and riprap by Riddle Quarries, Inc., and the county highway department.

Riley.—Kershaw Ready-Mix Concrete & Sand Co., Inc., produced sand for building and paving uses. Dimension limestone was quarried and prepared by Bayer Stone, Inc. Limestone was quarried and crushed for concrete aggregate and roadstone by Grosshans & Petersen, Inc., Bayer Construction Co., Inc., and Anderson-Oxandale.

Rush.—Kansas Refined Helium Co. expects to complete its 24-million-cubic-foot-per-day plant during the first half of 1966. The plant is located near Otis, and will recover 500,000 cubic-foot-per-day of helium. Sand for paving and road maintenance was obtained by the county highway department. Exploratory drilling resulted in discovery of Schadel oilfield.

Russell.—The county ranked third in value of mineral production and first in value of petroleum production. San Ore Construction Co., Inc., Siebert Sand Co., Inc., and the county highway department produced sand and gravel for paving and road maintenance.

Scott.—Century Refining Co. operated its petroleum refinery at Shallow Water. Kansas-Nebraska Natural Gas Co. scheduled completion of a 200-million-cubic-foot-per-day refrigeration plant for January 1966. The plant will be located near Scott City, and produce 15,000 gallons of butane and 40,000 gallons of gasoline per day.

Sedgwick.—Sedgwick County ranked second in value of sand and gravel production and fifth in recovery of natural gas liquids. Sand and gravel was produced by 16 commercial producers in 1965. Leaders were Superior Sand Co., Inc., Miles Sand, Inc., Dolese Bros. Co., and Walt Keeler Co., Inc. The city of Wichita quarried limestone for riprap. Frontier Chemicals Division, Vulcan Materials Co., announced a $2 million expansion of its facilities at Wichita. Brine is pumped from wells to manufacture chlorine and caustic soda; the company also produced ammonia from natural gas. Cities Service Oil Co. recovered natural gas liquids at its Wichita plant. Derby Refining Co. operated its petroleum refinery at Wichita. Dodson Manufacturing Co., Inc., of Wichita, exfoliated vermiculite, using crude vermiculite produced out of State.

Seward.—National Helium Corp. operated its helium extraction plant near Liberal and the county ranked first in value of helium production. Natural gas liquids were recovered by National Helium Corp., Anadarko Production Co., and Northern Natural Gas Co.

Shawnee.—Shawnee County ranked third in value of sand and gravel production and third in value of stone output. Sand and gravel was produced by six commercial operators; the leaders were Kansas Sand Co., Inc., Consumers Sand Co., and Victory Sand & Concrete, Inc. Limestone for concrete aggregate, roadstone, riprap, and agstone was quarried and crushed by Concrete Materials Division, Martin Marietta Corp., N. R. Hamm Quarry, Inc., and Henry C. Luttjohann, Inc.

Stevens.—The county was first in value of natural gas production. The county highway department produced sand for road maintenance.

Wallace.—Diatomaceous marl was quarried near Edson by DeLore Division, National Lead Co. Principal uses were as paint filler and whiting material. Paving sand was produced by Siebert Sand Co., Inc.

Wilson.—The county ranked fourth in value of clay output. Shale and limestone for manufacture of portland and masonry cements were mined by Victor Division, General Portland Cement Co. Shale for building brick was mined by Excelsior Brick Co. and Acme Brick Co. Carr Rock

Products Co. and Benedict Rock & Lime Co. quarried and crushed limestone for concrete aggregate, roadstone, agstone, and riprap. American Oil Co. operated its petroleum refinery at Neodesha.

Wyandotte.—The county ranked first in value of stone production and first in value of sand and gravel production. Lone Star Cement Corp. quarried limestone and manufactured portland and masonry cements at its Bonner Springs plant. Thompson-Strauss Quarries and J. A. Tobin Construction Co. quarried and crushed limestone for concrete aggregate, riprap, and roadstone. Sand and gravel, mainly for building and paving, was produced by seven producers; the largest producer was Holliday Sand & Gravel Co. Crude perlite, mined out of State, was expanded by Lite Weight Products, Inc., at its Kansas City plant for use as building material.

Phillips Petroleum Co. operated its petroleum refinery at Kansas City; the company produced rubber extender and process oils, using petroleum fractions as feedstock. Reichold Chemicals, Inc., produced phenol-formaldehyde resins, polyvinyl acetate emulsions, and formaldehyde at its chemical plant in Kansas City.

The Mineral Industry of Kentucky

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U. S. Department of the Interior, and the Kentucky Geological Survey, for collecting information on all minerals except fuels.

By H. L. Riley [1] and Preston McGrain [2]

Mineral production value in Kentucky in 1965 increased 5 percent, the second highest production value on record, but was 8 percent below 1948, the record year. The value of coal production increased 5 percent and the total tonnage increased 4 percent for a new record. Among the States, Kentucky ranked second in production of bituminous coal, with 17 percent of the national total, and ranked second in production of ball clay and fluorspar, with 13 percent of the national total.

Coal mining dominated the Kentucky mineral industry and supplied 70 percent of the total value for 1965, the same percentage as in 1964. Leading companies, based on value of production, were Peabody Coal Co., Island Creek Coal Co., P & M Coal Co., and U.S. Steel Corp.

Trends and Developments.—Tennessee Valley Authority (TVA) announced plans to build a $130 million steam-electric generating unit at the Paradise steam plant in Muhlenberg County. The new unit has a planned capacity of 1.3 million kilowatts and will burn up to 10,500 tons of coal per day. TVA awarded a $92 million coal contract to Republic Coal & Coke Co. for 31.3 million tons of coal over a 12-year period. The coal is to be delivered to truck hoppers at the Paradise plant. TVA coal contracts require reclamation of lands which are stripped to supply coal to TVA's steam plants.

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Table 1.—Mineral production in Kentucky [1]

Mineral	1964 Quantity	1964 Value (thousands)	1965 Quantity	1965 Value (thousands)
Barite ---------- short tons	6,014	$96	------	------
Clays [2] ---------- thousand short tons	920	1,801	1,059	$2,580
Coal (bituminous) ---------- do	82,747	309,896	85,766	$24,523
Fluorspar ---------- short tons	38,214	1,693	31,992	1,485
Lead (recoverable content of ores) ---- do	858	225	756	236
Natural gas ---------- million cubic feet	76,940	18,257	78,976	18,638
Petroleum (crude) -- thousand 42-gallon barrels	19,772	56,746	19,386	55,638
Sand and gravel ---------- thousand short tons	6,560	6,297	6,742	6,332
Silver (recoverable content of ores) troy ounces	1,673	2	1,931	2
Stone [3] ---------- thousand short tons	21,868	29,594	26,029	34,533
Zinc (recoverable content of ores) -- short tons	2,063	561	5,654	1,651
Value of items that cannot be disclosed: Cement, ball clay, natural gas liquids, and dimension sandstone ----------	XX	19,211	XX	20,763
Total ----------	XX	444,379	XX	466,381

XX Not applicable.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Excludes ball clay, included with "Value of items that cannot be disclosed."
[3] Excludes dimension sandstone, included with "Value of items that cannot be disclosed."

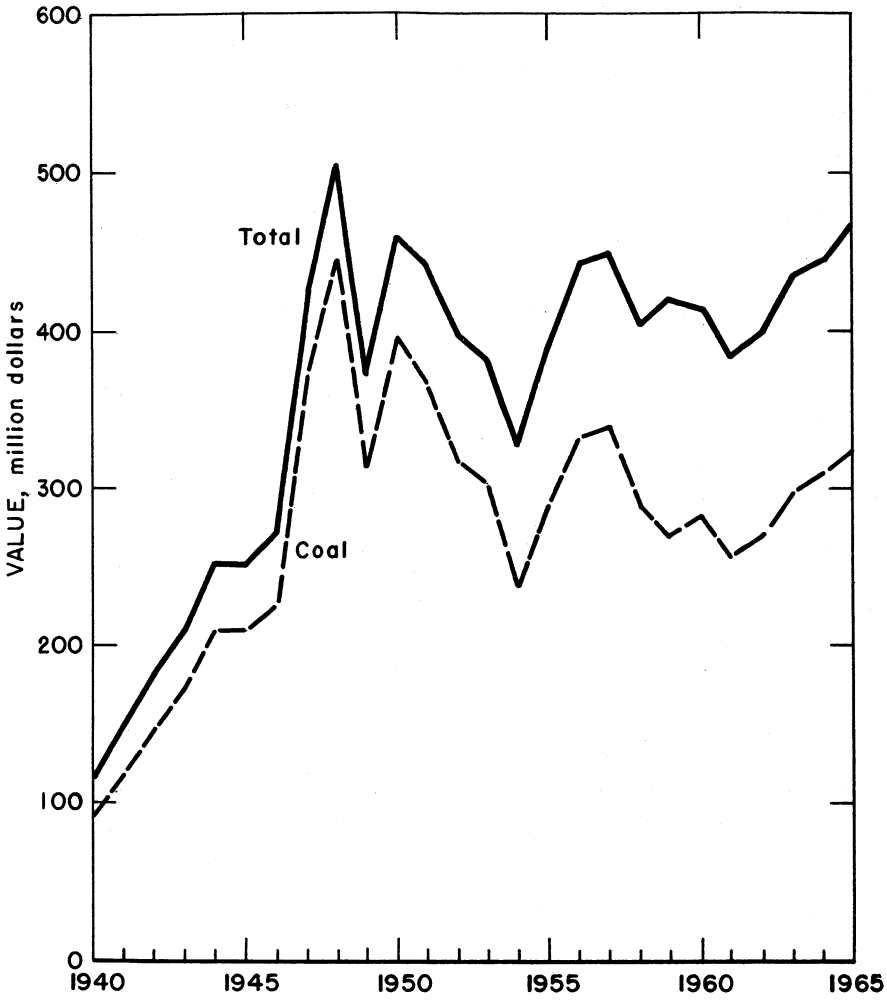

Figure 1.—Value of coal and total value of mineral production in Kentucky.

Table 2.—Value of mineral production in constant 1957–59 dollars

(Millions)

Year	Value
1956	$458
1957	439
1958	405
1959	429
1960	429
1961	402
1962	423
1963	468
1964	r 474
1965	p 498

p Preliminary. r Revised.

Kentucky Carbon Corp. announced plans to open a 1-million-ton-per-year underground coal mine in Pike County.

Legislation and Government Programs.—The Federal Geological Survey and the Kentucky Geological Survey continued the cooperative program of mapping the geology of the State on 7.5-minute quadrangles. At yearend 178 maps involving all or parts of 189 quadrangles had been published.

At yearend, a total of 303.9 miles of interstate highways and toll facilities had been completed to full or acceptable stand-

Table 3.—Employment and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1964:								
Coal	23,532	190	4,465	35,401	47	1,790	51.89	12,525
Metal and nonmetal	432	215	93	752	1	38	51.79	8,792
Sand and gravel	322	273	88	882	1	25	29.46	7,822
Stone	2,162	227	490	4,034	4	91	23.55	8,179
Total	26,448	194	5,136	41,069	53	1,944	48.63	11,929
1965:[p]								
Coal	23,200	179	4,151	33,270	41	1,875	57.59	12,466
Metal and nonmetal	430	249	107	854		64	74.94	1,436
Sand and gravel	275	258	71	709	1	26	38.08	9,306
Stone	2,230	222	496	4,078	3	120	30.16	6,485
Total	26,135	185	4,825	38,911	45	2,085	54.74	11,540

[p] Preliminary.

ards, and were open to traffic. An additional 416.1 miles were either under construction or work was in progresss on engineering or obtaining right-of-way.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

The 1965 value of bituminous coal, natural gas, and crude petroleum was $399 million and was responsible for 86 percent of the total mineral value of the State. The increase in value for 1965 over the 1964 value was 4 percent.

Coal (Bituminous).—Production of coal increased 4 percent and was 2 percent above the 1947 record. The value of coal production was $324,523,000 and was 27 percent below the 1948 record year. Bituminous coal was mined at 1,827 mines in 41 counties, compared with 2,002 mines in 42 counties in 1964. Leading counties were Muhlenberg, Pike, Hopkins, Letcher, and Harlan. Leading producing companies on the basis of tonnage were Peabody Coal Co., Island Creek Coal Co., P & M Coal Co., and Gibraltar Coal Co.

In the eastern Kentucky coalfield, 1,735 mines in 31 counties produced 46,567,000 tons, compared with 1,903 mines in 31 counties and 44,891,000 tons in 1964. Average production per mine increased from 24,000 tons to 27,000 tons. Underground mines produced 80 percent, auger mines 11 percent, and strip mines 9 percent of the total. Shipments were 85 percent by rail or water and 15 percent by truck. Captive tonnage was 15 percent of the total.

Equipment used at 1,548 underground mines included 1,083 cutting machines, which cut 74 percent of the tonnage; 1,526 power drills, which drilled 82 percent of the tonnage; 414 mobile loading machines, which loaded 52 percent of the tonnage; 53 continuous mining machines, with 6 mobile loaders used in conjunction, which produced 16 percent of the tonnage; and 32 hand-loaded conveyors upon which were loaded less than 1 percent of the tonnage. Other equipment included 685 locomotives, 655 shuttle cars, 695 shuttle buggies, and 141 gathering conveyors.

Equipment used at 73 strip mines included 92 power shovels, 4 draglines, 94 bulldozers, 27 power drills, and 91 trucks. An estimated 29 million cubic yards of overburden was removed.

Equipment used at 114 auger mines included 115 coal recovery augers, 2 power shovels, 53 bulldozers, 2 carryall scrapers, 8 power drills, and 110 trucks. Of the total coal production from the eastern Kentucky field, 37 percent was cleaned at 32 cleaning plants, 24 percent was crushed, and 11 percent was treated with oil or other materials.

In the western Kentucky coalfield, 92 mines in 10 counties produced 39.2 million tons compared with 99 mines in 11 counties producing 37.9 million tons in 1964.

Average production per mine increased from 382,000 tons to 426,000 tons. Underground mines produced 34 percent and strip mines 66 percent of the total. Shipments were 88 percent by rail or water and 12 percent by truck. All coal was sold on the open market.

Equipment used at 46 underground mines included 102 cutting machines, which cut 92 percent of the tonnage; 116 power drills, which drilled 92 percent of the tonnage; 99 mobile loading machines, which loaded 92 percent of the tonnage; and 10 continuous mining machines, which mined 8 percent of the tonnage. Other equipment included 78 locomotives, 197 shuttle cars, and 85 gathering conveyors.

Equipment used at 43 strip mines included 88 power shovels, 28 draglines, 126 bulldozers, 53 power drills, and 220 trucks. An estimated 242 million cubic yards of overburden was excavated.

Equipment used at three auger mines included three recovery augers, one dragline, and four bulldozers.

Twenty-eight cleaning plants cleaned 71 percent of the coal produced; 60 percent was crushed, and 8 percent was treated with oil or calcium chloride.

Coke.—Two companies produced coke in Boyd and Marshall Counties; Allied Chemical Corp. and New York Mining & Mfg. Co.

Natural Gas.—Marketed production of natural gas increased 1 percent but was 19 percent below the 1947 record. Kentucky's Appalachian area continued to be the principal gas-producing area, yielding 68 billion cubic feet of the State's total. In-

Table 4.—Coal (bituminous) production, by counties

County	1964		1965	
	Short tons	Value	Short tons	Value
Bell	2,067,620	$7,040,717	2,247,149	$6,891,231
Boyd	41,164	154,958	30,736	121,038
Breathitt	260,164	963,982	470,833	1,415,484
Butler	187,038	784,653	170,000	657,760
Carter	27,006	107,705	19,155	77,769
Christian	13,573	68,685	36,354	132,423
Clay	1,484,790	5,848,581	1,482,991	5,906,475
Clinton	13,801	57,964	11,500	46,690
Daviess	876,601	2,287,545	1,052,780	2,717,377
Elliott	13,852	63,580	8,251	36,799
Floyd	4,679,505	25,404,228	4,957,516	26,123,150
Hancock	1,000	3,240	4,000	12,000
Harlan	5,641,856	28,439,463	5,634,624	29,065,220
Henderson	155,227	404,270	154,901	399,644
Hopkins	10,263,283	34,425,922	9,794,918	33,874,689
Jackson	44,631	219,443	21,581	86,324
Johnson	261,586	845,556	214,092	622,782
Knott	2,058,662	6,248,342	2,371,683	7,456,233
Knox	266,938	931,947	W	W
Laurel	136,651	523,124	W	W
Lawrence	8,789	29,069	2,800	9,408
Lee	61,105	244,420	23,900	119,500
Leslie	1,806,531	7,452,254	1,864,239	7,776,388
Letcher	5,573,790	24,218,520	5,787,726	24,062,912
Magoffin	95,805	318,072	62,333	193,232
Martin	196,526	820,329	406,180	1,313,916
McCreary	465,709	1,629,981	466,532	1,665,519
McLean	18,498	52,349	---	---
Morgan	36,687	167,363	62,199	286,246
Muhlenberg	17,634,686	56,225,558	17,613,846	56,482,664
Ohio	4,567,237	14,743,766	5,039,971	16,343,167
Owsley	9,200	27,600	3,500	10,500
Perry	3,944,118	11,295,230	3,922,686	16,297,408
Pike	14,836,047	59,812,149	15,420,122	60,808,493
Pulaski	158,212	525,636	272,524	1,230,412
Rockcastle	1,100	4,620	---	---
Union	4,067,691	15,140,064	5,315,584	19,198,873
Wayne	52,500	149,000	21,384	60,819
Webster	70,985	184,868	16,711	51,527
Whitley	638,263	1,994,444	541,230	2,140,772
Wolfe	8,744	36,725	4,000	16,240
Undistributed	---	---	235,180	811,769
Total	82,747,171	309,895,922	85,765,711	324,522,853
Earliest record to date	3,004,000,000	NA	3,089,766,000	NA

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
NA Not available.

creases in western Kentucky's gas production came primarily from Hopkins and Muhlenberg Counties.

Natural Gas Liquids.—*Natural Gasoline.*—Production of natural gasoline decreased 1 percent, and was 51 percent below the 1958 record.

LP Gases.—Production of liquefied petroleum (LP) gases increased 2 percent, but was 15 percent below the 1956 record.

Petroleum.—Oil production in Kentucky for 1965 was 19,386,000 barrels, a decrease of 386,000 barrels from the 1964 production. Sixty-one of the State's 120 counties contributed to the total production.

Henderson County in western Kentucky continued to be the leading oil-producing county with 3,610,474 barrels. Other western Kentucky counties producing more than 1 million barrels in 1965 were Union, McLean, Daviess, Webster, and Hopkins. Lee County led eastern Kentucky counties with 2,604,011 barrels.

A total of 2,200 wells were drilled in 1965; 807 were completed as oil wells; 209 were completed as gas wells; 157 were water injection wells for secondary recovery; 43 were injection wells for gas storage; and 984 were reported as dry holes. Daviess, Henderson, Hopkins, McLean, Metcalfe, Muhlenberg, and Ohio Counties had more than 100 completions each.

The discovery of oil near Sulphur Lick in northern Monroe County started a small oil boom in south-central Kentucky. Some of the wells had initial production rates of 200 to 300 barrels per day from depths of about 300 feet. The pay zone was an Upper Ordovician limestone.

The sale of mineral rights at Camp Breckinridge in Henderson, Union, and Webster Counties in western Kentucky by the Federal Government created a major exploration program in that area. Although the drilling and production statistics for the Camp Breckinridge property have not been completely released by the operating companies, it is known that a number of new oilfields have been discovered.

Table 5.—Crude petroleum production by counties

County	1964		1965	
	Barrels	Value	Barrels	Value
Adair	---	---	2,213	$6,351
Allen	69,445	$202,779	65,039	186,661
Barren	19,364	56,543	18,355	52,678
Bath	4,784	13,969	4,216	12,099
Bell	82	239	259	743
Boyd	39	114	37	106
Breathitt	64,132	187,265	52,506	150,692
Breckinridge	55,405	161,783	35,504	101,896
Butler	136,920	399,806	117,865	338,272
Casey	11,604	33,884	12,118	34,778
Christian	487,125	1,422,405	429,771	1,233,442
Clay	---	---	16,643	47,765
Clinton	62,039	181,154	52,902	151,828
Crittenden	390	1,139	251	720
Cumberland	42,216	123,271	54,972	157,769
Daviess	1,610,140	4,701,609	1,479,103	4,245,025
Edmonson	1,244	3,632	945	2,712
Elliott	49,995	145,985	55,298	158,705
Estill	164,265	479,654	164,216	471,300
Floyd	25,283	73,826	30,107	86,407
Green	185,240	540,901	136,022	390,383
Greenup	521	1,521	833	2,390
Hancock	185,187	540,746	165,246	474,256
Hart	50,653	147,907	44,433	127,522
Henderson	4,014,257	10,733,389	3,610,474	10,362,269
Hopkins	1,520,849	4,440,879	1,089,817	3,127,774
Jackson	878	2,564	835	2,396
Johnson	393,876	1,150,118	536,630	1,540,128
Knott	12,320	35,974	11,134	31,954
Knox	1,796	5,244	1,953	5,605
Laurel	565	1,650	1,485	4,261
Lawrence	534,442	1,560,571	521,578	1,496,928
Lee	2,467,917	7,206,318	2,604,011	7,473,511
Leslie	2,348	6,856	3,328	9,551
Letcher	10,114	29,533	13,599	39,029
Lincoln	3,109	9,078	4,332	12,432
Logan	1,642	4,795	927	2,660
Magoffin	882,841	2,577,896	734,018	2,106,631

Table 5.—Crude petroleum production by counties—Continued

County	1964		1965	
	Barrels	Value	Barrels	Value
Martin	14,954	$43,666	14,187	$40,716
McCreary	4,131	12,063	4,290	12,312
McLean	1,167,065	3,407,830	1,502,797	4,313,027
Menifee	1,563	4,564	1,199	3,441
Metcalfe	233,179	680,883	273,433	784,752
Monroe	4,006	11,698	22,988	65,975
Morgan	899	2,625	1,077	3,090
Muhlenberg	485,288	1,417,041	675,556	1,938,845
Ohio	891,672	2,603,682	747,190	2,144,435
Owsley	934	2,727	994	2,852
Perry	26,011	75,952	25,315	72,654
Pike	37,775	110,303	34,087	97,829
Powell	197,285	576,072	146,979	421,829
Russell	2,297	6,707	1,876	5,384
Simpson	5,273	15,397	6,282	18,029
Taylor	1,016	2,967	1,218	3,495
Todd	3,169	9,253	1,434	4,115
Union	2,116,903	6,181,357	2,507,590	7,196,783
Warren	38,991	113,854	36,842	105,736
Wayne	17,092	49,909	20,539	58,946
Webster	1,404,979	4,102,539	1,249,244	3,585,330
Whitely	18,462	53,909	19,793	56,806
Wolfe	26,029	76,005	18,115	51,990
Total	19,772,000	56,746,000	19,386,000	55,638,000
Earliest record to date	r 491,447,000	r 1,154,746,000	510,833,000	1,210,384,000

r Revised.
Source: Kentucky Geological Survey.

NONMETALS

Production of nonmetals accounted for 15 percent of the total value of mineral production in the State.

Cement.—Kosmos Portland Cement Co. operated the Kosmosdale plant throughout 1965. Shipments of portland cement increased 16 percent but were 13 percent below the 1963 record year. Shipments of masonry cement increased 9 percent and were 9 percent above the 1963 record year. Raw materials used in portland cement included limestone (80 percent), miscellaneous clay (16 percent), gypsum (3 percent), and iron ore (1 percent).

Clays.—Kentucky ranked second in the United States in ball clay production. Kentucky-Tennessee Clay Co. and Old Hickory Clay Co. mined ball clay at three mines in Graves County. Ten companies mined fire clay at 18 mines in three counties for firebrick, mortar, and other uses. Leading producers were General Refractories Co., Davis Firebrick Co., and M. A. McCoy & Sons. Production icreased 112 percent but was 55 percent below the 1951 record. Total production was 221,000 tons valued at $1,447,000.

Miscellaneous clay was mined by 13 companies at 14 mines in 9 counties for heavy clay products, lightweight aggregate, and cement. Leading producers were Kentucky Light Aggregates, Inc., Kosmos Portland Cement Co., and General Shale Products Co. Production increased 3 percent over that of 1964, the record year. Total production was 838,000 tons valued at $1,132,000.

Fluorspar.—In Livingston County, fluorspar was mined for use in manufacturing hydrofluoric acid, glass, steel, ceramics, ferroalloys, and for use in iron foundries. The producers were Calvert City Chemical Co. (Dyer's Hill mine) and Nancy Hanks Mines, Inc. (Nancy Hanks mine). Total shipments were 32,000 tons valued at $1,485,000. Marketable production was 33,000 tons valued at $1,534,000, a decline of 6 percent, and was 77 percent below the 1941 record.

Lime.—National Carbide Co. calcined sludge to produce captive byproduct lime in plants in Marshall and Jefferson Counties.

Perlite.—Great Lakes Carbon Corp. of Kentucky expanded perlite, mined in the Western States, at the Florence plant. The perlite was used in the manufacture of insulation board. W. R. Grace & Co. expanded perlite at the Wilder plant near Newport.

Sand and Gravel.—Sand and gravel was mined by 23 producers, including the State and county highway departments, at 29 mines in 20 counties. Leading counties were Jefferson, Boone, and Trimble. Leading producers were Standard Materials Corp., Ohio River Sand Co., and Evansville Materials, Inc. Production increased 3 percent over the 1964 record. Of the total production, 87 percent was prepared. Of the commercial production, 60 percent was hauled by truck, 31 percent by water, and 9 percent by rail.

Stone.—Eighty-one producers crushed limestone at 112 quarries in 66 counties. Leading counties were Livingston, Hardin, and Jefferson. Leading producers were Reed Crushed Stone Co., Inc. (Livingston County), Kentucky Stone Co. (Anderson, Breckinridge, Hardin, Jessamine, Laurel, Lee, Logan, Rockcastle, and Todd Counties), and Geoghegan & Mathis, Inc. (Henry, Nelson, and Pendleton Counties). Production increased 19 percent and was 5 percent above the 1963 record. Of the total commercial tonnage, 82 percent was hauled by truck, 6 percent by rail, and 12 percent by water.

Vermiculite.—W. R. Grace & Co. exfoliated vermiculite from other States at the Wilder plant.

Table 6.—Sand and gravel sold or used by producers, by counties

(Thousand short tons and thousand dollars)

County	1964		1965	
	Quantity	Value	Quantity	Value
Ballard	28	$16	30	$18
Boone	W	W	1,357	1,340
Carlisle	19	12	25	16
Fulton	29	15	27	14
Graves	58	29	56	28
Hickman	28	14	28	14
Jefferson	2,432	2,292	2,012	1,693
Livingston	61	49	----------	----------
Lyon	13	7	----------	----------
Marshall	40	19	76	38
Martin	----------	----------	23	20
Mason	68	108	71	111
Pike	4	4	4	4
Union	80	89	34	36
Other counties [1]	3,700	3,643	2,999	3,000
Total	6,560	6,297	6,742	6,332

W Withheld to avoid disclosing individual company confidential data; included with "Other counties."

[1] Includes Breckinridge, Calloway, Carroll (1965), Daviess, Gallatin, Henderson, Logan (1964), Marion (1964), McCracken, Oldham (1965), and Trimble Counties, and counties indicated by symbol W.

Table 7.—Sand and gravel sold or used by producers, by uses

(Thousand short tons)

Use	1964			1965		
	Quantity	Value		Quantity	Value	
		Total	Average per ton		Total	Average per ton
Sand:						
Structural	1,972	$2,044	$1.04	2,104	$2,119	$1.01
Paving	1,962	1,726	.88	1,499	1,308	.87
Fill	616	376	.61	800	475	.59
Gravel:						
Paving	1,239	1,300	1.05	1,383	1,423	1.03
Structural	614	697	1.14	745	823	1.10
Fill	104	61	.59	161	89	.55
Total sand and gravel [1]	6,560	6,297	.96	6,742	6,332	.94

[1] Includes molding, engine (1965), and other sands; railroad ballast (1965), and other gravel.

Table 8.—Crushed limestone sold or used by producers, by counties

County	1964		1965	
	Short tons	Value	Short tons	Value
Barren	196,000	$312,200	W	W
Bourbon	385,000	476,600	W	W
Boyle	387,596	547,952	228,248	$354,637
Calloway	105,668	159,604	208,606	312,787
Carter	902,846	1,230,967	415,605	571,625
Casey	105,500	182,250	91,123	155,273
Christian	1,010,962	1,089,181	943,876	1,118,265
Fayette	1,368,724	2,003,856	1,073,420	1,530,961
Garrard	94,755	131,357	97,984	149,200
Hardin	695,348	966,995	2,280,628	2,580,672
Hart	166,115	232,592	W	W
Jefferson	1,547,898	2,168,994	1,652,606	2,529,036
Kenton	4,333	6,500	5,734	8,585
Marion	W	W	139,000	273,000
Meade	W	W	887,271	1,328,747
Menifee	W	W	85,845	138,922
Monroe	109,720	168,700	125,000	156,040
Montgomery	63,200	94,800	76,800	91,460
Morgan	332,387	445,416	478,067	564,072
Muhlenberg	351,054	403,868	W	W
Nicholas	23,100	56,200	44,000	88,000
Oldham	484,533	618,600	508,000	620,200
Other counties [1]	13,533,275	18,296,905	16,686,761	21,960,902
Total	21,868,014	29,593,537	26,028,574	34,532,384

W Withheld to avoid disclosing individual company confidential data; included with "Other counties."

[1] Includes Adair, Allen, Anderson, Breckinridge, Butler, Caldwell, Clinton, Crittenden, Cumberland, Edmonson, Estill, Fleming, Franklin, Grayson, Green, Harlan, Harrison, Henry, Jackson, Jessamine, Laurel, Lee, Letcher, Livingston, Logan, Madison, Mercer, Metcalfe, Nelson, Ohio, Pendleton, Pike, Powell, Pulaski, Rockcastle, Rowan, Scott, Simpson, Taylor (1964), Todd, Trigg, Warren, Washington, Wayne, and Wolfe (1965) Counties, and counties indicated by symbol W.

Table 9.—Crushed limestone sold or used by producers, by uses

Use	1964			1965		
		Value			Value	
	Short tons	Total	Average per ton	Short tons	Total	Average per ton
Concrete and roads	17,210,017	$23,762,183	$1.38	19,969,952	$27,345,994	$1.37
Agstone	1,795,999	2,521,667	1.40	2,221,865	3,120,335	1.40
Stone sand	14,000	21,000	1.50	32,400	35,246	1.09
Other [1]	2,847,998	3,288,687	1.15	3,804,357	4,030,809	1.06
Total	21,868,014	29,593,537	1.35	26,028,574	34,532,384	1.33

[1] Includes riprap, railroad ballast, asphalt filler (1965), cement, fluxing stone (1964), fertilizer filler (1964), and other uses.

METALS

Production of metals accounted for less than 1 percent of the total value of mineral production in Kentucky.

Lead.—Byproduct recovery of lead concentrate from fluorspar milling decreased 12 percent.

Pig Iron and Steel.—Armco Steel Corp. produced foundry and basic pig iron at Ashland; production was 35 percent greater than in 1964. Steel was produced by Armco Steel Corp. at Ashland, Interlake Steel Corp. at Newport, Green River Steel Corp. at Owensboro, and Kentucky Electric Steel Co. near Princess. Iron ore consumed was 1 percent domestic and 99 percent imported.

Silver.—Byproduct recovery of silver from milling of fluorspar ore increased 15 percent but was 6 percent below the 1961 record.

Zinc.—Production of zinc concentrate from the Hutson mine and from fluorspar milling increased 174 percent and was 64 percent above the 1951 record.

REVIEW BY COUNTIES

Of the 120 counties, 107 reported production, 1 less than in 1964. The leading counties were the large coal and petroleum producers; Pike, Muhlenberg, Hopkins, Harlan, Union, Floyd, and Letcher, which supplied more than 56 percent of the total mineral production value. In addition to detailed county production listed in table 9, natural gas and natural gas liquids, of undetermined county origin, were produced.

Adair.—Shamrock Stone Co. (Butler and Patton quarries) crushed limestone for concrete, roads, and agricultural stone (ag-

Table 10.—Value of mineral production in Kentucky, by counties [1]

County	1964	1965	Minerals produced in 1965 in order of value [2]
Adair	W	W	Limestone, petroleum.
Allen	W	W	Petroleum, limestone.
Anderson	W	W	Limestone.
Ballard	$16,000	$18,000	Sand and gravel.
Barren	368,743	W	Limestone, petroleum.
Bath	13,969	12,099	Petroleum.
Bell	7,040,956	6,891,974	Coal, petroleum.
Boone	W	1,340,000	Sand and gravel.
Bourbon	476,600	W	Limestone.
Boyd	253,312	195,544	Coal, miscellaneous clay, petroleum.
Boyle	547,952	354,637	Limestone.
Breathitt	1,151,247	1,566,176	Coal, petroleum.
Breckinridge	W	W	Limestone, petroleum, sand and gravel.
Bullitt	W	W	Miscellaneous clay.
Butler	W	W	Coal, petroleum, limestone.
Caldwell	W	W	Limestone.
Calloway	W	W	Limestone, sand and gravel.
Carlisle	12,000	16,000	Sand and gravel.
Carter	1,687,483	1,367,955	Fire clay, limestone, coal.
Casey	216,134	190,051	Limestone, petroleum.
Christian	2,584,299	2,488,713	Petroleum, limestone, coal, miscellaneous clay, sandstone.
Clay	5,848,581	5,954,240	Coal, petroleum.
Clinton	W	W	Petroleum, limestone, coal.
Crittenden	W	W	Limestone, petroleum.
Cumberland	W	W	Petroleum, limestone.
Daviess	W	W	Petroleum, coal, sand and gravel, miscellaneous clay.
Edmonson	W	W	Limestone, petroleum.
Elliott	209,565	195,504	Petroleum, coal.
Estill	W	W	Petroleum, limestone.
Fayette	2,003,856	1,530,961	Limestone.
Fleming	W	W	Do.
Floyd	r 25,478,054	26,209,557	Coal, petroleum.
Franklin	W	W	Limestone.
Fulton	15,000	14,000	Sand and gravel.
Gallatin	W	W	Do.
Garrard	131,357	149,200	Limestone.
Graves	W	W	Ball clay, sand and gravel.
Grayson	W	W	Limestone.
Green	W	W	Limestone, petroleum.
Greenup	110,451	322,990	Fire clay, petroleum.
Hancock	802,186	790,956	Petroleum, miscellaneous clay, coal.
Hardin	966,995	2,580,672	Limestone.
Harlan	W	W	Coal, limestone.
Harrison	W	W	Limestone.
Hart	380,499	W	Limestone, petroleum.
Henderson	W	W	Petroleum, sand and gravel, coal.
Henry	W	W	Limestone.
Hickman	14,000	14,000	Sand and gravel.
Hopkins	38,866,801	37,002,463	Coal, petroleum.
Jackson	W	W	Limestone, coal, petroleum.
Jefferson	W	W	Cement, limestone, sand and gravel, miscellaneous clay.
Jessamine	W	W	Limestone.
Johnson	1,995,674	2,162,910	Petroleum, coal.
Kenton	6,500	8,585	Limestone.
Knott	6,284,316	7,488,187	Coal, petroleum.
Knox	937,191	W	Coal, miscellaneous clay, petroleum.
Laurel	W	W	Coal, limestone, petroleum.
Lawrence	1,589,640	1,506,336	Petroleum, coal.
Lee	W	W	Petroleum, limestone, coal.
Leslie	7,459,110	7,785,939	Coal, petroleum.
Letcher	W	W	Coal, limestone, petroleum.
Lincoln	9,078	12,432	Petroleum.
Livingston	W	W	Limestone, zinc, fluorspar, lead, silver.

Table 10.—Value of mineral production in Kentucky, by counties [1]—Continued

County	1964	1965	Minerals produced in 1965 in order of value [2]
Logan	W	W	Limestone, petroleum.
Lyon	$7,000		
Madison	W	W	Limestone.
Magoffin	2,895,968	$2,299,863	Petroleum, coal.
Marion	W	273,000	Limestone.
Marshall	19,000	38,000	Sand and gravel.
Martin	863,995	1,374,632	Coal, petroleum, sand and gravel.
Mason	108,000	111,000	Sand and gravel.
McCracken	W	W	Do.
McCreary	1,642,044	1,677,831	Coal, petroleum.
McLean	3,460,179	4,313,027	Petroleum.
Meade	W	1,328,747	Limestone.
Menifee	W	142,363	Limestone, petroleum.
Mercer	W	W	Limestone.
Metcalfe	W	W	Petroleum, limestone.
Monroe	180,398	222,015	Limestone, petroleum.
Montgomery	94,800	91,460	Limestone.
Morgan	615,404	853,408	Limestone, coal, petroleum.
Muhlenberg	58,046,467	W	Coal, petroleum, limestone.
Nelson	W	W	Limestone.
Nicholas	56,200	88,000	Do.
Ohio	W	W	Coal, petroleum, limestone.
Oldham	618,600	W	Limestone, sand and gravel.
Owsley	30,327	13,352	Coal, petroleum.
Pendleton	W	W	Limestone.
Perry	11,371,182	16,370,062	Coal, petroleum.
Pike	W	W	Coal, petroleum, limestone, sand and gravel.
Powell	W	W	Petroleum, limestone, miscellaneous clay.
Pulaski	W	W	Coal, limestone.
Rockcastle	W	W	Limestone.
Rowan	490,153	468,380	Fire clay, limestone, miscellaneous clay.
Russell	6,707	5,384	Petroleum.
Scott	W	W	Limestone.
Simpson	W	W	Limestone, petroleum.
Taylor	W	3,495	Petroleum.
Todd	W	W	Limestone, petroleum.
Trigg	W	W	Limestone.
Trimble	W	W	Sand and gravel.
Union	21,414,421	26,431,656	Coal, petroleum, sand and gravel.
Warren	W	W	Limestone, petroleum.
Washington	W	W	Limestone.
Wayne	W	W	Limestone, coal, petroleum.
Webster	4,287,407	3,636,857	Coal, petroleum.
Whitley	W	2,197,578	Do.
Wolfe	112,730	W	Petroleum, coal, limestone.
Undistributed [3]	r 230,580,469	296,270,809	
Total	444,379,000	466,381,000	

r Revised.
W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] Excludes natural gas and natural gas liquids; included with "Undistributed." The following counties did not report production: Bracken, Campbell, Carroll, Clark, Grant, Larue, Lewis, Owen, Robertson, Shelby, Spencer, and Woodford.
[2] Other than natural gas and natural gas liquids.
[3] Includes natural gas, natural gas liquids, and values indicated by symbol W.

stone). Petroleum production was reported.

Allen.—McLellan Stone Co. (Scottsville quarry) crushed limestone for concrete, roads, and agstone. Production of petroleum decreased 6 percent.

Anderson.—Kentucky Stone Co. (Tyrone mine) crushed limestone for concrete, roads, railroad ballast, and agstone.

Barren.—J. F. Pace Construction Co. crushed limestone for concrete, roads, agstone, and other uses. Production of crude petroleum decreased 5 percent.

Bell.—Coal was produced at 47 underground mines, 17 strip mines, and 8 auger mines. Leading producers were Round Mountain Coal Co. (No. 3A strip mine), Black Raven Coal Co. Inc. (High Splint strip mine), and Mountain Drive Coal Corp. (No. 1C strip mine).

Boone.—Standard Materials Corp. (Belleview mine), R. W. Greene, Jr. Sand & Gravel Co. Inc. (Burlington mine), and Kentucky Sand Co. (Taylorsport mine) mined sand and gravel for structural, paving, and fill uses. Great Lakes Carbon Corp. of Kentucky expanded perlite at the Florence plant for use in manufacturing insulation board.

Bourbon.—Bourbon Limestone Co., Inc. (Snapp quarry) crushed limestone for concrete, roads, and agstone.

Boyd.—Rush Coal Corp. (No. 1 strip mine) and Big Run Coal & Clay Co. (Big Run strip mine) mined bituminous coal. Big Run Coal & Clay Co. (Princess mine) mined miscellaneous clay for manufacturing brick. A small quantity of petroleum was produced. Armco Steel Corp. produced pig iron and steel at the Ashland plant. Kentucky Electric Steel Co. produced steel near Princess.

Boyle.—Caldwell Stone Co., Inc. (Danville quarry) and Boyle County Highway Department (Perryville quarry) crushed limestone for concrete, roads, and agstone.

Breathitt.—Seven mines produced coal, four underground mines, two strip mines, and one auger mine. The leading producers were Breathitt County Coal Corp. (No. 1 strip mine), Trail Run Coal Co. (No. 1 strip mine) and Ten Mile Coal Co. (No. 9 mine). Petroleum production decreased 18 percent.

Breckinridge.—Kentucky Stone Co. (Webster quarry) and White Stone Co. (Hardinsburg quarry) crushed limestone for concrete, roads, railroad ballast, and agstone. Cloverport Sand & Gravel Co. mined structural and paving sand and gravel. Production of crude petroleum decreased 36 percent.

Bullitt.—Kentucky Light Aggregates, Inc. (Shepherdsville mine) mined miscellaneous clay for lightweight aggregates.

Butler.—Three underground mines and two strip mines produced coal. The leading producers were Key-Wilson Co., Inc. (Key strip mine), Jonell Coal Co. (No. 1 mine), and Skoog & Stuart Coal Co. (No. 2 mine). Gary Bros. Crushed Stone Co. (Morgantown quarry) crushed limestone for concrete, roads, and agstone. Crude oil production decreased 14 percent.

Caldwell.—Cedar Bluff Stone Co. Inc. (Princeton mine) and Fredonia Valley Quarries, Inc. (Fredonia quarry) crushed limestone for concrete, roads, and agstone.

Calloway.—Western Materials of Kentucky crushed limestone for concrete, roads, and agstone. The Calloway County Highway Department and the State highway department mined paving gravel. Murray Silica Sand Co. mined molding sand.

Campbell.—Zonolite Co. exfoliated crude vermiculite, and expanded perlite at the Wilder plant. Interlake Steel Corp. produced steel at Newport.

Carter.—Acme Stone Co., Inc. (Olive Hill quarry), Valley Stone Co., Inc. (Olive Hill quarry), and Standard Slag Co. (Carter quarry) crushed limestone for concrete, roads, and agstone. Ten mines produced fire clay for firebrick and block, and fire clay mortar. The leading producers were General Refractories Co. and Davis Fire Brick Co. Lost Creek Coal Co. (No. 1 mine) and Elliott County Mining Co. (No. 6 mine) were the only coal producers.

Casey.—Casey Stone Co. (Bethel Ridge mine) crushed limestone for concrete, roads, and agstone. Crude petroleum production increased 4 percent.

Christian.—Hopkinsville Stone Co., Inc. (Hopkinsville quarry), Harry Berry, Inc. (Fort Campbell quarry), and Christian Quarries, Inc. (Hopkinsville quarry) crushed limestone for concrete, roads, agstone, and riprap. Production of crude petroleum declined 12 percent. Auger Mining Co. was the only coal producer, and in addition to an underground mine, conducted strip and auger operations. Dalton Bros. Brick Co. mined miscellaneous clay. V. F. Coleman (Cerulean quarry) quarried a small quantity of dimension sandstone.

Clay.—Coal was produced at 59 mines, 56 underground mines, 2 strip mines, and 1 auger mine. Shamrock Coal Co. (No. 15 mine), Finley Coal Co. (No. 5 mine), and Black Diamond Coal Co., Inc. (Black Diamond mine) were the leading producers. Petroleum production was 16,643 barrels.

Clinton.—Shamrock Stone, Inc. (Caldwell quarry) crushed limestone for concrete, roads, and agstone. M & G Coal Co. (No. 1 mine) and Cross Coal Co. (No. 2A mine) were the only coal producers, and operated underground. Petroleum production decreased 15 percent.

Crittenden.—Alexander Stone Co., Inc. and Contractor's Paving Co. crushed limestone for concrete, roads, and agstone. Kentucky Fluorspar Co. purchased fluorspar for shipment to consumers. Calvert City Chemical Co. operated its fluorspar flotation mill at Mexico. United States Steel Corp. abandoned its fluorspar operation at Mexico and razed the plant site.

Cumberland.—Shamrock Stone, Inc. (Wells quarry) crushed limestone for concrete,

roads, and agstone. Petroleum production increased 30 percent.

Daviess.—Four coal mines were active, two strip and two underground. The leading producers were Green Coal Co. (K–9 strip mine) and Morris Enterprises (Morris strip mine). Owensboro River Sand & Gravel Co. and Daviess County Sand & Gravel Co. mined sand and gravel for structural, paving, and fill uses. Joseph L. Clark Tile Co. (Moselyville mine) mined miscellaneous clay for use in heavy clay products. Crude petroleum production decreased 8 percent.

Edmonson.—McLellan Stone Co. (Park City quarry) and Nolin Stone Co. (Bee Springs quarry) crushed limestone for concrete, roads, and agstone.

Elliott.—Four small coal mines, all underground, were in operation. Copley Coal Co. was the leading producer. Petroleum production increased 11 percent.

Estill.—Estill County Stone Co., Inc. mined limestone for concrete, roads, and agstone. Petroleum production was substantially the same.

Fayette.—Vulcan Materials Co. (Lexington quarry), Central Rock Co., Inc. (Lexington quarry and mine), and Blue Grass Stone Co. crushed limestone for concrete, roads, and agstone.

Fleming.—Gorman Construction Co., Inc. crushed limestone for concrete, roads, and agstone.

Floyd.—Coal was produced at 224 mines; 219 underground mines, 4 auger mines, and 1 strip mine. The leading producers were Inland Steel Co. (Wheelwright mine), Cedar Creek Mining Co., Inc. (No. 10 mine), and Princess Coals, Inc. (No. 4 mine). Petroleum production increased 19 percent.

Franklin.—Franklin County Stone Co. at three operations crushed limestone for concrete, roads, and agstone.

Gallatin.—Standard Materials Corp. (Warsaw mine) mined sand and gravel for building and paving.

Garrard.—Camp Nelson Stone, Inc. (Lancaster quarry) crushed limestone for concrete and roads.

Graves.—Kentucky-Tennessee Clay Co. and Old Hickory Clay Co. (Hickory and Lampkin mines) mined ball clay for whiteware, art pottery, floor and wall tile, enameling, foundries and steel works, plastics, and other uses. The State highway department mined paving gravel.

Grayson.—Ragland Quarry, Inc (Ragland No. 2 quarry) and Rogers & Brunnhoeffer (Grayson County quarry) crushed limestone for concrete and roadstone.

Green.—Nally & Gibson Stone Co. (Greensburg quarry) crushed limestone for concrete, roads, and agstone. Petroleum production decreased 27 percent.

Greenup.—Four mines produced fire clay for firebrick and block, fire clay mortar, and other clay specialties. The leading producers were McCoy Clay Co. (Large mine) and Harbison-Walker Refractories Co. (Riggs mine).

Hancock.—Four mines produced miscellaneous clay for heavy clay products. The leading producers were Owensboro Brick & Tile Co. (Owensboro mine) and Can-Tex Industries, Inc. (No. 1 mine). Watken Construction Co. (Carbon No. 2 strip mine) was the only producer of bituminous coal. Petroleum production decreased 11 percent.

Hardin.—Six quarries produced limestone for concrete, roads, agstone, and riprap. The leading producers were Quincy Quarries, Inc. (Boston quarry), Kentucky Stone Co. (Upton quarry), and Waters Construction Co. (Elizabethtown quarry).

Harlan.—Harlan County ranked fourth in the State in value of mineral production. Of the 136 coal mines in operation, 110 were underground mines, 11 were strip mines, and 14 were auger mines. The leading producers were United States Steel Co. (No. 32 and No. 7 South Main mines) and International Harvester Co. (No. 10 mine). Nally & Boone Stone Co. (Harlan quarry) crushed limestone for concrete, roads, and agstone.

Harrison.—Genet Stone Co. Inc. (Cynthiana quarry) crushed limestone for concrete, roads, and agstone.

Hart.—Hart Stone Co. (Horse Cave quarry) crushed limestone for concrete, roads, and agstone. Petroleum production decreased 12 percent.

Henderson.—Evansville Materials, Inc. dredged sand and gravel for construction and fill uses. Six mines, all underground

operations, produced coal. The leading producers were Dolph Hazelwood Coal Co. (No. 3 mine) and Goldsberry Coal Co. (No. 2 mine). Crude petroleum production decreased 10 percent.

Henry.—Geoghegan & Mathis, Inc. (Lockport quarry) crushed limestone for concrete, roads, and agstone.

Hopkins.—Hopkins County ranked third in the State in total value of mineral production. Of the 33 mines that produced coal, 15 were underground mines, 17 were strip mines, and 1 was an auger mine. The leading producers were Island Creek Coal Co. (East Diamond and Fies mines) and Pittsburg & Midway Coal Co. (Colonial strip mine). Petroleum production decreased 28 percent.

Jackson.—M. A. Walker, Inc. (Indian Creek and Clover Bottom mines) crushed limestone for concrete and roadstone. Coal was mined at seven small underground mines. The leading producers were Shepherd Coal Co. (No. 3 mine) and Hamm Coal Co., Inc. (No. 2 mine). Production of a small quantity of petroleum was reported.

Jefferson.—Kosmos Portland Cement Co. produced masonry and portland cements at Kosmosdale plant. Limestone was crushed at three quarries and one mine for concrete, roads, and agstone. The major producers were Vulcan Materials Co. (Okolona quarry), Falls City Stone Co. (Fern Creek quarry), and Louisville Crushed Stone Co. (Louisville quarry). Four producers mined sand and gravel for structural, paving, fill, and other uses; Ohio River Sand Co., Inc., E. T. Slider, Inc., and Nugent Sand Co. were the leading producers. Kosmos (Portland Cement Co. (Kosmosdale mine) and General Shale Products (Coral Ridge mine) mined miscellaneous clay for use in cement manufacture and heavy clay products. National Carbide Co. regenerated lime for chemical and industrial uses at the Louisville plant.

Jessamine.—Kentucky Stone Co. crushed limestone at High Bridge for concrete, roads, and agstone.

Johnson.—Coal was produced at 42 underground mines and 1 strip mine. Tutor Key Coal Co. (No. 1 mine) and Jeff Branch Coal Co., Inc. (No. 3 mine) were the leading producers. Crude petroleum production increased 36 percent.

Kenton.—Franxman Bros. crushed limestone for roadstone.

Knott.—Of the 111 coal mines, 103 were underground mines, 4 were auger mines, and 4 were strip mines. Pine Bluff Coal Co. (No. 1 auger mine), Mountain Top Stripping Co., Inc. (No. 1 strip mine), and Big Double Mining Co. (No. 1 mine) were the leading producers. Petroleum production decreased 10 percent.

Knox.—Coal was produced at 41 underground mines and 2 strip mines. Co-Op Coal Co. (No. 1 mine) and Jackson Coal Co. (No. 2 mine) were the leading producers. Corbin Brick Co., Inc. mined miscellaneous clay for brick.

Laurel.—Kentucky Stone Co. (Laurel quarry) crushed limestone for concrete and roadstone. Two strip mines and one underground mine produced coal. Laurel County Coal Co., Inc. (No. 1 strip mine) was the leading producer.

Lawrence.—Two small coal mines produced coal, Branham Coal Co. and Torchlight Coal Co. Petroleum production decreased 2 percent.

Lee.—Kentucky Stone Co. (Yellow Rock mine) crushed limestone for concrete, roads, railroad ballast, and agstone. Two underground mines produced coal. The leading producer was Congleton Bros. Coal Co., Inc. (Pacemaker No. 5 mine). Crude petroleum production increased 5 percent.

Leslie.—Of the 35 mines that produced coal, 30 were underground mines, 4 were auger mines, and 1 was a strip mine. The leading producers were Round Mountain Coal Co., Inc. (No. 2 strip mine), Liberty Coal Co. (Liberty No. 2 mine), and Deby Coal Co. (Deby No. 2 mine). Petroleum production increased.

Letcher.—Coal was produced by 216 mines, 196 underground mines, 17 auger mines, and 3 strip mines. Scotia Coal Co. (Scotia mine), Bethlehem Mines Corp. (No. 22 mine), and South East Coal Co. (Polly No. 4 mine) were the leading producers. Levisa Stone Corp. (Jenkins quarry) and Hurricane Gap Quarries, Inc. crushed limestone for concrete and roads. Crude petroleum production increased 34 percent.

Lincoln.—Crude petroleum production increased 39 percent.

Livingston.—Reed Crushed Stone Co. (Grand Rivers quarry) and Three Rivers Rock Co. (Smithland quarry) quarried limestone for riprap, concrete, roadstone, and agstone. Calvert City Chemical Co. mined and milled fluorspar at the Dyer's Hill mine and treated the concentrate in the Mexico mill in Crittenden County to recover acid-grade fluorspar. Nancy Hanks Mines, Inc. produced fluorspar at the Nancy Hanks mine. Byproduct crushed limestone, and zinc, lead, and silver concentrates were recovered from fluorspar milling. Eagle-Picher Co. mined and milled high-grade zinc ore at the Hutson mine.

Logan.—Kentucky Stone Co. and Kapco Co. crushed limestone at Russellville for concrete, roadstone, agstone, and railroad ballast.

Madison.—Boonesboro Quarry, Inc. mined limestone at Boonesboro for concrete, roadstone, and agstone.

Magoffin.—Nine underground coal mines were in operation. Tip Top Coal Co. (No. 34 and No. 32 mines) was the leading producer. Petroleum production declined 17 percent.

Marion.—Ward & Montgomery and Lebanon Stone Co., Inc. crushed limestone at Lebanon for concrete, roadstone, and agstone.

Marshall.—The State highway department mined paving gravel. National Carbide Co. regenerated lime for chemical and industrial uses at the Calvert City plant. Pittsburgh Metallurgical Co. produced ferroalloys at the Calvert City plant. New York Mining & Manufacturing Co. produced metallurgical coke.

Martin.—Coal was produced at 12 mines, 9 underground mines, 2 auger mines, and 1 strip mine. Wolf Creek Collieries was the leading producer. Petroleum production decreased 5 percent. Sands of Rockcastle Creek, Inc. (Rockcastle Creek mine) produced construction sand and gravel.

Mason.—J. F. Hardyman mined sand and gravel for structural, paving, and fill uses.

McCracken.—Federal Materials Co., Inc. and the County highway department mined sand and gravel for building and paving at Paducah.

McCreary.—Seven underground coal mines were operated. The leading producer was B. R. Campbell & Son, Inc. Petroleum production remained substantially the same.

McLean.—Petroleum production increased 29 percent.

Meade.—Kosmos Portland Cement Co. crushed limestone for use in its cement plant at Kosmosdale. Owensboro River Sand & Gravel Co., Inc. (Riverside mine) and Osborne Bros. Quarry Co. (Doe Run quarry) crushed limestone for concrete, roads, and agstone.

Menifee.—A. W. Walker & Son (Indian Creek quarry) crushed limestone for concrete, roads, and agstone. Crude petroleum production declined 23 percent.

Mercer.—Mercer Stone Co. (Mercer quarry) and the county highway department crushed limestone for concrete, roadstone, and agstone.

Metcalfe.—Montgomery & Co. (Chapman quarry) crushed limestone for concrete, roadstone, and agstone. Petroleum production increased 17 percent.

Monroe.—Trico Stone, Inc. (Monroe quarry) crushed limestone for concrete, roadstone, and agstone. Production of petroleum increased substantially.

Montgomery.—Montgomery County Stone Co. crushed limestone at Mount Sterling for concrete, roadstone, and agstone.

Morgan.—Kentucky River Road Oiling Co. (Wrigley quarry), Licking River Limestone Co. (Zag quarry), and Morgan County Limestone, Inc. (Sandy Hook quarry) crushed limestone for concrete, roadstone, and agstone. Four mines produced coal, three were strip mines, and one was an underground mine. Marshall, Branham & Sheets Coal Co. (No. 3 strip mine) was the leading producer.

Muhlenberg.—Muhlenberg County ranked second in the State in total value of mineral production. Coal was produced from 7 underground mines and 11 strip mines. Peabody Coal Co. (Sinclair and Vogue strip mines), River Queen Coal Co. (River Queen strip mine), and Gibraltar Coal Co. (Gibraltar strip mine) were the leading producers. AAA Stone Co., Inc. and Greenville Quarries, Inc. crushed limestone at Greenville for concrete, roadstone, and agstone. Petroleum production increased 39 percent.

Nelson.—Geoghegan & Mathis, Inc. (Nelson quarry) crushed limestone for concrete, roadstone, and agstone.

Nicholas.—The county highway department crushed limestone for concrete and roadstone.

Ohio.—Of the 14 mines that produced coal, 7 were underground mines, 6 were strip mines, and 1 was an auger mine. Peabody Coal Co. (Homestead, Ken, and Ken No. 3 strip mines) was the leading producer. Fort Hartford Stone Co., Inc. and State Contracting & Stone Co. crushed limestone for concrete, roadstone, railroad ballast, agstone, and riprap at Hartford. Crude petroleum production decreased 16 percent.

Oldham.—Ohio River Stone Co. (Prospect mine), Liter's Quarry, Inc. (Crestwood mine), and Joe Clark Stone Co. (Clark quarry) crushed limestone for concrete, roadstone, and agstone.

Owsley.—Booneville Fuel Co. (No. 1 mine), an underground operation, was the only coal producer.

Pendleton.—Geoghegan & Mathis, Inc. (Butler and Falmouth quarries) crushed limestone for concrete, roadstone, and agstone.

Perry.—Coal was mined at 70 underground mines, 17 auger mines, and 5 strip mines. Blair Fork Coal Co. (Blair Fork mine), Blue Diamond Coal Co. (Leatherwood No. 1 mine) and Caperton Coal Co. (No. 1 strip mine) were the leading producers. Petroleum production decreased 3 percent.

Pike.—Pike County ranked first in total value of mineral production. Of the 572 mines that produced coal, 527 were underground mines, 40 were auger mines, and 5 were strip mines. Eastern Coal Corp. (Stone mine), Kentland Elkhorn Coal Corp. (Kentland No. 1 mine) and Republic Steel Corp. (Republic mine) were the leading producers. Johnson Bros. Limestone Co. crushed limestone for concrete and roads. Pike Sand Co. (Walters mine) produced structural sand. Petroleum production decreased 10 percent.

Powell.—Natural Bridge Stone Co., Inc. (Stanton quarry) and A. W. Walker & Son (No. 213 quarry) crushed limestone for concrete, roads, and agstone. Big Run Coal & Clay Co. (West Bend mine) and H. B. Sipple Brick Co. (Ponderosa No. 1 mine) produced miscellaneous clay for use in heavy clay products. Crude petroleum production decreased 25 percent.

Pulaski.—Somerset Stone Co., Inc. (Somerset quarry) and Strunk Construction, Inc. (Tateville quarry) crushed limestone for concrete, roads, and agstone. Ten mines produced coal, eight underground mines, one strip mine, and one auger mine. The leading producers were Cumberland River Coal Co., Inc. (No. 1 mine) and Ikerd & Bandy Coal Co., Inc. (No. 4C strip mine and No. 1C auger mine).

Rockcastle.—Kentucky Stone Co. (Mt. Vernon and Mullins mines) crushed limestone for concrete, roads, railroad ballast, and agstone.

Rowan.—General Refractories Co. mined fire clay at three strip mines for use in making firebrick and block. Lee Clay Products Co., Inc. mined miscellaneous clay for use in heavy clay products. Kentucky Road Oiling Co. (Christy quarry) produced limestone for concrete, roads, and agstone.

Scott.—Nally & Gibson Stone Co. (Georgetown quarry) crushed limestone for concrete, roads, and agstone.

Simpson.—Southern Stone Co., Inc. (Franklin quarry) crushed limestone for concrete, roads, and agstone. Petroleum production increased 19 percent.

Todd.—Kentucky Stone Co. (Todd quarry) crushed limestone for concrete, roads, and agstone. Petroleum production declined.

Trigg.—Cedar Bluff Stone Co., Inc. crushed limestone for concrete, roads, and agstone.

Trimble.—Standard Materials Corp. (Milton mine) produced sand and gravel for building, paving, and fill uses.

Union.—Union County ranked fifth in the State in total value of mineral production. Five mines produced coal, four were underground operations and one was a strip mine. P&M Mining Co. (DeKoven and DeKoven No. 6 mines) and Island Creek Coal Co. (Uniontown mine) were the leading producers. Union Sand & Gravel Co. mined sand and gravel for structural, paving, and fill uses. Crude petroleum production increased 18 percent.

Warren.—Gary Bros. Crushed Stone Co. (Warren County quarry), McLellan Stone Co. (Warren County and Smith Grove

quarries), and Tri-County Stone Co. (Rockfield quarry) crushed limestone for concrete, roads, agstone, and other uses. Petroleum production decreased 6 percent.

Washington.—Nally & Gibson Stone Co. (Washington quarry) crushed limestone for concrete, roads, and agstone.

Wayne.—One strip mine and one underground mine produced coal. Clinton Coal & Fuel Co., Inc. (Spann Hill strip mine) was the leading producer. Bassett Products Co. (Bassett quarry) crushed limestone for concrete, roads, and agstone. Petroleum production increased 20 percent.

Webster.—Petroleum production decreased 11 percent. Two strip mines and one underground mine produced coal. Fiddle Bow Coal Co. was the leading producer.

Whitley.—Of the 57 mines that produced coal, 48 were underground mines, and 9 were strip mines. Royal Jellico Coal Co. (No. 1–A mine), Twin Peaks Coal Co. (No. 3 mine) and Hop Coal Co. (Piney Grove strip mine) were the leading producers. Petroleum production increased 7 percent.

Wolfe.—Bill Fallen Coal Co. (No. 1 mine), an underground operation, produced coal. Petroleum production decreased 30 percent. Porter Construction Co. (Rogers quarry) crushed limestone for concrete and roads.

The Mineral Industry of Louisiana

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the Louisiana Geological Survey for collecting information on all minerals except fuels.

By Owen W. Jones [1] and Leo W. Hough [2]

Louisiana, with a 1965 mineral output worth nearly $3 billion, ranked second in the Nation in value of mineral production for the eighth consecutive year. New records were achieved in production of crude petroleum, natural gas, natural gas liquids, salt, sulfur, and stone.

Hydrocarbon fuels—crude petroleum, natural gas, and natural gas liquids—furnished 94 percent of the total value of mineral output. Discovery of 47 oilfields and gasfields (30 onshore and 17 offshore) allowed proved recoverable reserves of the fuels to reach new highs despite increased production. In quantity of reserves added during 1965, Louisiana ranked first in the Nation for natural gas and natural gas liquids, and was second only to California for crude petroleum.

Trends and Developments.—Construction of new plants and expansion of existing plants continued at a high level. The Louisiana State Board of Commerce and Industry approved ad valorem tax exemption applications representing a total investment of $485 million. About 89 percent of the 1965 total investment approved was for plants of electric power, petroleum products, chemical, and mineral industries. Substantial approved applications included the following: $77.8 million for the Union Carbide Corp. petrochemical plant to be constructed in St. Charles Parish at Taft; $75 million for a refinery being constructed in St. James Parish near the north end of the Sunshine Bridge by Texaco Inc.; a total of $100 million for petrochemical plant

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Table 1.—Mineral production in Louisiana [1]

Mineral	1964 Quantity	1964 Value (thousands)	1965 Quantity	1965 Value (thousands)
Clays ---thousand short tons--	780	$797	909	$936
Lime ---do---	725	8,312	842	9,980
Natural gas ---million cubic feet--	r 4,152,731	793,328	4,466,786	812,955
Natural gas liquids:				
Natural gasoline and cycle products thousand gallons--	1,352,980	91,931	1,431,836	102,731
LP gases ---do---	1,247,484	45,935	1,300,038	46,101
Petroleum (crude) ---thousand 42-gallon barrels--	549,698	1,709,622	594,853	1,841,714
Salt ---thousand short tons--	6,401	36,056	8,126	41,812
Sand and gravel---do---	13,594	15,253	14,298	16,405
Stone (shell) ---do---	5,459	7,228	7,452	10,905
Sulfur (Frasch process) ---thousand long tons--	2,733	54,996	3,577	71,966
Value of items that cannot be disclosed:				
Cement, gypsum, and miscellaneous stone------	XX	21,549	XX	23,350
Total ----	XX	2,785,007	XX	2,978,855

r Revised. XX Not applicable.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

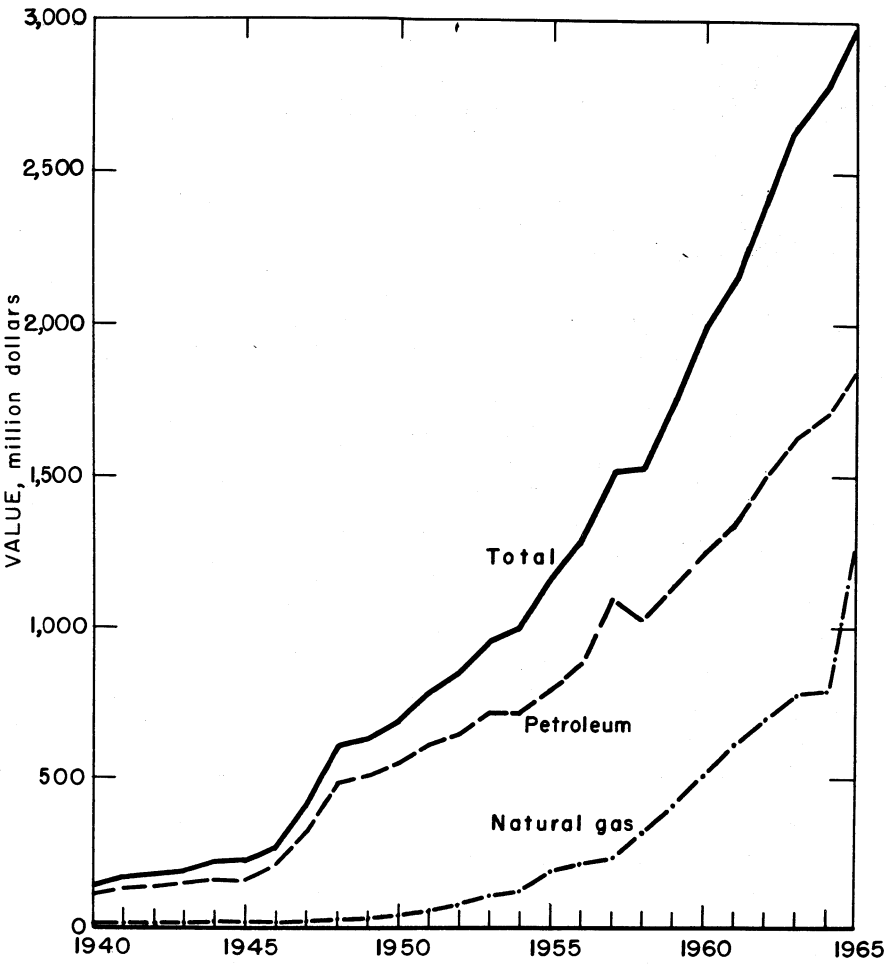

Figure 1.—Value of petroleum, natural gas, and total value of mineral production in Louisiana.

Table 2.—Value of mineral production in constant 1957–59 dollars

(Millions)

Year	Value
1956	$1,391
1957	1,504
1958	1,523
1959	1,790
1960	1,991
1961	2,141
1962	2,362
1963	2,558
1964	r 2,723
1965	2,899

r Revised.

construction at or near Geismar by Allied Chemical Corp., Borden Co., first Nitrogen Corp., Wyandotte Chemicals Corp., and others; and $40 million for a plant to generate electricity for New Orleans Public Service, Inc., at New Orleans.

Early in 1965 Central Louisiana Electric Co. announced it would spend $26.6 million on construction of gas and electric facilities to serve more than 130 communities in 31 parishes. The major 1965 project was a $15 million electric generating unit in St. Landry Parish to double the generating ca-

pacity of the Coughlin power station. Completion was scheduled for early 1966.

The Senate appropriations committee recommended $7 million for the Mississippi River-Gulf Outlet at New Orleans for fiscal year 1966. The tidewater channel, which is a shortcut to the sea, will cost an estimated $95 million; thus far $52.7 million has been appropriated. The outlet serves shipping for all the Mississippi Valley.

Because of rapid development of gas resources the industry added two new gas-processing plants and increased storage space in salt dome caverns for the recovered plant liquids by 1.3 million barrels.

The Federal Power Commission reported that the total 17,836 million kilowatt-hours generated in 1965 by all Louisiana plants was 11.1 percent higher than the 1964 total, compared with a national increase of 7.4 percent. Louisiana's 1965 electric output was about 1.7 percent of the national output—up slightly from 1.6 percent in 1964.

Legislation.—Controversy continued over the location of the coastline between inland waters and the ocean, under the 1960 U.S. Supreme Court decision which gave Louisiana ownership of inland waters and submerged lands extending 3 miles seaward from the coastline. Near the end of 1965, the Supreme Court approved a plan to release $33 million in impounded tidelands mineral lease funds to Louisiana and $170 million to the Federal Government from areas where State and Federal ownership is not in dispute. An escrow fund of about $640 million will remain, representing the aggregate still claimed by both the United States and the State of Louisiana. The amended Chapman line (amended as a result of a precedent set by a California case before the Supreme Court) changed Zone 1 in certain areas and awarded the State of Louisiana approximately 152,000 acres containing about 190 producing wells.

Employment and Injuries.—Employment in Louisiana's petroleum industry in 1965 amounted to 95,250 workers, 3,850 more than in 1964. In mineral production, including fuels (establishments with four or more employees), employment increased about 6 percent. Oil and gas operations provided 93 percent of employment and 93.5 percent of wages derived from mineral industries in 1965.

A 4-week labor stoppage at the Kaiser Aluminum & Chemical Corp. plant in Baton Rouge ended October 7. New contract disagreements brought on several minor labor stoppages during the year but, in general, labor-management relations were very good in 1965 in the minerals industry.

Two oil well service employees were killed in January. The men were servicing a well near Fordoche in Pointe Coupee Parish when the well caught fire.

On March 4, a 32-inch natural gas pipeline operating under a normal pressure of 750 pounds exploded near a row of homes

Table 3.—Employment and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1964:								
Metal	906	351	318	2,546	-----	11	4.32	203
Nonmetal	1,942	290	564	4,833	-----	121	25.04	1,183
Sand and gravel	1,077	266	286	2,498	-----	30	12.01	2,288
Stone	417	331	138	1,213	-----	31	25.55	1,223
Total	4,342	301	1,306	11,090	-----	193	17.40	1,212
1965: p								
Metal	1,090	364	397	3,182	-----	15	4.71	203
Nonmetal	2,145	289	620	5,469	2	100	18.65	4,246
Sand and gravel	1,210	262	318	2,783	-----	28	10.06	392
Stone	400	338	135	1,174	-----	28	23.85	931
Total	4,845	303	1,470	12,608	2	171	13.72	2,066

p Preliminary.

Table 4.—Total wage and salaried workers in petroleum production, refining, and related industries

Year	Crude petroleum and natural gas production	Petroleum refining [1]	Pipeline transportation (except natural gas)	Gas utilities	Petroleum bulk tank stations	Retail filling stations	Chemicals and allied products [2]	Total
1956–60 (average)	41,220	14,700	1,374	6,036	4,488	8,650	16,720	93,188
1961	40,300	12,800	1,150	6,350	4,000	8,700	16,300	89,600
1962	40,400	12,000	1,000	6,250	3,900	8,900	16,100	88,550
1963	40,400	11,400	1,000	6,200	4,000	9,400	16,500	88,900
1964	43,100	10,400	950	6,100	4,100	9,650	17,100	91,400
1965 [p]	45,900	10,500	950	6,100	4,300	10,100	17,400	95,250

[p] Preliminary.
[1] Employment in petroleum refineries and petrochemicals manufactured in petroleum refineries.
[2] Employment in petrochemical manufacturing facilities located outside petroleum refineries.

Source: Louisiana State Department of Labor, Division of Employment Security.

Table 5.—Value of construction contracts awarded

(Thousands)

Type	1962	1963	1964	1965	Percent change from 1964
Residential [1]	$271,162	$344,422	$419,174	$447,880	+6.8
Nonresidential [2]	192,929	216,579	289,026	477,167	+65.1
Nonbuilding [3]	194,836	377,909	287,530	265,166	—7.8
Total	658,927	938,910	995,730	1,190,213	+19.5

[1] Includes apartments, hotels, dormitories, and one- and two-family dwellings.
[2] Includes commercial, manufacturing, educational, and other nonresidential buildings.
[3] Formerly reported as Public Works and Utilities.

Source: Louisiana Business Review, Dodge Statistical Research Service. V. 30 No. 2, February 1966, p. 13.

in Natchitoches. Seventeen persons were killed outright by the explosion and subsequent fire which devastated a 10-acre area containing seven houses.

One man was killed and three others were injured March 26 when an oil tank exploded on an offshore drilling platform in south Timbalier Bay. A series of explosions in an oil barge on Bayou Lafourche in Lockport killed two men and injured three others May 19. A drilling rig explosion at Garden Island Bay 5 miles south of Pilottown killed one man and injured five on November 27.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Louisiana ranked second to Texas in oil and gas production and remained a major supplier of natural gas liquids and refined petroleum products. At yearend, 1,192 oilfields and gasfields in the State contained 38,742 producing wells (37,712 in 1964). North Louisiana had 14,441 oil wells and 4,558 natural gas wells producing; south Louisiana onshore had 11,716 oil and 3,323 natural gas producers; offshore, 4,022 oil wells and 682 natural gas wells were producing.

In the gulf coast area, leasing activity onshore continued at about the same rate as in 1964. No large lease blocks were acquired, but small tract leases and farmouts were numerous. Offshore, State lease sales of Zone 1 acreage within 3 miles of the coastline brought a total bonus of $8,814,650 for 26,790 acres.

There were no Federal lease sales in 1965. A Federal sale of Zone 2 acreage (between 3-mile and 3-league lines) was held in 1964 by joint consent of the State of Louisiana and the U.S. Government. Previously the last Federal sale (of acreage beyond the 3-league or 10.5-mile line) was held in 1962. The leases expire in April

1967 and many are still not explored. Accordingly, farmouts were numerous in 1965.

In north Louisiana 483,313 acres (553,878 acres in 1964) were assembled into blocks. Principal activities were in Grant Parish (22 percent of total), Jackson Parish (18 percent of total), and Natchitoches Parish (11 percent of total).

Exploration, Development, and Reserves.—Statewide drilling of 5,387 development and exploratory wells (5,275 in 1964) proved 61 percent productive (59 percent productive in 1964). Statewide drilling of 913 exploratory wells (1,102 in 1964) proved 25 percent productive (20 percent productive in 1964). Inland drilling of 754 exploratory wells proved 24 percent productive and opened 30 fields—12 oil and 4 gas discoveries in north Louisiana and 2 oil and 12 gas discoveries in south Louisiana.

Offshore well drilling decreased to 159 exploration wells (275 in 1964) and development wells increased to 708 (508 in 1964). Seventeen new fields, 5 oil and 12 gas, were discovered, compared with 10 in 1964.

The Louisiana Department of Conservation granted 6,349 permits to drill during the year, 133 fewer than in 1964. Abandoned wells totaled 1,079 compared with 769 in 1964.

Parker Lake field in Catahoula Parish was probably the most important field discovery in north Louisiana. A Wilcox producer at 6,393 feet, the discovery well flowed 60 barrels of oil per day through a 12/64-inch choke. There were 19 oil producers at yearend and production from both Catahoula and Concordia Parishes.

Another important Wilcox field, the North Bougere field in Concordia Parish, flowed 70 barrels of oil per day through a 6/64-inch choke. Nine wells were producing at yearend.

In south Louisiana offshore, most of the discoveries were on new structures, either piercement salt domes or faulted anticlines. Important offshore field discoveries include Block 218 Vermilion area, and Blocks 19 and 280 West Cameron area.

Onshore Cypress Island field, St. Martin Parish, and Hell Hole Bayou field, Vermilion Parish, were important discoveries.

On September 9, Hurricane Betsy, the petroleum industry's most expensive storm, severely damaged the offshore and coastal areas of south Louisiana. Within the previous 4 years, three storms of an intensity expected only once in 100 years had hit the area; these three storms inflicted several hundred million dollars of physical damage on the petroleum industry. Additional costs represented by lost lives and possessions of personnel, lost production, higher insurance, higher costs for overdesigning equipment in anticipation of new storms, and other intangible costs, may run the total bill due to hurricanes in the last 10 years to several billion dollars.

According to The Oil and Gas Journal, 35.0 million feet of hole was drilled in the State during 1965. The number of drilling

Table 6.—Oil and gas well drilling and total crew-weeks spent in geophysical oil and gas prospecting in 1965

Location	Drilling							Geophysical, crew-weeks		
	Proved field wells			Exploratory wells			Total	Gravity meter method	Reflection seismograph method	Total
	Oil	Gas	Dry	Oil	Gas	Dry				
Parish:										
Acadia	9	7	36	7	4	5	68	---	60	60
Allen	1	---	6	---	--	7	14	---	56	56
Ascension	19	1	5	1	--	1	27	---	32	32
Assumption	6	2	7	1	3	8	27	---	39	39
Avoyelles	10	---	10	2	--	7	29	---	4	4
Beauregard	6	---	11	2	1	11	31	---	36	36
Bienville	1	1	4	---	6	1	13	---	9	9
Bossier	13	---	30	2	1	10	56	---	4	4
Caddo	666	13	35	1	--	1	716	---	4	4
Calcasieu	12	3	31	1	2	7	56	---	25	25
Caldwell	---	---	3	---	--	1	4	---	9	9
Cameron	30	18	35	---	7	13	103	---	109	109
Cathahoula	26	---	86	3	1	66	182	---	---	---
Claiborne	8	9	8	4	1	3	33	---	10	10
Concordia	80	3	115	15	--	92	305	---	---	---
De Soto	20	34	38	4	3	11	110	---	---	---

Table 6.—Oil and gas well drilling and total crew-weeks spent in geophysical oil and gas prospecting in 1965—Continued

Location	Drilling							Geophysical, crew-weeks		
	Proved field wells			Exploratory wells			Total	Gravity meter method	Reflection seismography method	Total
	Oil	Gas	Dry	Oil	Gas	Dry				
Parish—Continued										
East Baton Rouge	----	---	2	1	--	---	3	---	15	15
East Carroll	----	---	----	---	--	2	2	---	1	1
East Feliciana	----	---	----	---	--	---	----	---	4	4
Evangeline	2	4	5	---	1	5	17	---	27	27
Franklin	2	---	2	---	--	8	12	---	1	1
Grant	6	---	2	---	--	2	10	---	26	26
Iberia	4	8	14	---	5	4	35	---	70	70
Iberville	48	2	22	3	--	16	91	---	89	89
Jackson	----	6	2	---	--	4	12	---	2	2
Jefferson	33	3	15	3	2	11	67	---	32	32
Jefferson Davis	25	11	26	1	2	8	73	---	31	31
Lafayette	----	3	9	1	3	3	19	---	18	18
Lafourche	117	22	44	1	5	22	211	---	213	213
La Salle	82	2	95	3	--	21	203	---	6	6
Lincoln	----	2	3	---	--	---	5	---	----	----
Madison	1	---	----	---	--	2	3	---	1	1
Morehouse	----	71	10	---	--	3	84	---	8	8
Natchitoches	13	7	4	---	--	14	38	---	37	37
Ouachita	----	51	7	---	3	2	63	---	2	2
Plaquemines	241	24	34	12	2	39	352	---	101	101
Pointe Coupee	27	4	9	3	1	7	51	---	17	17
Rapides	47	---	58	3	--	11	119	---	4	4
Red River	39	---	2	---	--	5	46	---	----	----
Richland	1	---	3	---	1	1	6	---	3	3
Sabine	145	6	237	3	4	18	413	---	58	58
St. Bernard	2	---	5	---	--	10	17	---	13	13
St. Charles	27	3	10	2	1	5	48	---	34	34
St. James	3	---	5	---	--	2	10	---	21	21
St. John the Baptist	----	---	1	---	--	7	8	---	----	----
St. Landry	4	4	21	1	1	8	39	---	29	29
St. Martin	27	1	26	4	2	8	68	---	121	121
St. Mary	69	16	27	3	5	4	124	---	198	198
St. Tammany	----	---	----	---	--	---	----	---	5	5
Tensas	8	2	15	1	1	6	33	---	----	----
Terrebonne	108	28	27	3	8	25	199	---	303	303
Union	----	80	6	---	--	4	90	---	----	----
Vermilion	8	11	37	3	8	13	80	---	228	228
Vernon	----	---	----	---	--	4	4	---	----	----
Washington	----	---	----	---	--	1	1	---	----	----
Webster	6	6	4	---	1	3	20	---	3	3
West Baton Rouge	----	---	1	---	--	1	2	---	----	----
West Carroll	----	---	----	---	--	---	----	---	1	1
West Feliciana	----	---	----	---	--	2	2	---	----	----
Winn	24	---	22	---	--	20	66	---	54	54
Total:										
1965	2,026	468	1,272	94	85	575	4,520	---	2,173	2,173
1964	2,057	411	1,197	82	56	689	4,492	95	2,091	2,186
Offshore:										
Bay Marchand	3	---	3	---	--	---	6	---	1	1
Breton Sound	7	2	6	2	3	11	31	---	62	62
Cameron East	1	4	5	---	4	8	22	---	64	64
Cameron West	1	17	3	---	5	7	33	---	85	85
Chandeleur Sound	6	---	5	3	--	13	27	---	61	61
Delta West	112	11	17	1	1	11	153	---	84	84
Eugene Island	39	11	24	1	2	10	87	---	97	97
Grand Isle	26	2	9	1	--	4	42	---	48	48
Main Pass	68	9	15	---	--	2	94	---	103	103
Marsh Island, South	19	13	21	6	1	4	64	---	70	70
Pelto, South	5	2	----	---	--	1	8	---	9	9
Ship Shoal	22	8	14	2	6	15	67	---	71	71
South Pass	45	3	9	1	--	2	60	---	56	56
Timbalier, South	90	4	9	1	4	8	116	---	68	68
Vermilion	9	11	18	2	2	15	57	---	99	99
Total:										
1965	453	97	158	20	28	111	867	---	978	978
1964	348	53	107	42	41	192	783	44	868	912
Grand total:										
1965	2,479	565	1,430	114	113	686	5,387	---	3,151	3,151
1964	2,405	464	1,304	124	97	881	5,275	139	2,959	3,098

Source: International Oil Scouts Association. International Oil and Gas Development. Austin, Tex., v. 36 in 1965 Review.

Table 7.—Crude petroleum, natural gas, and natural gas liquids production and addition to reserves

Year	Crude petroleum (million barrels)		Natural gas (billion cubic feet)		Natural gas liquids (million barrels)	
	Production	Net additions to reserves	Production	Net additions to reserves	Production	Net additions to reserves
1961	425	146	3,272	2,643	41	61
1962	477	155	3,525	5,906	45	204
1963	515	2	3,928	3,821	54	143
1964	550	74	r 4,153	3,711	62	101
1965	595	83	4,467	3,735	65	227
Total proved reserves by Dec. 31, 1965						
1965	5,246		82,811		2,169	

r Revised.

Source: Reserves based on American Gas Association, American Petroleum Institute, and Canadian Petroleum Association, Proved Reserves of Crude Oil, Natural Gas Liquids, and Natural Gas, v. 16–20, 1961–65.

rigs operating offshore averaged 95 in 1965 and 91 in 1964; for the entire State, the average number was 270 in 1965 and 282 in 1964.

According to American Petroleum Institute figures, proved recoverable reserves of crude oil, natural gas, and natural gas liquids in Louisiana reached new highs in 1965. At yearend the crude oil reserve comprised 16.7 percent of the U.S. reserve. The natural gas reserve was 28.9 percent of the U.S. total, and the natural gas liquids reserve was 27.0 percent of the U.S. total. Of the total additions to Louisiana's crude petroleum reserve, 68 percent was attributed to extensions and revisions of reserves in previously discovered fields and the remainder to new discoveries.

According to The Oil and Gas Journal, 29.4 percent of the Louisiana crude reserve was offshore.

Carbon Black.—Output of carbon black from natural gas and petroleum distillates gained about 13 percent. The product was mainly used as an additive in rubber manufacturing. Ouachita Parish had two plants, St. Mary Parish had three, and Avoyelles, Calcasieu, and Evangeline Parishes each had one plant.

Columbian Carbon Co., a subsidiary of Cities Service Co., announced plans for a multimillion-dollar carbon black unit at its North Bend plant. The plant is designed to produce 30 million pounds of thermal-type carbon black yearly. Completion is scheduled for 1966.

Natural Gas.—Marketed production of natural gas continued a strong growth trend for the 20th consecutive year, showing an increase of 8 percent over that of 1964. Louisiana retained second position among the States as a supplier of natural gas, furnishing 28 percent of the total natural gas marketed. National demand for gas as a fuel and as a raw material for petrochemicals continued to grow rapidly.

Pan American Petroleum Corp. contracted to furnish 1.5 trillion cubic feet of natural gas for Florida Power & Light Co. at Miami, Fla., over a 20-year period. Most of the gas will come from southwest Louisiana and adjacent offshore areas. Expansion of the existing pipeline facilities to carry the supply will cost an estimated $93 million. Florida Power & Light Co. has been using fuel oil from Venezuela as a fuel. The change to natural gas will represent an increased cost, but will decrease the smoke now contributing to smog along the east coast of Florida.

Table 8.—Carbon black production

Year	Million pounds
1956–60 (average)	561
1961	583
1962	608
1963	649
1964	726
1965	821

One underground gas storage project was active in Louisiana in 1965, one was under construction, and one was planned. South Louisiana Production Co. operated a gas-

storage reservoir in Holly field, De Soto Parish; total storage capacity (1.5 billion cubic feet) represented 1 billion cubic feet "working" storage and 500 million cubic feet "cushion" storage.

United Gas Pipe Line Co. began a $30.8 million gas storage reservoir development in the old Bistineau field of Bienville and Bossier Parishes. Gas from the gulf coast area will be transported and stored in the northwest Louisiana reservoir during seasons of low gas demand and held ready for immediate distribution to meet winters peak demands.

Conservation Commissioner James M. Menefee appointed a Gas Advisory Board to study such matters related to Louisianas natural gas industry. One of the principal duties of the Industry Gas Committee was to search for ways the gas market might be shared more equitably. Early estimates showed 1,700 gas wells shut in for lack of a market. Questionnaires sent to 400 operators, however, showed only 291 shut-in wells in south Louisiana. Of these, 110 have no marketing problem and 32 others will probably obtain a market within 1 year. This survey showed the shut-in wells to be about equally divided between offshore and onshore.

Orleans Parish was added to the list of gas-producing parishes in July. The first Orleans Parish natural gas wells are in Lake St. Catherine field, discovered more than 6 years ago, and are shut in pending connection to a pipeline.

Natural Gas Liquids.—Louisiana again ranked second in the Nation as a producer of natural gas liquids. New plants and expansions completed and under construction in 1965 raised the States daily processing capacity from 12.1 to 13.1 billion cubic feet (22.7 percent of the Nation's total capacity).

Natural gasoline and cycle products were recovered at 108 gasoline plants and 14 recycling plants (111 gasoline and 16 recycling plants in 1964) in 35 parishes. Increased output of total condensable liquids was attributed mainly to a gain in natural gas produced and processed. Recovery of condensable liquids gained about 5 percent and amounted to 14.7 percent of the Nation's annual total. Output was 52 percent natural gasoline and the remainder LP gases.

Table 9.—Natural gas data

(Million cubic feet)

Year	Withdrawals [1]			Marketed production [2]	Value at wells (thousands)	Disposition	
	From gas wells	From oil wells	Total			Repressuring	Vented and wasted [3]
1956–60 (average)	2,185,800	512,200	2,698,000	2,415,095	$337,274	200,896	82,009
1961	2,930,100	640,700	3,570,800	3,271,857	611,837	201,989	96,954
1962	3,124,000	730,000	3,854,000	3,525,456	694,515	221,167	107,377
1963	3,540,100	710,000	4,250,100	3,928,427	777,829	212,116	109,557
1964	3,682,200	808,400	4,490,600	r4,152,731	793,328	221,280	116,589
1965	3,912,300	852,000	4,764,300	4,466,786	812,955	174,951	122,563

[1] Marketed production plus quantities used in repressuring, vented, and wasted.
[2] Comprises gas sold or consumed by producers, including losses in transmission, amounts added to storage, and increases in pipelines.
[3] Partly estimated. Includes direct waste on producing properties and residue blown to the air.

Table 10.—Natural gas liquids production

(Thousand gallons and thousand dollars)

Year	Natural gasoline and cycle products		LP gases		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
1956–60 (average)	810,747	$60,646	439,460	$21,015	1,250,207	$81,661
1961	931,176	61,714	806,559	33,214	1,737,735	94,928
1962	1,010,137	74,726	862,772	29,037	1,872,909	103,763
1963	1,143,707	81,332	1,113,670	41,043	2,257,377	122,375
1964	1,352,980	91,931	1,247,484	45,935	2,600,464	137,866
1965	1,431,836	102,731	1,300,038	46,101	2,731,874	148,832

New facilities for processing natural gas and for recovering, delivering, and storing the plant liquids were being constructed. Two new processing plants were completed in 1965. McWood Corp. added a small plant at Fort Jessup, Sabine Parish, north Louisiana. The major capacity increase for the State resulted from completion of the North Terrebonne plant. The plant is operated by Shell Oil Co. for 30 owners and removes liquid hydrocarbons from the gas of United Gas Pipe Line Co. and Transcontinental Gas Pipe Line Co. The product is shipped 54 miles by 8-inch pipeline to a related facility, Tebone fractionation plant at Geismar, where it is separated into propane, butane, isobutane, and natural gasoline fractions. At full capacity, the plant will process 950 million cubic feet of natural gas and extract approximately 615,000 gallons of liquid hydrocarbons per day.

Increased production of natural gas liquids largely results from requirements of petrochemical producers. The prime feedstocks, ethane and propane, are used mainly in production of ethylene, but are also in demand for a host of other petrochemicals. Nationally, petrochemical industry demand for propane is almost equal to domestic and commercial demand; in the gulf coast area, about 70 percent of the propane production goes to petrochemical plants.

New plant construction to process south Louisiana gas supplies was trending toward larger capacity refrigeration-absorption systems with low-temperature operating ranges, fuller automation, and use of central fractionators. Central fractionator sites provide for convenient storage and transportation of the liquid components.

Capacity of underground storage facilities increased about 13 percent. As reported by The Oil and Gas Journal survey, capacity was 9.64 million barrels of natural gas liquids plus 1.60 million barrels of ethylene for a total capacity of 11.24 million barrels. The underground storage cavities, all in salt domes, were operated by 11 companies in 7 parishes. In 1965 Promix (Wanda Petroleum Co., Inc. et al) was constructing two salt cavities for natural gas liquid storage in St. Martin Parish. Socony Mobil Oil Co., Goliad Division, planned a salt-dome storage cavity for propane near Geismar, and Warren Petroleum Corp. (Gulf Oil Co.) planned salt-dome storage for propane and butane at Venice, Plaquemines Parish. For future storage possibilities, aboveground refrigerated storage and frozen-earth pits promise to provide economical storage in areas where suitable salt domes do not exist.

Petroleum.—The petroleum industry in Louisiana established a production record of 595 million barrels—second highest in the Nation. The gain (slightly more than 8 percent) came from new fields discovered both offshore and onshore. To balance production with demand, the State Conservation Commission adjusted petroleum allowables. Daily allowable production for the period January to April continued at 33 percent of the per-well-depth-bracket formula, the same per-well rate in effect at the end of 1964. Production at the end of 1964 was at an alltime high rate, and new records continued to be set as new wells were brought into production status.

In May, the allowable rate was reduced to 32 percent of depth bracket formula, and it remained there through October. Following the large crude production losses due to Hurricane Betsy on September 9, the October allowable was raised to 34 percent. This rate was retained to the end of the year, and various privileges to allow make-up of hurricane losses were extended to both onshore and offshore wells suffering losses.

Secondary recovery projects (water, gas, or other injections) accounted for 81.7 million barrels of petroleum, or 13.5 percent of the 1965 production.

Table 11.—Crude petroleum production

(Thousand barrels and thousand dollars)

Year	Quantity	Value
1956–60 (average)	341,341	$1,079,915
1961	424,962	1,338,160
1962	477,153	1,502,568
1963	515,057	1,608,120
1964	549,698	1,709,622
1965	594,853	1,841,714
1902–65	8,078,809	20,906,032

In 1965 a survey[3] reported that Louisiana had 11,989 oil wells classified as "stripper" wells at the end of 1964. For

[3] Interstate Oil Compact Commission. National Stripper Well Survey, Jan. 1, 1965. Oklahoma City, Okla., October 1965.

Table 12.—Crude petroleum production, indicated demand, and stocks, in 1965, by months

(Thousand barrels)

Month	Production	Indicated demand	Stocks (end of month)
January	49,996	49,342	23,226
February	45,203	45,375	23,054
March	50,004	49,605	23,453
April	48,241	46,845	24,849
May	49,201	48,371	25,679
June	48,462	49,462	24,679
July	50,029	50,658	24,050
August	50,144	50,232	23,962
September	39,611	40,306	23,267
October	53,863	51,403	25,727
November	53,981	54,179	25,529
December	56,118	56,567	25,080
Total:			
1965	594,853	592,345	XX
1964	549,698	548,550	XX

XX Not applicable.

Table 13.—Number of producing oil wells and average production per well

Year	Number of producing wells Dec. 31	Average production per well per day (barrels)
1956–60 (average)	21,978	42.5
1961	24,740	47.1
1962	26,382	49.6
1963	27,638	51.8
1964	29,452	51.0
1965	30,179	53.9

Table 14.—Production of crude petroleum by districts and selected fields

(Thousand barrels)

District and field [1]	1964	1965
Gulf Coast:		
Onshore: [2]		
Avery Island	2,531	2,569
Bastian Bay	2,948	3,874
Bateman Lake	2,844	2,787
Bay De Chene	2,713	2,712
Bay St. Elaine	7,705	7,431
Bayou Penchant	2,204	1,944
Bayou Sale	7,283	8,365
Breton Sound, Blk. 20	445	2,113
Caillou Island	22,186	23,500
Delta Duck Club	2,550	2,586
Delta Farms	2,635	2,545
Duck Lake	3,143	2,934
East and West Hackberry	8,050	8,224
Erath	3,120	2,772
Garden Island Bay	5,710	6,682
Golden Meadow	2,757	3,163
Grand Bay	6,443	6,188
Krotz Springs	4,047	3,796
La Fitte	5,813	6,443
Lake Barre	11,634	12,414
Lake Pagie	------	2,094
Lake Pelto	4,324	4,387
Lake Salvador	2,888	3,177
Lake Washington	10,242	9,661
Leeville	3,680	3,863
Little Lake	2,597	2,375
Main Pass, Blk. 35	4,371	4,301
Opelousas	1,863	2,172
Paradis	2,023	2,585
Quarantine Bay	5,043	5,506
Rayne	2,520	2,365
Romere Pass	3,029	2,945
South Pass, Blk. 24	19,968	21,576
Timbalier Bay	16,876	19,037
Venice	4,674	5,466
Weeks Island	6,983	6,310
West Bay	8,299	9,122
West Black Bay	3,677	3,758
West Cote Blanche Island	7,567	9,096
West Lake Verret	1,787	2,008
White Castle	2,603	2,858
Other	105,205	85,393
Total onshore	326,980	323,097

See footnotes at end of table.

Table 14.—Production of crude petroleum by districts and selected fields—Continued

(Thousand barrels)

District and field [1]	1964	1965
Offshore: [2]		
Bay Marchand, Blk. 2	25,056	25,298
Eugene Island	13,483	14,663
Grand Isle	17,033	20,943
Main Pass	10,888	14,384
Ship Shoal	6,808	10,054
South Marsh Island	------	3,682
South Pass, Blk. 27	16,822	18,323
South Timbalier, Blk. 131	2,279	2,698
Vermilion	1,579	2,221
West Delta	20,862	27,751
Other	54,361	72,441
Total offshore	169,171	212,458
Total Gulf Coast	496,151	535,555
Northern:		
Caddo	6,387	6,297
Cotton Valley	3,498	3,171
Delhi	4,703	4,530
Fort Jessup	------	2,076
Haynesville	2,904	2,989
Pendleton	4,896	4,178
Other	31,159	36,057
Total Northern	53,547	59,298
Total Louisiana	549,698	594,853

[1] Breakdown for individual fields from The Oil and Gas Journal.
[2] Some fields include onshore and offshore.

Table 15.—Crude petroleum production and estimated reserves in Louisiana offshore area

(Thousand barrels)

Offshore area	Number of wells		Production			Estimated reserve Dec. 31, 1965
	1964	1965	1964	1965	Cumulative total	
Bay Marchand: Block 2 [1 2]	493	491	25,056	25,298	151,403	444,213
Belle Isle [2]	64	63	1,713	1,605	13,954	21,046
Caillou Island [1 2]	684	693	22,186	23,500	263,295	236,705
East Cameron: Block 64	----	36	------	1,100	1,100	11,000
Eugene Island:						
Block 18	50	54	2,396	2,609	19,471	20,529
Block 32	34	46	958	1,233	11,238	23,762
Block 45	9	9	532	570	4,560	6,440
Block 100	19	25	627	962	4,543	15,457
Block 126 [1]	92	102	4,335	4,702	40,655	84,345
Block 128	46	52	2,094	2,837	17,996	42,004
Block 188	24	30	1,247	1,323	7,052	27,948
Block 208	33	16	1,294	427	6,232	28,768
Grand Isle:						
Block 16 [1]	221	227	10,584	11,743	52,961	122,039
Block 18	35	41	1,743	1,778	22,001	17,999
Block 43	----	74	------	3,609	8,076	15,000
Block 47 [1]	92	83	4,706	3,813	31,567	68,433
Lake Washington: [1 2]	402	365	10,242	9,661	114,850	185,150
Main Pass:						
Block 41	29	115	816	3,438	5,640	4,360
Block 69 [1]	236	257	10,072	10,946	91,155	208,845
Ship Shoal:						
Block 28	23	22	1,401	1,901	5,208	4,892
Block 107	50	54	3,445	3,857	13,070	46,930
Block 154	36	22	1,166	792	12,625	27,385
Block 176	24	7	796	477	4,937	17,063
Block 208	----	52	------	3,027	5,766	60,000
South Marsh Island:						
Block 6	----	26	------	1,305	1,908	36,504
Block 23	----	48	------	1,839	3,917	50,065
Block 73	----	11	------	538	562	16,461
South Pass:						
Block 24 [1 2]	618	625	19,968	21,576	233,862	516,138
Block 27 [1]	406	465	16,822	18,323	91,166	219,834

See footnotes at end of table.

Table 15.—Crude petroleum production and estimated reserves in Louisiana offshore area—Continued

(Thousand barrels)

Offshore area	Number of wells		Production			Estimated reserve Dec. 31, 1965
	1964	1965	1964	1965	Cumulative total	
South Pelto:						
Block 20	27	33	942	1,034	3,993	16,007
Tiger Shoal	20	20	923	854	4,412	5,588
Timbalier Bay [1 2]	469	480	16,876	19,037	135,412	164,588
South Timbalier: Block 131	46	63	2,279	2,698	9,014	40,986
Vermilion:						
Block 14	39	35	1,579	1,698	7,123	24,877
Block 16	----	5	------	523	747	6,004
West Cameron:						
Block 45	33	27	803	633	7,113	18,000
Block 192	38	39	516	415	2,975	17,025
West Delta:						
Block 24	21	52	728	3,437	5,942	32,058
Block 30 [1]	458	462	20,134	21,103	101,090	298,910
Block 53 [2]	14	16	643	729	8,260	13,740
Block 27	----	10	------	731	2,440	10,467
Block 41	----	33	------	1,984	2,048	31,000
Block 58	----	4	------	496	1,794	5,000
Total	4,885	5,390	189,622	220,161	1,533,133	3,263,565

[1] Estimated ultimate recovery of 100 million barrels or more.
[2] Combined onshore and offshore.

Source: The Oil and Gas Journal. V. 64 No. 5, Jan. 31, 1966, pp. 166–169.

1964, stripper wells represented 32 percent of total oil wells, but only 2 percent of the annual production and 3 percent of the State's recoverable oil reserves. Thus, normal production decline from stripper wells was not expected to affect appreciably the State's productive capacity and reserves in the immediate future.

Refineries.—At yearend, 14 petroleum refineries were in Louisiana; 13 were operating, 1 was shut down. Total crude oil capacity (barrels per calendar day) was 873,600, a gain of approximately 12,500 over 1964. Crude oil runs to refinery stills totaled 310 million barrels (33 million barrels more than in 1964), and represented about 52 percent of the crude oil production in the State.

Humble Oil & Refining Co. neared completion of a 13,500-barrel-per-day hydrocracker at its Baton Rouge refinery. The new unit will convert heavier petroleum liquids into high-quality gasoline. Completion was scheduled for early 1966.

Gulf Oil Corp. at Venice was constructing a multimillion-dollar refinery and gas plant complex consisting of a natural gas processing plant and a 20,000-barrel-per-day refinery, 70 miles southeast of New Orleans in Mississippi River Delta marshland. Gulf Oil Corp. has substantial oil and gas production in the area, both offshore and on land, and a deepwater barge and tanker terminal at Ostrica on the Mississippi River below New Orleans. The processing complex will include one of the country's largest natural gas processing plants (800 million cubic feet per day). Condensate from the natural gas produced, and liquids recovered from the gas processed, will provide feedstock for the refinery. The refinery will include 16,500-barrel-per-day catalytic reforming and 15,000-barrel-per-day hydrocracking facilities. Construction should be completed in mid-1966.

Texaco Inc. was building a new $75 million refinery at Convent on the east bank of the Mississippi River near the Sunshine Bridge in St. James Parish. Major units were a 100,000-barrel-per-day crude unit, 12,000-barrel-per-day visbreaker, 30,000-barrel-per-day platformer, 50,000-barrel-per-day fluid catalytic cracking unit, 12,500-barrel-per-day sulfuric acid alkylation unit, and 50,000-barrel-per-day naphtha and middle distillate hydrotreater. Crude oil will be supplied through a 40-mile pipeline from Houma. Refined products from the plant will be routed through a 50-mile feeder line into the recently completed Colonial system.

Practically all new refinery construction includes hydrogen cracking units. Most modernization projects now underway are

aimed at reducing costs. Outmoded units are being replaced by units operating less expensively and adapted to automation. Continental Oil Co. at Lake Charles, Murphy Oil Co. at Meraux, and Shell Oil Co. at Norco were constructing additions to their existing refinery facilities.

Petrochemicals.—In the New Orleans area at Michoud, Air Products & Chemicals, Inc., completed its hydrogen plant capable of producing 12.2 million cubic feet of 90-percent-pure hydrogen per day using natural gas as the feedstock. The hydrogen will be used for the National Aeronautics and Space Administration Saturn program. A 600-ton-per-day ammonia plant on the same site will share a common cooling tower and monitoring facilities. American Cyanamid neared completion of a $30 million expansion of its Fortier complex to produce acrylonitrile, ammonia (1,000 tons per day), and urea (300 tons per day).

At Lake Charles, Continental Oil Co. was building a plant to double company production of cyclohexane for use in production of nylon. The world's largest ammonia plant, a $19 million facility, was completed by Olin Mathieson Chemical Corp. Daily capacity is 1,450 tons.

At Geismar Allied Chemical & Dye Corp. began construction of a 1,000-ton-per-day ammonia plant, the first unit in its $100 million, 1,500-acre chemical complex. Construction of a new multimillion-dollar, 500-ton-per-day phosphoric acid plant began in November. In July, Shell Oil Co. started constructing a $25 million plant to make ethylene oxide derivatives and primary range detergent alcohols. Borden Co. was constructing an acetic acid, ammonia, and urea plant. Daily capacity will be 100 tons, 1,000 tons, and 500 tons, respectively.

At Baton Rouge, Ethyl Corp. had a $5 million vinyl chloride unit under construction scheduled for completion in early 1966. Enjay Chemical Co. was expanding ethylene and butadiene facilities at the Baton Rouge refinery. The $20 million expansion should be completed by mid-1966.

At Luling, Monsanto Chemical Co. completed an ammonia plant with capacity of 600 tons per day. Four more all-centrifugal plants patterned after this new unit were scheduled for completion by the end of 1966.

At Donaldsonville, First Nitrogen Corp. was building a 1,000-ton-per-day anhydrous ammonia plant to use natural gas as feed. The plant was scheduled for completion in early 1966.

NONMETALS

Value of nonmetals (chemical and construction materials) produced in 1965 was $175 million or 6 percent of total minerals value and an increase of 22 percent over the 1964 total. Combined value of construction materials (clay, lime, cement, gypsum, sand and gravel, and stone or shell) gained 16 percent.

Barite.—Crude barite from Arkansas, Missouri, and foreign countries was ground at three plants in New Orleans and one in Lake Charles. Output of barite was used mainly as a weighting agent in oil well drilling fluids. Production was 421,000 short tons, substantially the same as in 1964.

Cement.—Portland cement production gained slightly. Hurricane Betsy in September 1965 temporarily disrupted construction in the New Orleans area and damaged the new Louisiana Cement Co. plant. The plant was shut down about 3 weeks for repairs and cleanup.

Clay.—There was a 17 percent gain in miscellaneous clay produced; clay used for cement gained about 7 percent. About 172,000 tons of local clay, 5 percent less than in 1964, was used to manufacture heavy clay products at nine brick plants in nine parishes. Lightweight aggregate was produced at Alexandria and Erwinville.

Gypsum.—Winn Rock, Inc., Winn Parish, mined crude gypsum for retarder in portland cement. National Gypsum Co. at Westwego and U.S. Gypsum Co. and Bestwall Gypsum Co. at New Orleans, calcined imported crude gypsum and manufactured plaster, lath, and wallboard.

Table 16.—Shipments of portland cement to Louisiana consumers

Year	Thousand barrels
1956–60 (average)	8,211
1961	7,865
1962	8,875
1963	9,112
1964	10,405
1965	11,294

Table 17.—Miscellaneous clay sold or used by producers

(Thousand short tons and thousand dollars)

Year	Quantity	Value
1956–60 (average)	767	$767
1961	645	645
1962	638	641
1963	655	655
1964	780	797
1965	909	936

Lime.—Lime production gained about 16 percent. Four companies produced lime; Olin Mathieson Chemical Corp. in Lake Charles and Allied Chemical Co. in Baton Rouge produced lime for their own use; U.S. Gypsum in New Orleans and Pelican State Lime Co. in Morgan City produced primary lime from oystershell for sale on the open market. Primary lime was principally used at chemical plants and papermills. Regenerated lime for use in paper and pulp was produced by four companies at six plants as follows: Calcasieu Paper Co. at Elizabeth; International Paper Co. at Hodge, Bastrop, and Springhill; Olin Mathieson Chemical Corp. at West Monroe; and Crown Zellerbach at Bogalusa. Regenerated lime production in 1965 was 946,000 short tons with a reported value of $17.7 million.

Nitrogen Compounds.—Air Reduction Sales Co. operated its air separation plant at the old Ronaldson airport near Baton Rouge. Daily productive capacity was 30 tons of liquid oxygen, nitrogen, and argon for industrial uses. Air Products & Chemicals started operating its new complex on Michoud Canal in east New Orleans. The $30 million cryogenics installation is the largest industrial gas producer in the South. The plant will use 1 million cubic feet of natural gas every hour and requires 2.2 million gallons of water per day. Louisiana became a net exporter of industrial gases when this plant opened, whereas previously it was a net importer.

Salt.—Louisiana was the leading salt-producing State. Output gained about 27 percent in 1965. Increased consumption of rock salt by chlorine, caustic soda, detergent, and other chemical producers, meat packers, other food processors, and grocery stores, accounted for most of the increase. Evaporated and/or rock salt was produced by six salt companies; brine was produced by six chemical companies.

Flooding in the Carey salt mine at Winnfield salt dome forced complete evacuation in November. The flow of water was so strong that all equipment was left in the mine. The mine will be abandoned.

Sand and Gravel.—Production of 14.3 million tons of sand and gravel—about 5 percent more than in 1964—reflected a small gain in building. Washed sand and gravel amounted to 14 million tons or 98 percent of the total. Sand use was as follows: Building sand, 57 percent; paving sand, 36 percent; and industrial, other construction, and fill sand, 7 percent. Gravel use was as follows: Building gravel, 57 percent; paving gravel, 37 percent; and other construction and fill gravel, 6 percent. Sand and gravel operations totaled 108 in 27 parishes.

Jahncke Services, Inc., operated specialized facilities to handle high-purity silica sand to manufacture glass at its plant in New Orleans. Sand for the plant was

Table 18.—Salt sold or used by producers

(Thousand short tons and thousand dollars)

Year	Quantity	Value
1956–60 (average)	4,041	$19,695
1961	4,722	23,357
1962	5,248	27,407
1963	6,199	30,450
1964	6,401	36,056
1965	8,126	41,812

Table 19.—Salt production

(Thousand short tons and thousand dollars)

Year	Evaporated salt		Rock salt		Brine	
	Quantity	Value	Quantity	Value	Quantity	Value
1956–60 (average)	148	$3,332	1,462	$10,221	2,431	$6,142
1961	196	4,430	1,770	12,884	2,756	6,043
1962	246	6,298	2,004	13,531	2,998	7,578
1963	250	5,988	2,294	15,227	3,655	9,235
1964	252	6,080	2,516	16,537	3,633	13,439
1965	256	6,293	3,016	17,828	4,854	17,691

dredged from West Pearl River near Bogalusa in St. Tammany Parish. Sand from the dredges was barged about 50 miles via the river, the Intracoastal Canal, and the Inner Harbor Navigation Canal.

Stone.—Most of the stone produced was shell (clam and oyster). Some anhydrite was produced in Winn Parish for road surfacing and concrete. Lacking an adequate supply of stone, Louisiana relied on shell as a substitute. Shell used for concrete aggregate and road construction was 75 percent; as cement raw material, 21 percent. The remainder was burned to lime, used as paint filler, rubber filler, and mineral food. Total output of shell was about 36 percent higher than that of 1964.

Winn Rock, Inc., at Winnfield, operated an asphalt filler plant; silica sand was purchased for use as base material.

Sulfur.—Shipments of Frasch sulfur were at a record level, exceeding the 1964 total by 31 percent. Work began on reestablishing sulfur production at the old Sulphur Mines salt dome, site of the first successful installation of the Frasch method of mining brimstone in 1894.

Freeport Sulphur Co., the world's largest producer of sulfur in 1965, shipped about the same amount it produced. The sulfur

Table 20.—Sand and gravel sold or used by producers

(Thousand short tons and thousand dollars)

Year	Commercial		Government-and-contractor		Total sand and gravel	
	Quantity	Value	Quantity	Value	Quantity	Value
1956–60 (average)	14,269	$17,817	348	$124	14,617	$17,941
1961	11,783	14,729	259	104	12,042	14,833
1962	11,701	14,682	339	135	12,040	14,817
1963	12,125	14,551	375	150	12,500	14,701
1964	13,228	14,959	366	294	13,594	15,253
1965	14,024	16,306	274	99	14,298	16,405

Table 21.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1964		1965	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	2,613	$2,426	2,717	$2,643
Paving	1,843	1,562	1,708	1,593
Fill	15	15	(1)	(1)
Other [2]	254	186	340	302
Total	4,725	4,189	4,765	4,538
Gravel:				
Building	4,600	5,807	5,313	6,640
Paving	3,598	4,625	3,409	4,121
Other [3]	305	338	537	1,007
Total	8,503	10,770	9,259	11,768
Total sand and gravel	13,228	14,959	14,024	16,306
Government-and-contractor operations:				
Sand: Paving	8	9	1	2
Gravel:				
Building	188	75	168	19
Paving	170	210	105	78
Total	358	285	273	97
Total sand and gravel	366	294	274	99
Grand total	13,594	15,253	14,298	16,405

[1] Included in "Other" commercial sand.
[2] Includes fill (1965), blast, other construction, and ground sand.
[3] Includes railroad ballast (1964), fill, other construction, and miscellaneous gravel.

Table 22.—Sand and gravel production in 1965, by parishes

(Thousand short tons and thousand dollars)

Parish	Quantity	Value	Parish	Quantity	Value
Beauregard	22	$35	St. Bernard	1	$2
Catahoula	474	508	St. Helena	383	280
Claiborne	4	4	Vernon	3	3
East Baton Rouge	1,140	943	Washington	965	869
East Feliciana	1,150	1,068	Webster	945	1,461
Lincoln	168	19	Winn	13	13
Morehouse	31	12	Other parishes [1]	8,951	11,079
Red River	48	109	Total	14,298	16,405

[1] Includes Allen, Evangeline, Grant, Jefferson, La Salle, Livingston, Madison, Ouachita, Rapides, St. Tammany, Tangipahoa, Vermilion, and West Feliciana, and undistributed amounts from various parishes, combined to avoid disclosing individual company confidential data.

was almost entirely from four mines along the Louisiana Gulf Coast—Grand Isle offshore, Grande Ecaille and Garden Island Bay along the lower Mississippi River, and Lake Pelto to the west. These properties were hit in September by Hurricane Betsy. Despite widespread damage to facilities, operations were resumed promptly. The equivalent of approximately 9 days' production was lost.

Sulfur is now shipped mainly in liquid form. In February, a new 24,000-ton vessel, the SS *Louisiana Brimstone,* was put into service between Port Sulphur and coastal terminals in Florida and along the Atlantic seaboard. New barges were added to the inland waterway fleet, and replacement of older rail tank cars by newer and larger leased units began near yearend.

Consumption of elemental sulfur historically has increased at an average rate of about 5 percent per year, but the average annual growth rate in the past 2½ years has been about 12 percent. The largest part of the increase in domestic demand has been due to the fertilizer industry. In Florida—the most important single sulfur market in the world—the fertilizer industry used 25 percent more sulfur than in 1964, converting it to sulfuric acid for processing local phosphate rock into fertilizers. At the sulfur research laboratory in Belle Chasse, studies continued on fundamental characteristics of sulfur.

Table 23.—Sulfur produced and shipped from Frasch mines

(Thousand long tons and thousand dollars)

Year	Production	Shipments	
		Quantity	Value
1956–60 (average)	2,182	2,186	$53,018
1961	2,608	2,352	55,164
1962	2,363	2,262	49,772
1963	2,469	2,445	48,905
1964	2,739	2,733	54,996
1965	3,582	3,577	71,966

METALS

Aluminum.—Kaiser Aluminum & Chemical Corp. produced alumina at its Gramercy and North Baton Rouge plants and aluminum at its reduction plant at Chalmette, the Nation's largest aluminum reduction plant. A coke calcining facility being built at Norco went into full operation during 1965. The four Kaiser facilities in Louisiana were damaged and operations temporarily interrupted by Hurricane Betsy. An additional interruption was due to a monthlong strike at the Baton Rouge alumina plant.

Production of hydrogen fluoride was increased 50 percent, enabling the Gramercy plant to increase the production capacity of aluminum fluorides and fluorocarbons.

Iron Ore.—The presence of large deposits of iron ore in north Louisiana has been known for at least 80 years. Great quantities have been used as a road-building material. A report based on a comprehensive survey of the deposits was released June 4 by the Department of Conservation, Louisiana Geological Survey.[4] The report contains maps locating the deposits within Claiborne, Webster, Lincoln, Bienville, and Jackson Parishes. Bedded siderite and limonite deposits are reportedly similar to deposits in east Texas which are being mined for the Lone Star Steel Co. mills at Daingerfield, Tex.

The possibility of developing a steel in-

[4] Louisiana Geological Survey, Department of Conservation. Iron Ore of Central North Louisiana. Bull. 41, 1966.

dustry in the Homer area was studied in 1965. Homer Development Co., formed to promote area industry, leased several thousand acres of the potential ore body so it could be offered in a block to anyone interested in building a steel industry in the area. Phosphorus content of the ore presents a problem in processing, and further experiments in smelting techniques are needed. A direct-reduction process, using the natural gas of the area as fuel, would be most desirable.

REVIEW BY PARISHES

Minerals were produced in all but 1 of the State's 64 parishes. Mineral fuels were produced in 58 parishes; other minerals in 42 parishes. Eight parishes reported mineral production valued at over $100 million; 3 parishes reported between $100 million and $50 million; and 40 other parishes reported mineral production valued at over $1 million.

Ascension.—Natural gas liquids from Terrebonne Parish (North Terrebonne plant) were fractionated at the Tebone fractionator at Geismar beginning in 1965. The Geismar chemical complex continued to expand.

Assumption.—During the year 12 exploratory wells were drilled, proving 2 gasfields, Coteau Frene and Delia.

Beauregard.—East Bancroft gasfield was discovered in January. Natural gas liquids were recovered at Neale, Clear Creek, and Hurricane Creek plants.

Bossier.—The Poole oilfield was opened.

Caddo.—The parish ranked first in total number of oil and gas wells drilled—716 wells in 1965 (749 in 1964). All but two were development wells, many in the Pine Island area. Sizable amounts of oil lie within the low-permeability Annona chalk reservoir, and close drilling seems to be the only alternative to abandoning much of this oil. At Shreveport, Universal Oil Products Co. manufactured special catalysts for petroleum refinery processes.

Table 24.—Value of mineral production in Louisiana, by parishes [1]

Parish	1964 [r]	1965	Minerals produced in 1965, in order of value
Acadia	$114,830,827	$110,659,704	Natural gas, natural gas liquids, petroleum.
Allen	11,425,019	9,744,441	Petroleum, natural gas, sand and gravel, natural gas liquids.
Ascension	3,746,591	4,831,547	Petroleum, salt, natural gas.
Assumption	19,189,570	19,940,938	Natural gas, petroleum.
Avoyelles	2,674,700	3,660,447	Petroleum, natural gas, natural gas liquids.
Beauregard	9,421,364	8,998,340	Petroleum, natural gas, natural gas liquids, sand and gravel.
Bienville	9,963,085	9,072,233	Natural gas, petroleum.
Bossier	40,984,361	34,714,994	Natural gas, petroleum, natural gas liquids.
Caddo	34,152,418	33,498,076	Petroleum, natural gas, natural gas liquids, clays.
Calcasieu	42,614,975	41,514,907	Petroleum, natural gas, cement, natural gas liquids, lime, salt, clays.
Caldwell	2,516,899	2,560,937	Natural gas, petroleum.
Cameron	159,956,635	153,745,670	Natural gas, petroleum, natural gas liquids, salt, shell.
Catahoula	10,158,775	10,377,000	Petroleum, sand and gravel, natural gas.
Claiborne	25,431,891	25,682,140	Petroleum, natural gas, natural gas liquids, sand and gravel.
Concordia	15,628,391	18,972,201	Petroleum, natural gas, natural gas liquids.
De Soto	11,395,894	11,159,099	Natural gas, petroleum, natural gas liquids.
East Baton Rouge	15,589,849	16,830,602	Cement, lime, petroleum, sand and gravel, natural gas, natural gas liquids, clays.
East Feliciana	1,111,000	1,068,000	Sand and gravel.
Evangeline	10,493,367	10,634,252	Petroleum, natural gas, natural gas liquids, sand and gravel.
Franklin	2,772,218	1,978,104	Petroleum, natural gas.
Grant	1,037,374	862,082	Petroleum, sand and gravel, natural gas.
Iberia	89,836,921	92,224,859	Petroleum, natural gas, salt, natural gas liquids, clays.
Iberville	38,982,408	44,193,599	Petroleum, salt, natural gas, natural gas liquids.

See footnotes at end of table.

Table 24.—Value of mineral production in Louisiana, by parishes [1]—Continued

Parish	1964 [r]	1965	Minerals produced in 1965, in order of value
Jackson	$308,829	$330,272	Natural gas, petroleum.
Jefferson	115,079,170	134,322,738	Petroleum, sulfur, natural gas, salt, sand and gravel, natural gas liquids, shell.
Jefferson Davis	52,360,339	52,118,465	Natural gas, petroleum, natural gas liquids.
Lafayette	14,316,306	14,034,723	Natural gas, petroleum, clays.
Lafourche	293,951,328	309,069,232	Petroleum, natural gas, natural gas liquids.
La Salle	18,036,487	18,531,842	Petroleum, natural gas, sand and gravel.
Lincoln	25,149,136	22,204,665	Natural gas, natural gas liquids, petroleum, sand and gravel, clays.
Livingston	448,925	306,054	Petroleum, sand and gravel, natural gas.
Madison	959,445	1,598,662	Do.
Morehouse	1,784,797	1,872,566	Natural gas, sand and gravel, petroleum.
Nachitoches	277,361	212,935	Petroleum, clays, natural gas.
Orleans	W	13,487,675	Cement, lime, shell, natural gas.
Ouachita	10,511,417	9,417,485	Natural gas, sand and gravel, petroleum, natural gas liquids, clays.
Plaquemines	575,038,133	668,349,940	Petroleum, natural gas, sulfur, natural gas liquids.
Pointe Coupee	9,158,198	11,422,011	Petroleum, natural gas, natural gas liquids, clays.
Rapides	3,997,528	5,111,374	Petroleum, sand and gravel, natural gas, natural gas liquids, clays.
Red River	696,807	961,137	Petroleum, sand and gravel, natural gas.
Richland	15,287,305	15,069,511	Petroleum, natural gas liquids, natural gas.
Sabine	20,377,907	20,427,484	Petroleum, natural gas, natural gas liquids.
St. Bernard	16,813,293	16,560,800	Natural gas liquids, petroleum, natural gas, clays, sand and gravel.
St. Charles	40,101,236	44,676,567	Petroleum, natural gas, natural gas liquids.
St. Helena	W	280,000	Sand and gravel.
St. James	4,942,641	5,353,749	Petroleum, natural gas, natural gas liquids.
St. John the Baptist	3,778,668	3,729,536	Petroleum, natural gas.
St. Landry	49,564,035	47,433,163	Petroleum, natural gas, natural gas liquids.
St. Martin	65,392,870	64,502,426	Petroleum, natural gas, salt, natural gas liquids.
St. Mary	195,065,538	234,936,040	Petroleum, natural gas, natural gas liquids, salt, lime, shell.
St. Tammany	3,364,795	3,445,532	Shell, sand and gravel, natural gas, petroleum, clays.
Tangipahoa	756,459	790,064	Sand and gravel, petroleum, clays.
Tensas	18,032,086	17,405,067	Petroleum, natural gas, natural gas liquids.
Terrebonne	339,807,345	365,171,473	Petroleum, natural gas, sulfur, natural gas liquids.
Union	15,920,042	13,480,705	Natural gas, petroleum.
Vermilion	147,349,118	149,061,774	Natural gas, petroleum, natural gas liquids, sand and gravel.
Vernon	48,000	3,000	Sand and gravel.
Washington	774,510	869,000	Do.
Webster	31,015,577	28,500,894	Petroleum, natural gas, natural gas liquids, sand and gravel.
West Baton Rouge	875,494	651,679	Petroleum, clays, natural gas.
West Carroll	271,489	210,618	Natural gas.
West Feliciana	W	W	Sand and gravel.
Winn	4,125,790	3,826,302	Petroleum, salt, gypsum, stone, natural gas, sand and gravel.
Undistributed	15,354,064	12,193,668	
Total	2,785,007,000	2,978,855,000	

[r] Revised.
W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] East Carroll not listed because no production was reported.

Calcasieu.—The Lake Charles Industrial Complex remained one of the important industrial concentrations in the State. Over a dozen large plants have been built to facilitate producing and processing crude petroleum, natural gas, natural gas liquids, cement, sulfur, lime, and salt.

Cameron.—The parish ranked fifth in total value of mineral production and fourth in value of natural gas produced. East Cameron Block 24 gasfield was discovered offshore and East Cameron Meadows gasfield was discovered onshore. Natural gas liquids were recovered at 12 gas processing plants.

Catahoula.—Larto Lake and Parker Lake oilfields were discovered. The parish ranked second in number of exploratory wells drilled—70 in 1965.

Concordia.—Drilling of 107 exploratory wells, the largest number in any parish, opened 5 oilfields—Cocodrie Lake, Goose

Lake, North Bougere, West Slocum, and Float Bayou.

De Soto.—Chemard Lake oilfield was discovered. South Louisiana Production Co. operated its underground gas storage system in the Holly field reservoir. Working capacity of the storage was 1 billion cubic feet. Another gas storage project was planned for the old Grand Cane field.

East Baton Rouge.—Construction of petroleum and petro-chemical facilities, and expansion of existing facilities, was reported in the Baton Rouge area.

Ethyl Corp. announced plans for a $5 million expansion (two new production units to produce vinyl chloride and ethylene dichloride).

Enjay Chemical Co., Chemical Division of Humble Oil & Refining Co., announced a $20 million expansion. The new facilities will produce ethylene and butadiene.

Riegel Paper Corp., New York, and Inveresk Paper Co., Ltd., of Great Britain, planned to build a $40 million mill in the northwestern corner of the parish at Port Hudson.

Reynolds Metals Co. calcined coke to make electrodes for use in aluminum reduction plants. Ethyl Corp., a principal producer of motor fuel additives, also produced chlorine and caustic soda. Polymer Chemical Division, W. R. Grace & Co., produced polyethylene plastics.

Natural gas liquids were recovered at the Burtville plant of Shell Oil Co. Clay for making building brick was mined by Acme Brick Co. Ideal Cement Co. produced portland, high-early-strength, and masonry cement from shell barged up the Mississippi River by a New Orleans supplier. Kaiser Aluminum & Chemical Corp. processed Jamaican bauxite into alumina at its North Baton Rouge plant.

Evangeline.—West Fenris gasfield was discovered in June. Natural gas liquids were recovered at the Ville Platte plant of Continental Oil Co. and at the Mamou plant of Socony Mobil Oil Co.

Iberia.—The parish ranked first in salt production; nearly 50 percent of the State output came from three large mines in Iberia Parish. Natural gas liquids were recovered at four plants. Lake Tom gasfield was discovered.

Jefferson.—Two oilfields were discovered in the Grand Isle area offshore—Grand Isle Block 41 and Block 82. Freeport Sulphur Co. produced sulfur at its Grand Isle offshore platform.

Lafourche.—The parish ranked third in total value of minerals produced, second in crude oil produced, third in geophysical crew-weeks worked, and fifth in exploratory and development drilling. No new fields were discovered. Natural gas liquids were recovered at four gas-processing plants.

La Salle.—Nolans Bayou oilfield was opened.

Lincoln.—Lincoln Parish, with four natural gasoline plants, ranked fifth in recovery of natural gas liquids. Natural gas, petroleum, and sand and gravel also were produced. Ruston Brick Works mined clay at Ruston.

Orleans.—Most of the barite ground in the State was from foreign ores and was processed in Orleans Parish by three companies. Alatex Construction Services, Inc., processed crude perlite from Western States into expanded perlite for use in acoustical plasters and concrete aggregate.

At New Orleans, U.S. Gypsum Co. manufactured building lime, quicklime, and hydrated lime at its lime plant adjacent to the company's gypsum products plant, and fronting on the Inner Harbor Industrial Canal. Bestwall Gypsum Co. operated its gypsum lath and plaster products plant near New Orleans.

Louisiana Cement Co. operated its plant, designed to produce 1.5 million barrels of cement annually.

To meet demand in the New Orleans area for high-purity silica sand to manufacture glass, Jahncke Services, Inc., operated its new plant on the industrial canal in New Orleans.

Ouachita.—Acme Brick Co. mined clay at Monroe for brick and tile. Natural gas liquids were recovered at the Calhoun plant of Southwest Gas Producing Co., Inc. North Carlton gasfield was opened. Work began on an anhydrous ammonia plant of Commercial Solvents Corp. at Sterlington. Planned capacity was 340,000 tons annually, or nearly 1,000 tons per day. The new plant will be one of the largest and most advanced in the Nation. Completion is scheduled for late 1966.

Plaquemines.—Total value of mineral production, highest in the State, increased from $575 million in 1964 to $668 million in 1965, a gain of 16 percent. The parish ranked third in exploration, development, and total drilling; first in petroleum and sulfur production; and second in natural gas production. Two new oilfields—Pelican Point onshore and Breton Sound Block 39 offshore—were opened. A gasfield was opened offshore in West Delta Block 105 area.

Humble neared completion of its Delta gas plant at Venice. The refrigerated absorption plant will be able to process 310 million cubic feet per day. Product capacities included 88,000 gallons per day of propane, and 138,600 gallons per day of isobutane plus.

Gulf Oil Corp. was building an 800-million-cubic-foot-per-day gas-processing plant at Venice. The liquids produced will be used at Gulf's refinery under construction at the same location. Completion was scheduled for mid-1966.

St. Bernard.—Chandeleur Sound Block 25 oilfield was discovered. The parish ranked fourth in value of natural gas liquids which were recovered at three plants.

Tenneco Oil Co. operated its 55,000-barrel-per-day refinery at Chalmette, and Murphy Corp. operated its 24,000-barrel-per-day refinery at Meraux.

Kaiser Aluminum & Chemical Corp. operated its Chalmette aluminum reduction plant.

St. Charles.—West Ponchartrain Block 35 gasfield was opened.

St. Landry.—The Sambo gasfield was opened.

St. Martin.—The Cypress Island oilfield was opened. The parish ranked fifth in number of crew-weeks of geophysical work during the year.

St. Mary.—The parish ranked fourth in total value of minerals and in petroleum production, and was fifth in production value of natural gas. Operation of the Humble Garden City gas-processing plant advanced the parish from 10th to 3d in value of natural gas liquids recovered. The parish also produced appreciable quantities of salt and shell.

St. Tammany.—Mulatto Bayou gasfield was opened.

Terrebonne.—The parish ranked second in total value of minerals produced, first in natural gas production, third in oil production, and fourth in exploratory drilling for petroleum and natural gas. The North Terrebonne gas-processing plant—the largest natural gas processing facility in Louisiana (the liquids are fractionated in Geismar, Ascension Parish)—went onstream early in 1965, although it did not operate at full capacity. Shell Oil Co. acts as operator for the 30 owners.

Vermilion.—The parish ranked third in value of natural gas and second in value of natural gas liquids produced and geophysical crew-weeks worked. South Marsh Island Block 8 gasfield and Vermilion Block 218 oilfield were discovered offshore, and Hell Hole Bayou gasfield was discovered onshore.

Natural gas liquids were recovered at six gas-processing plants. One of these plants (Cow Island) supplied mixed liquids by pipeline to the Goliad Corp. Riverside fractionator at Geismar. The separated hydrocarbons from the fractionator were supplied as feedstock to the petrochemical plants at Geismar.

Winn.—South Atlanta gasfield was discovered in January.

Winn Rock Inc. at Winnfield mined crude gypsum. The firm also operated an asphalt-filler rock plant; silica sand was purchased for the base material.

On November 18, flooding of the Carey Salt Co. mine near Winnfield forced abandonment of the mine which will remain closed. The mine employed 80 persons.

The Mineral Industry of Maine

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the Geological Survey of Maine, for collecting information on all minerals except fuels.

By John W. Hartwell [1]

Value of mineral production in Maine continued to increase and reached a new peak, 1 percent above the high set in 1964. Increased output of sand and gravel offset declines in peat and stone. The quantity and value of other commodities remained nearly the same. Knox County continued as the leading mineral-producing area, followed by Penobscot, Aroostook, Cumberland, and York Counties.

Exploration for copper, lead, zinc, nickel, gold, and silver ore deposits in the State by domestic and foreign mining companies continued. Development of deposits in the Blue Hill and Harborside areas of Hancock County continued.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Cement.—Portland cement production and shipments remained about the same as in 1964; masonry cement production and shipments increased. Dragon Cement Co., Division of Martin-Marietta Corp., was the only cement producer in Maine. Average value per barrel of portland cement decreased and yearend stocks were below those of 1964. Types I–II (general use) and type III (high-early strength) portland cements were produced.

The principal raw materials were cement rock, gypsum, sand, and iron products such as mill scale, pyrite cinders, and iron-rich slags and residues; others included air-entraining compounds, coloring agents, and grinding aids. Portland and masonry cement shipments, mostly to consumers in the New England States, were largely by truck in both bulk and paper bags, although substantial quantities were shipped by rail. Principal consumers, in order of size, were ready-mixed concrete companies

[1] Mining engineer, Bureau of Mines, College Park, Md.

Table 1.—Mineral production in Maine [1]

Mineral	1964		1965	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays—thousand short tons	45	$58	49	$63
Gem stones	NA	35	NA	35
Peat—short tons	6,350	171	1,275	56
Sand and gravel—thousand short tons	13,552	6,463	17,294	7,831
Stone—do	1,414	4,506	1,100	3,409
Value of items that cannot be disclosed: Cement and feldspar	XX	6,341	XX	6,347
Total	XX	17,574	XX	17,741

NA Not available. XX Not applicable.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Value of mineral production in constant 1957–59 dollars

(Thousands)

Year	Value
1956	$12,492
1957	12,917
1958	12,681
1959	13,432
1960	14,002
1961	15,637
1962	15,056
1963	14,380
1964	r 18,144
1965	18,116

r Revised.

and concrete product manufacturers, and building material dealers.

Clays.—Building brick was manufactured from miscellaneous clay; no use of shale was reported. A limited quantity of stoneware clay was produced for use in manufacturing dinnerware, art pottery, flowerpots, and glaze slip. Production of clay was reported from two pits in Androscoggin County, three in Cumberland County, and one each in Hancock and York Counties. Cumberland County continued to lead in clay production.

Feldspar.—The value of marketable crude ore increased 18 percent over that of 1964. Production was limited to mines in Oxford County and the average value for crude material remained at $6.00 per long ton. All crude ore was processed at West Paris, Oxford County, by Bell Minerals Co. Ground feldspar was produced from crude ore from nearby mines in Oxford County and the Ruggles mine in Grafton, N.H., and sold principally for ceramic applications. Shipments of ground feldspar were chiefly to consumers in Pennsylvania, Ohio, and Wisconsin. Limited quantities were shipped to other States and some was exported to Africa and Canada.

Gem Stones.—Mineral localities, consisting primarily of old mines, quarries, and dumps, continued to attract large numbers of gem and mineral collectors. Oxford County continued to be the chief collecting area. Included among the various minerals collected in this county were purple apatite, agate, beryl, aquamarine, rose amethyst, rutilated quartz, and lithium miner-

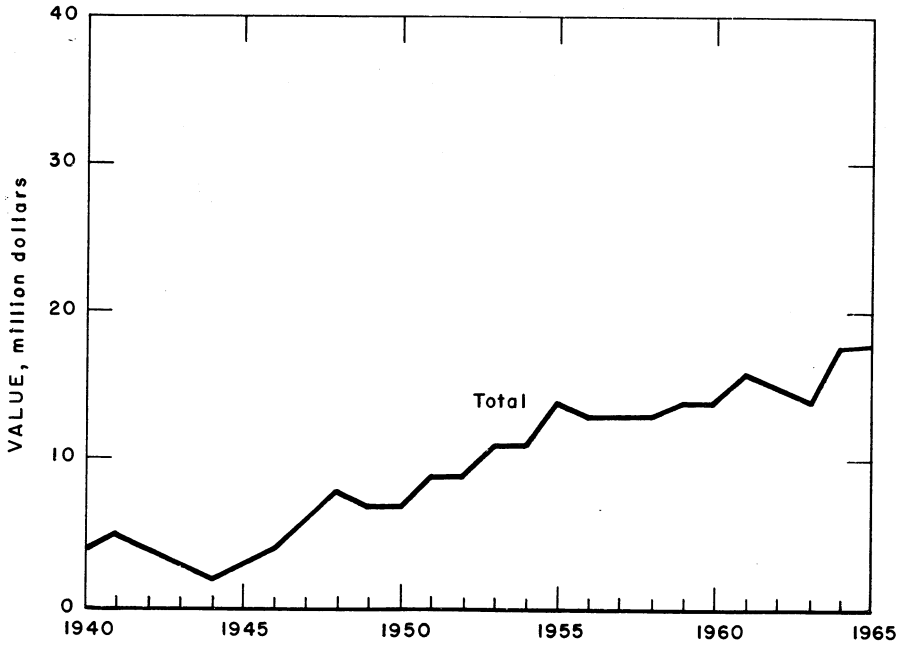

Figure 1.—Total value of mineral production in Maine.

Table 3.—Employment and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1964:								
Peat	37	238	9	70	----	----	----	----
Metal and nonmetal	162	167	27	214	----	9	41.70	653
Sand and gravel	1,264	247	312	2,510	----	48	19.12	549
Stone	517	232	120	982	----	31	31.57	244
Total	1,980	236	468	3,776	----	88	23.31	466
1965: p								
Peat	20	110	2	17	----	----	----	----
Metal and nonmetal	175	206	36	286	1	22	80.42	21,734
Sand and gravel[1]	320	246	79	638	----	12	18.81	113
Stone	490	237	116	984	----	15	15.24	208
Total	1,005	232	233	1,925	1	49	25.97	3,373

p Preliminary.
[1] Late information indicates preliminary data for sand and gravel are: 1,500 men, 375,000 man-days, 3,000,000 man-hours, 60 nonfatal injuries, 20.00 frequency rate, and 360 severity rate.

als. Gems and mineral specimens were also found in Franklin, Sagadahoc, Washington, and York Counties.

Lime.—Quicklime for manufacturing paper was used by Oxford Paper Co. at Rumford, Oxford County. The company regenerated and reused its lime and purchased lime from outside sources only to make up losses. The company used fuel oil at its rotary kiln plant.

Nitrogen Compounds.—Northern Chemical Industries, Searsport, Waldo County, produced anhydrous ammonia for use as a fertilizer component.

Peat.—Peat output declined to 20 percent of 1964 production largely because the Richland Peat Corp., Penobscot, Hancock County, stopped production to rebuild its plant. Richland expected to resume operations in 1966. All peat produced during the year was the sphagnum variety and was used principally as a soil conditioner.

Sand and Gravel.—Sand and gravel production increased for the fourth consecutive year. The 1965 output was 17.3 million tons, a 28-percent increase over that of 1964. The primary factor in the increased output was the continued expansion of work on highway construction and road maintenance. Increased production and value was recorded only for Government-and-contractor operations. Commercial tonnage decreased but value increased slightly. The average value for commercially produced sand and gravel was $0.77 per short ton, compared with $0.72 in 1964. Paving material accounted for 63 percent of total production, compared with 88 percent in 1964. Of this, 92 percent was by Government-and-contractor operations; the Maine Highway Commission was the State's leading producer. Washed, screened, or otherwise prepared material comprised 54 percent of the commercial sand and gravel, the same as in 1964. Almost all material was shipped by truck. Commercial production centered, in decreasing order, in Cumberland, Penobscot, Androscoggin, and York Counties. These counties accounted for 72 percent of the total commercial production. Output by Government-and-contractor operations was chiefly in Penobscot, Aroostook, Kennebec, Cumberland, and Washington Counties.

Stone.—Dimension granite was produced in Hancock, Knox, and York Counties; crushed granite was produced in Cumberland, Knox, and York Counties. The output of dimension granite included rough and dressed construction, monumental, and architectural stone, as well as rubble, curbing, and flagging. Miscellaneous stone was used as concrete aggregate, roadstone, and riprap. Slate was used as electrical slate and flagging. Limestone production was marketed for concrete, roadstone, cement manufacture, agriculture, railroad ballast, and miscellaneous uses. Trucks were used principally for shipment of limestone. Knox County continued as the leading limestone producing area followed by Aroostook, Kennebec, and Waldo Counties.

Table 4.—Sand and gravel sold by producers, by classes of operations and uses
(Thousand short tons and thousand dollars)

Class of operation and use	1964		1965	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Structural	310	$255	331	$254
Paving	229	187	255	193
Fill	199	83	277	121
Engine	2	2	4	6
Other	73	51	51	40
Total	813	578	918	614
Gravel:				
Structural	284	306	195	202
Paving	663	506	667	695
Railroad ballast	W	W	31	10
Fill	220	110	257	111
Other	296	136	142	62
Total	1,463	1,058	1,292	1,080
Total sand and gravel	2,276	1,636	2,210	1,694
Government-and-contractor operations:				
Sand:				
Structural	----	----	3	2
Paving	908	672	792	600
Fill	3	1	4,629	1,622
Other	203	158	227	178
Total	1,114	831	5,651	2,402
Gravel:				
Paving	10,157	3,994	9,199	3,639
Fill	----	----	231	95
Other	5	2	3	1
Total	10,162	3,996	9,433	3,735
Total sand and gravel	11,276	4,827	15,084	6,137
All operations:				
Sand	1,927	1,409	6,569	3,016
Gravel	11,625	5,054	10,725	4,815
Total	13,552	6,463	17,294	7,831

W Withheld to avoid disclosing individual company confidential data; included with other gravel.

METALS

Black Hawk Mining Corp., a subsidiary of Denison Mines, Ltd., Toronto, Ontario, completed shaft sinking. Three levels at 300, 440, and 580 feet below the shaft collar were opened to prove and develop zinc reserves. The Maine State Legislature, in a special session, granted the company permission for 2 years to deposit tailings or demineralized waste into Second Pond, which is nearby.

Callahan Mining Corp., New York, completed underground exploration and sampling of its copper-zinc mine at Harborside, Hancock County. Plans were completed for draining Goose Pond and developing an open pit 900 feet in diameter. A mining rate of 425 tons per day was anticipated. Based on proved reserves, the life of the mine would be about 7 years.

Roland Beers, Inc., continued to conduct intensive geophysical exploration of a large mineralized area containing nickel, copper, and cobalt in Union Township, Knox County. Dolsan Mines, Ltd., Montreal, Quebec, explored by diamond drilling a mineralized area containing copper, zinc, silver, and gold near Pembroke, Washington County. James R. Dunn and Associates Co., Troy, N.Y., explored by diamond drilling in an area near Appleton, Knox County. During the 1880's copper was produced in this area.

REVIEW BY COUNTIES

Paving sand and gravel was produced in all counties by the Maine State Highway Commission. Output was obtained by the Commission's own crew and by contract workers. Limited quantities of sand were also produced for highway ice control. Various municipalities in the State and Acadia National Park in Hancock County, produced sand and gravel for local street and road maintenance. Crushed granite, as reported in previous years, was not produced by Maine State Highway Commission in 1965.

Androscoggin.—Commercial output of sand and gravel was reported from 12 operations. Of the output, 67 percent was processed for use chiefly as building and paving material. The balance was used chiefly as fill and for engine sand. Principal producers were Lewiston Crushed Stone Co., Inc., Lewiston; Blue Rock Sand and Gravel, Leeds; P. E. Dunn, Inc., Poland; and G. A. Peterson Co., Auburn. Miscellaneous clay used for manufacturing building brick was produced from open pits near Auburn by Morin Brick Co. and Dennis Brick Co., Inc.

Aroostook.—Commercial sand and gravel production decreased slightly in quantity and value and was used principally as building, paving, and railroad ballast. Producers were Bull Brothers, Inc., Presque Isle; Lawrence E. Burleigh, Houlton; and Bangor Aroostook Railroad, Houlton. Limestone used mainly for concrete aggregate, roadstone, and railroad ballast, was quarried near Presque Isle by McKay Rock Products, Inc.

Cumberland.—Output of commercial sand and gravel decreased 14 percent. Building and paving uses were 75 percent; the balance was used mostly for fill. Principal producers were Cumberland Sand & Gravel Co., Inc., and Maynard W. Robinson & Sons, both near Cumberland Center; Leroy S. Prout Sand and Gravel and Harry C. Crooker & Sons, Inc., both at Brunswick. The sand and gravel pit at South Portland has been sold to the city of South Portland. Cook & Co., Inc., quarried granite at a site near Portland; all granite produced was crushed and used in the company's ready-mixed plant. Blue Rock Quarry produced crushed miscellaneous stone for concrete aggregate, roadstone, and riprap. Miscellaneous clay used for manufacturing brick was produced by Lachance Bros. Brick Co., South Windham; Fred S. Liberty & Son, Inc., North Yarmouth; and Royal River Brick Co., Inc., Gray.

Franklin.—Commercial sand and gravel, principally for building and paving, was recovered from eight pits. Producers were Omer Beisaw, Wilton; Thomas A. Skolfield, Weld; White Bros., Weld; and Brown Co., of Berlin, N.H. The latter, a manufacturer of paper and paper products, recovered

Table 5.—Value of mineral production in Maine, by counties

County	1964	1965	Minerals produced in 1965 in order of value
Androscoggin	$488,940	$577,050	Sand and gravel, clays.
Aroostook	710,945	1,590,848	Sand and gravel, stone.
Cumberland	1,214,250	1,088,795	Sand and gravel, stone, clays.
Franklin	190,000	177,000	Sand and gravel.
Hancock	1,058,967	571,949	Stone, sand and gravel, clays.
Kennebec	1,270,678	474,961	Sand and gravel, stone.
Knox	W	W	Cement, stone, sand and gravel.
Lincoln	132,000	130,000	Sand and gravel.
Oxford	283,667	236,110	Sand and gravel, feldspar.
Penobscot	1,040,000	2,038,000	Sand and gravel.
Piscataquis	W	W	Stone, sand and gravel.
Sagadahoc	101,000	161,000	Sand and gravel.
Somerset	542,000	294,000	Do.
Waldo	W	W	Stone, sand and gravel.
Washington	321,500	351,900	Sand and gravel, peat.
York	W	W	Stone, sand and gravel, clays.
Undistributed [1]	10,220,742	10,049,632	
Total	17,574,000	17,741,000	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] Includes value of gem stones that cannot be assigned to specific counties and values indicated by symbol W.

bank run material from five pits at various locations in the county.

Hancock.—Deer Island Granite Corp. produced dimension granite from a quarry on an island off the coast near Stonington and the reopened Settlement quarry at Buckmaster Neck, a peninsula of Deer Island also near Stonington. The company prepared stone for the permanent grave site of John F. Kennedy at Arlington National Cemetery, Va. The memorial, when completed, will contain 2,000 tons of Deer Island granite. Dimension granite also was produced by Joseph Musetti from Joe's quarry, Mt. Desert.

Commercial sand and gravel production declined as compared with that of 1964. Forty-one percent was used for building and paving, the balance for fill. Producers were Raymond F. Sargent, Inc., Ellsworth; Byron P. Young, Gouldsboro; Harold MacQuinn, Inc., Bar Harbor; Alvin R. Whitten, Winter Harbor; and Blue Hill Gravel Pit, Blue Hill. Stoneware clay was produced by Rowantrees, Inc., from a pit near East Blue Hill. The Richland Peat Corp. plant at Penobscot was being rebuilt and no production was reported.

Base metal exploration and development continued as the Callahan Mining Corp. made plans for mining a copper and zinc ore deposit near Harborside and Black Hawk Corp. completed shaft sinking at its mine near Blue Hill.

Kennebec.—Commercial sand and gravel production increased slightly. Output came from Calvin Rundstrom, Pittston, and V. E. Dunn & Son, Augusta. Crushed and broken limestone for use as concrete aggregate and roadstone was produced by Blue Rock Quarry, Sidney.

Knox.—Portland and masonry cements were produced at Thomaston by Dragon Cement Co., Division of Martin-Marietta Corp. The principal cement material used by the company was cement rock quarried nearby. Rockland-Rockport Lime Co., Rockland, and Lime Products Corp., Union, quarried limestone. The material was principally used for agricultural stone, paper manufacture, and concrete aggregate. Limited quantities of limestone for poultry grit and packaged dry-mixed concrete were produced by Rockland-Rockport Lime Co. Dimension granite was quarried by Hocking Granite Industries, Inc., Clark Island. Most of the material was used in construction and architectural applications as well as for monuments and curbing. Some of the output was used for fill and stone sand. C. R. Wallace & Son, Inc., continued to be the only producer of commercial sand and gravel. James R. Dunn and Associates Co. of Troy, N.Y., drilled for base metals near Appleton.

Oxford.—Commercial sand and gravel output decreased. Producers were Donald E. Wood, Norway, and Brown Co., Berlin, N.H. Brown Co. operated nine pits in various locations for bank run material. Crude feldspar was recovered principally from the Perham, Conant, Bessey, Lord Hill, Bumpus, and Newry mines. Bell Minerals Co., the leading producer, operated the Bessey, Lord Hill, and Newry mines, and subleased the Perham and Conant mines to other operators for part of the year. All crude material was ground at the Bell Minerals Co. mill at West Paris. Ground feldspar was used for ceramic purposes, including electrical porcelain, sanitary ware, tile and pottery, for soaps and abrasives, and for metal polishes. Oxford County mines, quarries, and dumps continued to be the rock collectors' principal source of gems and mineral specimens.

Penobscot.—Commercial sand and gravel production totaled 450,000 tons, a 42-percent increase over that of 1964. Eight operators were active mainly near Stillwater, Orono, Lincoln, Bangor, Milford, and Old Town. The material was used principally for highway construction and maintenance, fill, building, and ice control.

Piscataquis.—The Portland-Monson Slate Co., owned by Tatko Brothers Slate Co., produced slate for heavy switch gear panels, flagging, and floor tile at a mine near Monson. The slate was fabricated at the local finishing mill. No commercial sand and gravel production was reported.

Sagadahoc.—Commercial sand and gravel output increased. Producers were Almon R. Mitchell, Sr., Bath; Jack's Pit, Pejepscot; and A. R. Maynard, Inc., Topsham. The material was used for construction and fill.

Somerset.—Commercial sand and gravel output decreased by 150,000 tons compared to that of 1964. About one-half of the production was used for fill, while most of the

balance was used in building construction and paving. Producers were Donald J. Gurney, Inc., Waterville; Steelstone Corp., Fairfield; and J. R. Cianchette & Sons, Inc., Pittsfield.

Waldo.—Grenchi & Ellis, Inc., produced dimension granite for architectural work at its Frankfort quarry. McKay Rock Products, Inc., produced crushed limestone from its quarry near Prospect for use in concrete and as roadstone. No commercial sand and gravel was produced during the year.

Washington.—Commercial sand and gravel output increased. Producers were William A. Hill & Lincoln C. Sennett, Machias, and Maine Central Railroad, East Machias. Peat was produced by Eric W. Kelley Peat Moss Co., Inc., Centerville, and New England Peat Industries, Jonesport. Dolsan Mines, Ltd., Montreal, continued exploratory drilling of base and precious metal deposits near Pembroke.

York.—Dimension granite for construction and architectural use was produced from the Swenson Green quarry, York, and Swenson Pink quarry, Wells, by John Swenson Granite Co., Inc., of Concord, N.H. Broken ashlar, anchors, bounds, mantels, and riprap also were produced at the Swenson Pink quarry. Commercial sand and gravel output was less than that of 1964. Six pits were operated near North Berwick, York Harbor, Biddeford, Sanford, Saco, and York. Miscellaneous clay for brick manufacturing was produced by Morin & Sons, Inc., Eliot.

The Mineral Industry of Maryland

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U. S. Department of the Interior, and the Maryland Geological Survey for collecting information on all minerals except fuels.

By Melvin E. Hinkle [1]

Value of mineral production in Maryland established a new high of $78 million in 1965, a 6-percent increase over that of the previous high in 1964. The increase was chiefly the result of greater output and increased sales of stone, sand and gravel, and clays. Stone continued to be the principal mineral industry, accounting for over one-third of the total value of State mineral output.

Mineral production was reported from every county in the State except Queen Annes. Baltimore County continued to rank first in value of mineral output, followed closely by Carroll.

[1] Mining engineer, Bureau of Mines, Pittsburgh, Pa.

Table 1.—Mineral production in Maryland [1]

Mineral	1964		1965	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays—thousand short tons	[2] 635	[2] $798	914	$1,088
Coal (bituminous)—do	1,136	4,511	1,210	4,389
Gem stones	NA	3	NA	3
Lime—short tons	W	W	37,294	481
Natural gas—million cubic feet	1,373	366	408	103
Sand and gravel—thousand short tons	15,041	18,071	16,200	21,188
Stone—do	13,348	26,715	14,553	28,432
Value of items that cannot be disclosed: Ball clay, cement (portable and masonry), greensand marl, lime (1964), peat, potassium salts, talc, and soapstone	XX	23,429	XX	22,311
Total	XX	73,893	XX	77,995

NA Not available.
W Withheld to avoid disclosing individual company confidential data.
XX Not applicable.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Excludes ball clay; included with "Value of items that cannot be disclosed."

Table 2.—Value of mineral production in constant 1957–59 dollars

(Thousands)

Year	Value	Year	Value
1956	$39,916	1961	63,173
1957	40,088	1962	67,418
1958	46,131	1963	[r] 72,067
1959	54,171	1964	[r] 75,801
1960	57,472	1965	80,281

[r] Revised.

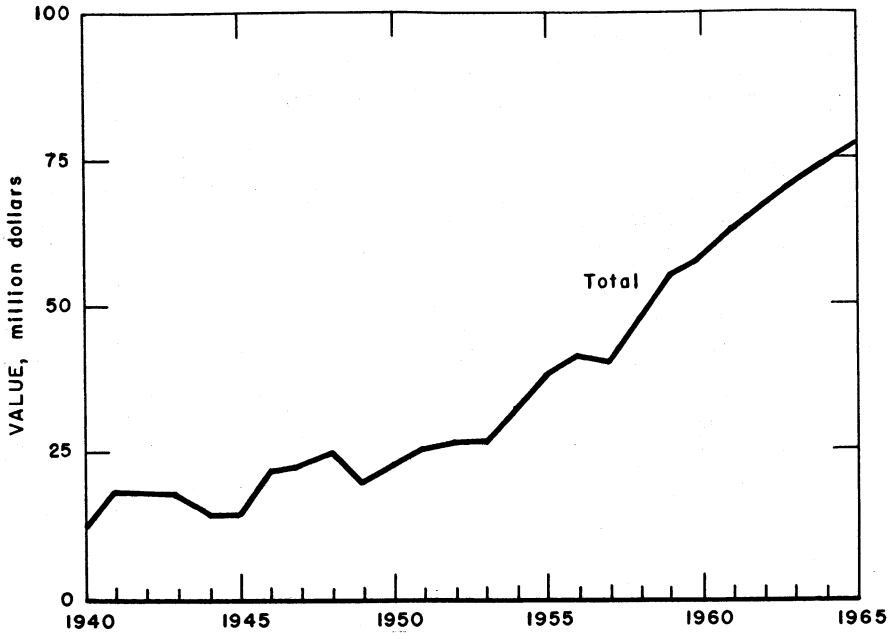

Figure 1.—Value of mineral production in Maryland.

Table 3.—Employment and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1964:								
Coal and peat	437	199	87	679	1	14	22.09	9,411
Nonmetal	265	245	65	529	---	22	41.55	844
Sand and gravel	1,089	253	275	2,342	---	66	28.18	1,162
Stone	1,347	275	369	3,206	1	69	21.83	3,431
Total	3,138	254	796	6,756	2	171	25.61	3,043
1965:p								
Coal and peat	457	197	90	715	---	15	20.98	587
Nonmetal	245	273	67	548	---	36	65.69	1,226
Sand and gravel	1,155	253	292	2,476	1	73	29.89	4,120
Stone	1,100	261	287	2,473	---	53	21.43	310
Total	2,957	249	736	6,212	1	177	28.65	1,941

p Preliminary.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Cement.—Production of cement was lower than in 1964. Portland cement accounted for 91 percent of the total output. Both portland and masonry cements were produced at three plants, one each in Carroll, Frederick, and Washington Counties. At another plant in Frederick County only masonry cement was produced. More than one-half of the total output was used in ready-mixed concrete. Large quantities were shipped to concrete product manufacturers, highway contractors, and building-material dealers.

Clays.—Total output of clays was 44 percent more than in 1964, primarily because of initial production of shale used for

manufacturing lightweight aggregate in Frederick County; increased demand for building brick also was a contributing factor. In 10 counties 17 operations were active. Ball clay, produced only in Baltimore County, was used in pottery, floor and wall tile, and firebrick and block. Fire clay products included firebrick and block and vitrified sewer pipe. Miscellaneous clay and shale were used mostly in manufacturing building brick and cement. Small quantities were used in other heavy clay products and as a filler for fertilizers.

Gem Stones.—Collection of a wide variety of semiprecious gem material and mineral specimens was reported by hobbyists.

Lime.—Lime was produced at three plants in Frederick County. All lime produced in the State was used for agricultural purposes.

Marl, Greensand.—Greensand marl was produced in Calvert County for use as a fertilizer and soil conditioner.

Perlite (Expanded).—Crude perlite mined in other States was expanded at plants in Baltimore and Prince Georges Counties. More than 50 percent of the output was used in building plaster. Other uses were for ultralightweight concrete aggregate and as filter aid.

Pigments.—Finished natural and manufactured iron oxide pigments were produced at a plant in Prince Georges County. Titanium dioxide pigment was manufactured at two plants in Baltimore County from titanium mineral concentrates. All crude pigment material was shipped in from other States.

Potassium Salts.—Potassium sulfate continued to be recovered as a byproduct of cement manufacture in Washington County. Output and value remained about the same as in 1964. The product was sold for agricultural uses.

Sand and Gravel.—Tonnage and value of sand and gravel increased compared with that of 1964. Commerical production amounted to 99 percent of the total State output. Of the 14 counties producing commercial sand and gravel, Prince Georges County led with 42 percent of the total tonnage, followed in decreasing order, by Anne Arundel, Baltimore, and Cecil Counties. A total of 75 operations were active. The chief uses were for building, paving, and fill.

Table 4.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1964		1965	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Structural	3,149	$4,271	4,094	$5,390
Paving	1,969	2,916	2,157	3,277
Other [1]	1,862	1,556	2,017	1,837
Total	6,980	8,743	8,268	10,504
Gravel:				
Structural	2,125	4,048	2,848	5,361
Paving	2,677	3,056	2,207	3,017
Fill	1,662	883	1,649	900
Other [2]	1,087	1,202	1,075	1,347
Total	7,551	9,189	7,779	10,625
Total sand and gravel	14,531	17,932	16,047	21,129
Government-and-contractor operations:				
Sand	78	20	6	2
Gravel	432	119	147	57
Total sand and gravel	510	139	153	59
All operations:				
Sand	7,058	8,763	8,274	10,506
Gravel	7,983	9,308	7,926	10,682
Total	15,041	18,071	16,200	21,188

[1] Includes sand for glass, fill, and other uses.
[2] Includes railroad ballast, miscellaneous, and other gravel.

Stone.—In terms of value, the stone industry was the most important mineral industry in the State. Output was reported from quarry operations in 11 counties. Limestone was the leading industrial stone, and output increased 14 percent. Limestone was crushed, and used mainly for concrete aggregate, roadstone, filler, and the manufacture of cement. Production of basalt (gabbro) remained about the same as in 1964, and was used for concrete aggregate, roadstone, railroad ballast, and riprap. Production of crushed granite increased 11 percent and was used as concrete aggregate, roadstone, and riprap; a small tonnage of dimension granite was quarried for rough architectural building stone. Production of crushed and dimension sandstone remained about the same as in 1964. Crushed sandstone was used in cement manufacture and crushed quartzite as refractory silica brick; dimension sandstone and quartzite was used in rough construction, as dressed stone, flagging, and rubble. Dimension marble was processed as dressed building stone; crushed marble was used for terrazzo. Output of oystershell, which was used for poultry grit and lime manufacture, increased 10 percent. Miscellaneous stone (serpentine and mica schist) was also produced and used for building stone, rubble, flagging, concrete aggregate, and roadstone.

The leading stone producing counties in order of tonnage produced were Baltimore, Washington, Frederick, Montgomery, Carroll, and Howard.

Talc and Soapstone.—Both output and value of talc and soapstone increased 2 percent. Most of the crushed material was ground and sold for asphalt filler, roofing granules, and foundry facings. Lava-grade talc was sawed and processed at a plant in Harford County, and ground soapstone was produced in Carroll County.

Vermiculite (Exfoliated).—Crude vermiculite from outside the State was exfoliated at a plant in Prince Georges County, and sold for insulation, concrete and plaster aggregate, and agricultural purposes.

MINERAL FUELS

Coal (Bituminous).—Production of coal from Allegheny and Garrett Counties amounted to 1.2 million tons, a gain of 7 percent over the 1964 output, but value declined 3 percent. Garrett County produced 75 percent of the coal.

Production was from a total of 69 active mines; 32 underground mines (3 less than in 1964) produced 36 percent of the coal; 35 strip mines (3 more than in 1964) accounted for 61 percent of production; and the remaining 3 percent was recovered from 2 auger operations. There were 16 underground mines and 1 auger operation located in each county. Allegheny County had 18 strip operations, and 17 were located in Garrett County. Underground production increased 13 percent, but strip-mine production was 2 percent less than in 1964.

Of the total underground tonnage, 74 percent was mined at six operations from the Tyson, Bakerstown, Freeport, and Clarion seams. The largest underground and strip mines were located in Garrett County. In both counties 43 mines produced less than 10,000 tons each annually. Largest tonnage came from the Kittanning coal seam, followed by the Freeport.

Underground coal was valued at an average of $4.02 per short ton, compared with $3.43 for strip-mined coal and $3.00 for auger coal. The average overall value per ton of coal produced was $3.63, a decrease of $0.34 per ton from the 1964 average.

The Western Maryland railroad carried 61 percent of the total coal produced in the State; the balance was trucked.

The Baltimore & Ohio Railroad announced plans to construct a new $10 million coal pier at Curtis Bay. Eleven load tracks will have a capacity of 439 coal hopper cars.[2]

Coke and Chemicals.—Bethlehem Steel Corp. produced coke and coal chemicals at its Sparrows Point ovens. Coproducts included coke breeze, coke oven gas, ammonium sulfate, soft pitch of tar, crude tar, crude chemical oil, intermediate light oil, crude light oil and derivatives (benzene, toluene, xylene), and naphthalene.

Natural Gas and Petroleum.—Mountain Lake Park and Accident fields in Garrett County continued to be the only sources of natural gas in Maryland. There were 15 producing wells in Mountain Lake Park and

[2] Coal Age. V. 70, No. 6, June 1965, p. 44.

19 in Accident field. Texas Eastern Transmission Corp. continued to pump gas to their pipeline from all wells in the Accident field. None was taken out of production as reported for 1964.

According to Kenneth N. Weaver, Director, Maryland Geological Survey, Texas Eastern continued to develop the Accident field for gas storage by completing 10 storage wells in 1965. The cycle of injection and removal from storage was planned to begin in 1966. The Cumberland and Allegheny Gas Company completed a production well on Negro Mountain in Garrett County.

American Bitumuls and Asphalt Co. and American Oil Co. processed imported crude oil at refineries with a combined capacity of 20,000 barrels of crude oil per day in the Baltimore area. The Humble Oil and Refining Co. plant was shut down in 1965.

Peat.—Value of Maryland peat production was 44 percent greater than in 1964. Peat was recovered as reed-sedge and humus and processed at plants in Garrett and Kent Counties. The product was sold in bulk and packaged for general soil improvement.

METALS

Copper.—Plants at Hawkins Point and Baltimore produced high-purity electrolytic copper from copper anodes received from smelters outside the State.

Iron and Steel.—The Bethlehem Steel Corp., at its Sparrows Point plant near Baltimore, produced basic and offgrade pig iron from imported iron ores. The ore was shipped from five foreign countries. Bethlehem Steel Corp. completed plans for a 400,000-ton-per-year high-speed rod mill to cost $34 million.

REVIEW BY COUNTIES

Allegany.—Bituminous coal mining was the largest industry in the county. It represented 50 percent of total value of mineral production. County output of coal increased 20 percent mainly due to larger strip mine production. A total of 35 mines were active. Output from 18 strip mines increased 36 percent, whereas tonnage from 16 underground mines declined 2 percent. One auger operation produced less than 1 percent of total coal mined. Largest production was from the Pittsburgh coal seam. The largest coal producer in the county was Georges Creek Lumber Co., with five strip operations. The W. & W. Coal Co., operating two mines produced the largest underground tonnage.

Production of sand and gravel increased 23 percent in tonnage and 22 percent in value. The Manley Sand Division, Martin Marietta Corp., produced building and glass sand. The Cumberland Cement & Supply Co. produced processed sand and gravel for building and paving. Crushed limestone was produced by the Appalachian Stone Division, Martin Marietta Corp., at Corriganville for use as concrete aggregate and roadstone.

Kaiser Refractories Division of Kaiser-Aluminum & Chemical Corp., produced fire clay from its underground mine and strip operation near Frostburg for use in manufacturing firebrick.

West Virginia Pulp & Paper Co. regenerated lime at its plant at Luke for use in paper and pulp, sewage and trade-wastes treatment, and water purification and softening.

Anne Arundel.—Sand and gravel was the only mineral commodity produced in the county; output and value increased 2 percent and 3 percent, respectively, over that of 1964. Leading producers were The Arundel Corp., Chesapeake Terrace Corp., and The Belle Grove Corp., all near Baltimore; Reliable Asphalt, Inc., Millersville; and Ferndale Farms, Inc., Glen Burnie. Chief uses were for building and paving.

Baltimore and Baltimore City.—Baltimore continued to be first in terms of value among the mineral-producing counties in the State. The value of mineral production increased 4 percent over that of 1964, and accounted for 18 percent of the 1965 State total. Stone was the leading mineral produced, comprising 78 percent of the total value of county output. Crushed limestone was produced by The Arundel Corp. at its Greenspring quarry for concrete and roadstone. Harry T. Campbell Sons' Corp., a subsidiary of The Flintkote Co., produced crushed limestone at the Texas and Mar-

Table 5.—Value of mineral production in Maryland, by counties [1]

County	1964	1965	Minerals produced in 1965 in order of value
Allegany	$2,166,485	$2,547,885	Coal, sand and gravel, stone, clays.
Anne Arundel	2,409,000	2,492,000	Sand and gravel.
Baltimore	13,494,468	14,000,315	Stone, sand and gravel, clays.
Calvert	W	W	Greensand marl.
Caroline	W	W	Sand and gravel.
Carroll	W	W	Cement, stone, clays, soapstone.
Cecil	3,753,436	3,790,552	Stone, sand and gravel, clays.
Charles	W	W	Sand and gravel.
Dorchester	W	W	Sand and gravel, stone.
Frederick	9,108,075	7,363,668	Cement, stone, lime, clays.
Garrett	4,183,582	3,880,319	Coal, stone, natural gas, sand and gravel, peat.
Harford	1,590,265	1,767,835	Stone, sand and gravel, clays, talc.
Howard	W	W	Stone.
Kent	W	W	Peat, clays.
Montgomery	W	W	Stone.
Prince Georges	9,287,600	9,471,300	Sand and gravel, clays.
St. Marys	146,000	W	Sand and gravel.
Somerset	W	----------	
Talbot	W	W	Sand and gravel.
Washington	W	W	Cement, stone, clays, potassium salts.
Wicomico	W	W	Sand and gravel, clays.
Worcester	37,000	W	Sand and gravel.
Undistributed [2]	27,716,950	32,681,126	
Total	73,893,000	77,995,000	

W Withheld to avoid disclosing individual company confidental data; included with "Undistributed."
[1] Queen Annes County is not listed because no production was reported.
[2] Includes gem stones, some sand and gravel that cannot be assigned to specific counties, and values indicated by symbol W.

riottsville quarries for use mainly as concrete aggregate, roadstone, filler, and agricultural purposes. Crushed basalt (gabbro), used for concrete, roadstone, and railroad ballast, was produced by The Arundel Corp., Woodberry quarry and by The Arundel Corp., formerly The J. E. Baker Co., at its Blue Mount serpentine quarry. Dimension quartzite was quarried near Butler by the Weaver Stone Co. and used for dressed architectural stone, rough construction and flagging. Oyster Shell Corp. crushed ground oystershell at its mill in Baltimore for poultry grit and lime. The Arundel Corp. produced crushed miscellaneous stone (serpentine) for use in concrete and for roadstone.

Four sand and gravel pits were active during the year. The largest producer was Harry T. Campbell Sons' Corp., at their White Marsh pit. Other producers of sand and gravel were Nottingham Farms Inc., at its Joppa Road plant and Harry A. Smuck & Sons at their Lansdowne plant. Ouput from these pits was used for building and paving. William Spiegel & Son, Kingsville, produced sand for building use.

National Gypsum Co., and United States Gypsum Co., at plants near Baltimore, produced calcined-gypsum products from crude imported gypsum. Expanded perlite, used mainly for building plaster and concrete aggregate, was produced at Baltimore plants of National Gypsum Co., and Zonolite Division of W. R. Grace & Co.

Clay was produced by three operators. The only producer of ball clay was United Sierra Division, Cyprus Mines Corp., for use in whiteware pottery, floor and wall tile, and firebrick. Miscellaneous clay was produced by Champion Brick Co. and Baltimore Brick Co. for use in manufacturing building brick.

Calvert.—Kaylorite Corp., Dunkirk, produced greensand marl for use as a soil conditioner.

Carroll.—The county retained second position in value of mineral production in the State. Value was 18 percent greater than in 1964. The county led in output and value among cement producing counties. Lehigh Portland Cement Co. produced crushed limestone, quartzite, and shale, all at Union Bridge, for manufacturing cement at its three-kiln plant. Mansonry cement and types I and II (general use and moderate heat) and type III (high-early-strength) portland cements were produced. Shipments were by truck and railroad mostly to ready-mixed concrete companies, concrete product manufacturers, highway contractors, and building-material dealers. At its Medford plant, Teeter Stone, Inc., subsidiary of Harry T. Campbell Sons'

Corp., produced crushed limestone for concrete aggregate and roadstone. Liberty Talc Mines, Inc., mined soapstone at Marriottsville and processed the crude material at the company's Sykesville plant for use mainly in roofing, asphalt filler, and foundry facing.

Cecil.—Value of sand and gravel production increased 20 percent over that of 1964. Seven operations were active. The largest producer was the Mason-Dixon Sand and Gravel Co. which produced sand and gravel at its Perryville and North East operations for use in ready-mixed concrete. Maryland Sand, Gravel, & Stone Co., Elkton, produced and processed building sand.

Stone production increased 10 percent. Basalt (granite gneiss) was quarried by D. M. Stoltzfus & Son, Inc., at Elk Mills, and the stone was crushed for riprap and concrete aggregate. Port Deposit Granite Co., at its Port Deposit quarry, produced crushed granite for riprap, and dimension garnite for rough architectural stone. Maryland Materials, Inc., produced crushed granite near North East for riprap, concrete aggregate, and roadstone. Crushed quartzite for use as silica brick was quarried by Harbison-Walker Refractories Co. near Leslie.

Plastic fire clay was mined by Fred S. Russell at a pit near North East and sold for manufacturing firebrick and block.

Charles.—Potomac Sand & Gravel Co., Washington, D.C., subsidiary of Dravo Corp., dredged sand and gravel from the Potomac River in the vicinity of Washington. Sand was sold for building and paving, and to concrete product dealers; gravel was chiefly used in construction. Charles County Sand & Gravel Co., Inc., Waldorf, marketed sand and gravel for building and paving construction.

Dorchester.—J. Edwin Rosser, Inc., Federalsburg, produced sand and gravel for construction, and sand for fill.

Oystershell for poultry grit and lime was processed by J. M. Clayton Co., Cambridge.

Frederick.—Cement production ranked first in value of county mineral output. Alpha Portland Cement Co. manufactured portland and masonry cements at its plant located at Lime Kiln. M. J. Grove Lime Co., Division of The Flintkote Co., Lime Kiln, manufactured masonry cement at its Frederick plant.

Shale was quarried and expanded into lightweight aggregate by Lehigh Portland Cement Co. at its new, automated shale plant near Woodsboro. Commercial production started early in 1965. The sized products were delivered to the Baltimore, Md., and Washington, D.C., market areas. Total output of the lightweight aggregate was sold for concrete block mix.

Production of crushed limestone and cement rock was reported by five companies, the largest of which was the M. J. Grove Lime Co., Division of The Flintkote Co., near Frederick. Uses were for concrete aggregate and roadstone, cement, agriculture lime, stone sand, and railroad ballast. Three operators of lime kilns near Le Gore, Woodsboro, and Middletown produced quicklime and hydrated lime for agricultural uses.

Garrett.—Bituminous coal output represented 80 percent of the total value of mineral production in the county. Tonnage of coal was 3 percent greater than in 1964. A total of 34 mines were active, of which 16 were underground mines, 17 were strip mines, and 1 was an auger mine. Tonnage of coal from underground mining was up 19 percent, whereas, output from strip mining declined 11 percent. Auger production accounted for 4 percent of total coal mined. Most production was from the Kittanning and Freeport coal seams. Buffalo Coal Co., Inc., operating one underground mine in the Freeport seam and one strip mine in the Kittanning seam, was the largest producer in the county.

Silver Knob Sand Co., Inc., produced building sand at Oakland. Vetter Brothers, Inc., mined and crushed limestone near Oakland for concrete aggregate and roadstone. M & S Quarries and B. & B. Stone Co. operated sandstone quarries near Grantsville. Output was for rough construction and flagging. Garrett County Processing and Packaging Corp. recovered humus and reed-sedge peat from a bog near Accident for general soil improvement use.

Harford.—Output of sand and gravel was 25 percent greater than in 1964. Five operators produced sand and gravel, the largest of which was Stancill's, Inc., Edgewood. The chief uses of sand and gravel were for building, paving and fill.

Gatch Crushed Stone Co., Inc., and D. M. Stoltzfus & Sons, Inc., at quarries near

Churchville and Aberdeen mined and crushed gneiss and gabbro respectively, for concrete aggregate and roadstone. Maryland Green Marble Corp., Division of General Stone & Materials Corp., at Cardiff, produced sawed dimension marble for building interiors and crushed marble for terrazzo. Talc, mined by Harford Talc & Quartz Co., Inc., Dublin, was processed for foundry facings and ceramics.

Plastic fireclay was recovered by Stancill's, Inc., Edgewood, and Maryland Clay Co., Aberdeen, for use in vitrified sewer pipe.

Howard.—Howard-Montgomery Crushed Stone Co., Inc., Clarksville, quarried and crushed limestone for concrete aggregate and roadstone. The Arundel Corp., near Savage, produced crushed basalt (gabbro) for concrete aggregate and riprap.

Kent.—Chestertown Brick Co., mined miscellaneous clay from an open pit near Chestertown for manufacturing building brick.

Maryland Peat and Humus Co. recovered reed-sedge peat from a bog near Betterton, which was processed and marketed for general soil improvement use.

Montgomery.—Rockville Crushed Stone, Inc., quarried and crushed basalt (serpentine and gabbro) for concrete aggregate.

Dimension mica schist for rough, dressed, and rubble building stone and for flagging was quarried by Stoneyhurst Quarries near Bethesda.

Prince Georges.—The county ranked first in output and value of sand and gravel. Commercial sand and gravel accounted for 96 percent of the value of county mineral production. There were 17 active commercial operations. The larger producers included Contee Sand & Gravel Co., Inc., Laurel; Arundel Supply Corp., District Heights; Silver Hill Sand & Gravel Co., Silver Hill; and Buffalo Sand & Gravel Co., Inc., Washington, D.C. Sand and gravel was used chiefly for building, paving, and fill.

Miscellaneous clay, mainly used for building brick, was mined from open pits by The Washington Brick Div., Thomas Somerville Co., at Muirkirk, and West Brothers Brick Co., near Washington, D.C. United Brick Corp., Washington, D.C., obtained miscellaneous clay from various sources for manufacture of building brick.

Altantic Perlite Co., Washington, D.C., expanded perlite from crude material shipped from outside the State; the product was used chiefly for building plaster, concrete aggregate, and filter aid. Crude vermiculite obtained outside the State was exfoliated by Zonolite Division, W. R. Grace & Co., at Beaver Heights, and used mainly for agriculture, concrete aggregate, and insulation. Mineral Pigments Corp. manufactured a variety of iron oxide pigments at a plant in Muirkirk.

St. Marys.—Commercial production of sand and gravel, used chiefly for building and paving, was processed by Leonardtown Sand & Gravel Co., Leonardtown, and Charlotte Hall Sand & Gravel Co., Charlotte Hall. Bank-run gravel was produced by a contractor for the Maryland State Roads Commission.

Washington.—Cement was the leading commodity, comprising 68 percent of the total value of minerals produced. Marquette Cement Manufacturing Co. produced portland and masonry cements at its Hagerstown plant, and utilized nearly all the limestone quarried and crushed at the company's Security quarry. Some crushed limestone was used as commercial stone. Byproduct potassium sulfate was recovered from cement clinker by Marquette Cement Manufacturing Co.

Appalachian Stone Division of Martin Marietta Corp., produced crushed limestone for concrete aggregate and roadstone at quarries located near Hancock, Boonsboro, Hagerstown, and Pinesburg. Miscellaneous shale was mined from a pit near Williamsport by Victor Cushwa & Sons, Inc., for building brick and cement manufacture, earth fill, and fertilizer filler.

Wicomico.—Output from five sand and gravel pits was 96 percent sand. The largest producer was Raymond A. Weisner, Salisbury, who sold sand for fill. Salisbury Brick Co., Inc., Salisbury, recovered miscellaneous clay for use in manufacturing building brick.

Worcester.—Mervin L. Blades & Son produced processed sand and gravel from a dredge operation near Pocomoke City for building and road construction. Worcester County Roads Board at Snow Hill produced unprocessed sand and gravel for highway construction, maintenance, and repair.

The Mineral Industry of Massachusetts

By Melvin E. Hinkle [1]

Massachusetts mineral production declined less than 1 percent in total value from the 1964 high; 1965 was the second highest year on record. The values of stone and sand and gravel production together represented 92 percent of the State total value. Output of both was about the same as in 1964. Value of lime output was about 8 percent of the total value of mineral production. The value of clay produced amounted to less than 1 percent of the State total; however, output increased by more than one-third over the 1964 output. The value of both lime and clay output was the highest on record.

In terms of value, Middlesex County retained its lead as the State's chief mineral producing county.

[1] Mining engineer, Bureau of Mines, Pittsburgh, Pa.

Table 1.—Mineral production in Massachusetts [1]

Mineral		1964 Quantity	1964 Value (thousands)	1965 Quantity	1965 Value (thousands)
Clays	short tons	138,214	$174	181,100	$238
Gem stones		NA	2	NA	2
Lime	short tons	171,398	2,703	169,684	2,779
Sand and gravel	thousand short tons	21,341	16,794	22,141	16,172
Stone	do	6,519	16,663	6,168	16,980
Value of items that cannot be disclosed: Mineral fuels and nonmetals.		XX	31	XX	27
Total		XX	36,367	XX	36,198

NA Not available. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Value of mineral production in constant 1957–59 dollars

(Thousands)

Year	Value
1956	$24,545
1957	25,192
1958	24,104
1959	26,086
1960	28,098
1961	30,849
1962	30,274
1963	33,323
1964	r 37,141
1965	37,008

r Revised.

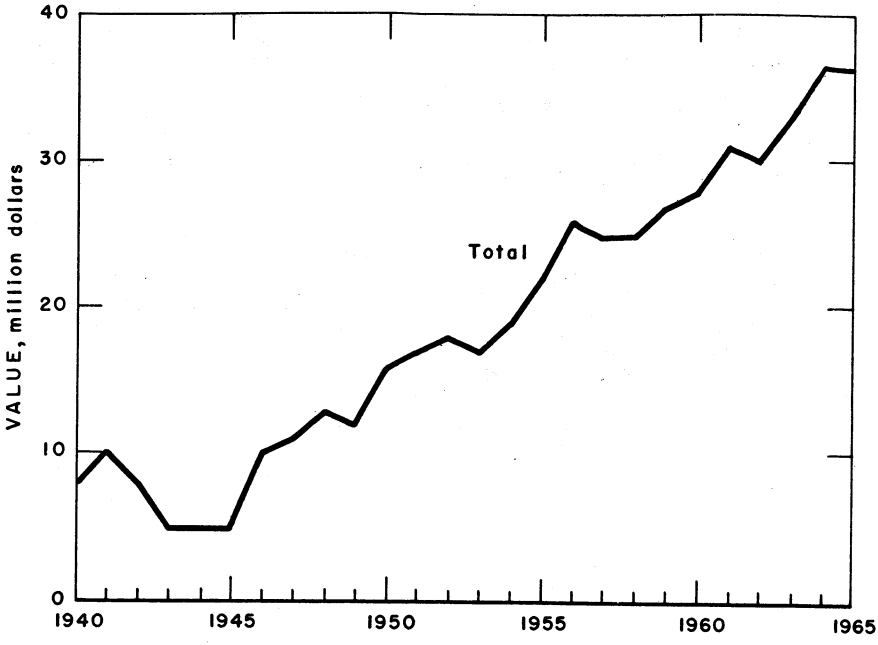

Figure 1.—Total value of mineral production in Massachusetts.

Table 3.—Employment and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1964:								
Nonmetal and peat	78	256	20	151	----	1	6.62	159
Sand and gravel	1,318	215	283	2,322	----	39	16.80	390
Stone	1,073	249	267	2,156	----	64	29.68	1,972
Total	2,469	231	570	4,629	----	104	22.47	1,119
1965: p								
Nonmetal and peat	80	250	20	153	----	----	----	----
Sand and gravel	1,465	215	314	2,577	1	43	17.07	2,645
Stone	1,030	249	256	2,065	----	46	22.28	925
Total	2,575	229	590	4,795	1	89	18.77	1,820

p Preliminary.

REVIEW BY MINERAL COMMODITIES

Clays.—Production and value of miscellaneous clay and shale rose 31 and 37 percent, respectively, over the 1964 figures. Norfolk County was the leading clay producer. Miscellaneous clay was mined by three companies for use in building brick. One company reported use of shale for manufacture of lightweight aggregate.

Gem Stones.—Mineral specimens were collected on a small scale at unspecified locations by hobbyists.

Gypsum.—Crude gypsum imported from Nova Scotia was manufactured into calcined gypsum products at Charlestown, Suffolk County.

Lime.—Quicklime and hydrated lime were produced from local limestone by three producers in Berkshire County. Production was slightly less, but value increased 3 percent over that of 1964. The chemical industry consumed 71 percent of the production. A sizable tonnage was used by the building industries, and a small amount for agriculture. The average unit price for lime increased from $15.77 per short ton in 1964 to $16.38 per ton in 1965.

Table 4.—Lime sold or used by producers

Year	Short tons	Value
1956–60 (average)	141,574	$2,221,182
1961	144,831	2,306,710
1962	148,401	2,337,027
1963	144,889	2,425,699
1964	171,398	2,703,276
1965	169,684	2,779,055

Peat.—Production and value of peat both declined about 13 percent. Peat was produced by two companies, one each in Essex and Worcester Counties.

Perlite (Crude).—A Roslindale, Suffolk County plant expanded crude perlite from Colorado and marketed the product for use as a lightweight aggregate in concrete and building plaster and as a soil conditioner. Production and value was more than double that of 1964.

Sand and Gravel.—Output of sand and gravel rose to a new high, being slightly greater than the previous record year, 1964, but value declined 4 percent. The high level of production was due especially to road building programs carried out by local, State, and Federal authorities. The average value per ton dropped from $0.79,

Table 5.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1964		1965	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Structural	3,371	$3,274	2,952	$2,808
Paving	2,242	1,972	2,024	1,877
Fill	421	163	478	193
Blast	5	55	W	W
Filtration	9	15	W	W
Undistributed [1]	650	993	553	1,013
Total	6,698	6,472	6,007	5,891
Gravel:				
Structural	2,960	3,976	2,741	3,646
Paving	2,679	2,565	2,247	2,364
Fill	1,328	633	1,172	678
Other	738	822	W	W
Miscellaneous	W	W	366	337
Undistributed [2]	379	313	558	536
Total	8,084	8,309	7,084	7,561
Total sand and gravel	14,782	14,781	13,091	13,452
Government-and-contractor operations:				
Sand:				
Paving	23	13	13	5
Fill	1	1	- -	- -
Other	17	20	21	27
Total	41	34	34	32
Gravel:				
Paving	1,553	755	2,224	1,080
Fill	4,961	1,218	6,777	1,579
Other	4	6	15	29
Total	6,518	1,979	9,016	2,688
Total sand and gravel	6,559	2,013	9,050	2,720
All operations:				
Sand	6,739	6,506	6,041	5,923
Gravel	14,602	10,288	16,100	10,249
Total	21,341	16,794	22,141	16,172

W Withheld to avoid disclosing individual company confidential data; included with "undistributed".
[1] Includes blast and filtration (1965), molding sand, and sand for other uses.
[2] Includes miscellaneous gravel (1964), other uses (1965), and railroad ballast.

recorded in 1964, to $0.73, reflecting the lower average value of gravel. Government-and-contractor tonnage was 41 percent of the total sand and gravel sold or used. Building and paving consumed 55 percent of the combined Government-and-contractor and commercial tonnage. Thirty-eight percent was used for fill and about 29 percent for paving. Small quantities of commercial sand and gravel were used as blast, molding, filtration, and railroad ballast. Eighty percent of the commercial output and 97 percent of Government-and-contractor tonnage was sold as processed material. Active operations in 1965 totaled 193. Production of sand and gravel in Hampshire County, the leading producing county in 1965, rose nearly 2 million tons to 6.3 million tons. Other counties with production over 1 million tons were Middlesex (largest producer in 1964), Norfolk, Bristol, Franklin, Worcester, and Hampden.

Stone.—Production of stone declined 5 percent, while value was slightly higher than in the previous record year, 1964. Basalt, consumed largely for concrete aggregate and roadstone, was the most important stone produced in the State in both quantity and value, but output decreased from that of 1964. Output of limestone, granite, and miscellaneous stone also decreased. Production and value of sandstone increased almost fourfold. Production of dimension stone (mostly granite and a small tonnage of sandstone) decreased moderately in tonnage to 128,994 tons valued at $4.9 million which represented a 12-percent increase over 1964 production. Crushed and broken stone used for concrete aggregate and roadstone accounted for 79 percent of the total stone sold or used in 1965.

As in previous years, stone was quarried in all counties except Barnstable, Dukes, and Nantucket. In tons, Middlesex County remained the leading stone-producing county, followed closely by Essex. However, in terms of value, the order of rank was Middlesex, Berkshire, Essex, and Norfolk.

Roofing Granules.—Bird & Son, Inc., at Norwood, Norfolk County, prepared roofing granules from rhyolite stone obtained from a quarry at Wrentham. For statistical purposes the stone was classified as miscellaneous stone. Production and value of roofing granules was less than in 1964.

Vermiculite.—Zonolite Co.'s plant in Hampshire County exfoliated vermiculite for sale as lightweight aggregate for concrete and plaster, for insulation, and for agricultural purposes. There was a large decrease in production of exfoliated vermiculite from that of 1964 because plants of Zonolite Co. (formerly California Products Corp.), Norfolk County, and Zonolite Co., Middlesex County, were idle.

Table 6.—Stone sold or used by producers, by uses

Use	1964		1965	
	Short tons	Value	Short tons	Value
Riprap	65,833	$92,960	60,905	$105,860
Concrete aggregate and roadstone	5,180,345	8,619,696	4,901,260	8,222,542
Agricultural (limestone)	236,078	768,513	187,526	621,836
Undistributed [1]	1,036,255	7,181,400	1,018,367	8,030,148
Total	6,518,511	16,662,569	6,168,058	16,980,386

[1] Includes dimension stone, furnace flux, railroad ballast, and other uses.

REVIEW BY COUNTIES

The Commonwealth of Massachusetts, Department of Public Works, quarried basalt with its own crews for roadstone, concrete aggregate, and riprap in Franklin, Hampden, Hampshire, and Worcester Counties. Basalt quarries in Middlesex and Norfolk Counties were idle in 1965. The Department of Public Works also mined sand and gravel in all counties except Dukes, Essex, Nantucket, Suffolk, and Worcester. Ninety-six percent of the output of sand and gravel was mined under contract, and the balance was produced by its own crews. Both sand and gravel was used mainly for paving and fill.

The municipalities of North Adams, Dartmouth, Malden, and Fall River produced small quantities of sand and gravel for their own street and road maintenance.

Table 7.—Value of mineral production in Massachusetts, by counties

County	1964	1965	Minerals produced in 1965, in order of value
Barnstable	$240,000	$215,000	Sand and gravel.
Berkshire	6,334,567	6,565,005	Stone, lime, sand and gravel.
Bristol	2,294,500	2,390,930	Sand and gravel, stone.
Dukes	W	W	Sand and gravel.
Essex	2,892,644	2,659,463	Stone, sand and gravel, peat.
Franklin	969,000	1,300,467	Sand and gravel, stone.
Hampden	2,112,214	2,570,219	Stone, sand and gravel, clays.
Hampshire	1,375,000	1,809,530	Sand and gravel, stone.
Middlesex	11,128,510	10,043,102	Stone, sand and gravel.
Nantucket	W	16,000	Sand and gravel.
Norfolk	5,615,520	4,883,563	Sand and gravel, stone, clays.
Plymouth	644,347	748,903	Sand and gravel, clays, stone.
Suffolk	420,702	486,836	Stone, sand and gravel.
Worcester	2,308,462	2,253,602	Sand and gravel, stone, peat.
Undistributed [1]	32,000	255,000	
Total	36,367,000	36,198,000	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed".
[1] Includes value of gem stones and some sand and gravel that cannot be assigned to specific counties, and value indicated by symbol W.

Barnstable.—Frederick V. Lawrence, Inc., Falmouth, produced and processed sand and gravel for paving. The company also sold bank-run sand and some processed gravel for fill. Concrete Products Co. of Cape Cod, Inc., Falmouth, mined sand and gravel for construction. The sand was processed and the gravel was sold as bank-run product. Whitehead Brothers Co., Provincetown, produced molding sand. Falmouth Cement Works, Inc., Teaticket, sold processed sand and gravel for building.

Berkshire.—Production of limestone was confined to five operators in Berkshire County. The operators were the Georgia Marble Co., Calcium Products Division, Adams; John S. Lane & Son, Inc., West Stockbridge; Minerals, Pigments & Metals Division, Chas. Pfizer & Co., Inc., Adams; Lee Lime Corp., Lee (two quarries); and United States Gypsum Co., Farnams. The chief uses for limestone were blast-furnace flux, agriculture, concrete aggregate and roadstone, mineral food, rubber and asphalt filler, and lime manufacture. Lime was produced by Minerals, Pigments & Metals Division, Chas. Pfizer & Co., Inc., Adams; Lee Lime Corp., Lee; and United States Gypsum Co., Farnams. The three most important uses were for agriculture, building, and various chemical and industrial purposes.

Production of sand and gravel declined less than 1 percent from that of 1964. Fourteen operators were active. General Sand & Stone Corp., Dalton, was the leading producer. Other large producers included Abby & Sons, Lee; W. E. Williams, Inc., Lenox Dale; Cairo Redi-Mix Corp., Great Barrington; James J. Quirico, Pittsfield; and Berkshire Gravel, Inc., Pittsfield.

Bristol.—Output of sand and gravel increased 7 percent. Government-and-contractor tonnage comprised 24 percent of the total. Eighty-seven percent of production was washed or screened material. Sales were chiefly for paving, building, and fill. There were 17 active operations. The leading commercial producer was Morse Sand & Gravel Co., Attleboro. Other leading producers were Assonet Sand & Gravel Co., Inc., Freetown; Courtois Sand & Gravel Co., North Attleboro; Easton Sand & Gravel Corp., North Easton; River Sand & Gravel Co., Seekonk; and Joseph Borge & Sons, Inc., Swansea.

Warren Bros. Road Co., Acushnet, and Morse Sand & Gravel Co., Attleboro, quarried basalt for roadstone and concrete aggregate.

Dukes.—Sand and gravel production decreased from the 1964 output. Sales were largely for paving and building. The two operators were Grant Brothers, Inc., Edgartown, and Goodale Construction Co., Inc., Vineyard Haven.

Essex.—Production of sand and gravel declined by 14 percent. There were nine producing operators. Merrimack Materials, Inc., Groveland, was the largest producer. Other leading producers were Georgetown Sand & Gravel Co., Georgetown; Andover Sand & Gravel, Inc., Lawrence; and Miles River Sand & Gravel, Inc., Ipswich. Sales of

sand and gravel were chiefly for building, paving, and fill.

Lynn Sand & Stone Co., Swampscott, quarried basalt, mostly for railroad ballast, riprap, concrete aggregate, and roadstone. Stone was also produced by Trimount Bituminous Products Co., Saugus, and Essex Bituminous Concrete Corp., Peabody, for concrete aggregate and roadstone. Dimension granite was produced by Rockport Quarries Co., Inc., at its Rockport quarry for use in architecture, and by Karl A. Persson, at a quarry near Rockport for construction and curbing. Humus peat was recovered by Andover Sand & Gravel, Inc., from a bog near Lawrence for sale in bulk.

Franklin.—Franklin County produced sand and gravel and stone. Production of sand and gravel increased by 30 percent over the 1964 figure. There were 10 producing operations. Eighty-seven percent of total production was processed sand and gravel. The largest commercial producer was Warner Brothers, Inc., Sunderland, producing paving and railroad ballast sand and gravel. Other large producers were Northfield Washed Sand & Gravel Co., Inc., Northfield, and Mackin Sand & Concrete Products, Greenfield.

Warner Brothers, Inc., quarried basalt near Deerfield for use in riprap, roadstone, and railroad ballast. The company had a contract for the construction of a 17-mile, main-line run of Interstate Highway 91 through Whately, Deerfield, and Greenfield.[2]

Hampden.—John S. Lane & Son, Inc., Westfield, quarried and crushed basalt for use as railroad ballast and concrete aggregate. McCormick Longmeadow Stone Co., Inc., East Longmeadow, sharply increased its output of dimension sandstone for architecture.

Production of sand and gravel declined by 11 percent. Thirteen operations were active. The largest commercial operator was North Wilbraham Sand & Gravel & Concrete Co., Inc., North Wilbraham. Other principal commercial operators were John's Trucking Co., Agawam; John S. Lane & Son, Inc., Westfield; and Monson Sand & Gravel Corp., Monson. The chief uses were for building, paving, and fill.

The Hampshire Brick Mfg. Co., Inc., Chicopee, and Westfield Clay Products Co., Westfield, mined miscellaneous clay for manufacturing building brick.

Hampshire.—Hampshire ranked first among sand- and gravel-producing counties; production rose 46 percent. Both commercial and Government-and-contractor output increased. Ninety-seven percent was processed by washing or screening. Gravel accounted for over 95 percent of total sales. Thirteen operations were active. The largest commercial producers were D. D. Ruxton Co., Inc., North Wilbraham; Eli Quenneville, South Hadley; Bill Willard, Inc., Northampton; and Donovan Brothers, Inc., Huntington. Chief uses were for building, paving, and fill. John S. Lane & Son, Inc., quarried basalt at Amherst for concrete aggregate and roadstone.

The Zonolite Co. exfoliated vermiculite at East Hampton for sale as insulation and lightweight aggregate.

Middlesex.—Middlesex remained first among Massachusetts counties in value of both sand and gravel and stone. Six operators in the Westford-Chelmsford area quarried dimension granite. Producers of dimension granite were Morris Bros. Granite Co., Inc., Oak Hill Granite Co., Inc., and Forest Road Granite Co., Inc., all near Westford; Le Masurier Granite Quarry, Inc., and Guilmette Bros. Corp., both near North Chelmsford; and H. E. Fletcher Co., West Chelmsford. Dimension stone sold included rough and dressed construction stone, paving block, curbing, rubble, and architectural and monumental stone. Crushed and broken granite, also, was produced by Le Masurier Granite Quarry for use as riprap, and by H. E. Fletcher Co. for agricultural use. Basalt production declined by more than 20 percent. Producers included George Brox, Inc., and John P. Condon Corp., both of Dracut; Massachusetts Broken Stone Co., Weston; Rowe Contracting Co., Malden; and B & M Crushed Stone Corp., Bayer & Mingolla Construction Co., Inc., Ashland. Output was consumed for concrete aggregate, roadstone, and riprap.

Middlesex was the second largest producer of sand and gravel in the State, but total tonnage declined 22 percent. Both commercial and Government-and-contractor output decreased. Over 50 percent of the output was gravel. Seventy-one percent of the material was screened, washed, and otherwise prepared. There were 31 active

[2] New England Construction. V. 30, No. 4, July 19, 1965, p. 44.

operations. The largest commercial producers were Lexington Sand & Gravel Co., South Acton; Pomerleau Brothers, Inc., Westford; J. J. Cronin Co., North Reading; Assabet Sand & Gravel Co., Acton; San-Vel Contracting Co., Littleton; New England Sand & Gravel Co., Inc., Framingham; Burlington Sand & Gravel Co., Burlington; and Vinson Reid, Westford. Sales were chiefly for building, paving, fill, molding, and filtration.

The vermiculite plant of the Zonolite Co., North Billerica, was idle during 1965.

Nantucket.—Nantucket Construction Co., Nantucket, produced a small tonnage of processed sand for paving.

Norfolk.—Output of sand and gravel declined 9 percent from the 1964 output. Sand comprised about half of the commercial output, and about one-third of total commercial and Government-and-contractor tonnage. Almost 100 percent of production was washed, screened, or otherwise prepared. Fifteen operations were active. The largest commercial producers were West Sand & Gravel Co., Walpole; Wrentham Sand & Gravel Co., Inc., Wrentham; Tresca Brothers Sand & Gravel, Inc., Millis; A. A. Will Sand & Gravel Corp., Canton; and L. Romano Construction Co., Plainville. Production was chiefly for building, paving, and fill.

Three operations produced dimension and crushed granite. Bates Bros. Seam Face Granite Co., quarried granite near Weymouth for rubble, architecture, and riprap. Simeone Stone Corp., Wrentham, and Old Colony Crushed Stone Co., Quincy, produced crushed granite mostly for concrete aggregate, roadstone, and stone dust. Simeone Stone Corp. at Stoughton, also quarried and crushed basalt for concrete aggregate and roadstone. S. M. Lorusso & Sons, Inc., quarried miscellaneous stone near Wrentham. The material was sold to Bird & Son, Inc., East Walpole, for manufacture into roofing granules.

Masslite, Division of Blackstone Industries, Inc., Plainville, mined shale and converted it into lightweight aggregate for building blocks and concrete. Shale output increased over the 1964 output.

California Products Corp., Vermiculite Division, Hingham plant, was purchased in 1965 by the Zonolite Company. The plant remained idle for the year.

Plymouth.—Production of commercial tonnage of sand and gravel declined by 22 percent from the 1964 figure. Government-and-contractor output rose 45 percent. However, combined commercial and Government-and-contractor output declined 8 percent. Ninety percent of the commercial output was washed or screened, and 72 percent consisted of sand. Twelve operations were active. The leading commercial producers included Marshfield Sand & Gravel, Inc., Marshfield; Petrino Sand & Gravel, Whitman; and Wareham Construction Co., West Wareham. Whitehead Bros. Co., Marion, produced molding sand. Other chief uses were for building, paving, and fill.

Stiles & Hart Brick Co., Bridgewater, mined clay for manufactured building brick. Granite was quarried by Plymouth Quarries, Inc., East Weymouth, at its Hingham quarry as rough architectural blocks, rubble, and irregular shapes for building purposes.

Suffolk.—West Roxbury Crushed Stone Co. produced crushed basalt near West Roxbury for concrete aggregate and roadstone.

Calcined gypsum products were manufactured by United States Gypsum Co., Charlestown, from raw material imported from Nova Scotia. The products were sold chiefly in the New England States.

Perlite was expanded by Whittemore Products, Inc., Roslindale, and sold as a soil conditioner, as insulating material, and as lightweight aggregate in concrete and plaster.

Worcester.—Commercial output accounted for the total production of sand and gravel. Output declined 20 percent. Over 90 percent of the tonnage was washed or screened, and 56 percent consisted of gravel. There were 17 operations active in the county. The leading producers included E. L. Dauphinais, Inc., North Grafton; Rosenfeld Washed Sand & Stone Co., Hopedale; De Falco Concrete Corp., Sutton; P. J. Keating Co., Lunenburg; Direnzo Brothers Sand & Gravel Co., Worcester. Chief uses were for building, paving, and fill.

Mario Pandolf Co., Inc., near Sterling, and Holden Trap Rock Co., Holden, quar-

ried and crushed basalt for concrete aggregate and roadstone. Output of basalt increased 44 percent over that of 1964. H. E. Fletcher Co. quarried and dressed dimension granite near Milford for architectural use. Castellucci & Sons, Inc., Milford, quarried pink dimension granite as rough architectural blocks for building. Reed-sedge peat was mined by Sterling Peat Co., near Sterling.

The Mineral Industry of Michigan

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the Geological Survey Division of the Michigan Department of Conservation, for collecting information on all minerals except fuels.

By Donald F. Klyce [1]

The value of mineral production in Michigan reached $565.6 million, 2 percent more than the record high set in 1964. Higher unit values for several mineral commodities combined with increased output of cement, copper, chemicals derived from well brines, and sand and gravel contributed to much of the increase. Petroleum production continued to decline, and lime output was curtailed by a labor strike at one of the major producers.

Iron ore remained first in value, followed by cement, copper, sand and gravel, and petroleum. Nonmetals, chiefly construction materials (cement, clays, gypsum, lime, sand and gravel, and stone) and natural saline minerals (bromine, calcium chloride, calcium-magnesium chloride, iodine, magnesium compounds, potassium salts, and salt from brine) again accounted for 55 percent of the State total mineral value. Metallic minerals increased to nearly 35 percent of the total value, while mineral fuels made up the remainder.

[1] Industry economist, Bureau of Mines, Minneapolis, Minn.

Table 1.—Mineral production in Michigan [1]

Mineral	1964		1965	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:				
Portland—thousand 376-pound barrels	26,745	$84,316	27,565	$86,996
Masonry—thousand 280-pound barrels	1,865	4,954	2,108	5,373
Clays—thousand short tons	2,385	2,592	2,402	2,580
Copper (recoverable content of ores, etc.)—short tons	69,040	45,014	71,749	50,798
Gypsum—thousand short tons	1,421	5,263	1,338	5,027
Iron ore (usable)—thousand long tons, gross weight	13,871	143,979	13,527	145,482
Lime—thousand short tons	1,430	19,246	1,095	13,057
Magnesium compounds—short tons	306,494	23,385	319,389	26,143
Natural gas—million cubic feet	31,388	7,984	34,558	8,674
Natural gas liquids:				
Natural gasoline—thousand gallons	W	W	9,054	607
LP gases—do	W	W	76,299	3,815
Peat—short tons	269,074	2,412	230,950	2,134
Petroluem (crude)—thousand 42-gallon barrels	15,601	43,839	14,728	41,091
Salt—thousand short tons	4,345	35,711	4,171	36,087
Sand and gravel—do	51,921	44,405	53,168	47,176
Silver (recoverable content of ores, etc.) thousand troy ounces	349	452	458	592
Stone—thousand short tons	34,650	37,002	34,713	36,438
Value of items that cannot be disclosed: Bromine, calcium chloride, calcium-magnesium chloride, gem stones, iodine, potassium salts, and values indicated by symbol W	XX	r 54,278	XX	53,490
Total	XX	r 554,832	XX	565,560

r Revised. W Withheld to avoid disclosing individual company confidential data. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

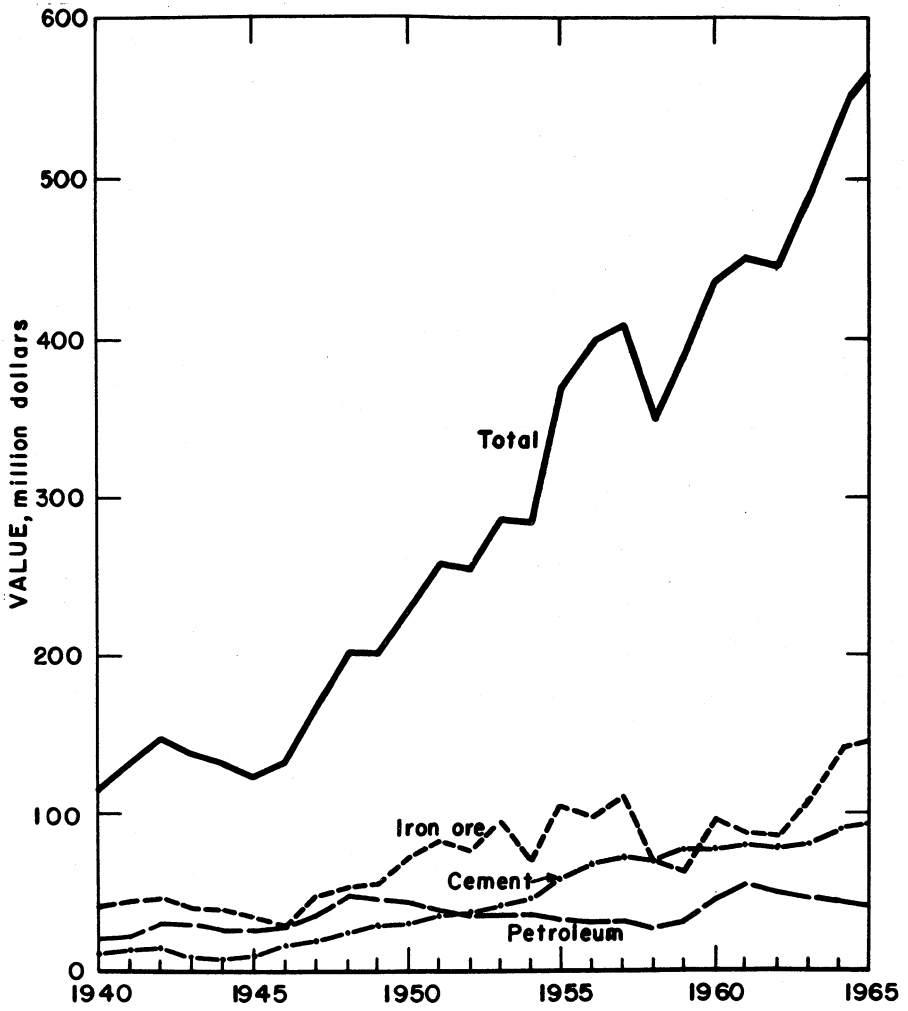

Figure 1.—Value of iron ore, petroleum, cement, and total value of all minerals produced in Michigan.

Table 2.—Value of mineral production in constant 1957-59 dollars
(Millions)

Year	Value	Year	Value
1954	$306	1960	$431
1955	385	1961	444
1956	396	1962	440
1957	412	1963	484
1958	352	1964	r 535
1959	384	1965	p 540

r Revised. p Preliminary.

Table 3.—Employment and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1964:								
Peat	291	186	54	495	-------	12	24.26	267
Metal	5,470	277	1,514	12,125	1	321	26.56	1,893
Nonmetal	2,303	299	688	5,500	-------	54	9.82	459
Sand and gravel	2,717	212	577	4,765	2	90	19.31	3,010
Stone	3,175	302	958	7,683	-------	42	5.47	333
Total	13,956	272	3,791	30,568	3	519	17.08	1,391
1965:p								
Peat	189	159	30	270	-------	3	11.11	148
Metal	5,605	284	1,593	12,739	4	341	27.08	2,739
Nonmetal	2,120	278	589	4,718	-------	43	9.11	269
Sand and gravel	2,715	212	577	4,765	2	90	19.31	3,897
Stone	3,315	292	968	7,767	-------	54	6.95	453
Total	13,944	269	3,757	30,259	6	531	17.75	1,926

p Preliminary.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Cement.—Shipments of cement reached a new high of nearly 29.7 million barrels with both portland and masonry cements registering substantial gains. Portland cement was produced at eight plants in six counties. At six of these plants masonry cement was produced. Total finished portland cement capacity at these plants was nearly 34.5 million barrels. Yearend stocks of portland cement at mills were nearly 2.2 million barrels, 547,000 barrels less than in 1964. More than 95 percent of the portland cement shipped was of types I and II (general-use and moderate-heat); the remainder was type III, high-early-strength. Nearly 55 percent of the cement was shipped to consumers within the State. Western New York and the States of Ohio, Illinois, Wisconsin, Indiana, and Minnesota received most of the remainder. Nearly 59 percent of the portland cement shipped was purchased by ready-mix concrete companies, with the remainder going principally to contractors, concrete product manufacturers, and building-material dealers.

Raw materials used in cement manufacture included 6.6 million tons of limestone, 2.1 million tons of clay and shale, as well as sand, gypsum, iron ore, mill scale, slag, grinding aids, and air-entraining compounds.

Over 650 million kilowatt-hours of electrical energy was used. The wet process was used at seven plants and the dry process at one. Major developments were the announcements by Martin Marietta Corp. of a $30 million cement plant and quarry facility to be built near Milan, and by Medusa Portland Cement Co. of a cement

Table 4.—Finished portland cement produced, shipped, and in stock
(Thousand 376-pound barrels and thousand dollars)

Year	Active plants	Production	Shipped from mills		Stocks at mills Dec. 31
			Quantity	Value	
1956–60 (average)	8	20,775	20,713	$67,753	2,472
1961	9	21,661	21,948	75,172	2,737
1962	9	23,070	22,682	73,267	3,354
1963	9	24,194	25,016	76,944	2,532
1964	9	26,802	26,745	84,316	r 2,737
1965	8	27,018	27,565	86,996	2,190

r Revised.

plant with annual capacity of 4 million barrels to be built at Charlevoix.

A strike at the Wyandotte Chemicals Corp. at Wyandotte, caused a shutdown of its cement plant from May 4 to December 31.

Clays.—According to reports from 14 mining operations in 10 counties, output of miscellaneous clay and shale was slightly greater than in 1964. About 88 percent of the total was used in manufacturing cement. The remainder was used in producing lightweight aggregate, vitrified and heavy clay products, and art pottery. The largest production was reported from Alpena County, followed by Wayne, Monroe, Saginaw, and St. Clair Counties.

Gem Stones.—Gem stones were collected principally in the upper peninsula, by hobbyists for personal collections and handmade jewelry. Native copper and hematite specimens as well as agates, thomsonite, and other semiprecious stones were found.

Gypsum.—Gypsum was quarried in Iosco County and mined from underground deposits in Kent County. Output was down about 6 percent from 1964. Plants at Detroit, Grand Rapids, and National City processed the crude ore for the manufacture of lath and plaster, wallboard, and other building uses. Crude ore was also shipped to plants in other States. Uncalcined gypsum was sold as a cement retarder.

Lime.—The output of lime was down more than 23 percent from that of 1964. A 7-month strike at Wyandotte Chemicals Corp. in Wyandotte caused a shutdown of their lime manufacturing facility and contributed substantially to the decline. Data for regenerated lime (produced by papermills, water purification plants, and acetylene processors) are excluded from the State total production. Wayne County again led in lime production. More than 83 percent of the lime manufactured was used by producers, and 97 percent was consumed within the State. Lime was used in paper and sugar manufacture, water and sewage treatment, and for chemical and metallurgical use. Nearly all of the lime produced was quicklime. The remainder was hydrated lime. The Detroit Lime Co. plant in River Rouge went into operation in November. A feature of the plant is a vertical lime kiln, reportedly the world's largest, with a capacity of 600 tons of lime per day. Output of the new plant will be used for basic-oxygen steelmaking at plants in the Detroit area. Construction of the 700,000-ton-per-year-capacity lime plant of Marblehead Lime Co. at River Rouge in Wayne County continued during the year. Operation was scheduled for early 1966.

Natural Salines.—Natural well brines, processed at plants in Gratiot, Lapeer, Manistee, Mason, Midland, and Wayne Counties, yielded bromine, calcium chloride, calcium-magnesium chloride, iodine, magnesium compounds, and potash. The value of chemicals, produced from natural salines, excluding salt, was 7 percent higher than in 1964.

Perlite. — Perlite was expanded from crude ore mined in western States at plants in Iosco, Kent, and Wayne Counties. The output was used chiefly as lightweight aggregate in plaster.

Salt.—Salt was recovered from natural and artificial brines in Gratiot, Manistee, Midland, Muskegon, St. Clair, and Wayne Counties. One underground salt mine was operated in Detroit. Output was 4 percent smaller than in 1964, but because of a unit price increase of 43 cents per ton, value of production increased 1 percent. Salt was sold principally for use in chemical manufacture, meatpacking, ice control, water softening, and animal feed.

Sand and Gravel.—Output of sand and gravel totaled nearly 53.2 million tons, exceeding the record high established in 1964. The State remained second to California in sand and gravel production. An increased demand over that of 1964 was registered for all types of sand and gravel, except for fill material which recorded a slight decrease. The most notable increase was in industrial sand production which exceeded 1964 output by more than 500,000 tons. Most of the increase resulted from a greater demand for molding sand. Sand and gravel was produced in all counties except Monroe.

The Detroit metropolitan area (Livingston, Macomb, Oakland, Washtenaw, and Wayne Counties), producing over 20.6 million tons of sand and gravel, accounted for about 39 percent of State total production. Output of more than 1 million tons was also reported from each of the following counties: Berrien, Ingham, Kent, Otsego, and Tuscola. More than 92 per-

Table 5.—Sand and gravel sold or used by producers, by classes of operations and uses
(Thousand short tons and thousand dollars)

Class of operation and use	1964		1965	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	5,754	$4,169	6,469	$4,726
Paving	5,135	4,274	5,377	4,697
Fill	3,204	1,412	3,265	1,484
Molding	2,819	5,085	3,298	5,903
Other [1]	694	1,620	917	2,014
Total	17,606	16,560	19,326	18,824
Gravel:				
Building	5,739	7,339	5,436	7,406
Paving	16,254	13,380	17,696	14,969
Railroad ballast	210	225	240	264
Fill	350	203	378	199
Other	418	457	347	397
Total	22,971	21,604	24,097	23,235
Total sand and gravel	40,577	38,164	43,423	42,059
Government-and-contractor operations:				
Sand:				
Building	107	48	74	33
Paving	1,659	744	1,699	790
Fill	1,215	394	1,224	400
Other	127	58	102	41
Total	3,108	1,244	3,099	1,264
Gravel:				
Building	196	76	103	56
Paving	7,641	4,764	6,265	3,707
Fill	347	141	190	63
Other	52	16	88	27
Total	8,236	4,997	6,646	3,853
Total sand and gravel	11,344	6,241	9,745	5,117
All operations:				
Sand	20,714	17,804	22,425	20,088
Gravel	31,207	26,601	30,743	27,088
Grand total	51,921	44,405	53,168	47,176

[1] Includes abrasive, engine, glass, grinding and polishing, railroad ballast, other construction and industrial uses (1964–65), and enamel and foundry sands (1965).

cent of the sand and gravel was processed. About 92 percent of the material was moved by truck, and the remainder by rail or water. Production was reported from 345 commercial operations and 187 Government-and-contractor operations.

Leading producers of sand and gravel, in alphabetical order, included the following:

American Aggregates Corp.
Construction Aggregates Corp.
Grand Rapids Gravel Co.
Holly Sand & Gravel Plant, J. P. Burroughs & Son, Inc.
Michigan Silica Co.
The Nugent Sand Co., Inc.
Pickitt & Schreur, Inc.
Sargent Sand Co.
Straits Aggregate & Equipment Corp.
I. L. Whitehead Co.

Stone.—Total stone output in 1965 was about the same as in 1964. Crushed limestone production of 34.6 million tons represented more than 99 percent of the stone production. It was quarried in 14 counties by 20 operators. Nearly 95 percent of the production came from large quarries, producing more than 1 million tons annually, in Alpena, Chippewa, Mackinac, Monroe, and Presque Isle Counties.

Nearly 27 million tons of crushed limestone was moved by water from company-operated ports on Lakes Huron and Michigan to industrial consumers, principally

Table 6.—Dimension stone sold or used by producers, by kinds

Year	Basalt		Limestone		Sandstone		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1961	--	--	27,516	$119,950	7,045	$54,057	34,561	$174,007
1962	--	--	7,798	51,603	15,223	65,406	23,021	117,009
1963	--	--	4,938	60,371	8,937	62,348	13,875	122,719
1964	150	$150	5,383	68,711	8,306	62,030	13,839	130,891
1965	--	--	5,286	76,989	6,396	42,760	11,682	119,749

Table 7.—Crushed and broken stone sold or used by producers, by kinds and uses

(Thousand short tons and thousand dollars)

Kind and use	1964		1965	
	Quantity	Value	Quantity	Value
Limestone:				
Riprap	W	W	100	$151
Flux	12,969	$14,792	12,550	14,447
Concrete aggregate and roadstone	4,593	5,464	5,614	6,540
Agriculture	679	1,147	609	1,069
Cement	9,273	7,610	8,999	7,303
Lime	2,956	2,709	4,514	3,814
Other [1]	4,048	5,065	2,183	2,904
Total	[2] 34,516	[2] 36,788	[2] 34,570	36,228
Marl: Agriculture	120	83	132	90
Grand total	34,636	36,871	34,702	36,318

W Withheld to avoid disclosing individual company confidential data: included with "Other."

[1] Includes limestone for riprap (1964), asphalt and miscellaneous filler, chemicals, dust for coal mines, mineral food, poultry grit, railroad ballast, stone sand, whiting or whiting substitutes, and other uses.

[2] Data do not add to total shown because of rounding.

steel mills, and cement and lime plants. Total crushed stone production did not vary appreciably from 1964, but some changes in the consumption pattern were noted. Shipments of fluxstone and cement rock were both down 3 percent from those of 1964. Demand for roadstone and stone for lime manufacture were 22 percent and 53 percent, respectively, greater than in 1964. Major producers of limestone, in alphabetical order, included the following:

Drummond Dolomite, Inc.
Dundee Cement Co.
The France Stone Co.
Huron Portland Cement Co.
Inland Lime & Stone Co. (Div. of Inland Steel Co.)
The Michigan Stone Co.
Penn-Dixie Cement Corp.
Presque Isle Corp.
United States Steel Corp.
The Wallace Stone Co. (Division of J. P. Burroughs & Son, Inc.)

Marl was produced at 35 operations in 14 counties. The largest output was reported from Allegan, Barry, Calhoun, Cass, and Kalamazoo Counties. Dimension sandstone was quarried and milled in Baraga and Jackson Counties.

Sulfur.—Byproduct sulfur was recovered from crude petroleum by Leonard Refineries, Inc., at Alma using the hydrofining process and at Detroit, Marathan Oil Co. used the Parsons process.

Vermiculite.—At Dearborn, Zonolite Division, W. R. Grace & Co. exfoliated crude vermiculite, mined in southern and western States. The material was used for loose fill insulation, plaster and concrete aggregates, agricultural, and miscellaneous uses.

METALS

Metals accounted for nearly 35 percent of the total value of mineral production.

Copper.—Production of copper in terms of recoverable metal was 4 percent higher than in 1964. The value of output increased nearly 13 percent because the average weighted price rose to 35.4 cents per pound compared with 32.6 cents in

1964. The price, quoted by primary producers for delivered electrolytic copper at the beginning of 1965, was 34 cents per pound. The price of copper remained at 36 cents per pound from May 5 to November 12 and was 36 cents at yearend.

Calumet & Hecla, Inc., operated eight mines, one reclamation plant, and one smelter in Houghton and Keweenaw Counties. A labor strike which started on August 21 and lasted through October 31 interrupted copper production at the Calumet Division of Calumet & Hecla, Inc. Work was completed on the surface installations at the Kingston mine, and it was put into operation on July 6.

Copper Range Co. operated the Champion mine and the Freda mill in Houghton County. The mill concentrated ore from the mine and from the Atlantic tailings.

Table 8.—Mine production of copper in 1965, by months, in terms of recoverable metal

Month	Short tons
January	6,415
February	6,035
March	6,745
April	6,170
May	6,560
June	6,320
July	6,200
August	5,310
September	4,885
October	5,175
November	5,755
December	6,179
Total	71,749

Quincy Mining Co. operated a reclamation plant and smelter in Houghton County. White Pine Copper Co. operated a mine, mill, and smelter in Ontonagon County.

Table 9.—Mine production of copper, in terms of recoverable metal

Year	Mines producing		Material treated		Copper	
	Lode	Tailing	Ore (short tons)	Tailing (short tons)	Short tons	Value
1956–60 (average)	11	3	5,918,166	2,014,499	57,923	$37,623,580
1961	10	3	7,109,924	2,122,286	70,245	42,147,000
1962	9	3	7,555,357	1,812,530	74,099	45,644,984
1963	10	3	7,211,387	2,226,129	75,262	46,361,392
1964	9	3	6,717,862	2,174,478	69,040	45,014,080
1965	10	3	7,367,571	1,611,378	71,749	50,798,292

Iron Ore. — Iron ore shipments totaled 13.5 million long tons, a decrease of 344,000 tons from those of 1964. Value of shipments, however, increased by $1.5 million. Much of the gain was due to increased shipments of concentrates from low-grade ores. These accounted for 52 percent of total shipments compared with 47 percent in 1964. Fourteen underground and five open pit mines were active all or part of the year. About 73 percent of the crude ore mined came from open pit operations, the same proportion as in 1964. Average iron content of usable ore produced was 58.25 percent natural. The average weighted mine value of Michigan iron ore, without respect to grade, was $10.76 per long ton, compared with $10.38 in 1964.

Michigan iron ore was shipped to producers of pig iron and steel, except for a small quantity used in manufacturing iron oxide pigments.

About 93 percent of the ore was shipped by rail to ore docks in Ashland, Wis., and in Escanaba and Marquette, Mich. The ore was then shipped by water to lower lake ports. The remaining 7 percent was shipped by rail to the consuming districts. The lake shipping season for Michigan iron ores opened at Escanaba on April 6 and closed at the same port on December 19.

According to a study by the Michigan Department of Conservation,[2] the average mining cost per ton for underground mines was $9.80 in 1965, compared with $9.99 in 1964. Labor costs increased in 1965 to $2.77 per ton from $2.68, but taxes (excluding Federal income tax) decreased to $0.41 per ton from $0.49 in 1964. Deferred costs per ton were $0.55 in 1965,

[2] Geological Survey Division, Michigan Department of Conservation. General Statistics Covering Costs and Production of Michigan Iron Mines. July, 1966, 12 pp.

Table 10.—Crude iron ore data, in 1965, by counties and ranges

(Thousand long tons)

County and range	Stocks Jan. 1	Production		Shipments		Stocks Dec. 31
		Underground	Open pit	Direct to consumers	To concentrators	
County:						
Dickinson			3,452		3,452	
Gogebic	460	753		773		441
Iron	627	2,980		2,832		776
Marquette	1,520	2,829	13,890	1,365	15,859	1,015
Total	[1] 2,608	6,562	17,342	[1] 4,969	19,311	2,232
Range:						
Gogebic	460	753		773		441
Marquette	1,520	2,829	13,890	1,365	15,859	1,015
Menominee	627	2,980	3,452	2,832	3,452	776
Total	[1] 2,608	6,562	17,342	[1] 4,969	19,311	2,232

[1] Data do not add to total shown because of rounding.

Table 11.—Usable iron ore [1] produced (direct-shipping and all forms of concentrate), by ranges

(Thousand long tons)

Year	Marquette range	Menominee range (Michigan part)	Gogebic range (Michigan part)	Total [2]
1854-1955	283,429	[3] 236,620	[3] 233,277	753,326
1956	5,869	4,264	2,910	13,043
1957	6,557	4,201	2,868	13,626
1958	4,111	2,896	1,397	8,404
1959	2,851	2,616	1,663	7,129
1960	6,619	4,079	2,169	12,866
1961	3,205	4,097	1,062	8,364
1962	4,563	3,460	1,237	9,259
1963	5,706	3,729	902	10,336
1964	7,898	4,551	1,227	13,676
1965	8,973	4,595	753	14,322
Total [2]	339,780	[3] 275,109	[3] 249,464	864,353

[1] Exclusive, after 1905, of iron ore containing 5 percent or more manganese.
[2] Data may not add to some totals shown because of rounding.
[3] Distribution by range partly estimated before 1906.

Table 12.—Usable iron ore shipped from mines, by ranges [1]

(Thousand long tons)

Year	Marquette range	Menominee range (Michigan part)	Gogebic range (Michigan part)	Total [2]
1956-60 (average)	4,763	3,534	2,065	10,362
1961	4,141	3,881	1,362	9,384
1962	4,479	3,462	1,480	9,422
1963	5,809	4,168	813	10,789
1964	7,909	4,560	1,403	13,871
1965	8,303	4,451	773	13,527

[1] Exclusive of iron ore containing 5 percent or more manganese, natural.
[2] Data may not add to some totals shown because of rounding.

Table 13.—Production of usable iron ore
(Thousand long tons)

Year	Gross weight		Iron content (percent)	Year	Gross weight		Iron content (percent)
	Ore	Iron content			Ore	Iron content	
1946	8,689	4,502	51.82	1956	13,043	6,746	51.72
1947	12,577	6,441	51.21	1957	13,626	7,108	52.16
1948	13,102	6,737	r 51.42	1958	8,404	4,460	53.07
1949	11,199	5,747	r 51.32	1959	7,129	3,791	53.17
1950	12,691	6,508	51.28	1960	12,866	6,920	53.78
1951	13,704	6,962	r 50.80	1961	8,364	4,589	54.87
1952	11,810	6,030	51.06	1962	9,259	5,160	55.73
1953	13,813	7,039	50.96	1963	10,336	5,913	57.21
1954	10,751	5,494	51.10	1964	13,676	7,923	57.93
1955	12,311	6,359	r 51.66	1965	14,322	8,343	58.25

r Revised.

Table 14.—Iron ore [1] shipped from mines
(Thousand long tons)

Year	Direct-shipping ore [2]	Concentrates			Total usable ore	Proportion of concentrates to total usable ore (percent)
		Agglomerates	Other	Total		
1956–60 (average)	9,063	383	916	1,299	10,362	12.54
1961	6,041	1,580	1,764	3,344	9,384	35.63
1962	5,557	2,222	1,644	3,865	9,422	41.03
1963	4,852	4,364	1,574	5,938	10,789	55.03
1964	5,753	6,573	1,546	8,118	13,871	58.53
1965	4,969	7,554	1,004	8,558	13,527	63.26

[1] Exclusive of ore containing 5 percent or more manganese.
[2] Includes crushed, screened, and sized ore not further treated.

compared with $0.56 in 1964. Other costs per ton in 1965 compared with 1964 were as follows: General overhead, $1.42 from $1.49; transportation, $3.04 from $3.05; royalty unchanged at $0.31; and marketing $0.09 from $0.08.

Pig Iron and Steel.—Pig iron and steel were manufactured in the Detroit area. Pig iron shipments and value were slightly higher (1 percent) than those in 1964. Basic, foundry, and low-phosphorus grades were produced. According to the American Iron & Steel Institute, Michigan steel production was 9.7 million tons, about 3 percent greater than in 1964.

Silver.—Silver was recovered from copper ore mined at the White Pine mine. Concentrate from a silver-recovery circuit in the White Pine mill was smelted separately for delivery to electrolytic refineries where the silver was recovered. Silver contained in fire-refined copper was not recovered but was marketed as a constituent of lake copper.

MINERAL FUELS

Natural Gas and Natural Gas Products.—Natural gas production increased both in volume and value. The largest production, again, came from St. Clair County, which supplied more than 35 percent of the State total. The Albion-Scipio trend fields in Hillsdale, Calhoun, and Jackson Counties accounted for 29 percent, and Macomb County, another major producing area, accounted for 22 percent. The balance, 14 percent, came from fields in 21 counties.

At the end of 1965 there were 89 producible gas fields, of which 34 produced gas for commercial sale, compared with 83 total fields and 32 commercial fields in 1964.

Production of natural gasoline and liquid petroleum gases was 31 percent larger than in 1964.

Processing of natural gas for natural gas liquids was concentrated in St. Clair, Hillsdale, and Washtenaw Counties. These

counties accounted for 89 percent of the State total natural gas liquids. Gas processed in Washtenaw County was from out-of-State fields, delivered via interstate pipeline.

Peat.—Michigan was again the leading peat-producing State with over 38 percent of the national output. Peat was produced in 15 counties with 91 percent coming from Lapeer, Lenawee, Oakland, and Sanilac Counties. Peat was marketed principally as a soil conditioner. None was sold for fuel.

Petroleum. — Petroleum production declined about 873,000 barrels below the 1964 figure. Nearly half of this loss was reported from fields of the Albion-Pulaski-Scipio trend in Calhoun, Hillsdale, and Jackson Counties. However, this area still accounted for 60 percent of State production. According to data compiled by the Geological Survey Division of the Michigan Department of Conservation, no significant oil reserves were found or developed in 1965 that would offset the decline. Oilfield discoveries in 1965 increased the number of active fields to 187, up from 184 in 1964. During the year, five fields or pools were abandoned and one pool reactivated. At yearend, the number of producing wells was 4,036, compared with 4,151 at the end of 1964.

Most of the geophysical exploration was concentrated in the St. Clair-Macomb County area of eastern Michigan. Less gravimeter exploration was reported in 1965, but seismograph exploration exceeded that of previous years. Exploratory well completions were about 15 percent less than in 1964. Total exploratory and development well completions during 1965 were 378 compared with 506 in 1964.

Wells that reached total depth in Cambrian or older rocks were drilled mainly in the less shallow part of the basin. The deepest hole drilled during the year bottomed-out at 8,372 feet in the Treampealeau formation. Two Precambrian test holes were drilled, one on Harsen's Island, St. Clair County, and one in Berrien County. The Berrien County well was reported to have drilled over 1,000 feet of granite before reaching a total depth of 5,647 feet. The hole was drilled by a rotary rig with water as the primary drilling fluid.

Petroleum was produced in 42 counties. Eleven refineries had an operating capacity of 177,500 barrels per day.

Fluid injection was used in producing about 1.3 billion cubic feet of gas and 3.3 million barrels of petroleum. Nearly 45.4 million barrels of fluid, mostly brines, were injected through 341 wells. From the same fields, about 40.5 million barrels of fluid, nearly all brine, was produced.

REVIEW BY COUNTIES

Mineral production was reported from all counties in Michigan. Value of output increased in 36 counties and decreased in 47 counties. More than $1 million in minerals was produced in each of 42 counties. Marquette County led in value of production.

Allegan.—Several commercial operators and Government agencies produced 877,000 tons of sand and gravel at plants near Allegan, Fennville, and Otsego. Most of the material was used in road construction with the remainder being used for fill and building construction. Marl, for agricultural use, was dipped from pits near Allegan and Martin.

Natural gas production declined about 29 percent to 310 million cubic feet, while petroleum output remained at the same level as in 1964. More than half of the output came from the Wayland field (147,000 barrels). Moss and reed-sedge peat were dug from bogs near Middleville and Wayland and sold for soil conditioning and for packing plants and shrubs.

Alpena.—Portland and masonry cements were produced at the world's largest cement plant by Huron Portland Cement Co., subsidiary of National Gypsum Co., at Alpena. During the year new dryers, a new raw-mix mill, and two new kilns were put into operation at the plant. This was one phase of a program designed to increase annual capacity to 24 million barrels per year by 1975. Clay and limestone for use at the cement plant were mined in the area. About 392,000 tons of sand and gravel was produced in the county, mostly for road construction. Output was from fixed and portable plants near Alpena and Ossineke.

Antrim. — Penn-Dixie Cement Corp. mined shale near Ellsworth for use in manufacturing cement at its Petoskey plant.

Table 15.—Value of mineral production in Michigan, by counties [1]

County	1964	1965	Minerals produced in 1965 in order of value
Alcona	$178,000	$141,000	Sand and gravel.
Alger	69,000	25,000	Do.
Allegan	1,347,433	[2] 1,284,132	Petroleum, sand and gravel, peat, stone, natural gas.
Alpena	W	W	Cement, stone, clays, sand and gravel.
Antrim	216,986	204,696	Clays, sand and gravel.
Arenac	1,247,038	1,153,056	Petroleum, stone, sand and gravel.
Baraga	44,850	104,400	Sand and gravel, stone.
Barry	443,214	497,631	Sand and gravel, petroleum, stone.
Bay	8,359,197	10,342,073	Cement, petroleum, lime, sand and gravel.
Benzie	13,000	30,000	Sand and gravel.
Berrien	1,072,741	1,376,055	Sand and gravel, stone.
Branch	102,920	199,537	Do.
Calhoun	6,782,895	[2] 6,784,379	Petroleum, sand and gravel, stone, natural gas.
Cass	270,749	334,969	Sand and gravel, petroleum, stone.
Charlevoix	42,000	17,000	Sand and gravel.
Cheboygan	202,189	141,097	Sand and gravel, stone.
Chippewa	3,324,830	4,739,350	Stone, sand and gravel.
Clare	1,736,725	[2] 1,903,929	Petroleum, sand and gravel, natural gas.
Clinton	319,604	369,366	Sand and gravel, clays.
Crawford	264,145	[2] 269,202	Petroleum, sand and gravel, natural gas.
Delta	170,146	259,148	Sand and gravel, stone.
Dickinson	17,808,288	20,102,845	Iron ore, stone, sand and gravel.
Eaton	505,861	562,878	Sand and gravel, stone, clays, peat.
Emmet	8,968,440	7,285,985	Cement, stone, sand and gravel.
Genesee	709,376	652,164	Sand and gravel, petroleum.
Gladwin	1,315,528	W	Petroleum, sand and gravel.
Gogebic	11,680,042	6,587,762	Iron ore, sand and gravel.
Grand Traverse	106,000	W	Sand and gravel.
Gratiot	W	W	Salines, salt, sand and gravel, petroleum, natural gas.
Hillsdale	14,741,652	[2] 14,235,692	Petroleum, sand and gravel, stone, natural gas.
Houghton [3]	[r] 9,729,022	7,829,391	Copper, sand and gravel, stone.
Huron	978,621	[2] 1,295,026	Stone, sand and gravel, lime, petroleum, natural gas.
Ingham	972,096	1,221,912	Sand and gravel, peat.
Ionia	382,000	274,000	Sand and gravel.
Iosco	4,822,188	4,555,659	Gypsum, sand and gravel.
Iron	23,514,489	21,225,886	Iron ore, sand and gravel.
Isabella	1,742,337	1,729,101	Sand and gravel, petroleum, stone.
Jackson	5,844,547	[2] 4,753,171	Petroleum, sand and gravel, stone, natural gas.
Kalamazoo	1,250,698	945,341	Sand and gravel, stone, peat.
Kalkaska	72,043	[2] 59,281	Petroleum, sand and gravel, natural gas.
Kent	3,686,003	3,081,727	Sand and gravel, gypsum, petroleum, peat.
Keweenaw	(4)	(4)	Copper, sand and gravel.
Lake	110,968	75,816	Petroleum, sand and gravel.
Lapeer	1,682,723	1,642,947	Peat, sand and gravel, salines, petroleum.
Leelanau	51,000	53,000	Sand and gravel.
Lenawee	1,418,847	708,357	Sand and gravel, cement, peat, clays, petroleum.
Livingston	2,736,000	[2] 3,743,000	Sand and gravel, natural gas.
Luce	40,000	90,000	Sand and gravel.
Mackinac	W	W	Stone, sand and gravel.
Macomb	2,028,025	[2] 1,950,236	Sand and gravel, petroleum, natural gas.
Manistee	18,909,056	19,964,216	Salines, salt, sand and gravel.
Marquette	W	99,075,859	Iron ore, sand and gravel.
Mason	W	W	Salines, lime, sand and gravel, petroleum.
Mecosta	248,123	[2] 223,611	Sand and gravel, petroleum, peat, stone, natural gas.
Menominee	781,177	1,063,482	Lime, sand and gravel.
Midland	W	W	Salines, salt, petroleum, sand and gravel, natural gas.
Missaukee	1,265,072	W	Petroleum, sand and gravel, natural gas.
Monroe	W	W	Cement, stone, clays, petroleum, peat.
Montcalm	1,077,159	[2] 968,561	Petroleum, sand and gravel, natural gas.
Montmorency	76,211	3,000	Sand and gravel.
Muskegon	1,915,869	[2] 2,166,691	Salt, sand and gravel, petroleum, natural gas.
Newaygo	170,608	[2] 186,857	Sand and gravel, petroleum, natural gas.
Oakland	7,393,223	8,083,304	Sand and gravel, peat, petroleum.
Oceana	855,040	660,047	Sand and gravel, petroleum.
Ogemaw	1,035,098	[2] 898,233	Petroleum, sand and gravel, natural gas.
Ontonagon	36,230,897	43,817,777	Copper, silver, sand and gravel.
Osceola	887,699	[2] 1,489,667	Petroleum, sand and gravel, natural gas.
Oscoda	28,055	23,688	Sand and gravel, petroleum.
Otsego	52,000	[2] 33,000	Sand and gravel, natural gas.
Ottawa	2,627,931	[2] 2,731,187	Sand and gravel, petroleum, stone, natural gas.
Presque Isle	W	W	Stone, sand and gravel.
Roscommon	714,813	[2] 675,618	Petroleum, sand and gravel, natural gas.
Saginaw	480,329	449,643	Clays, petroleum, lime, sand and gravel.
St. Clair	16,183,055	[2] 16,487,453	Salt, cement, petroleum, sand and gravel, clays, peat, natural gas.
St. Joseph	211,300	269,746	Sand and gravel, peat, stone.
Sanilac	1,148,822	982,419	Peat, sand and gravel, lime.
Schoolcraft	71,000	2,000	Sand and gravel.
Shiawassee	671,032	569,152	Sand and gravel, clays, peat.

See footnotes at end of table.

Table 15.—Value of mineral production in Michigan, by counties[1]—Continued

County	1964	1965	Minerals produced in 1965 in order of value
Tuscola	2,209,389	2,065,030	Sand and gravel, petroleum, lime, peat.
Van Buren	323,459	258,041	Sand and gravel, petroleum, stone.
Washtenaw	938,456	[2] 1,564,849	Sand and gravel, petroleum, natural gas.
Wayne	47,394,260	[2] 40,047,759	Cement, salt, lime, sand and gravel, clays, stone, salines, petroleum, natural gas.
Wexford	114,000	[2] 106,000	Sand and gravel, natural gas.
Undistributed [5]	r 267,714,411	185,855,913	
Total	r 554,832,000	565,560,000	

r Revised. W Withheld to avoid disclosing individual company confidential data.
[1] Values for natural gas and natural gas liquids are not available on a county basis, but are included with "Undistributed."
[2] Excludes value of natural gas.
[3] Includes value of mineral production in Keweenaw County.
[4] Value of mineral production is included in that of Houghton County.
[5] Includes values for natural gas, natural gas liquids, gem stones, some sand and gravel that cannot be assigned to specific counties, and values indicated by symbol W.

About 103,000 tons of gravel for road use was produced for county and State highways.

Arenac.—About 303,000 barrels of petroleum was produced. The Deep River and Sterling fields produced the largest output. Crushed limestone and sand and gravel, primarily for road construction and maintenance, was produced at several sites in the county.

Baraga. — Superior Natural Redstone Quarry quarried and milled sandstone for building use at Arnheim. Sand and gravel, mainly for road use, was produced by county crews, under contract for the State highway department.

Barry.—Sand and gravel was produced at four fixed plants and at several sites with portable plants throughout the county. Output was 90,000 tons larger than the tonnage reported in 1964. The material was used for building, road construction, and other uses. Pits near Caledonia and Nashville yielded marl for agricultural use. A small quantity of petroleum was produced.

Bay.—Aetna Portland Cement Co., Division of Martin Marietta Corp., produced portland and masonry cements at Bay City. Quicklime for use in sugar refining was produced by the Monitor Sugar Division of Robert Gage Coal Co. About 334,000 barrels of petroleum was recovered from county oil fields, with the Kawkawlin field accounting for 75 percent of the total. Bay Refining, Division Dow Chemical Co., refined crude oil at Bay City. The Bay County Road Commission crews produced 98,000 tons of sand for road construction and maintenance.

Berrien.—County sand and gravel output was approximately 1.2 million tons. Industrial sand (primarily blast, engine, and molding) was mined at Bridgman by Arrowhead Silica Corp. and at Sawyer by Manley Sand Division, Martin Marietta Corp. Sand and gravel for building and paving was produced at pits with fixed and portable plants throughout the county. Marl for agricultural use was dug from two pits near Three Oaks.

Branch. — Pits near Kinderhook and Sherwood yielded marl for agricultural use. Sand and gravel for building, road construction, and other uses was produced from pits near Coldwater and Union City by commercial operators. State and county agencies used portable plants at several sites to obtain gravel for road use.

Calhoun.—Both petroleum and natural gas production was slightly higher than in 1964. The county maintained its position of second place in petroleum production, 2.3 million barrels, and fourth place in natural gas output, 4 billion cubic feet. Sand and gravel production of 733,000 tons was 15 percent greater than in 1964. Marl was obtained from pits near Burlington and Union City and sold for agricultural use.

Cass.—Nearly 20,000 tons of marl was dipped from pits near Cassopolis, Dowagiac, Edwardsburg, and Union. Output was sold for agricultural use. About 376,000 tons of sand and gravel was produced from fixed plants near Dowagiac and Niles and with portable plants at several sites.

Production of 5,000 barrels of petroleum was reported from the Jefferson field.

Cheboygan. — Limestone was quarried and crushed near Afton and sold for flux, concrete aggregate and roadstone, and agricultural use. About 154,000 tons of sand and gravel, down from 220,000 tons in 1964, was produced at several sites with portable plants. Most of the material was used for road construction and maintenance.

Chippewa.—Drummond Dolomite, Inc., operated one of the largest limestone quarries in the State on Drummond Island in Lake Huron. The material was used for flux, concrete aggregate and roadstone, and agricultural purposes. Sand and gravel output nearly doubled to 600,000 tons. Production was with portable plants in the Kinross and Soo areas.

Clare.—Petroleum output was 651,000 barrels compared with 614,000 in 1964. Although production was reported from 11 fields, more than 78 percent came from the Hamilton, Cranberry Lake, and East Cranberry Lake fields. Natural gas production declined slightly to 187 million cubic feet. Output of sand and gravel increased substantially to 189,000 tons.

Clinton.—Clay was mined at two sites near Grand Ledge and used in the manufacture of vitrified sewer pipe and other heavy clay products. Sand and gravel output totaled 451,000 tons, an increase of 90,000 tons over that of 1964. Principal uses were for building, road construction, and fill.

Crawford.—Petroleum production from the Beaver Creek field declined to 66,000 barrels from 85,000 in 1964, while natural gas output was 345 million cubic feet compared with 440 million in 1964. Sand and gravel production was 92,000 tons compared with 56,000 in 1964. Output was for building, paving, and fill.

Delta. — Limestone was quarried and crushed at Escanaba for use as concrete aggregate and roadstone. About 372,000 tons of sand and gravel, used mostly for building and road construction, was produced at several sites in the county.

Dickinson. — The Hanna Mining Co. operated its Groveland open pit iron mine, concentrator, and pelletizing plant near Randville. Shipments were 13 percent greater than in 1964. Limestone was quarried near Randville for use as terrazzo and ornamental concrete and quarried near Felch for roofing granules and other uses. The Randville-Graceville quarry was operated the first quarter by the Superior Rock Products Co. and for the remainder of the year by the Great Lakes Select Stone Product Co. About 104,000 tons of sand and gravel was produced, principally for building and road use. The material was produced from pits near Iron Mountain and Norway.

Eaton.—Grand Ledge Clay Product Co. mined clay for its own use in manufacturing vitrified sewer pipe and other heavy clay products. About 362,000 tons of sand and gravel, compared with 324,000 tons in 1964, was produced mainly with portable plants at sites throughout the county. One stationary plant was operated near Charlotte. Most of the material was used for road construction and maintenance. Cheney Limestone Co. produced limestone near Bellevue for roadstone, agricultural use, and rubble. Reed-sedge peat was obtained from a bog near Charlotte and sold for soil improvement.

Emmet. — Penn-Dixie Cement Corp. operated a cement plant and limestone quarry at Petoskey. During the year, the expansion and improvement program begun in 1964 was completed. In addition to the new raw grinding mill and kiln, a computer control system was developed, reportedly the first industrial data logging system in this country using a computer for a wet-process cement plant. Raw material proportions are calculated to assure correct feed to the two kilns and the computer is used on-line to monitor raw mill, kiln, and cooler operations. A detailed article describing the plant operation was published.[3]

Sand and gravel for road use was produced by county crews and under contract for the State highway department.

Genesee. — Sand and gravel output totaled 732,000 tons, nearly 200,000 tons less than in 1964. Production came from five fixed plants and several portable plants. Most of the material was used for building and road construction. About 2,000 barrels of petroleum was recovered from the Otisville field.

Gladwin.—Nearly 439,000 barrels of petroleum was produced from 12 fields.

[3] Pit and Quarry. New Computer Control Concept Adapted to Penn-Dixie's Petoskey Wet process Plant. V. 68, No. 12, December 1965, pp. 78–91.

More than half of the output came from the Grout and North Buckeye fields. A small quantity of sand and gravel was produced near Gladwin for building and road construction.

Gogebic.—Pickands Mather & Co. produced direct-shipping iron ore from the Geneva and Peterson underground mines. The company discontinued mining activities at the Geneva mine in January and final shipments were completed later in the year. Competition from pellets and high-grade ores from other sources forced the shutdown of the mine. The Peterson mine, the last operating iron mine on the Gogebic range, was scheduled to close in February 1966.

About 346,000 tons of sand and gravel was produced, mainly with portable plants at sites throughout the county. The material was used for building, road construction, fill, and other purposes.

Gratiot.—Bromine, calcium chloride and calcium-magnesium chloride, and magnesium compounds were produced at St. Louis from natural well brines by Michigan Chemical Co. In the same area salt was extracted from natural well brines by Michigan Salt Co.

A crude oil refinery was operated at Alma by Leonard Refineries, Inc. At the refinery, byproduct sulfur was also recovered using the hydrofining process. About 46,000 barrels of petroleum was produced from the Sumner field. The North Star field yielded a small quantity of natural gas. Approximately 232,000 tons of sand and gravel was produced with fixed plants at Alma and Ithaca and with portable plants at several locations in the county. The material was used for building, paving, and other purposes.

Hillsdale.—Petroleum output of nearly 5 million barrels was the largest in the State and only 100,000 barrels less than in 1964. About 4.2 billion cubic feet of natural gas was produced. The county ranked second in the production of natural gas liquids, accounting for more than a third of the State total. A total of 339,000 tons of sand and gravel for road and building use, and fill was produced at a fixed plant in Jerome and with portable plants at several locations.

Marl, for agricultural use, was dipped from pits near Allen and Mosherville.

Houghton.—Copper was produced by Calumet & Hecla, Inc., Copper Range Co., and Quincy Mining Co. Calumet & Hecla operated the Ahmeek group of mines which included the No. 2 Centennial, No. 3 Centennial, No. 6 Osceola, No. 13 Osceola, the Kingston mines in Houghton County, the No. 4 Ahmeek Peninsula, Seneca, and the No. 3 Allouez mines in Keweenaw County. The company also operated the Tamarack reclamation plant and a smelter near Hubbell. Copper Range Co. operated the Champion mine and Freda mill which treated the Champion ore as well as the Atlantic tailings. Quincy Mining Co. operated a reclamation plant at Hubbell and a smelter at Hancock. The reclamation plant, operated with power purchased from Calumet & Hecla, Inc., was forced to close down for the duration of a 10-week strike at the latter company's operations.

The Limestone Mountain Co. reopened its quarry near Pelkie and produced limestone for roadstone and agricultural use.

Sand and gravel for building and paving was produced at Hancock and by the county road commission at several sites.

Huron.—Michigan Sugar Co. produced hydrated lime for its own use, in sugar refining, at Sebewaing. The Wallace Stone Co. (Division J. P. Burroughs & Son, Inc.) quarried and processed limestone at Bay Port. The output included rubble and house stone veneer, riprap, roadstone, railroad ballast, and agricultural limestone. About 738,000 tons of sand and gravel was produced, mostly for building and paving. A small quantity of natural gas and petroleum was recovered from county fields.

Ingham.—Sand and gravel output slightly exceeded 1.5 million tons, up from 1.1 million tons in 1964. Increased demand for road construction and maintenance materials was chiefly responsible for the gain. A small quantity of humus peat was dug from a bog near Lansing and sold in bulk for soil improvement. The Lansing Board of Water & Light recovered quicklime from calcium carbonate, precipitated at the city water purification plant.

Iosco.—National Gypsum Co. operated a gypsum quarry and board plant near National City and a port facility at Tawas City. At the plant, in addition to manufacturing building products, crude perlite mined in the Southwest was expanded for use in plaster. United States Gypsum Co. operated a quarry, processing plant, and port facility at Alabaster. The material was shipped to other company plants for

use in manufacturing wallboard and other building materials. Michigan Gypsum Co. operated a gypsum quarry south of Whittemore. The material was sold as a cement retarder. About 203,000 tons of gravel for road use was produced in the county, principally near Greenbush.

Iron.—The Hanna Mining Co. mined and shipped iron ore from the Hiawatha No. 2, Homer, and Wauseca underground mines. A crushing station and ore transfer system on the 16th level was completed to serve both the Homer and Wauseca mines. Inland Steel Co. operated the Bristol and Sherwood mines and installed new screening facilities which were operating by the end of the year. Output of these mines will be shipped as coarse ore and fines.

About 458,000 tons of sand and gravel, used mostly for fill and road construction, was produced in the county. The fill was produced and used by The Hanna Mining Co. for back-filling stopes in the company iron mines.

Isabella. — About 308,000 barrels of petroleum was produced from 10 fields with seven-eighths of the output coming from the Coldwater and Mt. Pleasant fields. Leonard Refineries, Inc., refined crude oil at Mount Pleasant.

Marl, for agricultural use, was dipped from a pit near Wiedman. About 904,000 tons of sand and gravel was produced and used mostly for road construction and repair. Operations were chiefly in the vicinity of Mount Pleasant.

Jackson.—About 1.6 million barrels of petroleum and 2 billion cubic feet of natural gas were produced from county fields of the Albion-Pulaski-Scipio trend. Oil output dropped about 300,000 barrels from that of 1964, while gas production remained about the same.

Limestone was quarried and crushed at Parma for use in concrete aggregate, roadstone, and agricultural application. Marl was produced near Horton for agricultural use. Output of sand and gravel totaled 371,000 tons, down more than 300,000 tons from that of 1964. The loss was due to less requirements of the county and State highway departments.

Sandstone was quarried and milled for building use in the Napoleon area. Output was 20 percent less than in 1964.

Kalamazoo.—Sand and gravel output, principally from the Kalamazoo area, totaled 916,000 tons, down 364,000 tons from that of 1964. The loss was due to smaller demand for road material. Marl and peat, both used for soil improvement, were produced at several sites in the county.

Kalkaska.—Petroleum and natural gas were produced from the Beaver Creek field, while a small quantity of petroleum was reported from the Excelsior field. About 49,000 tons of sand and gravel was produced for county and State highway use.

Kent.—Gypsum was produced from underground mines by Bestwall Gypsum Division of Georgia-Pacific Corp. and Grand Rapids Gypsum Co. The material was processed and manufactured into building products at company-owned plants in the Grand Rapids area. Perlite, mined in western States, was expanded for use in plaster at the Bestwall plant. About 2,034,000 tons of sand and gravel, 652,000 tons less than in 1964, was produced, mostly in the Grand Rapids area. The decline in output reflected a lesser demand for both building and road materials. Peat was dug from several bogs in the county. Most of it was sold in bulk for soil improvement.

About 108,000 barrels of petroleum was produced, of which 90 percent came from the Walker field.

Keeweenaw.—The county road commission produced 39,000 tons of sand and gravel for its own use. Value of copper produced by Calumet & Hecla, Inc., from No. 4 Ahmeek Peninsula, No. 3 Allouez, and Seneca mines is included with Houghton County.

Lake.—About 15,000 barrels of petroleum was produced. Most of it, over 13,000 barrels, came from the newly opened Luther Lake field. The county road commission produced about 42,000 tons of sand and gravel for county roads.

Lapeer. — Wilkinson Chemical Corp. produced calcium-magnesium chloride from natural well brines at Mayville. Half of the peat produced in the State came from bogs near Imlay City. The reed-sedge peat was sold in both bulk and packaged form for soil improvement, potting soils, and other horticultural uses. The peat operation of Hofman Peat Co. was acquired by J.M. Huber Corp. Most of the

463,000 tons of sand and gravel produced was used on county and State highways.

About 26,000 barrels of petroleum was recovered from the Rich field.

Lenawee.—Peninsular Portland Cement, Division of General Portland Cement Co. used its manufacturing facility at Cement City as a distribution center. No cement was manufactured during the year, although a small amount was shipped from stock. Comfort Brick & Tile Co. mined miscellaneous clay for use in manufacturing draintile. Midwest Peat Co., Adrian, produced reed-sedge peat and sold it in packaged form for soil improvement. About 537,000 tons of sand and gravel was produced in the Adrian and Tecumseh areas for building, paving, railroad ballast, and fill. The Macon Creek field yielded a small quantity of petroleum.

Mackinac.—Limestone was quarried by Inland Lime & Stone Co., Division of Inland Steel Co., near Port Inland and at Cedarville by the United States Steel Corp. Both companies maintained large processing plants and port facilities for shipping the material to industrial consumers by water transport.

About 77,000 tons of sand and gravel, mostly road material and fill, was mined in the county.

Macomb.—About 2,445,000 tons of sand and gravel was produced, compared with 2,753,000 tons in 1964. The decrease was mainly due to lesser demand for road materials. Plants were operated near Armada, Macomb, Mount Clemens, Romeo, and Utica.

Natural gas production was 7.9 billion cubic feet compared with 5.3 billion in 1964. Most of the output came from the Ray field. The county ranked second in the State in natural gas production. About 4,000 barrels of petroleum was produced.

Manistee.—Bromine, calcium-magnesium chloride, and magnesium compounds were extracted from natural well brines. Salt was recovered from artificial brines. Chemical plants were operated in or near Manistee by Great Lakes Chemical Corp., Manistee Salt Works, Michigan Chemical Corp., Morton Chemical Co., Morton Salt Co., and Standard Lime & Refractories Co. (Division Martin Marietta Corp.). At Filer City, quicklime was produced by calcining calcium carbonate sludge by Packaging Corp. of America. The lime was used in paper manufacture. About 559,000 tons of sand and gravel was produced—the gravel for building and road use and the sand for industrial use, mainly molding sand.

Marquette.—Value of mineral production in the county exceeded $99 million and again was the highest in the State. County iron ore shipments were up 5 percent over those of 1964. The output of underground mines was up less than 1 percent and open pit mines 7 percent. Cleveland-Cliffs Iron Co. operated nine iron ore mines, five underground and four open pit mines. Expansion of the company's underground Mather mine began in June. Upon completion in 1966, production is expected to be at the rate of 2.4 million tons of crude ore per year. Some ore from the Mather mine was pelletized at the Pioneer Pellet Plant, which began operating in June. At the newly completed Empire mine complex near Palmer, a $40 million program for expansion of pelletizing facilities was announced. Pellet output will be increased from 1.5 million to 3.2 million tons per year. Jones & Laughlin Steel Corp. operated the Tracy underground mine, and North Range Mining Co. operated the Champion underground mine.

Sand and gravel production totaled 787,000 tons. The output was used for road construction and maintenance, building, railroad ballast, and fill.

Mason.—Bromine, calcium chloride, calcium-magnesium chloride, and magnesium compounds were extracted from well brines at Ludington by The Dow Chemical Co. The company also produced quicklime in the same area. Harbison-Walker Refractories Co. produced refractory magnesia from purchased magnesium hydroxide.

Industrial sand, mainly molding and grinding and polishing sand, was produced near Ludington. Sand and gravel for road use was produced at several sites with portable plants.

Six fields produced 157,000 barrels of petroleum.

Mecosta. — About 23,000 barrels of petroleum was produced, largely from the Paris field. Natural gas production was reported from seven fields and totaled 75 million cubic feet. Peat was dug from a bog near Lakeview and marl from pits near Mecosta. Both products were used

for soil enrichment. About 273,000 tons of sand and gravel was produced, mainly for road construction, building use, and fill.

Menominee. — Quicklime and hydrated lime were produced at Menominee by Limestone Products Division of The C. Reiss Coal Co. (formerly Limestone Products Division of North Western-Hanna Fuel Co.). The material was sold for a variety of industrial uses including paper and pulp manufacture, tanning, water purification, and steelmaking. About 596,000 tons of sand and gravel was produced, 104,000 tons more than in 1964. Most of the material was used in road construction and maintenance.

Midland.—The Dow Chemical Co. produced a variety of chemical products at Midland from well brines, including bromine, calcium chloride, calcium-magnesium chloride, iodine, magnesium compounds, and potash. The company extracted salt from artificial brines. Kaiser Aluminum & Chemical Corp. produced refractory magnesia from purchased magnesium hydroxide. Sand and gravel for road use and fill was produced near Midland. About 236,000 barrels of petroleum was produced from five fields and 12 million cubic feet of natural gas from the Mount Pleasant field.

Missaukee.—Petroleum output, 433,000 barrels, was slightly below that of 1964. Natural gas output decreased to 811 million cubic feet from 1.2 billion cubic feet in 1964. Largest production came from East Norwich, Enterprise, Falmouth, Forward, and McBain fields. A small quantity of road gravel was produced.

Monroe. — Portland and masonry cements, as well as clay and limestone, were produced at Dundee by Dundee Cement Co. Limestone was also quarried and crushed at Maybee, Monroe, and Ottawa Lake. It was used for flux, roadstone, railroad ballast, agricultural application, and riprap. Peat, for soil improvement, was dug from bogs near Ida and Petersburg. The Deerfield field yielded 8,000 barrels of petroleum. At South Rockwood, F. W. Ritter Sons Co. mined miscellaneous clay for use in making art pottery, flowerpots, and glazed products.

Montcalm.—About 239,000 barrels of petroleum was produced from 12 fields, and 43 million cubic feet of natural gas was produced, mainly from the Edmore field. Crude oil was refined by Crystal Refining Co. at Carson City. Sand and gravel output totaled 733,000 tons, up from 569,000 tons in 1964. Most of the material was used for road construction and maintenance.

Muskegon.—Hooker Chemical Corp. extracted salt from artificial brines at Montague. Union Carbide Corp. produced hydrated lime as a byproduct at their acetylene producing operations. The lime was sold for use as mason's lime, soil stabilization, and sewage and industrial waste treatment.

About 11,000 barrels of petroleum and 6 million cubic feet of natural gas were produced. Crude oil was refined at Muskegon by Marathon Oil Co. and Naph-Sol Refining Co. About 575,000 tons of sand and gravel was produced. Output included considerable quantities of industrial sand, mainly engine and molding sand, as well as materials for building, road use, and fill.

Newaygo.—About 274,000 tons of sand and gravel was produced, most of it for road use. About 20,000 barrels of petroleum was produced from four fields. A small amount of natural gas was produced from the Ensley field.

Oakland.—The county maintained first place in sand and gravel production, with a total of nearly 8.7 million tons, compared with 8.1 million tons in 1964. The material was used mainly for building and road construction and fill in the Detroit area. Peat was dug from bogs near New Hudson and Novi and sold in bulk form for soil improvement. Gibbs Peat Co., near Clarkston, did not operate in 1965.

A small quantity of petroleum was recovered from the Northville field.

Oceana.—About 101,000 barrels of petroleum was produced from eight fields, compared with 170,000 barrels in 1964. The Pentwater, Eldridge, and Stony Lake fields contributed 95 percent of the total. About 730,000 tons of sand and gravel was produced, mostly for building and road use.

Ogemaw.—Petroleum production totaled 281,000 barrels and natural gas 553 million cubic feet. The Rose City, West Branch, and Logan fields contributed nearly all of the output. Osceola Refining Co. refined crude oil at West Branch. Most of 222,000

tons of sand and gravel produced, was for road use.

Ontonagon. — White Pine Copper Co. (subsidiary of Copper Range Co.) operated a mine, mill, and smelter at White Pine. Both copper and silver were produced. The company announced an expansion program to cost $100 million in the next 6 years. The first phase was to be construction of a second reverberatory furnace with a maximum smelting capacity of 175 million pounds of copper annually. The company continued study of the long-wall mining method which will permit a larger recovery of ore. In addition to the original experimental panel, a second panel is being developed. In September, the company produced its billionth pound of copper. About 140,000 tons of sand and gravel for road use was produced, compared with 398,000 tons in 1964.

Osceola. — Petroleum production was 404,000 barrels compared with 265,000 barrels in 1964, while natural gas output totaled 161 million cubic feet compared with 219 million cubic feet in 1964. C. Stanley Hooker discontinued his marl operation near Tustin.

Sand and gravel production reached 553,000 tons compared with 224,000 in 1964. Requirements of the State highway department accounted for the increase.

Ottawa.—Sand and gravel output totaled 2.6 million tons, compared with 2.1 million tons in 1964. In addition to building and road materials, some molding and engine sand was produced. Pits near Hudsonville and Jenison yielded small amounts of marl for agricultural use.

Petroleum production declined to 176,000 barrels from 267,000 in 1964, while natural gas output increased to 178 million cubic feet from 170 million.

Presque Isle.—Limestone was quarried and crushed at Rogers City by United States Steel Corp., and by Presque Isle Corp. near Presque Isle. The material was shipped by water to steel mills, cement and lime plants, and other industrial consumers. It was also used for concrete aggregate, roadstone, and agricultural application. At Onaway, limestone was quarried and milled, mostly for building use. Sand and gravel production totaled 569,000 tons and was used for building, road construction, and railroad ballast.

Roscommon.—About 196,000 barrels of petroleum and 922 million cubic feet of natural gas were produced from the East Norwich, Enterprise, Headquarters, and St. Helen fields. Sand and gravel output totaled 231,000 tons compared with 349,000 tons in 1964. Most of the material was used for road construction and fill.

Saginaw.—Clay was mined near Saginaw from the Calvin No. 2 mine by Aetna Portland Cement Co. for its own use. Michigan Sugar Co. produced hydrated lime for use in sugar refining.

About 31,000 barrels of petroleum was produced from five fields, nearly the same quantity as in the previous year. A small amount of road gravel was produced for the State highway department.

St. Clair. — Portland and masonry cements were produced at Port Huron by Peerless Cement Co., Division of American Cement Corp. The company produced clay for its own use from a pit at Smiths Creek. Salt was recovered from artificial brines by Morton Salt Co. at Marysville and Diamond Crystal Salt Co. at St. Clair.

A bog near Capac yielded peat which was sold both in bulk and packaged form for soil improvement. About 371,000 tons of sand and gravel was produced for building, paving use, and fill. Petroleum production totaled 808,000 barrels and natural gas output totaled 12.4 billion cubic feet. Gas production was the largest of any county in the State.

St. Joseph.—Marl and peat, for soil enrichment, were dug from pits and a bog in the Three Rivers area and near Nottawa.

Sand and gravel production of 326,000 tons was 79,000 tons larger than in 1964. Output was mostly from pits in the Three Rivers and White Pigeon areas. The material was used for building and road construction, fill, and other purposes.

Sanilac.—Peat bogs near Minden City and Sandusky yielded moss and reed-sedge peat for horticultural use and soil improvement. The material was sold both in bulk and packaged form. Michigan Sugar Co. produced hydrated lime at Croswell for use in sugar refining. About 645,000 tons of sand and gravel was produced for building and paving use and fill.

Schoolcraft.—At Port Inland, the Inland Lime & Stone Co., Division of Inland Steel Co. maintained a crushing and processing

plant as well as port facilities to handle the output of its large limestone quarry in adjoining Mackinac County. The Port Inland complex has processed and handled more than 100 million tons of limestone since operations began. The county road commission produced 5,000 tons of sand for its own use.

Shiawassee.—Clay was mined at Corunna for manufacturing vitrified sewer pipe. Peat was dug from a bog near Ovid and sold in bulk and packaged form for soil improvement. Sand and gravel production totaled 684,000 tons, compared with 720,000 in 1964. It was sold for railroad ballast and fill, as well as for building and paving use.

Tuscola.—Sand and gravel production reached nearly 1.5 million tons, compared with 1.9 million tons in 1964. Some of the large suppliers of road materials did not operate in the county in 1965. In addition to materials for building and road use, a considerable quantity of molding sand was produced. Michigan Sugar Co. produced hydrated lime at Caro for its own use. Moss peat was produced and sold in both bulk and packaged form for general soil improvement. About 74,000 barrels of petroleum was produced from four fields

Van Buren.—Molding and engine sand was produced at South Haven. Road gravel was produced at several sites with portable plants. The Lime Lake pit near Paw Paw yielded marl for agricultural use. Four fields yielded 15,000 barrels of petroleum.

Washtenaw.—About 1.6 million tons of sand and gravel was produced, up from 921,000 tons in 1964. The increase was largely in building and road materials. About 28,000 barrels of petroleum and 191 million cubic feet of natural gas were produced from the Northville and Lyndon fields.

Wayne. — The county dropped to fifth place in value of mineral production from third place in 1964. Output of several commodities was affected in the long labor strike at Wyandotte Chemicals Corp. Sand and gravel output totaled 4,367,000 tons, compared with 4,324,000 tons in 1964. Building and road materials as well as industrial sand were produced. Salt was mined in Detroit by International Salt Co., Inc., and recovered from artificial brines at Wyandotte by Pennsalt Chemicals Corp. and Wyandotte Chemicals Corp.

Portland and masonry cements were produced by Peerless Cement Co., Division of American Cement Corp., at two plants in Detroit. The company mined clay for cement from a pit in Allen Park. Wyandotte Chemicals Corp. produced portland cement at Wyandotte.

Flat Rock Clay Products Co. mined clay at Flat Rock for use in making draintile, and Light Weight Aggregate Corp. mined clay at Livonia for its own use. Quicklime was produced in Detroit by Solvay Process Division of Allied Chemical Corp., at River Rouge by Detroit Lime Co. (subsidiary of Edward C. Levy Co.) and at Wyandotte by Wyandotte Chemicals Corp. The Marblehead Lime Co. plant under construction in the River Rouge area was scheduled for production early in 1966.

Calcium chloride was produced by Wyandotte Chemicals Corp. at Wyandotte for its own use and for sale.

United States Gypsum Co. operated a calcining and board plant at Detroit. The crude ore was shipped down lake from the company quarries and port in Alabaster, Iosco County. The company also expanded perlite at the Detroit plant. Zonolite Division, W. R. Grace & Co., exfoliated vermiculite at a plant in Dearborn. Marathon Oil Co. recovered byproduct sulfur from crude oil, using the Parsons process, at its Detroit refinery. Socony Mobil Oil Co. refined crude oil at Trenton.

About 21,000 barrels of petroleum and 708 million cubic feet of natural gas was recovered from the Northville field.

The Mineral Industry of Minnesota

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the Minnesota Geological Survey for collecting information on all minerals except fuels.

By L. F. Heising [1] and M. G. Sikich [2]

Minnesota continued as the leading iron ore producing State, supplying 60 percent of the total usable ore shipped from mines in the United States. Iron-bearing ores (including manganiferous ores) represented 91 percent of the total value of the State mineral production. Shipments of taconite concentrate decreased slightly, 1 percent from the record output in 1964.

Increases in total value and quantity were recorded for usable iron ore, manganiferous ore, sand and gravel, and grinding pebbles. Quantity and value decreases were recorded for portland and masonry cements, miscellaneous and fire clays, lime, and peat.

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Table 1.—Mineral production in Minnesota [1]

Mineral		1964		1965	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Clays [2]	thousand short tons	213	$319	207	$311
Iron ore (usable) thousand long tons, gross weight		49,626	449,289	50,873	459,290
Manganiferous ore (5 to 35 percent Mn)	short tons, gross weight	188,481	W	280,705	W
Peat	short tons	19,188	405	7,346	123
Sand and gravel	thousand short tons	35,817	25,907	37,545	27,296
Stone	do	3,588	12,297	4,371	11,680
Value of items that cannot be disclosed: Abrasive stones, cement, fire clay, gem stones, lime, and values indicated by symbol W		XX	9,278	XX	9,060
Total		XX	497,495	XX	507,760

W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed."
XX Not applicable.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Excludes fire clay included with "Value of items that cannot be disclosed."

Table 2.—Value of mineral production in constant 1957–59 dollars
(Millions)

Year	Value	Year	Value
1956	$548	1961	436
1957	593	1962	416
1958	394	1963	r 425
1959	341	1964	r 451
1960	507	1965	p 459

p Preliminary. r Revised.

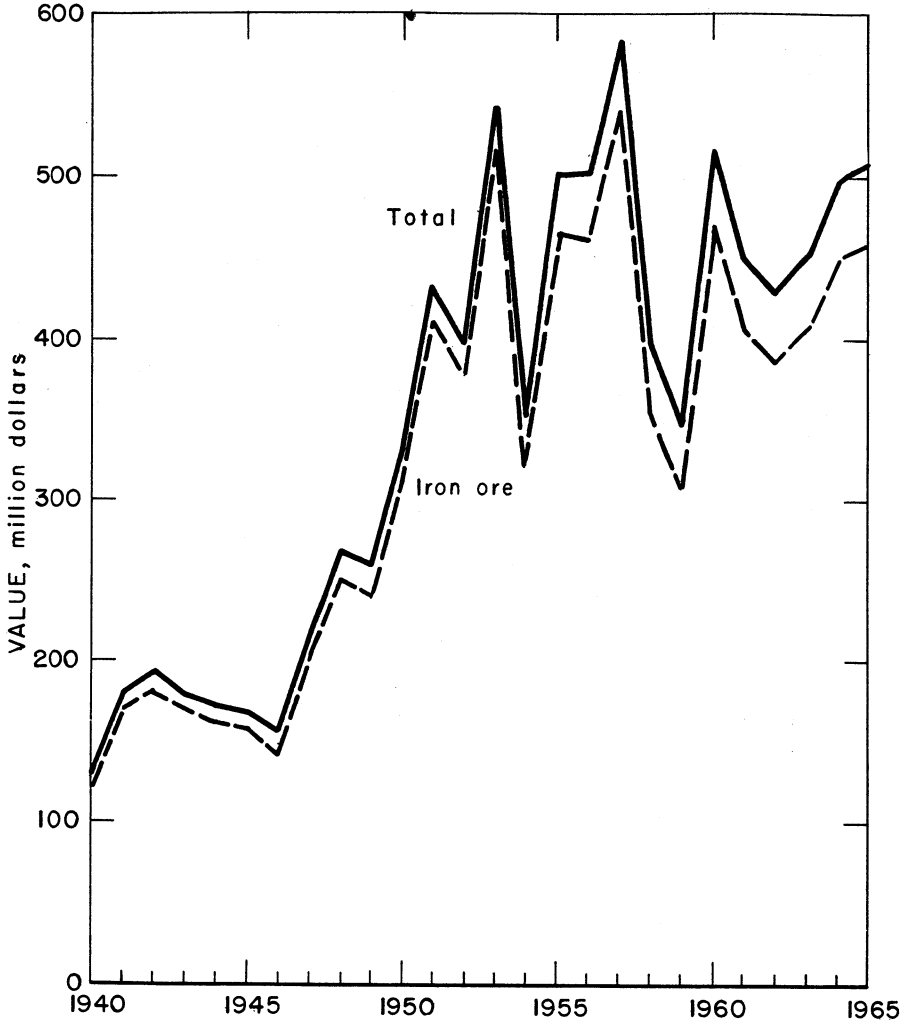

Figure 1.—Value of iron-ore shipments and total value of mineral production in Minnesota.

Table 3.—Employment and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1964:								
Peat	88	68	6	47	-------	-------	-------	-------
Metal	9,219	270	2,493	19,869	3	45	2.42	1,183
Nonmetal	249	245	62	493	1	28	58.80	13,093
Sand and gravel	2,213	164	364	3,098	2	53	17.76	5,081
Stone	1,701	256	436	3,657	-------	89	24.34	548
Total	13,470	249	3,361	27,164	6	215	8.14	1,756
1965:p								
Peat	38	53	2	16	-------	-------	-------	-------
Metal	9,505	288	2,741	21,944	-------	80	3.65	237
Nonmetal	225	271	61	486	1	33	69.96	13,840
Sand and gravel	2,180	164	358	3,054	-------	52	17.03	494
Stone	1,590	241	383	3,209	-------	60	18.70	414
Total	13,538	262	3,545	28,709	1	225	7.87	514

p Preliminary.

REVIEW BY MINERAL COMMODITIES

METALS

Iron Ore.—Minnesota mines shipped 50.9 million long tons of usable iron ore (excluding ore containing 5 percent or more manganese), 2 percent more than in 1964. Total mine value of shipments increased to $459.3 million. Nearly 77 percent of the total usable ore shipped in 1965 was beneficiated. Shipments of taconite concentrates were 18.9 million tons and comprised 37 percent of the State iron ore shipments. Average natural iron content of usable ore was 56.7 percent, compared with 56.4 percent in 1964. Fourteen mining companies produced iron ore from five counties. Mesabi Range mines in St. Louis and Itasca Counties produced 97 percent of the total. The Vermilion Range in St. Louis County, the Cuyuna Range in Crow Wing County, and the Spring Valley district in Fillmore and Olmsted Counties produced the remainder.

Minnesota observed the tenth anniversary of the start of its full-scale commercial taconite industry. Reserve Mining Co.'s Silver Bay plant had an initial rated capacity of 3.75 million tons when it began processing in October 1955. This plant, the world's largest, will have a rated capacity of 10.7 million tons of pellets per year on completion of its current expansion program in 1966. Since passage of the taconite amendment in 1964, Minnesota has had extensive activity in taconite plant construction with an estimated $400 million committed for new taconite plants and expansion programs. Eveleth Taconite Co.'s 1.6-million-ton-per-year pellet plant at Forbes was completed in November, and production of pellets began in December. Three new plants were in various stages of construction. In the Nashwauk-Keewatin area, The Hanna Mining Co. was building two plants with a total rated capacity of 4.4 million tons of pellets per year. United States Steel Corp. was constructing a 4.5-million-ton-per-year pellet plant at Mountain Iron. Jones & Laughlin Steel Corp.'s proposed 2-million-ton-per-year pellet plant near Biwabik was in design stage. A $50 million expansion program at Erie Mining Co.'s taconite plant at Hoyt Lakes was in progress. Annual capacity will be increased 2.8 million tons to 10.3 million tons of pellets. Development of the Dunka River mine, which will supplement Erie's crude ore supply, was completed. Including presently operating plants and those in construction and design stages, Minnesota will have in the near future an annual pellet capacity of 33.5 million tons, representing an investment of over $1 billion.

Pacific Isle Mining Co. reopened the Higgins No. 2 mine, and Pittsburgh Pacific Co. opened a new mine, the Arne, at Aurora. Both mines are natural ore operations. At the end of the shipping sea-

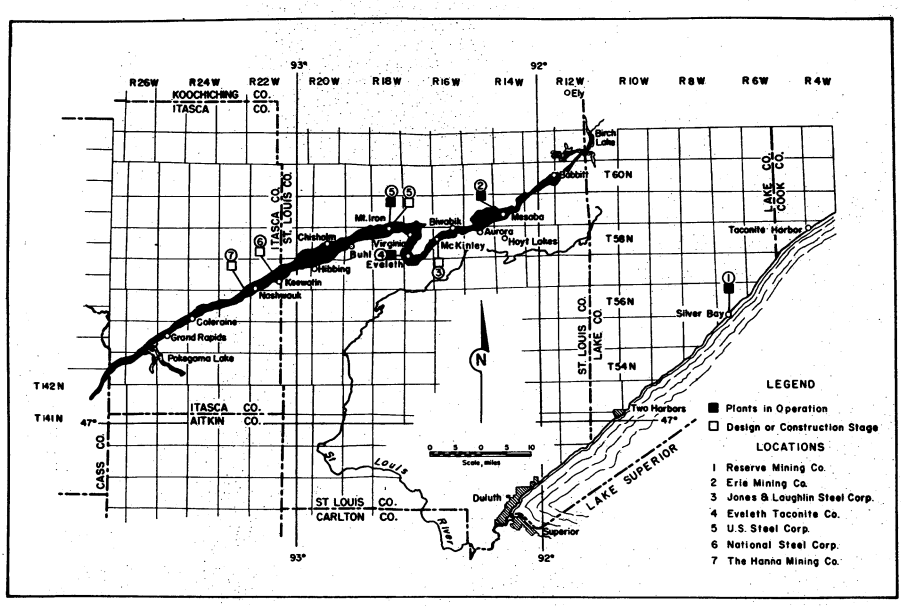

Figure 2.—Locations of currently operating and proposed Mesabi Range taconite-processing plants.

son, The Hanna Mining Co. discontinued mining at the Morton and Mississippi Group open-pit mines on the Mesabi Range. The Duluth, Missabe, and Iron Range Railway constructed a bulk material handling and storage facility at Duluth. The Reserve Mining Co. constructed a $5 million research laboratory at Silver Bay, primarily for research on plant processes and to improve the quality of Reserve pellets. The Hanna Mining Co. and Midland-Ross Corp. conducted research on a prereduced pellet process at Hanna's Cooley pilot plant. The Midland-Ross Corp. process for upgrading the iron content of pellets to as much as 90 percent iron was proposed for installation at the National Steel Pellet Co. taconite plant under construction near Keewatin.

W. S. Moore Co. and Northern Natural Gas Co. continued research on reduction roast techniques for low-grade nonmagnetic ores.

Lake Erie base prices for iron ore were unchanged from 1964. Average weighted mine value for Minnesota iron ore was $9.03 compared with $9.05 in 1964. The decrease was attributed chiefly to slightly lower taconite concentrate shipments in 1965.

The first iron ore cargo of the 1965 season was loaded at Duluth on April 19. The final cargo of the season left Silver Bay on December 14.

The Federal Bureau of Mines continued research on the beneficiation of nonmagnetic taconites and semi-taconites at its Twin Cities Research Center. Utilization of scrap iron from junked autos as a reductant to convert nonmagnetic iron oxides to magnetic form was investigated and found technically feasible. A pilot plant to be constructed in the western Mesabi Range area to demonstrate the feasibility of scrap iron reduction process and Bureau-developed flotation processes was in design stage.

A report on Bureau of Mines research on nonmagnetic taconites of the central Mesabi Range was published.[3]

The University of Minnesota Mines Experiment Station continued high intensity,

[3] Heising, L. F., and D. W. Frommer. Lake Superior Iron Resources. Preliminary Sampling and Metallurgical Evaluation of Central Mesabi Nonmagnetic Taconites. BuMines Rept. of Inv. 6650, 1965, 28 pp.

Table 4.—Crude iron ore [1] data, in 1965, by counties and ranges
(Thousand long tons)

County and range	Stocks Jan. 1	Production		Shipments		Stocks Dec. 31
		Underground	Open pit	Direct to consumers	To concentrators	
County:						
Crow Wing	65	337	30	359	---	73
Fillmore [2]	---	---	1,088	---	1,088	---
Itasca	---	---	29,590	97	29,493	---
St. Louis	696	926	81,957	11,123	71,474	983
Total [3]	761	1,263	112,664	11,579	102,054	1,056
Range:						
Cuyuna	65	337	30	359	---	73
Mesabi	696	---	111,547	11,220	100,041	983
Vermilion	---	926	---	---	926	---
Spring Valley district	---	---	1,088	---	1,088	---
Total [3]	761	1,263	112,664	11,579	102,054	1,056

[1] Exclusive of ore containing 5 percent or more manganese.
[2] Includes ore from one property in Olmsted County.
[3] Data may not add to totals shown because of rounding.

Table 5.—Usable iron ore [1] data, in 1965, by counties and ranges
(Thousand long tons)

County and range	Stocks Jan. 1	Production	Iron content of production	Shipments	Stocks Dec. 31
County:					
Crow Wing	65	367	180	359	73
Fillmore [2]	38	625	294	565	98
Itasca	1,374	10,401	5,847	9,053	2,722
St. Louis	2,855	40,660	23,189	40,896	2,619
Total	4,332	52,053	29,510	50,873	5,512
Range:					
Cuyuna	65	367	180	359	73
Mesabi	4,112	50,279	28,575	49,146	5,245
Vermilion	117	782	460	803	96
Spring Valley district	38	625	294	565	98
Total	4,332	52,053	[3] 29,510	50,873	5,512

[1] Exclusive of ore containing 5 percent or more manganese.
[2] Includes ore from one property in Olmsted County.
[3] Data do not add to total shown because of rounding.

flotation and pilot plant scale research on beneficiation of low-grade Mesabi iron ores under technical assistance grants provided by the Federal Area Redevelopment Administration and the Minnesota Iron Range and Rehabilitation Commission.

The Minnesota legislature passed a bill providing for a production tax in lieu of a real estate tax on plants constructed to agglomerate natural iron ores. A tax of 5 cents per ton of agglomerate produced, plus one-tenth of 1 cent for each 1 percent that the iron content exceeds 55 percent, will replace the real estate tax on the plant facilities. No firm plans to utilize the benefits of this law were announced, but an agglomerating plant for natural ores was being considered by the Snyder Mining Co. in the Buhl area.

Manganiferous Ore.—Manganiferous ore shipments (containing 5 to 35 percent manganese, natural) were 49 percent higher than in 1964. Total shipments were 250,630 long tons consisting of 47,782 tons of direct shipping grade and 202,848 tons of concentrates. Ferruginous manganese ore (containing 10 to 35 percent manganese, natural) represented 87 percent of the shipments. Average natural iron and manganese contents of shipments were

Table 6.—Usable iron ore [1] produced (direct-shipping and all forms of concentrate), by ranges

(Thousand long tons)

Year	Cuyuna	Mesabi	Vermilion	Spring Valley district	Total [2]
1884–1955	56,600	2,036,154	92,281	2,793	2,187,827
1956	2,242	59,346	1,285	350	63,222
1957	2,018	64,537	1,349	382	68,286
1958	1,119	39,833	1,027	241	42,221
1959	745	33,747	809	576	35,877
1960	1,166	54,442	1,361	473	57,442
1961	1,095	41,199	930	491	43,714
1962	655	43,041	1,158	362	45,216
1963	515	43,570	774	524	45,383
1964	513	47,256	865	420	49,054
1965	367	50,279	782	625	52,053
Total [2]	67,035	2,513,403	102,621	7,237	2,690,295

[1] Exclusive after 1905 of iron ore containing 5 percent or more manganese.
[2] Data may not add to totals shown because of rounding.

Table 7.—Production of usable iron ore in Minnesota

(Thousand long tons)

Year	Gross weight		Iron content (percent)	Year	Gross weight		Iron content (percent)
	Ore	Iron content			Ore	Iron content	
1946	49,291	25,375	51.48	1956	63,222	32,554	51.49
1947	62,493	31,865	50.99	1957	68,286	35,842	52.49
1948	68,036	33,923	49.86	1958	42,221	22,793	53.99
1949	55,862	28,070	50.25	1959	35,877	19,412	54.11
1950	65,235	32,206	49.37	1960	57,442	31,147	54.22
1951	78,486	39,659	50.53	1961	43,715	24,215	55.39
1952	63,790	31,997	50.16	1962	45,216	25,242	55.83
1953	80,086	40,291	50.31	1963	45,383	25,576	56.36
1954	48,752	24,835	50.94	1964	49,054	27,660	56.39
1955	69,356	35,130	50.65	1965	52,053	29,510	56.69

Table 8.—Iron ore [1] shipped from Minnesota mines

(Thousand long tons)

Year	Direct-shipping ore [2]	Concentrates			Total usable ore	Proportion of concentrates to total usable ore (percent)
		Agglomerates	Other	Total		
1956–60 (average)	25,922	8,173	18,631	26,804	52,726	50.84
1961	12,635	14,366	17,698	32,064	44,699	71.73
1962	11,466	14,085	18,744	32,829	44,295	74.11
1963	7,468	16,857	21,110	37,967	45,435	83.56
1964	10,441	19,267	19,917	39,184	49,626	78.96
1965	11,579	19,039	20,255	39,294	50,873	77.24

[1] Exclusive of ore containing 5 percent or more manganese.
[2] Includes crushed, screened, and sized ore not further treated.

35.28 and 12.03 percent, respectively.

Chief reason for the increased shipments was the resumption of ore shipments by the Algoma mine. The Algoma mine, opened originally as an underground mine in 1915, was last operated in 1920. The mine was reopened in 1965 as an open pit operation by The Hanna Mining Co. with ore treated at the Maroco Plant.

Stockpile shipments were made from the Robert, Hopkins, Mangan No. 1, and Sultana mines. Two mines produced manga-

Table 9.—Dates of first and final cargoes of iron ore at U.S. upper Great Lakes ports

Port and dock	1964		1965	
	First	Final	First	Final
Ashland, Wis.:				
C&NW	May 26	Oct. 23	May 3	[1] Oct. 30
Soo Line	May 26	Oct. 23	May 3	[1] Oct. 30
Duluth, Minn.: DM&IR	Apr. 4	Nov. 24	Apr. 19	Nov. 20
Escanaba, Mich.: C&NW	Apr. 3	Dec. 18	Apr. 7	Dec. 19
Marquette, Mich.:				
Soo Line	Apr. 29	Dec. 3	Apr. 26	Dec. 5
LS&I	Apr. 12	Dec. 13	Apr. 17	Dec. 12
Silver Bay, Minn.: Reserve	Apr. 9	Dec. 11	Apr. 23	Dec. 14
Superior, Wis.:				
GN	Apr. 5	Dec. 11	Apr. 24	Dec. 9
NP—Soo Line	Apr. 16	Oct. 27	Apr. 29	Oct. 25
Taconite Harbor, Minn.: Erie	Apr. 2	Dec. 9	Apr. 21	Dec. 9

[1] Dock closed August 16 but reopened for October shipment making October 30 shipment figure final for 1965 season. Ashland ore dock is not expected to resume iron-ore shipments in 1966.

Source: Skillings' Mining Review.

Table 10.—Shipments of usable [1] manganiferous iron ore and ferruginous manganese ore from mines in the Cuyuna Range

Year	Manganiferous iron ore (5 to 10 percent Mn, natural)			Ferruginous manganese ore (10 to 35 percent Mn, natural)			Total shipments (long tons)
	Shipments (long tons)	Contents (natural)		Shipments (long tons)	Contents (natural)		
		Fe (percent)	Mn (percent)		Fe (percent)	Mn (percent)	
1956–60 (average)	365,146	39.31	6.54	93,238	33.85	12.13	458,384
1961	80,603	32.05	9.01	81,750	35.58	12.29	162,353
1962	129,979	40.40	6.19	131,431	33.28	12.60	261,410
1963				310,121	33.39	12.18	310,121
1964	27,725	36.59	9.68	140,562	32.61	12.38	168,287
1965	32,935	33.99	7.27	217,695	35.47	12.75	250,630

[1] Direct-shipping and beneficiated ore.

niferous ore. The Pittsburgh Pacific Co. produced ore from the Sagamore mine.

The Cuyuna Range Mineral Research, Inc., continued research on beneficiation of Cuyuna Range low-grade ores under technical assistance grants from the Federal Area Redevelopment Administration (ARA) and the Iron Range Resource and Rehabilitation Commission (IRRRC). The University of Minnesota Mines Experiment Station continued research sponsored by the ARA and IRRRC to demonstrate the feasibility of producing a high-grade manganese product from Cuyuna Range tailing rejects resulting from the R-N direct reduction process.

The Federal Bureau of Mines continued research at its Twin Cities Research Center developing methods of utilizing Cuyuna Range low-grade manganese ores.

NONMETALS

Abrasive Stone.—The Jasper Stone Co. produced grinding pebbles and tube-mill liners from a quartzite deposit in Rock County. Sales of grinding pebbles increased substantially in both quantity and value. Output of tube-mill liners decreased in quantity but increased in total value.

Cement.—Shipments of portland and masonry cements decreased in both quantity and value from those of 1964. Universal Atlas Cement Division of United States Steel Corp. operated three kilns at the only cement plant in the State, at Duluth. Portland cement output consisted of types I and II (general use and moderate heat) and portland-slag cement. Raw materials used in the manufacturing process included limestone, sand, gypsum, slag,

iron ore, air-entraining aids, and grinding aids. Shipments of portland and masonry cements were primarily to Minnesota, with lesser shipments to Michigan, Montana, North Dakota, Ohio, South Dakota, and Wisconsin.

Marquette Cement Manufacturing Co. completed construction of a distributing plant in Bloomington. This plant was one of several constructed in recent years to facilitate rapid truck delivery of bulk cement in the Minneapolis-St. Paul metropolitan area. Shipments to distribution centers in this area were generally by rail from producing plants.

Clays.—Total production of miscellaneous clay and shale decreased 3 percent in quantity from 1964. Chief reason for the decline was a decrease in output for vitrified sewer pipe and building brick. Output for lightweight aggregate increased slightly over that of 1964.

Production was reported from Brown, Goodhue, Hennepin, Ramsey, and Redwood Counties. No production was reported from Carlton County in 1965. In previous years a minor amount of clay was produced for floor and wall tile.

Clay and shale were used for manufacture of lightweight aggregate, building brick, vitrified sewer pipe, and other products. Red Wing Potteries, Inc., produced dinnerware and art pottery at Red Wing, chiefly from raw materials produced in other States.

The Minnesota Geological Survey continued its investigation of kaolin and other clay resources of the Minnesota River Valley in Brown, Redwood, and Renville Counties.

Gem Stones.—Minor quantities of semiprecious gem stones, principally agates, were collected by hobbyists. Gem materials were found chiefly along the north shore of Lake Superior, along the Mississippi River, and in gravel pits in the southeastern part of the State. The material was used for handmade jewelry and personal collections.

Lime.—Cutler-Magner Co., the only commercial producer of lime, operated a kiln at Duluth, using Michigan limestone. Most of the lime produced was used in Minnesota with lesser amounts shipped to Iowa, Michigan, North Dakota, South Dakota, and Wisconsin. The American Crystal Sugar Co. produced lime at Chaska, Carver County; at Moorhead, Clay County; and at Crookston and East Grand Forks, Polk County. The lime produced was used for sugar refining. About 93 percent of the State total lime production was used for chemical and other industrial uses, 6 percent for construction, and the remainder for agricultural purposes.

Perlite.—Minnesota Perlite Corp. and Western Mineral Products Co. produced expanded perlite from crude material mined in Nevada and New Mexico. The expanded perlite was used for lightweight concrete aggregate, building plaster, filler, soil conditioning, and other miscellaneous uses. Total sales were about equal to those of 1964.

Sand and Gravel.—A record high was established for sand and gravel output. The new mark of 37.5 million tons represented a 5-percent increase over the previous high set in 1964. Chief reason for the gain was the 1.6-million-ton increase in demand for building construction. Significant decreases in quantity were reported for paving and railroad ballast. Industrial sand production increased 4 percent. About 80 percent of the total was used for paving and fill, 17 percent for building, and the remainder for other uses.

Sand and gravel production was reported from all 87 counties in the State. Seventy-one percent of the total output was produced by 296 commercial operations, and 267 Government-and-contractor operations supplied the remainder. Nearly 91 percent was transported by truck, 4 percent by rail, and 5 percent by river barge. Major producing counties in order of production were Hennepin, St. Louis, Washington, Dakota, Otter Tail, Le Sueur, Clay, Kanabec, Polk, and Ramsey. The above 10 counties produced about 51 percent of the State total.

Stone.—Combined output of stone increased about 22 percent in quantity but value decreased 5 percent. The decrease in value was attributed mainly to decreased sales of dimension granite and limestone for architectural purposes.

Limestone was produced in 15 counties in the southcentral and southeastern parts of the State. The five major limestone producing counties by value—Blue Earth, Scott, Winona, Washington, and Le Sueur—produced 62 percent of the total. Dimension limestone decreased 20 percent in

Table 11.—Sand and gravel sold or used by producers, by classes of operations and uses
(Thousand short tons and thousand dollars)

Class of operation and use	1964		1965	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	3,488	$2,697	4,454	$3,461
Paving	2,165	1,318	1,670	1,111
Fill	564	247	855	317
Railroad ballast	24	15	5	5
Other [1]	295	991	380	1,027
Total	6,536	5,268	7,364	5,921
Gravel:				
Building	2,682	3,763	3,319	4,896
Paving	12,161	8,285	13,786	8,962
Railroad ballast	431	251	357	165
Fill	942	513	1,951	951
Other	185	140	39	24
Total	16,401	12,952	19,452	14,998
Total sand and gravel	22,937	18,220	26,816	20,919
Government-and-contractor operations:				
Sand:				
Building	----	----	7	4
Paving	2,535	1,381	2,036	1,083
Fill	158	54	123	42
Other	14	5	36	12
Total	2,707	1,440	2,202	1,141
Gravel:				
Building	----	----	7	4
Paving	9,902	6,154	8,202	5,165
Fill	258	88	298	60
Other	13	5	20	7
Total	10,173	6,247	8,527	5,236
Total sand and gravel	12,880	7,687	10,729	6,377
All operations:				
Sand	9,243	6,708	9,566	7,062
Gravel	26,574	19,199	27,979	20,234
Grand total	35,817	25,907	37,545	27,296

[1] Includes grnding and polishing sand (1964), blast, engine, filler, foundry, glass, molding, oil (hydrafrac), pottery, porcelain, tile, and other construction and industrial sands.

both quantity and value, but increased output of crushed and broken limestone resulted in a slight increase in total value compared with 1964 figures. About 91 percent of the commercial crushed limestone was shipped by truck, 8 percent by water, and the remainder by rail.

Granite production increased about 18 percent in quantity but decreased 15 percent in value from that of 1964. Chief reason for the value decrease was attributed to lesser sales of dressed architectural stone. Quantity and value of crushed and broken granite increased 21 and 27 percent, respectively, compared with 1964 figures. Production was reported from Big Stone, Kanabec, Lac qui Parle, Mille Lacs, Redwood, Renville, Stearns, and Yellow Medicine Counties. Finishing plants were operated at Delano, Cold Spring, and St. Cloud.

Crushed and broken basalt for concrete aggregate and roadstone was produced in St. Louis County by the Zenith Dredge Co. All material was shipped by truck.

Quartzite production from Nicollet and Rock Counties increased 34 and 44 percent in quantity and value, respectively. Quantity increases were recorded for concrete aggregate and roadstone, poultry grit, filter, and refractory purposes whereas a decrease was reported for riprap use. About 59 percent of the total output was

Table 12.—Granite sold or used by producers, by uses

Use		1964		1965	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Dimension:					
Rough monumental	thousand cubic feet	7	$25	W	W
Dressed monumental	do.	93	950	84	$1,217
Other [1]	do.	352	4,157	226	2,837
Total	approximate thousand short tons [2]	38	[3] 5,133	26	4,054
Crushed and broken:					
Concrete aggregate and roadstone	thousand short tons	80	158	W	W
Stone sand	do.	69	9	W	W
Other [4]	do.	360	504	617	857
Total	do.	[3] 510	671	617	857
Grand total	do.	[3] 547	5,804	643	4,911

W Withheld to avoid disclosing individual company confidential data; included with "Other."
[1] Includes granite for rough (1964) and dressed architectual and rough monumental (1965) use.
[2] Average weight of 166 pounds per cubic foot used to convert cubic feet to short tons.
[3] Data do not add to total shown because of rounding.
[4] Includes granite for riprap, railroad ballast, fill, poultry grit, and items indicated by symbol W.

Table 13.—Limestone sold or used by producers, by uses

Use		1964		1965	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Dimension:					
Rough construction and rubble	thousand short tons	6	$44	W	W
Rough architectural	thousand cubic feet	W	W	W	W
Sawed	do.	40	259	21	$96
House stone veneer	do.	W	W	95	254
Cut	do.	158	1,731	134	1,416
Flagging	do.	W	W	W	W
Total	approximate thousand short tons [1]	30	2,323	24	1,847
Crushed and broken:					
Riprap	thousand short tons	19	28	159	100
Concrete aggregate and roadstone	do.	2,371	2,792	3,043	3,713
Agriculture	do.	412	645	293	466
Railroad ballast	do.	------	------	7	10
Other [2]	do.	66	399	57	343
Total	do.	[3] 2,869	[3] 3,865	[3] 3,560	[3] 4,631
Grand total	do.	2,899	6,188	[3] 3,583	6,478

W Withheld to avoid disclosing individual company confidential data; included with "Total."
[1] Average weight of 160 pounds per cubic foot used to convert cubic feet to short tons.
[2] Includes limestone for asphalt, fertilizer, flux, poultry grit, and other uses.
[3] Data do not add to total shown because of rounding.

shipped by truck, with the remainder by rail.

Production of marl for agricultural use decreased 11 percent in quantity and 21 percent in value, respectively, from 1964. Marl was produced in Wadena and Cass Counties.

Sulfur.—Elemental sulfur was recovered by the Great Northern Oil Co. as a by-product at its Pine Bend refinery in Dakota County. Shipments decreased in quantity but increased in total value compared with those of 1964.

Vermiculite.—Crude vermiculite mined in Montana was exfoliated by three companies in Ramsey and Hennepin Counties.

The exfoliated material was used for building insulation, plaster and concrete aggregate, litter, fireproofing, acoustical and other miscellaneous uses. Output was slightly less than in 1964.

MINERAL FUELS

Peat.—Production was reported by seven companies from operations in Aitkin, Carlton, Itasca, Otter Tail, Pine, and St. Louis Counties. Sales of peat decreased 62 percent in quantity and 70 percent in value from 1964 figures. Production problems due to excessively wet bogs were cited as the chief reason for the lower quantity produced. Moss peat was the predominate type produced, 88 percent of the total; reed-sedge represented 11 percent, and humus the remainder.

Peat was sold for soil improvement and other horticultural uses. It was sold in bulk and in containers ranging in size from 1 quart to 6 cubic feet.

REVIEW BY COUNTIES

Mineral output was reported from every county in the State. St. Louis and Itasca Counties, with their large-scale iron mining industry, contributed 77 and 14 percent, respectively, of the State total value. Sand and gravel was produced in each of the State's 87 counties. Stone was produced in 29 counties.

Mineral value increased in 41 counties and decreased in 46 counties. Virtually all gains, except for iron-ore producing counties, were the result of increased requirements for road construction.

Aitkin.—Kimball & Sons Co. and Colby Pioneer Peat Co. produced peat near Hill City and Wawina, respectively, for soil improvement and other horticultural uses. Production decreased considerably from that of 1964 because of excessively wet conditions in the bogs.

Three companies operated portable plants near Cromwell and Hill City and produced gravel for road use and fill. The State and county highway departments produced and/or contracted for paving sand and gravel.

Big Stone. Delano Granite Works, Inc., and Cold Spring Granite Co. quarried granite at Odessa and Ortonville, respectively. The rough stone was finished at plants in Delano and Cold Spring. Sand and gravel for building and road construction was produced by Duininck Bros. & Gilchrist Co. and Hallett Construction Co. The county highway department produced and contracted for paving gravel.

Blue Earth.—Mankato Ag Lime & Rock Co. and Lundin Construction Co. produced crushed and broken limestone near Mankato for road construction, agricultural use, and riprap. Vetter Stone Co. and Mankato Stone Co. produced dimension limestone at Mankato primarily for architectural use. Sand and gravel for building, road construction, and other uses was produced by Guaranteed Gravel & Sand Co., Hiniker Sand & Gravel Co., and North Star Concrete Co. with fixed plants at Mankato. The county highway department contracted for paving gravel.

Brown.—Ochs Brick & Tile Co. produced shale for building brick and lightweight aggregate from a pit near Springfield. About 367,000 tons of sand and gravel was produced. Roberts Bros. and Wallner Construction Co., Inc., operated fixed sand and gravel plants at Sleepy Eye and New Ulm, respectively, and produced material for building and road construction. The county highway department contracted for paving gravel. The State highway department produced and contracted for paving sand and gravel.

Carlton.—Red Wing Peat Co. produced peat for soil improvement from a bog near Cromwell. About 459,000 tons of sand and gravel was produced by five companies and three governmental units from pits near Carlton, Cloquet, and Moose Lake. The material was used for road construction, building, and railroad ballast. Nemadji Tile & Pottery Co., which produced clay at Moose Lake for floor tile in 1964, was idle.

Carver.—American Crystal Sugar Co. produced quicklime at Chaska and used the entire output for sugar refining. Wm. Mueller & Sons and Rosenwinkel Sand & Gravel Co., Inc., produced sand and gravel at fixed plants near Hamburg and Chaska, respectively. Output was for building, road construction, and fill.

Clay.—Quicklime was produced by American Crystal Sugar Co. for use in sugar refining at Moorhead. About 1 million tons of sand and gravel was produced

Table 14.—Value of mineral production in Minnesota, by counties

County	1964	1965	Minerals produced in 1965 in order of value
Aitkin	$356,000	$170,800	Sand and gravel, peat.
Anoka	W	W	Sand and gravel.
Becker	W	468,000	Do.
Beltrami	134,000	157,000	Do.
Benton	109,000	64,000	Do.
Big Stone	402,353	W	Stone, sand and gravel.
Blue Earth	1,776,355	1,528,448	Do.
Brown	351,519	319,593	Sand and gravel, clays.
Carlton	469,648	292,000	Sand and gravel, peat.
Carver	364,932	419,926	Sand and gravel, lime.
Cass	122,160	169,331	Sand and gravel, stone.
Chippewa	204,000	191,000	Sand and gravel.
Chisago	157,000	115,000	Do.
Clay	1,341,605	1,540,827	Sand and gravel, lime.
Clearwater	14,000	129,000	Sand and gravel.
Cook	62,000	270,000	Do.
Cottonwood	126,000	117,000	Do.
Crow Wing	4,657,656	4,460,550	Iron ore, manganiferous ore, sand and gravel.
Dakota	1,338,791	2,145,585	Sand and gravel, stone.
Dodge	W	W	Stone, sand and gravel.
Douglas	147,000	74,000	Sand and gravel.
Faribault	427,000	410,000	Do.
Fillmore	W	W	Iron ore, stone, sand and gravel.
Freeborn	164,000	314,000	Sand and gravel.
Goodhue	553,889	385,781	Stone, sand and gravel, clays.
Grant	45,000	137,000	Sand and gravel.
Hennepin	3,809,157	4,299,500	Sand and gravel, clays.
Houston	W	96,696	Stone, sand and gravel.
Hubbard	151,000	35,000	Sand and gravel.
Isanti	33,000	41,000	Do.
Itasca	74,828,569	71,644,513	Iron ore, sand and gravel, peat.
Jackson	188,000	107,000	Sand and gravel.
Kanabec	271,145	619,700	Sand and gravel, stone.
Kandiyohi	249,000	369,000	Sand and gravel.
Kittson	121,000	49,000	Do.
Koochiching	46,000	87,000	Do.
Lac qui Parle	784,415	520,852	Stone, sand and gravel.
Lake	103,000	115,000	Sand and gravel.
Lake of the Woods	137,000	108,000	Do.
Le Sueur	1,688,266	1,868,972	Sand and gravel, stone.
Lincoln	W	173,000	Sand and gravel.
Lyon	261,000	213,000	Do.
McLeod	123,000	143,000	Do.
Mahnomen	35,000	W	Do.
Marshall	155,000	195,000	Do.
Martin	168,000	254,000	Do.
Meeker	159,000	W	Do.
Mille Lacs	W	283,100	Stone, sand and gravel.
Morrison	80,000	193,000	Sand and gravel.
Mower	473,284	577,683	Stone, sand and gravel.
Murray	W	79,000	Sand and gravel.
Nicollet	351,320	569,095	Sand and gravel, stone.
Nobles	W	119,000	Sand and gravel.
Norman	247,000	146,000	Do.
Olmsted	1,116,579	646,685	Stone, sand and gravel, iron ore.
Otter Tail	802,310	752,000	Sand and gravel, peat.
Pennington	41,000	183,000	Sand and gravel.
Pine	146,600	79,975	Sand and gravel, peat.
Pipestone	185,000	W	Sand and gravel.
Polk	1,409,323	1,002,014	Sand and gravel, lime.
Pope	192,000	88,000	Sand and gravel.
Ramsey	805,250	706,500	Sand and gravel, clays.
Red Lake	23,000	61,000	Sand and gravel.
Redwood	369,619	373,350	Sand and gravel, stone, clays.
Renville	415,937	531,600	Stone, sand and gravel.
Rice	617,975	344,154	Sand and gravel, stone.
Rock	576,186	588,410	Sand and gravel, abrasives, stone.
Roseau	74,000	129,000	Sand and gravel.
St. Louis	377,761,742	389,850,510	Iron ore, cement, sand and gravel, lime, stone, peat.
Scott	818,370	1,270,998	Stone, sand and gravel.
Sherburne	82,000	143,000	Sand and gravel.
Sibley	77,000	157,000	Do.
Stearns	4,208,021	3,049,741	Stone, sand and gravel.
Steele	312,360	436,414	Sand and gravel, stone.
Stevens	161,000	W	Sand and gravel.
Swift	294,000	113,000	Do.
Todd	139,000	119,000	Do.
Traverse	78,000	21,000	Do.

See footnotes at end of table.

Table 14.—Value of mineral production in Minnesota, by counties—Continued

County	1964	1965	Minerals produced in 1965 in order of value
Wabasha	$172,290	$160,646	Stone, sand and gravel.
Wadena	36,930	61,280	Sand and gravel, stone.
Waseca	23,000	20,000	Sand and gravel.
Washington	2,155,310	2,506,529	Sand and gravel, stone.
Watonwan	148,000	W	Sand and gravel.
Wilkin	W	42,000	Do.
Winona	1,095,581	896,943	Stone, sand and gravel.
Wright	197,000	33,000	Sand and gravel.
Yellow Medicine	413,661	399,000	Stone, sand and gravel.
Undistributed [1]	4,760,892	6,209,299	
Total	497,495,000	507,760,000	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] Includes some sand and gravel and stone that cannot be assigned to specific counties, and values indicated by symbol W.

by six companies and the State highway department using fixed and portable plants near Felton, Glyndon, Hawley, Moorhead, and Sabin. Output was used for road construction, building, and other uses. The county highway department contracted for paving gravel.

Cook.—Erie Mining Co. shipped nearly 8 million tons of taconite pellets from Taconite Harbor. Pellets were produced at Erie's processing plant near Hoyt Lakes, St. Louis County. First cargo of the 1965 season was loaded April 21, and the final cargo left Taconite Harbor on December 9.

Sand and gravel (450,000 tons) was produced chiefly for building and road construction. Portable plants were operated near Grand Marais and Taconite Harbor by Ulland Bros., Inc., C. L. Stodolka Co., Inc., and Edwin E. Thoreson, Inc. The State highway department contracted for paving sand and gravel.

Crow Wing.—Shipments of manganiferous ore increased about 49 percent from those of 1964, whereas iron ore shipments decreased 32 percent. Major reason for the increase in manganiferous ore shipments was the reopening of the Algoma mine. The decrease in iron ore shipments was attributed to the temporary closure of the Rabbit Lake mine early in the shipping season.

Operating companies and mines from which iron and/or manganiferous ores were shipped were as follows:

Company:	*Mines*
The Hanna Mining Co	Algoma and Robert.
Inland Steel Co	Armour No. 2.
Pickands Mather & Co	Rabbit Lake.
Pittsburgh Pacific Co	Hopkins, Mangan No. 1, Sagamore, and Sultana.

The above mines were open pits with the exception of the Armour No. 2 underground mine. About 67 percent of the iron ores shipped was classed as direct shipping; the remainder was concentrate. The Hanna Mining Co. shipped from stockpiles at the Robert mine. The Algoma mine, stripped during the 1964–65 winter season, was Hanna's major producer in the county. The Hanna Mining Co. purchased the Rabbit Lake mine, formerly operated by Pickands Mather & Co., late in 1965 and announced plans to construct a beneficiation plant. The plant was scheduled to be operational during the 1966 shipping season. Pittsburgh Pacific Co. operated the Sagamore mine and shipped Hopkins, Mangan No. 1, and Sultana stockpile concentrates.

Les Roberts Sand, Gravel & Excavating Co., and Ripley Sand & Gravel, Inc., operated fixed sand and gravel plants near Brainerd and produced material for road construction, building, fill, and other uses. C. L. Stodolka Co., Inc., operated a portable plant near Brainerd and produced paving gravel. The county highway department produced and contracted for paving gravel.

Dakota.—Sand and gravel production increased substantially to 2.3 million tons. Output was used for building, road con-

struction, fill, and other uses. Portable plants were operated by Alexander Construction Co., Inc., Bituminous Surface Treating Co., Fischer Construction Co., Inc., Kimmes-Bartelma Construction Co., Inc., Edward Kraemer & Sons, Inc., and Solberg Construction Co. Fischer Sand & Aggregate Co., Inc., Northwestern Gravel Co., Inc., and Standard Building Material Co. operated fixed plants at Rosemont, Savage, and South St. Paul, respectively. The State and county highway departments produced and contracted for sand and gravel for road construction. Edward Kraemer & Sons, Inc., produced crushed limestone for roadstone and agricultural use. Byproduct sulfur was recovered by Great Northern Oil Co. at its Pine Bend refinery.

Faribault.—About 431,000 tons of paving gravel was produced by H. R. Loveall Construction Co. near Winnebago and by contractors for the Faribault County and Winnebago County, Iowa, highway departments. The 10-percent decrease in production was attributed to lack of purchases by the State highway department.

Fillmore.—Iron ore shipments from Fillmore County mines were 556,410 tons, 54 percent greater than in 1964. Virtually the entire output was shipped by rail to consuming furnaces at Granite City, Ill. The Hanna Mining Co. shipped 517,440 tons from its Spring Valley mine group. Schroeder Mining Co. shipped from the Evers, Hilsapple and Van Sande properties.

About 378,000 tons of crushed limestone was produced by six companies operating fixed and portable plants near Harmony, Ostrander, Preston, and Spring Valley. The greater portion of the 59-percent gain in production was due to increased road construction activity. Demand for agricultural limestone also increased.

Approximately 35,000 tons of sand and gravel was produced. Fixed plants were operated by Allen Thompson at Rushford and Bothun & Torgerson Sand & Gravel Co. at Lanesboro. The State highway department produced paving sand and gravel.

Goodhue.—Red Wing Sewer Pipe Corp. produced plastic fire clay to manufacture vitrified sewer pipe. The company operated two pits, Bellchester and North Star, near Goodhue. About 161,000 tons of sand and gravel was produced by nine companies and contractors for the State and county highway departments. The material was used for building, road construction, fill, and other uses. Fixed and portable plants were operated near Cannon Falls, Frontenac, Lake City, Pine Island, Red Wing, and Zumbrota. The sand and gravel operation of Lester W. Cordes near Red Wing was sold to John Savage.

About 213,000 tons of crushed limestone was produced, a 17-percent gain over 1964 figures. Kielmeyer Construction Co. operated a portable plant near Kenyon and produced roadstone. Mann Construction Co. operated portable plants at various locations for road construction material, agricultural limestone, and riprap. Quarve & Anderson Co. and Valley Limestone Co. operated a portable and fixed plant at Goodhue and Zumbrota, respectively, and produced crushed limestone for road construction and agricultural use.

Hennepin.—Total value of mineral production increased 13 percent over that of 1964, primarily because of a 1.4-million-ton increase in sand and gravel production for freeway construction. A total of 5.7 million tons of sand and gravel was produced by 16 companies at fixed and portable plants in various Minneapolis suburban areas. Output was used for road construction, building, fill, and other uses. Commercial operators included Alexander Construction Co., Inc.; Anderson Aggregates, Inc.; Barton Contracting Co. (Commercial Aggregate, Inc.); Consolidated Materials Co. (Hedberg & Sons Co.); J. A. Danens & Son, Inc.; Duininck Bros. & Gilchrist; Chas. M. Friedheim Co.; Glacier Sand & Gravel Co.; Hedberg & Sons Co.; Hopkins Sand & Gravel Co. (Woodrich Construction Co.); Keller Bros. Gravel Co.; Mapco Sand & Gravel Co.; Mound Sand & Gravel Co., Inc.; R. J. Porter, Inc.; Oscar Roberts Co.; and J. L. Shiely Co.

The State and county highway departments produced and/or contracted for sand and gravel for road construction purposes.

Clay was produced by North Central Lightweight Aggregate Co., Inc., and used to make sintered lightweight aggregate.

Exfoliated vermiculite was produced at Minneapolis by B. F. Nelson Manufacturing Co. and Western Mineral Products Co. for crude material mined in Montana. Output was sold for building insulation, plaster and concrete aggregate, litter, fireproofing, acoustical, and other uses. Expanded

perlite was produced by Western Mineral Products Co. and Minnesota Perlite Corp. from crude perlite mined in Nevada and New Mexico. Output was sold for lightweight aggregate in concrete and plaster, filler, soil conditioning, texture paint, and other uses.

Houston.—Hector Construction Co., Inc. operated portable crushing plants at six limestone quarries and produced 65,000 tons of roadstone and agricultural limestone, as well as 3,000 tons of paving sand from a pit near Houston. Crushed limestone for roadstone was produced at three quarries near Hokah, two operated by Botcher Construction Co. and one by Lloyd Debold.

Itasca.—The county mineral output, representing 14 percent of the State total value, decreased 4 percent, primarily because of a decrease in iron ore shipments. The use of taconite pellets and high-grade foreign ores in the steel industry reduced the demand for natural ores. All mines operated were open pits. About 99 percent of the usable iron ore shipments were concentrate. Operating companies and mines from which iron ore was shipped were as follows:

Company:	*Mines*
Cleveland-Cliffs Iron Co	Canisteo, Hawkins, Hill-Trumbull, Holman-Cliffs, and Sally.
The Hanna Mining Co	Harrison group, Hunner, Mississippi group, and Patrick group.
Jones & Laughlin Steel Corp	Hill Annex and Lind-Greenway.
Pickands Mather & Co	Danube and West Hill.
United States Steel Corp	Arcturus and Plummer.

The Hanna Mining Co. was constructing two magnetic taconite plants near Cooley and Keewatin with a combined initial annual capacity of 4.4 million tons of pellets. The National Steel Pellet Co. plant near Keewatin, with annual capacity of 2.4 million tons of pellets, was scheduled for operation in 1967. National Steel Corp. had an 85-percent interest in the project and The Hanna Mining Co. had a 15-percent interest. The 2-million-ton annual capacity Butler Taconite plant under construction at Cooley was scheduled for operation early in 1967. Participating in the project with The Hanna Mining Co. were Inland Steel Corp. and Wheeling Steel Corp. Production will be shared on a percentage of ownership basis. Hanna continued studies of methods of reducing normal iron oxide pellets to the prereduced form as part of a research program conducted jointly with National Steel Corp. and Surface Combustion Division of Midland-Ross Corp.

The Jessie H. Mining Co. operated the Jessie mine. All ore produced was placed in stockpiles. Cleveland-Cliffs Iron Co. depleted stockpiles at the Hawkins mine by the end of the shipping season.

Pacific Isle Mining Co. closed the St. Paul mine. At the end of the shipping season The Hanna Mining Co. discontinued mining operations at the Mississippi group.

About 350,000 tons of sand and gravel was produced. Output was used for road construction, building, and other uses. Commercial plants were operated by Brink Sand & Gravel Co. (formerly Neil Baker Co.) and Hawkinson Construction Co., Inc., at Grand Rapids. The State and county highway departments produced and contracted for sand and gravel for road construction.

Arrowhead Peat Co. produced peat for horticultural use from a bog near Wawina.

Kanabec.—Granite quarried by the Cold Spring Granite Co. at its Mora Gray quarry was processed at the company's Cold Spring plant and sold for architectural and monument purposes. About 969,000 tons of sand and gravel was produced by three commercial producers and two governmental units, operating portable plants near Isle, Mora, and Ogilvie. The material was used chiefly for road construction.

Lac qui Parle.—Bellingham Granite Co. and Dakota Granite Co. quarried granite near Bellingham for monument purposes. Cold Spring Granite Co. quarried granite at its Red quarry near Odessa and shipped rough stone to its Cold Spring plant for processing. Output was for architectural and monument purposes. North Star

Granite Corp. quarried granite near Bellingham. The rough stone was finished at the company's plant at St. Cloud for monument purposes. Northern Quarry Corp. quarried granite at Louisburg for monument purposes.

About 108,000 tons of sand and gravel was produced by Johnson Road Co., Inc., from two pits near Dawson and Montevideo and by W. J. Stolpman at a fixed plant near Rosen. Output was for paving, building, and fill. The State and county highway departments produced and contracted for sand and gravel for road construction purposes.

Lake.—Reserve Mining Co. operated its large taconite plant at Silver Bay and produced a record 10 million tons of iron ore pellets, 4 percent greater than in 1964, from about 29 million tons of crude ore mined at the Peter Mitchell mine at Babbitt, St. Louis County. Reserve constructed a $5 million research laboratory at Silver Bay.

Geologists representing major mining companies were actively investigating the potential of the copper-nickel occurrences in the Duluth Gabbro. This formation along the Kawishiwi River had been explored by the Bureau of Mines in 1951 and in 1953 and the results of the investigation were published.[4]

Two Harbors Aggregate Co. and Ulland Bros., Inc., operated plants at Two Harbors and Isabella, respectively, and produced a total of 15,000 tons of sand and gravel for road construction, building, and fill. The State and county highway departments produced and/or contracted for 170,000 tons of paving sand and gravel.

Le Sueur.—The Babcock Co. produced dimension limestone near Kasota. Principal products were cut stone and stone veneer. A portion of the product was marketed as marble for interior trim and facings. A fire damaged the company's stone sawing building early in May. Ed. Swartout produced limestone for use as roadstone and riprap at a quarry near Kasota.

Approximately 1.1 million tons of sand and gravel was produced. Silica sand was produced near Le Sueur by Gopher State Silica, Inc., and sold for glass manufacture, molding, oil-field fracturing, filler, and building. Sand and gravel for construction purposes was produced near Kasota, Le Center, and Le Sueur by Glander Sand & Gravel Co., Kielmeyer Construction Co., Lundin Construction Co., Inc., and Ed. Swartout. The State and county highway departments produced and/or contracted for sand and gravel for road construction.

Mille Lacs.—Cold Spring Granite Co. quarried granite at its Diamond Grey quarry near Isle. The rough stone was processed at the company's Cold Spring plant. Mille Lacs Sand & Gravel Co. produced 22,000 tons of sand and gravel at a fixed plant at Milaca. Output was used for building and paving. The Isanti County, Mille Lacs County, and the State highway departments produced and/or contracted for 88,000 tons of sand and gravel for road construction.

Mower.—Value of mineral production in Mower County increased 22 percent over that of 1964, chiefly because of increased production of limestone for roadstone and agricultural use. Four companies produced a total of 353,000 tons of limestone. The material was used for roadstone, agricultural purposes, fluxstone, fertilizer, and poultry grit. Operating portable plants were Osmundson Bros. at Le Roy and Grand Meadow and Quarve & Anderson Co. at Lyle. Martin Bustad & Son and Hickok Calcium White Rock Co. operated fixed plants at Austin and Le Roy, respectively.

About 251,000 tons of sand and gravel was produced for road construction, building, and other uses. Five commercial companies operated fixed and portable plants near Adams and Austin. The county highway department contracted for paving gravel.

Nicollet.—Value of mineral production increased 62 percent over that of 1964 principally because of increased production of sand and gravel for county highway construction. Approximately 542,000 tons of sand and gravel was produced. Courtland Ready Mix Co., Hallett Construction Co., and North Star Concrete Co. operated fixed sand and gravel plants at Courtland, St. Peter, and Judson, respectively, and produced material for building and road construction. Paving sand and gravel was

[4] Grosh, W. A., J. W. Pennington, P. A. Wasson, and S. R. B. Cooke. Investigation of Copper-Nickel Mineralization in Kawishiwi River Area, Lake County, Minn. BuMines Rept. of Inv. 5177, 1955, 18 pp.

produced by the State highway department and under contract for the Nicollet and Sibley County highway departments.

New Ulm Quartzite Quarries, Inc., produced crushed quartzite at a fixed plant near New Ulm. Production was sold for concrete aggregate, refractories, poultry grit, riprap, and other uses.

Olmsted.—Value of mineral production decreased 42 percent from that of 1964 chiefly because of lesser quantities of sand and gravel and iron ore produced. Schroeder Mining Co. produced iron ore from the Baker property near Chatfield. Most of the output was shipped by rail to consuming furnaces at Granite City, Ill. A portion was used in cement manufacture. The company's Bernard and Partello properties, from which production was reported in 1964, were inactive. About 365,000 tons of sand and gravel, a decrease of 39 percent from 1964 figures, was produced. The material was used for building, road construction, fill, and other uses. Operating fixed plants at Rochester were Quarve & Anderson Co., Riverside Sand & Gravel Co., and Rochester Sand & Gravel, Inc. The county highway department and city of Rochester contracted for sand and gravel for highway maintenance and construction. Quarve & Anderson Co. operated portable plants at five quarries and produced crushed limestone for roadstone and agricultural use.

Otter Tail.—About 1.3 million tons of sand and gravel was produced for road construction, building, railroad ballast, and other uses. Commercial producers included John Dieseth Co.; Thomas Leo Horstman; K. & G. Aggregates, Inc.; Mark Sand & Gravel Co.; J. D. Nelson Excavating Co.; and Soo Line Railroad Co. Plants were operated near Battle Lake, Bluffton, Fergus Falls, Underwood, and Vergas. The State and county highway departments produced and contracted for paving sand and gravel. Northland Peat Co. produced peat for soil improvement from a bog near Underwood.

Polk.—Value of mineral production decreased 29 percent from that of 1964 because of decreased production of sand and gravel. About 750,000 tons of sand and gravel was produced for road construction, building, railroad ballast, fill, and other uses. Commercial operators included Jay W. Craig Co.; Great Northern Railway Co.; Mahnomen Construction Co.; Northern Sand & Gravel, Inc.; Spring Gravel Co.; Thorson Gravel Co.; and Tuseth Gravel & Construction Co.

The State highway department produced sand and gravel for road construction purposes. The Polk and Red Lake County highway departments contracted for paving gravel. The American Crystal Sugar Co. produced quicklime at Crookston and East Grand Forks, using shaft kilns with coke as fuel. Output was used for sugar refining.

Ramsey.—Approximately 712,000 tons of sand and gravel was produced for building, road construction, and other uses. Arsenal Sand & Gravel Co. and Lange Bros. Building Materials Co. operated fixed plants at New Brighton and St. Paul, respectively. Jay W. Craig operated a portable plant near New Brighton. The State highway department contracted for paving sand and gravel.

The Sebesta Stone Co. quarry in St. Paul was taken for freeway right of way. Twin City Brick Co. produced about 27,000 tons of shale for building brick manufacture. The MacArthur Co. produced exfoliated vermiculite at its St. Paul plant from crude vermiculite mined in Montana. The exfoliated product was sold as building insulation, plaster and concrete aggregate, and steampipe insulation.

Redwood.—About 620,000 tons of sand and gravel, 16 percent more than in 1964, was produced for road construction, building, fill, and other uses. Chapman Sand & Gravel Co. and Walnut Washed Sand & Gravel Co. operated fixed plants at Belview and Walnut Grove, respectively. Duininck Bros. & Gilchrist and Werner & Unzeitig operated portable plants. The Redwood and Yellow Medicine highway departments produced and/or contracted for paving gravel. Johnson Quarry Co. and View Quarry Co. quarried granite near Belview for monuments. Ochs Brick & Tile Co. produced miscellaneous clay near Redwood Falls for processing at its Springfield brick plant.

Renville.—Approximately 390,000 tons of sand and gravel was produced, a 30-percent increase over that of 1964. Commercial producers included Danube Washed Sand & Gravel Co.; Duininck Bros. & Gilchrist; John Enestvedt Gravel Pit; Fairway Construction Co.; Johnson Road Co.,

Inc.; and Morton Aggregates, Inc. Operations were near Danube, Granite Falls, Hector, Morton, and Sacred Heart. Output was used for road construction, building, fill, and other uses. The county highway department produced and contracted for paving gravel.

Cold Spring Granite Co. quarried granite at its Rainbow quarry near Morton for architectural and monument purposes. The rough stone was processed at the company's Cold Spring plant.

Rice.—Limestone was produced by Bryan Rock Products, Inc., B. H. Heselton Co. (formerly Faribault Quarries), and Kielmeyer Construction Co. at portable plants near Northfield, Faribault, and Nerstrand, respectively. The material was used for roadstone, agricultural purposes, and riprap. About 431,000 tons of sand and gravel, a 51-percent decrease from 1964 figures, was produced from operations near Dundas, Faribault, and Northfield. The decrease was attributed to reduced road construction activity. Commercial operators included Charles W. Bickel; Condon Sand & Gravel; Jay W. Craig Co.; Hallett Construction Co.; Kielmeyer Construction Co.; Kimmes-Bartelma Construction Co., Inc.; and Owatonna Aggregates Corp. The Rice County, Waseca County, and State highway departments contracted for paving sand and gravel.

Rock.—Jasper Stone Co. produced grinding pebbles and tube-mill liners from a quartzite quarry near Jasper. Some stone was sold for riprap. About 489,000 tons of sand and gravel was produced in the county. Hallett Construction Co. and Pronk & Son operated fixed plants at Luverne and Leota, respectively. C. H. Hatting Gravel Co., Inc., operated a portable plant near Luverne. Output was used for road construction, building, fill, and other uses. The county highway department contracted for paving gravel.

St. Louis.—The value of St. Louis County mineral production increased 3 percent over that of 1964 and represented about 77 percent of the State total. The principal reason for the gain was a 5-percent increase in shipments of iron ore, which contributed 98 percent of the total county mineral production value. St. Louis County mines shipped 80 percent of the total iron ore shipped from the State. Operating companies shipping iron ore in 1965 were:

	Mines
Mesabi Range:	
The Hanna Mining Co	Agnew No. 2-South Agnew, Douglas, East Alpena, Morton-South Eddy, and Pierce group.
Inland Steel Co	Dean and Itasca.
Jones & Laughlin Steel Corp	Schley group.
Pacific Isle Mining Co	Higgins No. 2.
Pickands Mather & Co	Erie Commercial and Mahoning.
Pittsburgh Pacific Co	Albany Lean-ore Stockpile, Arne, Corsica Lean-ore Stockpile, Leonidas, Lincoln, Minnewas, Nelson, Spruce, South Stevenson, Stevenson Reserve, Susquehanna Lean-ore Stockpile, Wyoming, and Wyoming Annex.
Reserve Mining Co	Peter Mitchell.
Rhude & Fryberger	East Bay, Hull, Security, and Wade.
Snyder Mining Co	Shenango, Wanless, Whiteside, and Woodbridge.
United States Steel Corp	Burt Stockpile No. 41, Kosmerl, Pilotac, Rouchleau group, Sherman group, Spruce Stockpile, and Stephens.
Vermilion Range:	
United States Steel Corp	Pioneer.

The only operating underground mine in the county at the close of the year was the Pioneer mine of United States Steel Corp. at Ely. At yearend, a number of open pit mines were closed, including the Weggum (The Hanna Mining Co.); Bennett Annex (Pickands Mather & Co.); and the Brunt, Iroquois, and Wacootah (Pacific Isle Mining Co.). The Hanna Mining Co. discontinued mining operations at the Morton mine; some ore remained in stockpile at yearend. Leases cancelled at end of season included the Cloquet Lean-ore Stockpile and the Missabe Mountain

mine. Pittsburgh Pacific Co. reopened the Higgins No. 2 and opened a new mine, the Arne, at Aurora. Both mines were natural ore operations.

The United States Steel Corp. 4.5-million-ton taconite plant under construction on the Continental Divide north of Mountain Iron was scheduled for completion in 1967. United States Steel Corp. continued operations at its Pilotac taconite plant near Mountain Iron. Concentrate was shipped to its Extaca plant near Virginia for agglomerating.

The Eveleth Taconite Co., owned by Ford Motor Co. (85 percent) and Oglebay Norton Co. (15 percent), completed construction of its 1.6 million ton annual capacity concentrator. The Fairlane concentrator located 10 miles south of the company's Thunderbird mine received its first crude taconite shipment in November. Pellets were first produced in December and were stockpiled at the Duluth Missabe and Iron Range Railway's new Lakehead bulk storage facility at Duluth for Lake shipment the following season. The Lakehead storage facility was built to provide pellet storage for United States Steel Corp.'s Mountain Iron plant as well as the Fairlane plant. The facility was also designed to discharge and stockpile coal.

A $50 million expansion program at Erie Mining Co.'s taconite plant at Hoyt Lakes was in progress. Annual capacity will be increased 2.8 million tons to 10.3 million tons of pellets. Development work at the new Dunka River taconite mine, which will supplement Erie's crude ore supply, has been completed.

More than 37 percent of the State total iron ore output was taconite concentrate. Erie Mining Co. (Pickands Mather & Co., operating agents) produced a record 8.0 million tons of taconite pellets at its Hoyt Lakes plant. The taconite pellets were hauled 73 miles on the company-owned railroad to Erie's shipping port at Taconite Harbor.

Reserve Mining Co. mined more than 29 million tons of crude taconite at its Peter Mitchell mine near Babbitt. The crude material was crushed to about 3-inch size at the mine site and hauled over an interplant railroad to Silver Bay, Lake County, for processing. Jones & Laughlin Steel Corp. proposed 2-million-ton-per-year taconite pellet plant near Biwabik is in the design stage.

The Hanna Mining Co.'s leading shipper was the Pierce group at Hibbing. The South Agnew and Agnew No. 2 properties were also important producers.

Major producing mines operated by United States Steel Corp., in order of tonnage produced, were the Sherman group, Stephens, Rouchleau group, Pilotac, Pioneer, and Kosmerl. Company production in the county increased 5 percent over that of 1964. Pittsburgh Pacific Co. shipped from 13 properties. Shipments were 57 percent over those of 1964. During the year, Pittsburgh Pacific acquired the Minnewas mine (formerly operated by E. A. Young). Rhude & Fryberger operated the Hull mine (formerly part of United States Steel Corp. famed Hull-Rust group) and shipped from stockpile at the East Bay, Security, and Wade mines.

American Steel and Wire Division of United States Steel Corp. produced basic pig iron and steel at Duluth. During periods of maximum production, two blast furnaces were operated. Nine open hearths were available for steel production. Production increased slightly over that of 1964.

Universal Atlas Cement Division of United States Steel Corp. produced portland and masonry cements at its plant in Duluth. Michigan limestone and blast furnace slag were used in the manufacturing process. The firm was the only cement producer in the State. Cutler-Magner Co. produced quicklime and hydrated lime at Duluth from limestone mined in Michigan. Products were used for paper manufacturing, steelmaking, water purification and softening, and other uses.

Hallett Mineral Co. was formed to process crude bentonite from Montana for use in pelletizing taconite concentrates. The company's plant will be located at Burnett.

Mesabi Grow Co., Inc. (formerly St. Louis County Peat Products Co.) produced peat near Central Lakes and sold it mainly for soil improvement and other horticultural purposes.

Sand and gravel was produced by 13 commercial companies and the State and county highway departments. About 3.1 million tons, a 26-percent increase over 1964 figures, were produced for road construction, building, railroad ballast, and fill.

The Zenith Dredge Co. produced crushed basalt near Duluth for concrete aggregate and roadstone.

Scott.—Approximately 416,000 tons of crushed limestone, about double 1964 production, was produced near Shakopee for roadstone, railroad ballast, asphalt filler, agricultural use, and riprap. Producing companies were Bryan Rock Products, Inc., B & R Rock Products, and J. L. Shiely Co. Sand and gravel production increased substantially to about 441,000 tons. Commercial operators included Belle Plaine Sand & Gravel Co.; Jay W. Craig Co.; Haferman & Stark, Inc.; Hallett Construction Co.; Minnesota Quartz Co.; Shakopee Sand & Gravel Co.; and Wissota Sand & Gravel Co. Plants were operated near Belle Plaine, Chaska, Jordan, New London, and Shakopee. The State and county highway departments produced paving sand and gravel.

Stearns.—Mineral production value dropped 28 percent from that of 1964 primarily because of lesser production of granite for architectural stone. Cold Spring Granite Co. produced granite at six quarries near Cold Spring, Rockville, St. Cloud, and St. Joseph. The rough blocks were processed at the company's finishing plants in St. Cloud and Cold Spring. Some material was crushed at the Cold Spring plant and sold for poultry grit. Delano Granite Works, Inc., operated its Rockville quarry and shipped the rough granite to its plant at Delano for processing. Output was sold for monument and architectural use. North Star Granite Corp. produced granite from the Minnesota Pink and Pioneer Gray quarries near St. Cloud and processed the stone at its St. Cloud finishing plant for use as monuments. Shiely-Petters Crushed Stone Co., Inc., produced crushed granite near Waite Park for use as railroad ballast, roadstone, stone sand, and other uses.

Sand and gravel was produced at fixed plants near St. Cloud and Richmond by A. C. Petters Co., Inc., and Richmond Sand & Gravel Co., respectively. Output was used for building and road construction. The State and county highway departments produced and contracted for paving sand and gravel.

Washington.—About 2.3 million tons of sand and gravel was produced for road construction, building, fill, and other uses. Commercial producers included Alexander Construction Co., Inc.; Cemstone Products Co.; Jay W. Craig Co.; R. J. Jager Gravel Co.; Kimmes-Bartelma Construction Co., Inc.; Carl Olinger; Shalander & Shaleen; and J. L. Shiely Co. The county highway department produced paving sand. Moelter Construction Co., Inc., a producer in 1964, sold its gravel pit to Northern States Power Co.

Limestone for roadstone, agricultural purposes, and riprap was produced by Bryan Rock Products, Inc., at Marine-on-St. Croix, Nienaber Contracting Co. near Lake Elmo, and J. L. Shiely Co. at St. Paul Park.

Winona.—Value of mineral production decreased 18 percent to about $897,000, chiefly because of a lessening of road construction. Dimension limestone was produced by Biesanz Stone Co., Inc., at its Winona quarry, chiefly for architectural use. Crushed limestone for roadstone, agricultural use, and riprap was produced by Lloyd DeBold, Fred Fakler, Hector Construction Co., Inc., Patterson Quarries, Inc., and Quarve & Anderson Co. Quarries were operated near Dresbach, Lewiston, Pickwick, Ridgeway, Rollingstone, St. Charles, Wilson, Winona, and Witoka.

Wright.—Delano Granite Works, Inc., operated a sawing and finishing plant at Delano, processing granite blocks quarried by the company in Big Stone and Stearns Counties. The State and county highway departments produced and/or contracted for 53,000 tons of paving sand and gravel.

Yellow Medicine.—Crushed and broken granite for railroad ballast was produced near Granite Falls by The Green Co. The Signet Quarry Co., inactive since 1963, leased its quarry to the Delano Granite Co. A few test blocks were quarried. About 241,000 tons of sand and gravel for road construction, building, fill, and other uses was produced. Deutz & Crow Co., Inc., operated a fixed plant at Canby. John Dieseth Co., Johnson Road Co., Inc., and Megarry Bros., Inc., operated portable plants near Canby, Clarkfield, and Granite Falls. The State and county highway departments contracted for paving sand and gravel.

The Mineral Industry of Mississippi

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the Mississippi Geological Survey, for collecting information on all minerals except fuels.

By Nicholas A. Kendall [1] and William H. Moore [2]

Mississippi mineral production declined slightly for the second consecutive year. Mineral fuels—petroleum, natural gas, and natural gas liquids—represented 86 percent of the total value.

Construction of the Mississippi Power and Light Co. 550,000-kilowatt Baxter Wilson steam electric station near Vicksburg was 50-percent complete at yearend. When complete in late 1966, it will be one of the largest such generating plants in the world and will cost $43.7 million. The company also announced plans to construct a 750,000-kilowatt, $65 million generating station in Washington County. Mississippi Power Co. announced a $28.6 million expansion program to double the size of its 250,000-kilowatt Jack Watson steam generating electric plant at Gulfport.

The U.S. Army Corps of Engineers planned to construct two pumping stations on the Pearl River as part of an extensive project designed to protect Jackson and Flowood industrial areas from recurring floods. The electrically driven pumps will have a combined capacity of 221,000 gallons per minute. Comprehensive studies initiated in 1963, for the overall development of water resources of the Pearl, Big Black, and Pascagoula River Basins continued. Area IV Mineral Resource Office of the Federal Bureau of Mines was assisting in this work by supplying mineral resource studies of the basins involved.

The State entered the ranks of iron ore producers when shipment of the ore from a pit near Porterville, Kemper County, began in August.

Humble Oil and Refining Co. abandoned its exploratory well in southern Hancock County at a depth of 12,664 feet before

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Table 1.—Mineral production in Mississippi [1]

Mineral	1964 Quantity	1964 Value (thousands)	1965 Quantity	1965 Value (thousands)
Clays ---thousand short tons---	1,331	$6,130	1,502	$5,925
Natural gas ---million cubic feet---	180,428	31,385	166,825	28,861
Natural gas liquids:				
Natural gasoline and cycle products thousand gallons---	27,485	1,644	26,582	1,606
LP gases ---do---	23,277	780	22,150	975
Petroleum (crude) --thousand 42-gallon barrels---	56,777	151,595	56,183	148,437
Sand and gravel ---thousand short tons---	7,825	8,569	8,447	8,717
Stone (includes shell) ---do---	1,553	1,557	[2] 2,357	[2] 2,358
Value of items that cannot be disclosed: Cement, iron ore (1965), lime, magnesium compounds, and stone (dimension sandstone, 1965)	XX	10,533	XX	12,093
Total	XX	212,193	XX	208,972

XX Not applicable.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Excludes certain stones included in "Value of items that cannot be disclosed."

Table 2.—Value of mineral production in constant 1957–59 dollars
(Thousands)

Year	Value
1956	$143,443
1957	144,198
1958	151,715
1959	188,496
1960	198,993
1961	209,037
1962	207,218
1963	r213,711
1964	r207,872
1965	203,689

r Revised.

reaching contract depth of 16,500 feet. The well was to furnish geological information for the Company's 900,000-acre offshore lease, obtained from the State in 1964. A second well was abandoned at a depth of 10,924 feet.

Employment and Injuries.—Overall mineral industry employment decreased 9.5 percent and constituted 1.2 percent of the nonagricultural labor force, according to the Mississippi Employment Security Commission. Employment in petroleum and natural gas industries decreased 9.4 percent and constituted 84 percent of the labor force in mineral industries.

Four men were seriously injured when a high-pressure gasline exploded in northern Leflore County; the line serviced several small communities in the area.

Largely due to the "Balance Agriculture With Industry" program, instituted in 1936 by the late Governor Hugh L. White, balance was achieved in March when approximately 145,000 workers were employed in each category. However, the achievement was not so much the result of an increase in industrial employment (up 85 percent from 79,000 in 1930) as it was due to the drop in agricultural employment (down 74 percent from 557,000 in 1930).

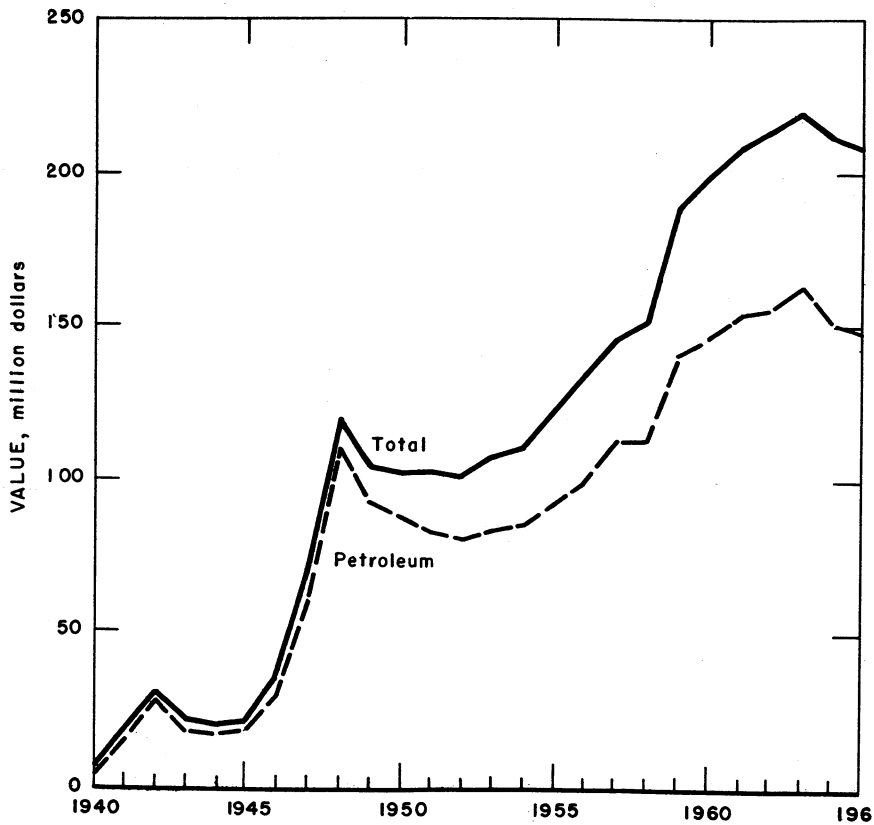

Figure 1.—Value of petroleum and total value of mineral production in Mississippi.

Table 3.—Wage and salaried workers in petroleum production, refining, and related industries

Year	Crude petroleum and natural gas production	Petroleum refining [1]	Pipeline transportation (except natural gas)	Gas utilities	Retail filling stations	Chemicals manufactured as byproducts of petroleum or used in the refining of petroleum [2]
1961	5,330	401	235	2,450	2,698	94
1962	5,232	392	202	2,376	4,850	92
1963	5,548	586	178	2,292	4,900	366
1964	5,300	700	150	2,300	5,250	300
1965	4,800	710	155	2,290	5,300	380

[1] Employment in petroleum refineries and petrochemicals manufactured in petroleum refineries.
[2] Employment in petrochemical manufacturing facilities located outside petroleum refineries.

Source: Mississippi Employment Security Commission.

Table 4.—Employment and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1964:								
Nonmetal	972	255	248	1,986	--	36	18.13	1,225
Sand and gravel	564	257	145	1,261	1	23	19.03	6,982
Stone	522	272	142	1,143	--	12	10.50	202
Total	2,058	260	535	4,390	1	71	16.40	2,613
1965: [p]								
Nonmetal	1,015	260	264	2,108	--	46	21.82	1,129
Sand and gravel	585	257	151	1,313	--	24	18.28	585
Stone	215	298	64	521	--	2	3.84	58
Total	1,815	264	479	3,942	--	72	18.26	806

[p] Preliminary.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Combined value of natural gas, natural gas liquids, and crude petroleum declined for the second year in succession.

Mississippi again ranked ninth among the oil-producing States. The six leading petroleum-producing counties were Pike, Jasper, Adams, Jones, Lincoln, and Lamar, in descending order.

Total drilling activity decreased 3 percent compared with a national decline of 8.4 percent. Average depth of all holes drilled was 7,831 feet, 297 feet less than in 1964; total footage drilled remained unchanged at 5.8 million feet, according to the "Oil and Gas Journal."

Twenty-five new field discoveries were Clifford, Grafton, Bourbon, Robins Bayou, and Springfield in Adams County; Providence, Kirby, Bonus, Leesdale Tower, East Roxie, South Morgan Creek, and Clear Springs in Franklin County; Waveland (gas) in Hancock County; Bay Springs in Jasper County; Choctaw in Jones County; Black Creek (gas) in Perry County; Lorena, Sylvarena, and Wisner in Smith County; Darbun (dual gas) in Walthall County; North Wausau in Wayne County; Sandy Creek, Rosetta, and Stamps in Wilkinson County; and Dorn in Yazoo County.

Mississippi Geological Survey Bulletin 105, "Hinds County, Geology and Mineral Resources," was expected to stimulate mineral activity in the county.

According to the "Mississipi State Oil and Gas Bulletin" as of December 31, 1965, the State had 293 oil pools and 54 gas pools producing in 274 fields; there were 3,524 wells capable of producing, compared with 3,531 wells in 1964.

Table 5.—Oil and gas well drilling and total crew-weeks spent in geophysical oil and gas prospecting in 1965, by counties

County	Drilling						Total	Geophysical (reflection seismograph) crew-weeks
	Proved field wells			Exploratory wells				
	Oil	Gas [1]	Dry	Oil	Gas [1]	Dry		
Adams	28	--	64	5	--	75	172	1
Amite	10	--	9	--	--	10	29	2
Calhoun	--	--	--	--	--	1	1	--
Clarke	--	--	1	--	--	6	7	62
Copiah	--	--	--	--	--	--	--	12
Covington	--	--	--	--	--	--	--	12
Forrest	--	4	3	--	--	--	7	2
Franklin	39	--	63	7	--	61	170	1
George	--	--	--	--	--	--	--	8
Greene	2	--	--	--	--	1	3	62
Hancock	--	1	2	--	1	--	4	--
Harrison	--	--	--	--	--	--	--	15
Hinds	2	--	1	--	--	3	6	9
Holmes	--	--	--	--	--	--	--	9
Humphreys	--	--	--	--	--	--	--	1
Issaquena	--	--	--	--	--	1	1	4
Itawamba	--	--	--	--	--	1	1	--
Jackson	--	--	--	--	--	1	1	14
Jasper	18	--	2	1	--	2	23	102
Jefferson	2	1	8	--	--	23	34	--
Jefferson Davis	--	2	--	--	--	--	2	2
Jones	13	--	8	1	--	3	25	15
Lamar	2	6	1	--	--	--	9	1
Lawrence	--	--	--	--	--	--	--	15
Leake	--	--	--	--	--	--	--	1
Lincoln	2	--	1	--	--	--	3	--
Madison	24	--	5	--	--	17	46	4
Marion	3	3	--	--	--	--	6	5
Monroe	--	1	--	--	--	--	1	4
Neshoba	--	--	--	--	--	1	1	--
Newton	--	--	--	--	--	1	1	3
Oktibbeha	--	--	--	--	--	1	1	--
Pearl River	--	1	--	--	--	2	3	1
Perry	--	--	--	--	1	--	1	16
Pike	6	1	3	--	--	7	17	--
Rankin	5	--	4	--	--	8	17	22
Scott	--	--	--	--	--	1	1	47
Sharkey	--	--	2	--	--	1	3	8
Simpson	5	--	1	--	--	3	9	22
Smith	1	--	2	3	--	7	13	97
Stone	--	--	--	--	--	--	--	20
Tishomingo	--	--	--	--	--	2	2	--
Walthall	2	--	7	--	1	4	14	9
Warren	--	1	--	--	--	--	1	--
Wayne	14	--	11	1	--	17	43	40
Wilkinson	21	--	28	3	--	48	100	--
Yazoo	2	--	5	1	--	7	15	18
Total:								
1965	201	21	231	22	3	315	793	666
1964	216	27	202	19	1	354	819	1,123

[1] Includes condensate.

Table 6.—Estimated proved recoverable reserves of crude oil, natural gas liquids, and natural gas

	Proved reserves, Dec. 31, 1964	Changes in proved reserves, owing to extensions and new discoveries in 1965	Proved reserves Dec. 31, 1965 (production was deducted)	Change from 1964 (percent)
Crude oil ----------thousand barrels---	356,567	57,896	359,756	+1
Natural gas liquids [1] ----------do---	32,875	—3,593	27,014	—18
Natural gas -------million cubic feet---	2,355,764	—198,653	1,973,447	—16

[1] Includes condensate, natural gasoline, and LP gases.

Source: American Gas Association, American Petroleum Institute, and Canadian Petroleum Association. Proved Reserves of Crude Oil, Natural Gas Liquids, and Natural Gas. V. 20, Dec. 31, 1965, pp. 12, 13, 24.

Natural Gas.—Five counties—Jefferson Davis, Forrest, Marion, Walthall, and Pearl River, supplied 82 percent of the State's natural gas production.

Reserves dropped 382,317 million cubic feet and represented 0.7 percent of the national reserves (0.8 percent in 1964). Ratio of reserves to yearly production was 11:1 (13:1 in 1964 and 14:1 in 1963).

Three new gasfields were discovered, Waveland in Hancock County, Black Creek in Perry County, and Darbun in Walthall County, a dual completion.

Table. 7.—Marketed production of natural gas [1]

Year	Million cubic feet	Value (thousands)
1956–60 (average)	169,964	$23,092
1961	172,543	32,093
1962	170,271	32,351
1963	176,807	31,825
1964	180,428	31,385
1965	166,825	28,861

[1] Comprises gas either sold or consumed by producers, including losses in transmission, amounts added to storage, and increases in gas pipelines.

Mississippi Valley Gas Co. had a working storage capacity of 707 million cubic feet of gas in the Amory field of Monroe County; United Gas Pipe Line Co. controlled 4,906 million cubic feet of storage capacity in formations of the Jackson Dome, Rankin and Hinds Counties. At yearend, the State gas storage capacity totaled 5,613 million cubic feet.

Natural Gas Liquids.—Reserves of natural gas liquids in Mississippi dropped 5,861,000 barrels, according to the American Gas Association, and constituted 0.3 percent of the national reserves, compared with 0.4 percent in 1964. Ratio of reserves to yearly production dropped from 27:1 in 1964 to 23:1.

Skelly Oil Co. planned to build a gas-processing facility in the new Bay Springs field in Jasper County. Initial input capacity will be 5 million cubic feet per day; initial output will be 550 barrels per day of propane and depropanized natural gasoline.

Total capacity of the State's natural gas processing and cycling plants remained 432.2 million cubic feet per day, according to the "Oil and Gas Journal."

According to the "Oil and Gas Journal," solution caverns in a Forrest County salt dome contained the following fuels as of October 1965: propane 986,000 barrels; butane 300,000 barrels; and LP gases 1,795,000 barrels.

Petroleum.—Production of crude oil decreased slightly in volume and value. Pike, Jasper, Adams, Jones, Lincoln, and Lamar Counties supplied about 58 percent of the State's crude oil production.

Discovery of 22 oilfields constituted a record high. Bay Springs in Jasper County was the most significant discovery in many years. The field was opened in January when the discovery well was completed in an 80-foot-thick producing section of the Cotton Valley formation of Jurassic Age below 14,500 feet, flowing 648 barrels per day after testing 100 barrels per day in the Smackover formation below 16,100 feet. At yearend, the field had produced nearly 1 million barrels of 48° API gravity oil from 17 wells. One well was found dry, and defined the west limits of the field. Development of the field continued on 80-acre-per-well spacing, with allowable set by the Mississippi State Oil and Gas Board at 500 barrels per day per well.

Table 8.—Natural gas liquids production
(Thousand gallons and thousand dollars)

Year	Natural gasoline and cycle products		LP gases		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
1956–60 (average)	24,515	$1,585	9,648	$517	34,163	$2,102
1961	25,135	1,625	15,510	700	40,645	2,325
1962	25,891	1,616	20,401	732	46,292	2,348
1963	28,757	1,755	24,541	956	53,298	2,711
1964	27,485	1,644	23,277	780	50,762	2,424
1965	26,582	1,606	22,150	975	48,732	2,581

Table 9.—Crude petroleum production
(Thousand 42-gallon barrels and thousand dollars)

Year	Production	Value
1956-60 (average)	44,110	$122,688
1961	54,688	154,220
1962	55,713	154,882
1963	58,619	161,788
1964	56,777	151,595
1965	56,183	148,437

Search accelerated to extend the Smackover Lime production trend, initiated by discovery of Bienville Forest field in Smith County in 1963 and confirmed by discovery of Barber Creek field in Scott County in 1964. At yearend, 21 exploratory wells had been or were being drilled. The wells were in Sharkey County in the northwest, and in Yazoo, Madison, Rankin, Newton, Simpson, Smith, Jasper, Jones, Wayne, Perry, and Greene Counties in the southeast. Depth ranged from 15,600 feet to 20,970 feet, the latter a new Mississippi depth record attained by a well in Greene County. The deep well penetrated the Smackover Lime, found it nonproductive, and bottomed in salt. The result of this drilling campaign in 1965 was one oilfield, Sylvarena field in Smith County; one oil pool, in the old Pool Creek field in Jones

Table 10.—Crude petroleum production, indicated demand, and stocks in 1965, by months
(Thousand 42-gallon barrels)

Month	Production	Indicated demand	Stocks originating in Mississippi
January	4,762	4,545	2,827
February	4,555	4,520	2,862
March	4,716	5,337	2,241
April	4,569	3,859	2,951
May	4,680	4,902	2,729
June	4,533	4,364	2,898
July	4,693	4,636	2,955
August	4,711	5,255	2,411
September	4,505	4,246	2,670
October	5,034	4,924	2,780
November	4,605	4,902	2,483
December	4,820	4,779	2,435
Total:			
1965	56,183	56,269	XX
1964	56,777	56,518	XX

XX Not applicable.

Table 11.—Crude petroleum production by fields [1]
(Thousand 42-gallon barrels)

Field	1961	1962	1963	1964	1965
Baxterville	5,949	5,808	5,823	5,822	5,592
Bay Springs	----	----	----	----	970
Bolton	1,136	1,127	1,256	1,190	906
Brookhaven	1,571	1,498	1,545	1,456	1,299
Bryan	3,391	2,068	2,017	1,773	1,312
Cranfield	901	905	863	513	253
Dexter	(2)	(2)	(2)	1,566	1,174
Diamond	924	751	640	571	536
Eucutta	1,261	1,151	1,088	1,232	1,050
Heidelberg	3,974	3,737	3,620	3,491	3,904
La Grange, N & S	1,471	1,322	1,234	1,236	1,245
Little Creek	6,431	5,384	6,107	5,589	4,137
McComb	2,949	4,383	4,482	4,379	3,837
Pistol Ridge Maxie	651	736	762	658	477
Pool Creek	(2)	(2)	(2)	(2)	1,055
Raleigh	1,820	1,392	1,573	1,511	1,304
Smithdale	(2)	(2)	(2)	1,019	1,155
Soso	3,418	2,998	2,643	2,380	2,070
Summerland	(2)	(2)	(2)	(2)	1,096
Tinsley	2,991	2,835	2,855	2,650	2,447
Yellow Creek, N & W	1,222	1,492	1,409	1,276	1,191
Other fields [3]	14,628	18,126	20,702	18,465	19,173
Total	54,688	55,713	58,619	56,777	56,183

[1] Based on "Oil and Gas Journal" data adjusted to Bureau of Mines total.
[2] Included with "Other fields."
[3] Bureau of Mines data.

County; and two distillate wells, producing gas with high hydrogen sulfide content. (See subsequent discussion of "Sulfur".) One of the distillate wells was the discovery well of the Black Creek field in Perry County producing from two intervals between 19,768 feet and 20,138 feet; the other distillate well, in Rankin County, was still in the process of completion.

Reserves of crude oil in Mississippi gained 3,189,000 barrels, according to the American Petroleum Institute; this constituted 1.1 percent of the national reserves, compared with 1.2 percent in 1964. Ratio of reserves to yearly production increased slightly from 6.3:1 in 1964 to 6.4:1 in 1965.

In 1965, the National Stripper Well Association classified 226 wells as stripper wells in 1964. The wells represented 6 percent of the producing oil wells and 1.6 percent of the State's 1964 reserves.

Four of the State's five plants refined 16.7 percent of the annual crude oil production and increased their capacity slightly to 34,500 barrels per stream day. The fifth plant, the Standard Oil Co. of Kentucky refinery at Pascagoula, processed Louisiana crude oil exclusively and increased its capacity to 130,000 barrels per stream day.

In July, Lamar Refining Co., Inc., opened its new 2,000-barrel-per-day refinery near Lumberton, Lamar County. The plant has an anticipated annual payroll of $300,000 and will employ between 30 and 60 persons.

Secondary recovery operations, utilizing new methods, expanded in older fields. Steam and carbon dioxide generators were used in low-gravity crude oilfields in the eastern part of the State. Pilot projects using steam were completed in Eucutta and Junction City fields; results were under study by the operators. Waterflood operations for secondary recovery were underway in a segment of Tinsley field in Yazoo County. This field, Mississippi's first oilfield, has produced over 170 million barrels of oil since its discovery in 1939. Waterflood operations in the McComb and Little Creek fields, at approximately 11,000 feet, are among the deepest in the Nation.

Petrochemicals.—Construction of the Coastal Chemical Corp. 1,000-ton-per-day single-train ammonia plant near Yazoo City was nearing completion. Standard Oil Co. of Kentucky started constructing two plants at the site of its refinery at Pascagoula. The first is a single-train, $22 million ammonia fertilizer plant with a scheduled capacity of 1,500 tons of anhydrous ammonia per day, reported largest in the world. Completion was scheduled for early 1967. Input will be natural gas from the Standard Oil Co. of California Main Pass Block 41 field in Chandeleur Sound, delivered to the refinery through the Chandeleur Pipe Line Co. 12-inch, 72-mile line completed last year. The pipeline, with a capacity of 30 million cubic feet per day, was originally designed to supply only fuel to the refinery. The second plant is a $30 million aromatics plant to produce paraxylene, a raw material used in producing polyester fiber and film. Completion was scheduled for mid-1967. Included in the projects are extensive marine shipping facilities to be located in the Bayou Casotte harbor.

In May, Reichhold Chemicals, Inc., began operating its $3 million plant on the Harrison County Development Commission Seaway near Gulfport. The facility produced synthetic resins from natural gas and petroleum for floor covering and rubber compounds and employed 150 persons.

American Potash and Chemical Co. started constructing a $1 million plant at its chemical complex near Hamilton for the manufacture of parathion, used in boll weevil insecticide. The process used methanol and other chemicals as a base.

NONMETALS

Cement.—Production of portland cement decreased 6 percent; output of masonry cement increased 12 percent.

In July, the Greenville plant of the U.S. Army Corps of Engineers produced its millionth concrete revetment block since production started in 1955. These blocks, measuring 25 feet long, 4 feet wide, and 3 inches thick, were used by the Army Engineers to cover the underwater portion of

Table 12.—Shipments of portland cement to Mississippi consumers

Year	Thousand barrels
1956–60 (average)	2,668
1961	3,603
1962	3,704
1963	3,999
1964	4,108
1965	4,212

the Mississippi River banks to prevent erosion and stabilize the position of the channel.

The Mississippi State Highway Commission, in a feasibility report made by a firm of commissioned consultants on development of offshore islands, received a recommendation to build a 13-mile causeway linking Gulfport with Ship Island at a cost of $17 million. The short-range project, to be completed in 1971, would later be implemented by a long-range program, linking Ship Island with Cat Island to the west, and Horn, Petit Bois, and Dauphin Island to the east at an estimated additional cost of $44 million.

Clays.—Clay production was 13 percent over that of 1964, establishing a record for the sixth consecutive year. Gains were reported in quantities of miscellaneous clay, fuller's earth, and bentonite sold or used. Total tonnage of miscellaneous clay, used for manufacturing heavy clay products and lightweight aggregate, increased 19 percent and constituted 61 percent of the State's clay production. Bentonite production rose 4 percent over that of 1964. Fire clay production decreased 1 percent. Ball clay was produced in Panola County.

Magnesium Compounds.—Production of magnesium compounds increased 10 percent over that of 1964. Magnesium-bearing lime, made from dolomite mined in Alabama, was used in the process.

Perlite.—Johns Manville Perlite Co., Adams County, reported production of expanded perlite.

Salt.—On October 22, 1964, the Atomic Energy Commission detonated a 5-kiloton nuclear device in Tatum Salt Dome near Baxterville as part of its Project Dribble. Two holes were drilled through the 110-foot-diameter cavity into the formation below to collect debris samples for radio-chemical yield determination, to obtain gas samples for chemical and radio-chemical analysis, to measure cavity volume, shape and temperature, and to permit down-hole logging and television study to determine extent of crushing and plastic deformation of the salt in the detonation area. Elaborate equipment, consisting of air compressors, scrubbers, and filters, was installed to purge the cavity of radioactive gases, so the effluent could be released to the atmosphere under controlled conditions. At yearend, the project was on a standby-ready status for future detonation of a 100-ton nuclear device in the cavity of the dome and of another 100-ton nuclear device in a tamped implacement 2,000 feet below the earth's surface.

By October, the U.S. Government had paid $368,000 to settle 870 formal claims for inflicted damage. Other suits for damage were still pending in Federal Court.

Sand and Gravel.—Sand and gravel output increased in volume and value. Production was reported from 22 of the State's 82 counties. Leading producers follow in order of value: Forrest, De Soto, Washington, Adams, and Copiah Counties. These five counties produced 37 percent of the tonnage and 41 percent of the value.

Stone and Shell.—Offshore recovery of oyster and clam shell in Harrison County was 3.5 times the tonnage and value of 1964, owing to year-round operation of the dredge. Stone production increased in volume and value.

Sulfur.—Value and quantity of sulfur recovered in 1965 were essentially unchanged from 1964.

In September, National Sulphur Co. placed its Loring sulfur and distillate recovery plant onstream in Madison County.

Table 13.—Clays sold or used by producers, by kinds
(Thousand short tons and thousand dollars)

Year	Bentonite		Ball clay, fire clay, and fuller's earth		Miscellaneous clay		Total	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1956–60 (average)	211	$2,441	120	$1,058	383	$384	714	$3,883
1961	228	2,836	226	1,547	650	651	1,104	5,034
1962	276	3,429	207	1,666	646	647	1,129	5,742
1963	280	3,480	230	1,761	725	727	1,235	5,968
1964	270	3,352	286	2,003	775	775	1,331	6,130
1965	280	3,477	299	1,498	923	950	1,502	5,925

Table 14.—Sand and gravel sold or used by producers
(Thousand short tons and thousand dollars)

Year	Commercial		Government-and-contractor		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
1956–60 (average)	5,616	$5,269	531	$450	6,147	$5,719
1961	5,536	5,314	384	589	5,920	5,903
1962	6,394	6,336	607	926	7,001	7,262
1963	6,306	6,266	519	790	6,825	7,056
1964	7,479	7,871	346	698	7,825	8,569
1965	7,192	7,785	1,255	932	8,447	8,717

Table 15.—Sand and gravel sold or used by producers, by classes of operations and uses
(Thousand short tons and thousand dollars)

Class of operation and use	1964		1965	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	1,015	$863	889	$783
Paving	1,109	958	1,245	1,094
Other [1]	144	222	201	275
Total	2,268	2,043	2,335	2,152
Gravel:				
Building	1,787	2,007	1,272	1,456
Paving	3,187	3,519	3,130	3,721
Railroad ballast	33	17	36	13
Other [2]	204	285	419	443
Total	5,211	5,828	4,857	5,633
Total sand and gravel	7,479	7,871	7,192	7,785
Government-and-contractor operations:				
Sand:				
Building	----	----	7	7
Paving	153	294	35	10
Fill	10	7	999	426
Gravel:				
Paving	175	389	27	10
Fill	----	----	187	479
Other	8	8	----	----
Total sand and gravel	346	698	1,255	932
Grand total	7,825	8,569	8,447	8,717

[1] Includes fill, other, and industrial sand.
[2] Includes fill, other, and miscellaneous gravel.

The facility, designed to produce 12 long tons of elemental sulfur per day, processes sour Smackover gas from two wells as feedstock.

A substantial quantity of sulfur may be recovered from a Perry County well in which Phillips Petroleum Co. found gas with very high hydrogen sulfide content at 19,768 feet in the Smackover Lime. Special completion equipment had to be designed and installed to alleviate corrosiveness of the sour gas. Tidewater Oil Co. encountered similar problems in a Smackover well in Rankin County. At yearend, both wells were being completed.

METALS

Iron Ore.—In August, Magnolia Mining Co. began shipping iron ore from its open pit near Porterville, Kemper County. The ore contains 49 to 53 percent metallic iron and was shipped by rail to a mill near Birmingham, Ala.

Titanium Dioxide.—The $13.5 million titanium dioxide plant at Hamilton, Monroe County, owned by American Potash and Chemical Corp., began production in October. The plant processed Australian rutile ore and had a capacity of 25,000 tons per year.

REVIEW BY COUNTIES

Only counties with significant mineral production are discussed in the following section. Additional details are presented in table 16.

Adams.—The county again led the State in oil-well-drilling activity. Five new oilfields, Clifford, Grafton, Bourbon, Robins Bayou, and Springfield, were discovered as the result of 80 exploratory wells. Development drilling added 28 oil wells to existing fields. The county ranked second in total value of minerals and natural gas liquids produced, third in petroleum output, and accounted for 10 percent of the State petroleum production and about three-quarters of its regenerated lime output. Production of expanded perlite was reported by Johns Manville Perlite Co.

Forrest.—The county led the State in sand and gravel production, ranked second in natural gas output, producing about 16 percent of the State's natural gas, and ranked third in natural gas liquids production.

Franklin.—Exploratory drilling of 68 wells resulted in discovery of 7 oilfields: Providence, Kirby, Bonus, Leesdale Tower, East Roxie, South Morgan Creek, and Clear Springs. The county again ranked second in oil well drilling activity, adding 39 oil wells to existing fields.

Harrison.—Jahncke Service, Inc., continued dredging oyster and clam shell in Mississippi Sound, more than tripling its 1964 output.

Hinds.—The county retained its lead in quantity and value of miscellaneous clay mined and used for manufacturing lightweight aggregate, face brick, and other clay products.

Jackson.—The county led the State in value of total lime and magnesium compounds produced.

Jasper.—The Bay Springs oilfield, discovered in January, had produced nearly 1 million barrels of oil by yearend, boosting the county to second place in the State in oil production and to third place in value of minerals produced. Of 18 productive development wells drilled in the county, 16 were in this field.

Jones.—Exploratory drilling resulted in discovery of the Choctaw oilfield and two new prolific Smackover Lime producers in the 6-year-old Pool Creek field, previously only producing from shallower horizons. The county again ranked fourth in value of petroleum and total minerals produced, accounting for 8 percent of the State's petroleum production. Development drilling resulted in 13 new oil wells in existing fields.

Kemper.—Magnolia Mining Co. in August started shipping iron ore from open pits near Porterville to a Birmingham, Ala., mill.

Lamar.—Development drilling added two oil wells and six gas wells to existing fields. Mississippi Gulf Refining Co.'s Black Creek refinery near Purvis furnished fluid coke to Kaiser Aluminum Co.'s adjoining calcining plant for use as electrodes in that company's alumina reduction plants.

Marion.—The county, third in natural gas production, produced 14 percent of the State total. Three oil wells and three gas wells were added to existing fields.

Marshall.—Holly Springs Brick and Tile Co. and Southern Brick and Tile Co. mined fire clay and miscellaneous clay from open pits to make building brick.

Monroe.—The county retained its lead in value of clay production, accounting for 36 percent of the State total. Bentonite was mined from open pits and processed for mold making, absorbing, filtering, and decolorizing.

Perry.—Phillips Petroleum Co. discovered the Black Creek gasfield, producing from two intervals between 19,768 feet and 20,138 feet in the Smackover Lime. Inasmuch as the gas contained more than 75 percent hydrogen sulfide, large quantities of sulfur will be recovered after successful completion of the discovery well.

Pike.—The county led in total value of minerals, petroleum, and natural gas liquids, accounting for 10, 14, and 52 percent, respectively, of the State total. Development drilling resulted in six new oil wells and one gas well in existing fields.

Rankin.—The county led in production of crushed marl and limestone used for manufacturing cement. Development drilling resulted in the addition of five oil wells in existing fields. Marquette Cement Manufacturing Co., one of the State's two cement plants, produced portland and masonry cement at Brandon.

Table 16.—Value of mineral production in Mississippi, by counties [1]

County	1964 [r]	1965	Minerals produced in 1965, in order of value
Adams	$19,059,576	$17,695,867	Petroleum, natural gas, sand and gravel, natural gas liquids.
Alcorn	W	W	Clays.
Amite	4,585,763	4,638,111	Petroleum, natural gas.
Attala	W	286,442	Clays.
Bolivar	73,000	103,000	Sand and gravel.
Carroll	W	W	Sand and gravel, clays.
Chickasaw	16,240	11,222	Natural gas.
Claiborne	15,908	12,055	Do.
Clarke	1,107,956	978,828	Petroleum, natural gas.
Clay	436,288	382,071	Natural gas, sand and gravel, petroleum, natural gas liquids.
Copiah	1,296,000	W	Sand and gravel.
Covington	1,087,442	847,087	Petroleum, natural gas.
De Soto	W	W	Sand and gravel.
Forrest	8,542,157	7,318,841	Natural gas, petroleum, sand and gravel, natural gas liquids, clays.
Franklin	5,754,815	8,714,926	Petroleum, natural gas.
Greene	205,351	273,026	Do.
Grenada	----------	W	Sand and gravel.
Hancock	181,503	123,340	Petroleum, natural gas.
Harrison	W	W	Shell, sand and gravel.
Hinds	3,657,395	3,260,600	Petroleum, clays, sand and gravel, natural gas.
Holmes	W	W	Sand and gravel.
Itawamba	581,081	W	Clays, natural gas.
Jackson	W	W	Lime, magnesium compounds.
Jasper	12,756,236	16,799,420	Petroleum, natural gas.
Jefferson	3,015,363	3,013,897	Do.
Jefferson Davis	5,985,075	11,862,463	Natural gas, petroleum.
Jones	14,933,843	12,852,939	Petroleum, natural gas, natural gas liquids, clays.
Kemper	----------	W	Iron ore.
Lamar	12,219,994	11,470,841	Petroleum, natural gas.
Lauderdale	78,829	111,953	Clays.
Lawrence	2,243	1,298	Petroleum, natural gas.
Lee	W	W	Clays.
Leflore	W	----------	
Lincoln	14,493,220	11,425,508	Petroleum, natural gas liquids, natural gas, clays.
Lowndes	339,250	289,200	Sand and gravel, clays.
Madison	552,682	1,507,842	Petroleum, natural gas liquids, natural gas.
Marion	7,545,053	7,156,260	Natural gas, petroleum, natural gas liquids, sand and gravel.
Marshall	W	W	Clays.
Monroe	2,870,700	2,932,362	Clays, natural gas, sand and gravel, petroleum.
Noxubee	W	W	Clays.
Panola	W	W	Do.
Pearl River	3,290,887	2,227,643	Natural gas, petroleum, sand and gravel, clays.
Perry	339,056	W	Sand and gravel, petroleum.
Pike	26,726,649	22,133,100	Petroleum, natural gas liquids, natural gas.
Pontotoc	7,000	W	Clays.
Prentiss	5,125	7,500	Do.
Rankin	6,532,290	6,461,323	Cement, petroleum, stone, natural gas.
Scott	68,829	90,049	Petroleum, natural gas.
Simpson	3,429,533	3,144,180	Do.
Smith	9,435,292	8,400,670	Petroleum, clays, natural gas, stone, sand and gravel.
Stone	W	W	Sand and gravel.
Sunflower	W	W	Clays.
Tippah	W	W	Do.
Tishomingo	W	W	Sand and gravel, stone.
Walthall	7,281,675	6,280,588	Petroleum, natural gas.
Warren	W	W	Cement, stone.
Washington	W	W	Sand and gravel.
Wayne	9,531,232	9,901,136	Petroleum, natural gas.
Wilkinson	2,765,997	3,670,562	Do.
Yalobusha	W	W	Sand and gravel.
Yazoo	8,287,276	7,349,757	Petroleum, sand and gravel, natural gas.
Undistributed	13,099,196	15,236,093	
Total	212,193,000	208,972,000	

[r] Revised.

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] The following counties were not listed because no production was reported: Benton, Calhoun, Choctaw, Coahoma, George, Humphreys, Issaquena, Lafayette, Leake, Montgomery, Neshoba, Newton, Oktibbeha, Quitman, Sharkey, Tallahatchie, Tate, Tunica, Union, Webster, and Winston.

Smith.—Exploratory drilling resulted in the discovery of the Lorena, Wisner, and Sylvarena oilfields, the latter producing from the Smackover Lime below 16,000 feet. Development drilling added five new oil wells to existing fields. The county ranked third in production of crushed limestone, used for agricultural purposes.

Walthall.—Drilling of five exploratory wells resulted in the discovery of the Darbun gasfield with two producing zones. Two new oil wells were added to existing fields.

Warren.—The county produced crushed marl and limestone for manufacturing cement. Mississippi Valley Portland Cement Co., one of the State's two cement plants, produced portland and masonry cement.

Wayne.—Drilling of 18 exploratory wells resulted in discovery of North Wausau oilfield. Development drilling added 14 new oil wells to existing fields.

Wilkinson.—The county again ranked third in total drilling activity; drilling of 51 exploratory wells led to discovery of Sandy Creek, Rosetta, and Stamps oilfields. Development drilling added 21 new oil wells to existing fields.

Yazoo.—Drilling of eight exploratory wells led to discovery of Dorn oilfield; two oil wells were added to existing fields.

The Mineral Industry of Missouri

This chapter has been prepared under a cooperative agreement between the Bureau of Bureau of Mines, U.S. Department of the Interior, and the Division of Geological Survey and Water Resources, Department of Business and Administration of Missouri, for collecting information on all minerals except fuels.

By Andrew Kuklis [1] and William C. Hayes [2]

The mineral production value of Missouri reached an alltime high of $225.6 million, an increase of $36.3 million over that of 1964. Nonmetals, with 62.5 percent of the total value, dominated the mineral industry, but for the second consecutive year, production value of metals gained due to full scale operation of the Meramec Mining Co. Pea Ridge iron mine and the three St. Joseph lead mines that supply the Viburnum mill. Principal minerals produced, listed in order of value, were stone, cement, lead, iron, lime, and coal.

Employment.—According to the Division of Employment Security, the mineral industry employed 8,121 workers in 1965, an increase of about 3 percent over that of 1964. Employment in the metal mining

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Table 1.—Mineral production in Missouri [1]

Mineral	1964 Quantity	1964 Value (thousands)	1965 Quantity	1965 Value (thousands)
Asphalt (native)—short tons	1,522	$13	W	W
Barite—do	266,814	3,451	328,585	$4,219
Cement:				
Portland—thousand 376-pound barrels	12,378	42,618	13,334	46,034
Masonry—thousand 280-pound barrels	334	1,046	377	1,173
Clays—thousand short tons	1,966	4,874	2,226	5,439
Coal (bituminous)—do	3,254	13,285	3,564	14,779
Copper (recoverable content of ores, etc.) short tons	2,059	1,343	2,331	1,650
Iron ore (usable)—thousand long tons gross weight	1,116	14,907	1,784	24,607
Lead (recoverable content of ores, etc.)—short tons	120,148	31,479	133,521	41,659
Lime—thousand short tons	1,219	14,328	1,442	16,782
Natural gas—million cubic feet	107	26	84	21
Petroleum (crude)—thousand 42-gallon barrels	65	163	73	184
Sand and gravel—thousand short tons	11,483	13,380	12,068	13,735
Silver (recoverable content of ores, etc.) thousand troy ounces	-	-	300	387
Stone—thousand short tons	31,487	47,984	36,247	53,574
Zinc (recoverable content of ores, etc.)—short tons	1,501	408	4,312	1,259
Value of items that cannot be disclosed: Asphalt (1965) and tripoli	XX	-	XX	66
Total	XX	189,305	XX	225,568

W Withheld to avoid disclosing individual company confidential data; included in total.
XX Not applicable.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Value of mineral production in constant 1957–59 dollars

(Thousands)

Year	Value
1956	$157,121
1957	158,710
1958	153,991
1959	158,976
1960	159,148
1961	151,214
1962	154,008
1963	r 161,147
1964	r 186,800
1965	217,353

r Revised.

segment of the mineral industry increased from 2,852 to 2,984 workers. This increase was due to the new iron and lead mines in southeast Missouri. Despite increased production, the coal mining industry reported a decrease of 39 workers in 1965 from the 705 employed in 1964.

A wage agreement affecting about 1,300 employees at the Bonne Terre, Flat River, Viburnum, Indian Creek, and Fletcher mines and processing facilities was negotiated between Local 6242 AFL-CIO and St. Joseph Lead Co. The agreement extended the existing contract to April 1, 1968, and included an increase totaling 40 cents per hour in wages and fringe benefits. Under the new contract, the minimum daily wage scale was increased from $13.38 to $14.96 and the maximum scale from $17.46 to $20.56.

Exploration.—Extensive exploratory drilling projects in conjunction with aeromagnetic mapping conducted over the past 20 years at a cost of over $50 million have resulted in discovery of vast base-metal resources in southeast Missouri. The ore-bearing rock ranges in depth from 800 to 3,000 feet, hence necessitating the large expenditures of capital. Significant mineral deposits which have been found and are now in various stages of development will assure continued growth of the mineral industry in the State. The Viburnum trend, situated along the western edge of the St. Francois Mountains, has an estimated potential of 1 billion tons of lead ores containing 20 to 30 million tons of recoverable lead metal. Lesser amounts of cadmium, copper, silver, and zinc are associated with the lead ores and will be recovered in the milling and smelting process. Iron ore discoveries also have been large, totaling more than ½ billion tons in several deposits. Though prospecting campaigns for iron were not as intensive as for lead ores, deposits of significant size were found at Pea Ridge, Pilot Knob, Bourbon, Kratz Springs, Boss and Camel's Hump. Much of the lead and iron ore reserves are on National Forest lands and, as a consequence, will return millions of dollars in royalty to the Federal Government, and southeast Missouri counties in the Clark National Forest.

According to yearend data, pertaining

Table 3.—Employment and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1964:								
Coal	458	238	109	823	------	23	27.93	889
Metal	2,364	261	616	4,936	5	250	51.66	8,026
Nonmetal and natural asphalt	993	232	230	1,854	1	55	30.20	3,972
Sand and gravel	806	233	188	1,532	1	29	19.58	4,423
Stone	4,196	268	1,124	9,137	3	153	17.07	2,347
Total	8,817	257	2,267	18,282	10	510	28.44	4,153
1965: p								
Coal	440	248	109	836	------	26	31.10	995
Metal	2,415	268	647	5,189	2	254	49.34	3,821
Nonmetal and natural asphalt	1,138	232	264	2,120	------	67	31.60	539
Sand and gravel	860	242	208	1,695	------	24	14.16	3,894
Stone	4,790	261	1,251	10,143	1	199	19.72	1,181
Total	9,643	257	2,479	19,983	3	570	28.67	2,021

p Preliminary.

Table 4.—Exploratory drilling in Missouri
(Linear feet)

Year	Churn	Rotary	Diamond
1959	218,482	--------	617,800
1960	268,819	15,871	451,295
1961	153,555	2,791	600,641
1962–63	73,120	8,549	188,120
1964	148,098	34,136	289,225
1965	111,786	5,324	188,071

to Clark National Forest, 81 prospecting permits covering 82,772 acres and 25 mineral leases covering 25,661 acres had been issued. Compared with 1964, acreages under prospecting permits and mineral leases increased 55 and 25 percent, respectively.

Drilling projects in 1965 generally were confined to known mineral deposits to secure mining and metallurgical data on the ore.

In 1965, 12 mining companies reported drilling 305,181 feet, of which 188,071 feet were diamond drilled, 111,786 feet were churn drilled, and the remainder were rotary drilled. American Zinc, Lead and Smelting Co. continued drilling on the copper-iron ore deposit in the Boss area. Company officials made no announcements concerning its development and production schedule. The data were being evaluated by computer to determine the most economical method of exploiting the deposit.

Phelps Dodge Corp. released lithologic logs of 35 exploratory drill holes in southeast Missouri to the Missouri Geological Survey for open-file purposes.

The Missouri Geological Survey contracted Aero Service Corp., Philadelphia, Pa., to conduct airborne magnetometer mapping of 1,527 acres in Benton, Camden, Hickory, Miller, Pulaski, and Laclede Counties.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Total value of nonmetallic output was $141 million, $13 million greater than in 1964. High consumption of industrial minerals produced in Missouri, continued as residential and non-residential construction rose to $517.9 million from the $503.4 million reported in 1964.

All nonmetals recorded gains in value over that of 1964. For the first time in many years, tripoli was mined in Missouri.

Barite.—Output of barite, sold or used, increased significantly, and the State continued to lead the Nation in barite output in 1965.

Crude barite was mined in 16 pits, all in Washington County. Leading producing companies included Magnet Cove Barium Corp., Milchem, Inc., and National Lead Co. At yearend barite held in stock by producers totaled 25,808 tons, about 18 percent less than in 1964.

Crushing and grinding plants in St. Louis and Washington Counties processed about 76 percent of the State's barite production; the remainder was processed in Arkansas and Texas. Processed material, largely used as a weighting agent in oil well drilling mud, was shipped to out-of-state markets.

Additional uses, in order of importance, include glass, paint, rubber, and other chemical products.

Table 5.—Barite sold or used by producers

Year	Short tons	Value
1956–60 (average)	275,011	$3,515,682
1961	227,323	3,051,663
1962	303,945	3,994,104
1963	286,750	3,679,764
1964	266,814	3,450,530
1965	328,585	4,219,343

Cement.—Masonry and portland cement were manufactured at two plants in St. Louis County and at one each in Cape Girardeau, Jackson, and Ralls Counties. Jefferson County produced portland cement only. The plants prepared masonry cement by mixing portland cement, finely ground limestone, and a plasticizer additive. Yearend stocks of masonry cement totaled 490,522 barrels, approximately the same as last year. At yearend, portland cement stocks totaled 2 million barrels, considably higher than in 1964.

The industry consumed 330.6 million kilowatt-hours of electrical energy, of which 87 percent was purchased and the remainder was generated. Cement was transported 58 percent by truck, 41 percent by rail, and 1 percent by barge.

River Cement Co., Division of Mississippi River Fuel Corp., began operating its new plant near Selma, Jefferson County, in May. The 3-million-barrel facility

Table 6.—Portland cement production and shipments

(Thousand 376-pound barrels and thousand dollars)

Year	Production	Shipments	
		Quantity	Value
1956–60 (average)	12,333	12,012	$39,383
1961	11,940	11,839	41,142
1962	12,239	12,739	44,004
1963	12,692	12,402	41,640
1964	12,399	12,378	42,618
1965	13,975	13,334	46,034

Table 7.—Shipments of portland cement to Missouri consumers

Year	Thousand 376-pound barrels
1956–60 (average)	7,728
1961	8,066
1962	8,814
1963	8,990
1964	10,266
1965	10,414

utilized a 560-foot, gas-fired klin, currently the Nation's largest dry process unit.

Dundee Cement Co. named Fruin-Colnon Contracting Co. of St. Louis as general contractor to construct its 7-million-barrel plant near Clarksville. Groundbreaking ceremonies on May 21 initiated construction of the facility, designed to have the largest cement kiln (760-foot) in the world. The highly automated plant will have an annual payroll of $2 million, and will employ approximately 200 workers. Completion is scheduled for late 1966.

Universal Atlas Cement Co. facility, south of Hannibal, Ralls County, was expanded and modernized. Activity at the project site was intensified; 300 construction workers were employed. The company was installing a single 620-foot kiln to replace smaller kilns.

A self-unloading cement barge dubbed "Tom Sawyer" was placed in service by the Universal Atlas Cement Co. Hannibal plant. The 245 by 52 by 12-foot barge can discharge cement at a rate of 1,000 barrels per hour. The barge is compartmentalized to permit simultaneous transportation of several types of cement and is expected to travel the Mississippi River-Illinois Waterway and the Chicago Ship and Sanitary Canal.

Clays.—Clay (fire and miscellaneous), sold and used, rose in quantity in value over that of 1964.

Fire clay was mined in 15 counties and comprised about one-half the tonnage and 79 percent of the value of clay sales. Important uses were refractory products and chemicals.

Miscellaneous clay was produced in 11 counties; important uses of miscellaneous clay were building brick, cement, lightweight aggregate, sewer pipe, and pottery.

The Refractories Division of H. K. Porter Co. announced construction of a new refractories plant north of Fulton. A 45-acre tract was purchased for the multimillion dollar facility. The plant will produce fire clay products and high-alumina refractories; completion is scheduled in mid-1966.

Kaiser Refractories Division of Kaiser Aluminum & Chemical Corp. and Harbison-Walker Refractories Co. were expanding and modernizing production facilities. Harbison-Walker announced development and marketing of a high-performance refractory brick in the 60-percent alumina class for use in blast furnaces and a vari-

Table 8.—Clays sold or used by producers, by kinds

(Thousand short tons and thousand dollars)

Year	Fire clay		Miscellaneous clay		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
1956–60 (average)	1,582	$6,222	926	$929	2,508	$7,151
1961	[1] 1,112	4,020	1,020	1,020	2,132	5,040
1962	1,080	4,060	973	973	2,053	5,033
1963	850	3,568	896	899	1,746	4,467
1964	1,002	3,905	964	969	1,966	4,874
1965	1,128	4,313	1,098	1,126	2,226	5,439

[1] Includes ball clay.

ety of other applications. The same company was also installing a new type of rotary kiln for use in manufacturing refractory specialties products.

Lime.—Sales of lime rose to $16.8 million, the highest on record. Most of the output went to out-of-State markets. Four plants situated in four counties manufactured lime products. Of the four plants, three produced hydrated lime and quicklime, and one produced dead-burned lime. Output of quicklime increased more than 20 percent over that of last year.

Table 9.—Lime sold or used by producers
(Thousand short tons and thousand dollars)

Year	Quantity	Value
1956–60 (average)	1,325	$15,368
1961	1,173	13,873
1962	1,176	13,703
1963	1,240	14,386
1964	1,219	14,328
1965	1,442	16,782

Sand and Gravel.—Sand and gravel industry in Missouri established a new production record during 1965; output rose 5 percent in quantity and 3 percent in value over that of 1964. Continued high level of activity in all phases of construction accounted for the large consumption. About 90 percent of the sand and gravel output was utilized in construction projects. Industrial markets consumed 9 percent, and the remaining 1 percent was consumed by other markets.

Output of sand and gravel came from 154 plants in Missouri; of these, 47 were stationary, 97 portable, and the remaining 10 plants were combinations of the two types. Stationary plants produced about 67 percent of the output.

Total sand and gravel including Government-and-contractor, was transported as follows: 79 percent by truck, 11 percent by railroad, and 10 percent by waterway and other methods.

Table 10.—Sand and gravel sold or used by producers
(Thousand short tons and thousand dollars)

Year	Commercial		Government-and-contractor		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
1956–60 (average)	8,569	$9,662	936	$697	9,505	$10,359
1961	8,744	10,266	627	422	9,371	10,688
1962	9,445	10,927	859	645	10,304	11,572
1963	9,808	11,580	845	680	10,653	12,260
1964	10,761	12,762	722	618	11,483	13,380
1965	11,229	12,954	839	781	12,068	13,735

Commercial operations in Missouri numbered 79 and produced 11.2 million tons or 93 percent of the output. Four sand and gravel operators produced over 500,000 tons each for a total of 3.4 million tons; 29 plants were in the 100,000-to-500,000-ton range and supplied 6.4 million tons; 46 plants produced up to 100,000 tons each for a total of 1.4 million tons.

Sand comprised 56 percent of the tonnage of sand and gravel produced in Missouri and gravel the remaining 44 percent. Missouri sand sold at an average price of $1.28 per ton and gravel sold for $0.96 per ton.

Pittsburgh Plate Glass Co. began constructing a float glass plant having a capacity of 50 million square feet of glass annually. Completion was scheduled for early 1966.

Stone.—For the third consecutive year, stone ranked first in value of mineral commodities produced in Missouri. Granite, limestone, marble, miscellaneous stone, and/or sandstone were mined in 79 counties; output gained 15 percent in quantity and 12 percent in value.

Limestone, because of its widespread availability and numerous uses, dominated the stone industry; production accounted for 96 percent of output and 93 percent of total value. More than half of the limestone output was utilized for concrete aggregate and roadstone. Other important uses included cement, agricultural lime (aglime), and riprap.

Dimension and crushed granite were produced in Iron County. Commercial-grade marble was mined in five counties—Jasper, Greene, Jefferson, Ste. Genevieve, and

Table 11.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1964		1965	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	3,622	$3,243	4,265	$3,763
Paving	1,213	1,172	859	821
Fill	421	371	405	358
Industrial glass	469	1,166	527	1,364
Other [1]	684	2,357	672	2,285
Total	6,409	8,309	6,728	8,591
Gravel:				
Building	2,595	3,033	2,749	3,094
Paving	1,279	1,139	1,001	828
Fill	199	86	W	W
Other [2]	279	195	751	441
Total	4,352	4,453	4,501	4,363
Total sand and gravel	10,761	12,762	11,229	12,954
Government-and-contractor operations:				
Sand:				
Paving	43	49	79	92
Gravel:				
Paving	679	569	760	689
Total sand and gravel	722	618	839	781
Grand total	11,483	13,380	12,068	13,735

W Withheld to avoid disclosing individual company confidential data; included with "Other."
[1] Includes railroad ballast, other construction sand, and various industrial sand (unground and ground).
[2] Includes railroad ballast, miscellaneous gravel, fill (1965), and other construction gravel (1965).

Table 12.—Stone sold or used by producers, by uses

Use	1964		1965	
	Quantity	Value	Quantity	Value
Dimension and building:				
Rough construction, short tons	7,294	$383,779	4,273	$101,804
Flagging and rubble, do.	21,336	83,289	W	W
Rough architectural, cubic feet	W	W	W	W
Dressed (cut or sawed), short tons	W	W	11,236	2,011,563
Total, approximate short tons	38,553	2,432,454	20,078	2,154,140
Crushed and broken:				
Riprap, short tons	2,482,274	2,216,059	3,473,232	2,671,388
Concrete aggregate, roadstone, etc., do.	18,244,289	25,045,716	20,887,782	28,388,518
Railroad ballast, do.	338,599	173,783	356,924	252,282
Agricultural, do.	3,303,573	5,475,150	3,509,192	5,572,749
Cement, do.	3,473,596	3,473,596	4,068,484	4,068,484
Other [1], do.	3,605,832	9,167,071	3,931,741	10,466,505
Total, do.	31,448,163	45,551,375	36,227,355	51,419,926
Grand total, do.	31,486,716	47,983,829	36,247,433	53,574,066

W Withheld to avoid disclosing individual company confidential data; included in total.
[1] Includes stone for terrazzo, roofing granules, glass, whiting, asphalt filler, fertilizer filler, other filler, coal dust, filter beds, mineral food, poultry grit, lime, refractory, flux, and miscellaneous uses.

Table 13.—Stone sold or used by producers, by kinds

Year	Granite		Limestone		Sandstone (dimension)		Other stone [1]		Total stone	
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)
1961	4,532	$295	24,852,463	$33,716	2,948	$42	770,727	$2,524	25,630,670	$36,577
1962	4,452	286	27,900,975	40,889	2,943	38	968,052	2,793	28,876,422	44,006
1963	2,958	317	29,776,088	42,711	3,655	55	1,101,840	3,047	30,884,541	46,130
1964	3,226	292	30,567,256	44,586	2,208	29	914,026	3,077	31,486,716	47,984
1965	[2] 3,124	234	34,952,692	49,770	2,258	52	1,289,359	3,518	36,247,433	53,574

[1] Includes crushed granite (1965), marble, miscellaneous stone, and crushed sandstone.
[2] Excludes crushed granite; included with "Other stone."

Madison. Important uses were building stone and terrazzo chips; value of the output was lower than in 1964.

Lower output was reported for miscellaneous stone. Two operators produced miscellaneous stone, principally waste products from lead-zinc mining, for road base, railroad ballast, roofing granules, and fluxing. Dimension sandstone was prepared for building purposes by operators in Shannon and Vernon Counties.

One Government-and-contractor operator produced crushed sandstone for riprap purposes from quarries located in Cooper, Howard, Platte, and Saline Counties. Output was significantly higher than in 1964.

The Ruberoid Co. plant in Annapolis, Iron County, began production at midyear. Raw material, consisting of felsitic rock mined in the area, was processed into roofing granules.

METALS

Value of metals recovered from Missouri mines rose substantially to $69.6 million from the $48.1 million in 1964. Iron and lead were the principal minerals mined. Silver-bearing residues, coproducts of refining operations at the Herculaneum smelter, were processed for silver; however, no silver recovery was reported in 1964. The average annual recovery of silver from Missouri lead ore was 234,300 ounces during the 1954–63 period.

Copper.—Output was valued at more than $1 million for the fourth consecutive year. Copper occurred in 4.8 million tons of lead ore mined in Crawford, Iron, St. Francois, and Washington Counties and was recovered as a coproduct in milling and smelting operations. Production is dependent on volume and copper content of lead ores processed.

Iron.—Iron ore shipments were substantially higher than in 1964. Significant contribution to the increased output was the full year's production of the pelletizing operations at the Meramec Mining Co. Pea Ridge facility in Washington County near Sullivan. Five levels between 1,395 and 2,275 feet were being mined. About 1 thousand workers were employed; half worked underground 6 days a week, and the remainder were in surface plants 7 days per week. The underground mine produced over 2 million tons of Precambrian magnetite ore; most was processed into high-grade iron pellets for shipment to Bethlehem Steel Corp., Johnstown, Pa.; Armco Steel Corp., Hamilton, Ohio; Sheffield Division of Armco Corp., Kansas City, Mo.; and Lone Star Steel Co., Daingerfield, Tex.

Crude iron ore output at the Iron Mountain mine of The Hanna Mining Co., Missouri Division, declined 4 percent from that of 1964. The ore was concentrated to 54 percent iron and shipped to Granite City Steel Co. steel complex near St. Louis under a long-term contract. The mine was scheduled to close in mid-1966.

Brown iron ores were mined by open-pit methods in Howell County by one operator for shipment to an out-of-State industry.

Development of huge iron ore reserves in Iron County was continued by the Pilot Knob Pellet Co., a joint venture of The Hanna Mining Co. and Granite City Steel Co. At yearend, the 20-foot-diameter concrete-lined shaft was sunk below the 900-foot level of the projected 1,600 feet; Frazier-Davis, St. Louis, is the contractor. At the 500-foot level, the contractor drove

Table 14.—Iron ore (usable)

(Thousand long tons and thousand dollars)

Year	Quantity	Value
1956–60 (average)	399	$3,781
1961	341	3,633
1962	346	3,188
1963	345	3,085
1964	1,116	14,907
1965	1,784	24,607

Table 15.—Ferrous scrap and pig iron consumption

(Thousand short tons)

Year	Ferrous scrap	Pig iron	Total scrap and pig iron
1961	869	24	893
1962	865	29	894
1963	908	33	941
1964	1,029	40	1,069
1965	1,096	42	1,138

a crosscut to the ore and mined a several-hundred-ton sample for pilot plant testing. Excavation of a 15-foot-diameter service shaft, about one-fourth mile from the production shaft, also was contracted.

Increasing strength of the steel industry in the area directly affects development of Precambrian iron resources in Missouri. Known iron ore reserves are tremendous and can supply area steel mills for centuries, notwithstanding the fact that the entire output of the Pea Ridge mine is shipped to steel mills outside the St. Louis area. As the Nation's demand for steel increases, the known iron deposits in Missouri, that is, Bourbon, Kratz Springs, Boss, and Camel's Hump, are expected to be developed by major mining companies.

Lead.—Output of recoverable lead metal increased about 11 percent compared with 1964 figures. The metal was recovered from 5.3 million tons of crude ore produced in Crawford, Iron, St. Francois, and Washington Counties; of this amount, 44 percent came from mines in the Viburnum trend, compared with 40 percent in 1964 and 38 percent in 1963. Recoverable metal attributed to ore mined in the new district exceeded 58 percent of the State output in 1965, thus reflecting the higher grade of ores.

Missouri ranked first among the States in lead production, a position it has held for 57 of the last 58 years. The price of lead metal remained unchanged at 16 cents per pound during the year.

Significant developments affecting the lead mining industry and economy of the State highlighted the year. Investments in new smelters, mines, concentrators, and related plants totaling about $150 million were obligated in 1965. These facilities were in various stages of construction and,

Table 16.—Mine production of silver, copper, lead, and zinc, in terms of recoverable metals

Year	Mines producing	Material sold or treated		Silver		Copper	
		Crude ore (short tons)	Old tailing (short tons)	Troy ounces	Value (thousands)	Short tons	Value (thousands)
1956–60 (average)	-----	6,257,574	595,035	216,962	$196	1,415	$935
1961	7	5,242,779	----------	11,793	11	1,479	887
1962	6	2,991,463	----------	490,896	533	2,752	1,695
1963	4	3,253,245	----------	131,664	168	1,816	1,119
1964	5	4,965,814	----------	-------	----------	2,059	1,343
1965	5	5,279,420	----------	299,522	387	2,331	1,650

Year	Lead		Zinc		Total value (thousands)
	Short tons	Value (thousands)	Short tons	Value (thousands)	
1956–60 (average)	116,073	$30,371	2,121	$542	$32,044
1961	98,785	20,350	5,847	1,345	22,593
1962	60,982	11,221	2,792	642	14,091
1963	79,844	17,246	321	74	18,607
1964	120,148	31,479	1,501	408	33,230
1965	133,521	41,659	4,312	1,259	44,955

Table 17.—Mine production of lead and zinc in southeastern and central Missouri, in terms of concentrates and recoverable metals [1]

Year	Lead concentrates (galena)		Zinc concentrates (sphalerite)		Recoverable metal content [2]			
					Lead		Zinc	
	Short tons	Value [3] (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)
1956–60 (average)	163,011	$26,518	3,793	$298	115,991	$30,346	1,897	$481
1961	137,862	18,720	11,024	973	98,785	20,350	5,847	1,345
1962	83,897	10,620	5,135	492	60,982	11,221	2,792	642
1963	109,960	15,054	666	50	79,844	17,246	321	74
1964	167,630	28,125	3,115	205	120,148	31,479	1,501	408
1965	186,368	36,537	8,792	891	133,521	41,659	4,312	1,259

[1] Based on southeastern and central Missouri ore "dirt" and old tailing treated at mills.
[2] In calculating metal content of ores from assays, allowance has been made for smelting losses. In comparing values of concentrate ore and metal, value for concentrate is that received by producer, whereas value of lead and zinc is calculated from average price for all grades.
[3] Values are arbitrary, because part of lead concentrate is smelted by producer.

when completed, will boost Missouri's lead production to about 400,000 tons from the 133,521 tons produced in 1965.

The Nation's first new lead smelter in more than 40 years is under construction near Bixby, Iron County, by Missouri Lead Operating Co., a joint venture of American Metal Climax, Inc., and Homestake Mining Co. The smelter is a part of an integrated ore-to-metal facility, costing $35 million, which includes a mine (Buick mine) and a highly automated mineral beneficiation plant. The lead ore discovery resulted from an extensive exploration program financed jointly by Climax and Homestake. Company officials estimated the size of the deposit in excess of 38 million tons having an average grade of 4 to 6 percent combined lead and zinc.

The Buick mine will include two 18-foot-diameter concrete-lined shafts bottomed at 1,390 and 1,365 feet, respectively. One will be utilized for hoisting ore and the other for lifting men and material and for ventilation. A tunnel will connect the shafts underground. Other tunnels and raises will be driven through the ore body on several levels, and sufficient working places will be developed to produce 70,000 tons of lead concentrate annually. At yearend, construction work at the mine site was initiated by Peter Kiewit & Sons, Omaha, Nebr., and Centennial Development Co., Eureka, Utah.

Table 18.—Tenor of lead and zinc ore milled and concentrates produced in southeastern Missouri

	1964	1965
Concentrate production:		
Lead ---------- short tons	167,630	186,368
Zinc ---------- do	3,115	8,792
Concentrate obtained from:		
Lead ---------- percent	3.38	3.53
Zinc ---------- do	0.06	0.17
Metal content of ore: [1]		
Lead ---------- do	2.42	2.53
Zinc ---------- do	0.03	0.08
Average lead content of galena concentrate ---------- do	73.14	73.11
Average zinc content of sphalerite concentrate ---------- do	53.55	54.49
Average value per ton:		
Galena concentrate ----------	$167.78	$196.05
Sphalerite concentrate ----------	$65.81	$101.32
Total material milled ---------- short tons	4,965,814	5,279,420

[1] Figures represent metal content of crude ore only as recovered in the concentrate; data on tailing losses not available.

Arthur G. McKee & Co. was awarded a contract in excess of $20 million for the design and construction of the Missouri Lead Operating Co. smelter and concentrator. Completion is scheduled for 1968. The mine-mill-smelter complex will be designed to allow substantial increase of capacity at minimum cost. The smelter will be located about 2 miles north of the mine and will produce 100,000 tons of pig lead annually. In addition, 50,000 to 70,000 tons of sulfuric acid will be produced annually as a byproduct of smelting operations. The conventional type smelter, utilizing blast furnaces and dezincing kettles, will be advanced in design and technology. When in full operation, the smelter will be on a 3-shift-per-day, 5-day-per-week schedule.

A joint exploration venture by Magnet Cove Barium Corp. and Cominco American, Inc., (formerly Montana Phosphate Co.) resulted in discovery of lead mineralization near Bixby, Iron County. The deposit (Magmont mine) contains an estimated 15 million tons of lead ore having a grade comparable to that mined in the new Viburnum trend. Plans to bring the property into production at a cost of $18.5 million were announced early in 1965, and Cominco American, Inc., was designated the operating company. Design and construction of a highly automated concentrator and other plants was awarded to Arthur McKee & Co., San Francisco. A long-term contract was negotiated with Missouri Lead Operating Co. for smelting the company's concentrates on a toll basis.

The Magmont mine will include two circular, concrete-lined shafts; one will be used for hoisting ore and the other for lifting men and materials and for ventilation. The capacity of the ore shaft will permit production of more than 70,000 tons of concentrates annually. At yearend, construction work at the mine site was started. Zeni-McKinney-Williams Corp., a shaft-sinking contractor, had excavated the ore shaft to a depth of 100 feet of the projected 1,250 feet. The mine-mill facility is scheduled for completion in 1968.

Ozark Lead Co., subsidiary of Kennecott Copper Corp., will invest $33 million for developing lead reserves northwest of Ellington in Reynolds County. The company disclosed that its mineral discovery contains ores averaging 4.5 percent lead and 1 percent zinc at a depth ranging from 1,100 to 1,400 feet. Size of the ore deposit was not revealed, but production is planned from three levels at a rate of 6,000 tons per day. A 7-foot-diameter development shaft has been drilled to the 1,200-foot level, crosscut to the ore body has been driven, and 7,000 tons of ore has been mined. At yearend, development work underground continued, and construction and design contracts were awarded for the production shafts and for a highly automated concentrator. The hoisting shaft, 20 feet in diameter and concrete lined, will be sunk to 1,430 feet. The mine and mill are expected to be operating in about 2 years. Ozark Lead Co. will sell its concentrates to American Smelting and Refining Company which also holds substantial lead deposits in the district.

American Smelting and Refining Company announced plans to construct a multimillion dollar smelter near Glover, Iron County. The contract was awarded to Kaiser Engineers. Initial capacity of the smelter will be about 78,000 tons of refined lead annually, but output may be increased substantially as larger supplies of concentrates become available. The principal source of concentrates for the smelter is expected to be Ozark Lead's production near Ellington and the company's own currently undeveloped lead reserves in the West Fork area. The facility will provide custom smelting for lead ore and concentrates produced at small mines in the southern Illinois area and Tri-State mining district. The ASARCO plant is scheduled for completion at the end of 1967 and will provide employment for 150 workers.

St. Joseph Lead Co., the only major company currently mining lead ore in southeast Missouri, also was investing large sums of money on expansion and construction of new mines, mills, and smelter facilities. The company's Fletcher mine project, costing $12 million, was reported over 50-percent complete. Some delays were experienced due to labor disputes, structural steel material shortages, and a change in contractor. The No. 30 production shaft was bottomed at 1,345 feet and considerable development work was completed underground. The companion shaft, No. 31, which will be utilized for transporting men and material and for ventilation purposes,

was reported sunk to 60 feet of its projected 980 feet. The mine-mill facility was expected to be operational by October 1966 and was expected to supply 60,000 tons of recovered lead metal annually.

St. Joseph Lead Co. discovered a lead deposit 2 miles northeast of its Indian Creek mine of sufficient magnitude to justify constructing a new mining facility. At yearend, the site was leveled, service buildings constructed, and sinking operations commenced on the No. 32 production shaft. The ore will be trucked to the Indian Creek mill for beneficiation. Completion of the new mine is expected in about 2 years.

The $10 million expansion of Herculaneum smelter capacity to more than 200,000 tons of refined lead per year was about 70 percent from its planned objectives. Completion was scheduled for September 1966. Principal areas of expansion include a new thaw house, an improved system for unloading raw materials, enlargement of blast furnaces and an improved method of charging them, and construction of a plant which will simplify handling dross and increase capacity of the refinery. In addition, building of a new updraft-type sinter plant was started at midyear. Overall plans call for constructing a byproduct sulfuric acid plant utilizing waste smelter gases.

Bunker Hill Co. began constructing a mine, mill, and related facilities at the Higdon lead-zinc ore deposit in southwest Perry County. Expenditure of $5 million was authorized. The property contains a reported 10-year's ore reserve having a grade comparable to that mined elsewhere in the district. At yearend, the mining site was prepared, some temporary buildings constructed, and shaft sinking started.

Zinc.—Zinc occurred in 2.3 million tons of lead ores mined in Crawford, Iron, and Washington Counties and was recovered as a coproduct in milling operations. Output is dependent on volume of the lead ores processed. No zinc was produced in the southwestern Missouri part of the Tri-State district for the eighth consecutive year.

MINERAL FUELS

Four mineral fuels supplied 7 percent of the total mineral value. Valued output was $1.5 million over that produced in 1964. Coal output had by far the greatest value; however, some natural gas, petroleum, and native asphalt was produced. Leading coal-producing counties include Henry, Macon, Boone, and Putnam.

Coal.—Output of coal increased in quantity and value for the third consecutive year; tonnage mined was 10 percent above the 1964 output.

Coal was utilized, principally as fuel, in steam-generated electric powerplants. Current consumption is about two-thirds of the State output.

Thirteen stripping operations in nine counties accounted for nearly all the coal mined in Missouri; less than 1 percent came from three underground mines. Overburden removed by stripping operations during 1965 totaled 51,458,577 cubic yards, or about 15 cubic yards of waste removed from each ton of coal mined.

The average cost of producing a ton of coal in Missouri was $4.15 compared with $4.08 in 1964 and $4.16 in 1963 and 1962.

Table 19.—Coal (bituminous) production

(Thousand short tons and thousand dollars)

Year	Quantity	Value
1956–60 (average)	2,898	$12,282
1961	2,938	12,567
1962	2,896	12,057
1963	3,174	13,196
1964	3,254	13,285
1965	3,564	14,779

Missouri coal was processed in crushing and cleaning plants. A total of 3.0 million tons or 84 percent of output was crushed in nine plants.

Eight cleaning plants processed over 2 million tons of coal or 56 percent of the production. A small tonnage of coal was oil treated.

Coal, mined by stripping and underground methods, was transported as follows: 51 percent by railroad and waterway; 10 percent by truck; and 39 percent unspecified.

Petroleum and Natural Gas.—Crude oil was produced from about 142 wells in six counties; St. Louis County was the largest producer. Output was higher than in 1964.

Marketed production of natural gas was reported from gasfields in Clinton, and Caldwell Counties. The Turney gasfield in Clinton County accounted for most of

the output. Natural gas was used locally for heating purposes.

Many oil companies were interested in the heavy oil potential of the Bluejacket formation in west-central Missouri. The formation underlies a predominantly leased area of several hundred square miles; Shell Oil Co. reportedly holds more than 100,000 acres under lease, mostly in Vernon County. For a number of years, the company has operated an experimental heat and steam project on its leases. Other pilot plant experimental projects were active in the area, but most of the information gained was confidential. Helmerich & Payne, Inc., in a joint venture with American Petrofina, began a heat flood project several miles west of Nevada. An oil company from Louisiana drilled several test holes near Stotesbury and a down-hole, electric heat-treating plant reportedly is being designed for the area.

REVIEW BY COUNTIES

Adair. — Billy Creek Coal Co., Inc., mined coal at the Baiotto & Son underground mine near Novinger, most of which was sold to the Kirksville city powerplant.

Audrain.—The county ranked first in value of clay production. Seven companies mined refractory clays in 10 pits; Havener mine was the largest. Molino Lime Quarry Co., Inc., produced crushed limestone for roadstone and aglime.

Barton.—John J. Stark, contractor, quarried and crushed limestone for aglime and road surfacing near Lamar. Bar-Co Roc Asphalt Co. mined asphaltic sandstone for road surfacing material; output rose significantly due to an active highway construction program.

Bates.—Three companies quarried and crushed limestone for aglime and road surfacing. Bates County Rock, Inc., the largest producer, was awarded the 1964 National Limestone Institute Safety Award for operating 20,000 man-hours without an accident. Miller Ranch pit produced gravel for fill near Rich Hill. Shell Oil Co. was conducting pilot plant studies on fireflooding of heavy oil deposits near Rich Hill.

Benton.—No mineral production was reported in 1965. Work was initiated on the Kaysinger Bluff Reservoir; Clarkson Construction Co., Kansas City, received a contract for clearing the area, excavating the dam's foundation, and some embankment work.

Boone.—Boone County ranked third in value of coal mined, Peabody Coal Co.'s Mark Twain mine near Hinton accounted for the county's coal production. Limestone was quarried and crushed for aglime and roadstone by Adrian Materials Co., Boone Quarries, Inc., and Garretts City Quarry Co. Columbia Sand Co. processed sand for building and paving. Fire clay and shale were mined by Columbia Brick & Tile Co. and processed into building bricks.

Buchanan.—Everett Quarries, Inc., and L. S. Stafford quarried and crushed limestone for aglime, road surfacing, and riprap. Pioneer Sand Co. processed sand for building, paving, and railroad ballast in St. Joseph.

Caldwell.—Everett Quarries, Inc., Farmers Rock & Lime, Inc., and Kingston Stone Co. quarried and crushed limestone for aglime, roadstone, and riprap. Some natural gas was produced from two wells in the Polo gasfield and used locally.

Callaway.—The county ranked third in value of clay output. Fire clay was processed into firebrick and block, high-alumina brick, mortar, and clay crucibles by Harbison-Walker Refractories Co., H. K. Porter Co., Inc., Kaiser Refractories, Division of Kaiser Aluminum & Chemical Corp., and Walsh Refractories Corp. Limestone was quarried and crushed for aglime, railroad ballast, riprap, and road material by Auxvasse Stone & Gravel Co., Mo-Con, Inc., of Fulton, Sulgrove Mining & Quarry Co., and Brown quarries. Clayton-Hensley strip mined coal at its Hammitt pit. Callaway County Sand Co. processed sand for building and paving near Mokane.

Cape Girardeau.—The county ranked sixth in value of mineral production, second in cement and miscellaneous clay output, and fourth in stone production. Marquette Cement Manufacturing Co. produced cement utilizing clay and limestone from company-operated quarries near Cape Girardeau. Miscellaneous clay was mined at two pits for building brick by Kasten Clay Products, Inc., and pottery by Ceramo Co., Inc. The Federal Materials Co., Inc.,

Table 20.—Value of mineral production in Missouri, by counties [1]

County	1964	1965	Minerals produced in 1965 in order of value
Adair	$133,424	$107,400	Coal.
Atchison	14,980	9,790	Petroleum.
Audrain	1,293,280	1,433,885	Clays, stone.
Barry	64,970	W	Stone.
Barton	W	W	Stone, asphaltic sandstone.
Bates	W	W	Stone, sand and gravel.
Boone	3,249,753	4,188,047	Coal, stone, sand and gravel, clays.
Buchanan	750,448	382,075	Sand and gravel, stone.
Butler	11,200	15,314	Sand and gravel, clays.
Caldwell	242,782	254,096	Stone, natural gas.
Callaway	2,151,192	2,097,627	Stone, clays, coal, sand and gravel.
Camden	27,590	258,900	Stone, sand and gravel.
Cape Girardeau	13,673,447	12,721,664	Cement, stone, clays, sand and gravel.
Carter	----------	12,000	Sand and gravel.
Cass	412,959	576,349	Stone, petroleum, clays.
Cedar	84,000	155,047	Stone, sand and gravel.
Chariton	4,000	----------	
Christian	26,000	11,000	Sand and gravel.
Clark	W	W	Stone, coal.
Clay	1,450,591	1,516,267	Stone.
Clinton	149,810	186,823	Stone, natural gas.
Cole	147,000	495,000	Sand and gravel.
Cooper	299,500	351,658	Stone, sand and gravel.
Crawford	6,149,257	5,623,264	Lead, zinc, copper, sand and gravel, silver, clays.
Dade	190,219	199,800	Stone, coal.
Dallas	16,000	28,000	Sand and gravel.
Daviess	554,442	539,400	Stone, sand and gravel.
De Kalb	417,904	373,477	Stone.
Dent	4,390	3,000	Sand and gravel.
Douglas	141,000	115,000	Do.
Dunklin	134,000	53,000	Do.
Franklin	596,584	629,843	Sand and gravel, stone, clays.
Gasconade	1,125,868	1,124,050	Clays, sand and gravel.
Gentry	W	W	Stone, sand and gravel.
Greene	3,677,415	3,449,637	Stone, lime, sand and gravel.
Grundy	239,324	278,960	Stone.
Harrison	W	W	Stone, sand and gravel.
Henry	6,537,729	W	Coal, stone.
Hickory	12,000	8,000	Sand and gravel.
Holt	W	W	Stone.
Howard	315,008	362,791	Stone, sand and gravel.
Howell	363,498	W	Iron ore, sand and gravel.
Iron	6,814,442	9,469,799	Lead, stone, zinc, copper, silver.
Jackson	11,605,087	13,633,377	Cement, stone, sand and gravel, clays, petroleum.
Jasper	2,858,740	2,914,783	Stone, sand and gravel.
Jefferson	1,565,013	5,889,893	Cement, stone, sand and gravel, clays.
Johnson	416,649	545,803	Stone.
Knox	W	W	Do.
Laclede	20,000	41,000	Stone, sand and gravel.
Lafayette	535,306	441,771	Do.
Lawrence	101,067	654,075	Do.
Lewis	803,603	579,253	Sand and gravel, stone.
Lincoln	315,750	446,450	Sand and gravel, stone, clays.
Linn	185,750	244,343	Stone.
Livingston	636,720	645,615	Stone, clays, sand and gravel.
McDonald	24,000	39,123	Stone, sand and gravel.
Macon	W	W	Coal.
Madison	W	W	Stone.
Maries	142,225	144,050	Stone, clays.
Marion	1,034,092	1,038,169	Stone, lime.
Mercer	279,837	346,155	Stone.
Miller	160,000	183,000	Sand and gravel, stone.
Mississippi	3,000	22,000	Sand and gravel.
Moniteau	88,250	94,750	Stone, sand and gravel.
Monroe	394,344	429,109	Clays, stone, sand and gravel.
Montgomery	967,482	913,464	Stone, clays, sand and gravel.
Morgan	52,000	32,000	Sand and gravel.
Newton	65,317	139,840	Stone, tripoli, sand and gravel.
Nodaway	370,896	W	Stone, sand and gravel.
Oregon	W	46,000	Sand and gravel, stone.
Osage	55,369	24,355	Sand and gravel, clays.
Ozark	6,000	W	Sand and garvel.
Pemiscot	343,000	277,000	Do.
Perry	W	W	Stone, sand and gravel.
Pettis	W	W	Stone.
Phelps	87,588	106,245	Stone, clavs, sand and gravel.
Pike	379,738	513,058	Stone, sand and gravel.
Platte	193,272	222,864	Stone, clays, petroleum.
Polk	2,000	28,000	Sand and gravel.

See footnotes at end of table.

Table 20.—Value of mineral production in Missouri, by counties [1]—Continued

County	1964	1965	Minerals produced in 1965 in order of value
Pulaski	$79,000	$255,000	Stone, sand and gravel.
Putnam	578,544	437,292	Coal, stone.
Ralls	8,154,061	7,862,133	Cement, stone, clays, sand and gravel.
Randolph	W	W	Stone.
Ray	1,017,707	877,500	Do.
Reynolds	2,000	8,000	Sand and gravel.
St. Charles	1,506,117	2,031,489	Stone, sand and gravel, clays.
St. Clair	1,292,557	157,098	Stone, sand and gravel, coal.
St. Francois	21,910,124	24,888,998	Lead, lime, iron ore, stone, copper, silver.
Ste. Genevieve	17,575,887	20,059,481	Lime, stone, sand and gravel.
St. Louis	31,925,879	32,653,471	Cement, stone, sand and gravel, clays, petroleum.
Saline	552,503	640,440	Stone.
Scotland	W	W	Do.
Scott	W	W	Stone, sand and gravel.
Shannon	W	W	Do.
Shelby	8,708	15,121	Stone.
Stoddard	W	W	Sand and gravel.
Stone	14,000	6,000	Do.
Sullivan	8,000	3,000	Do.
Taney	W	W	Stone.
Texas	10,000	23,000	Sand and gravel.
Vernon	290,060	274,102	Coal, petroleum, asphaltic sandstone, stone, sand and gravel.
Warren	254,209	314,424	Stone, clays, sand and gravel.
Washington	20,028,080	38,419,711	Iron ore, lead, barite, zinc, copper, sand and gravel, silver.
Wayne	W	W	Stone, sand and gravel.
Webster	15,000	57,206	Do.
Worth	W	W	Stone.
Wright	189,072	188,000	Do.
Undistributed	8,725,391	18,730,026	
Total	189,305,000	225,568,000	

W Withheld to avoid disclosing individual company confidential data, included with "Undistributed."
[1] The following counties were not listed because no production was reported in 1964 or 1965: Andrew, Benton, Bollinger, Carroll, New Madrid, Ripley, and Schuyler.

and Farmers Limestone Co. quarried and crushed limestone for aglime, riprap, and road material. Cape Girardeau Sand Co. processed sand for building, paving, and fill.

Cass. — Limestone was quarried and crushed for railroad ballast, aglime, riprap, and roadstone by Deitz-Hill Development Co., George M. Baker Co., Hackler & Limpus Quarry, and Marino & Hoover Construction Co., Inc. Acme Brick Co. processed miscellaneous clay into building bricks near Harrisonville. A small quantity of petroleum was produced from 28 wells.

Cedar. — Limestone was quarried and crushed for aglime, roadstone, and riprap by George M. Baker Co. Work on the 113-foot-high embankment for Stockton Dam continued in 1965 by the Ames Construction Co. of Oklahoma City, prime contractor. The multipurpose unit is on the Sac River, 2 miles east of Stockton. The powerplant will include a turbine-generator unit having an installed capacity of 45,200 kilowatts. At yearend, the company also was completing a $3 million contract for first stages of construction. Paving gravel was produced for Missouri State Highway Department.

Clay. — Limestone was quarried and crushed for aglime, riprap, road material, and miscellaneous uses by Everett Quarries, Inc., and Kansas City Concrete Co. Construction of two reservoirs on the Fishing River, costing $7.2 million, was proposed by U.S. Army Engineers. The reservoirs will be utilized for flood protection, recreation, water-quality control, and municipal water supply.

Clinton.— Everett Quarries, Inc., quarried and crushed limestone at two locations for aglime, riprap, and roadstone. Nine gas wells in the Turney gasfield supplied Plattsburg with natural gas for heating purposes.

Cole.—The county ranked fifth in value of sand and gravel. Output was higher than in 1964. Four commercial operators produced sand and gravel for building and paving and sand for fill; Leonard Barnhart Construction Co. was the largest producer.

Crawford.—St. Joseph's Viburnum No. 27 mine in southeast Crawford County pro-

duced more than 500,000 tons of lead ores. The ore was transported by truck to the Viburnum mill for processing. Zinc concentrates were recovered from the lead ores. Clyde Denton, Inc., and G. J. Marr Materials produced sand for building and paving and gravel for fill. Missouri State Highway Department contracted for paving gravel. Walsh Refractories Corp. mined fire clay for firebrick and block.

Dade. — Limestone was quarried for aglime and roadstone by Allen quarries. Tyler & Claypool Coal Co. strip mined coal east of Arcola.

Franklin. — Meramec Aggregates, Inc., Pacific Pebbles, Inc., and Washington Sand Co. processed sand and gravel for building and paving purposes. Paving gravel was contracted by the Missouri State Highway Department. Five commercial operators at six locations quarried and crushed limestone for aglime, riprap, and roadstone. Kaiser Refractories, General Refractories Co., and Walsh Refractories Corp. mined fire clay at five pits for processing into firebrick and block, high-alumina brick, mortar, and clay crucibles.

Gasconade.—The county ranked second in value of clay output. Eight companies mined fire clay at 42 pits for manufacturing refractories; A. P. Green Refractories Co. and Kaiser Refractories were the largest producers.

Greene.—Greene County ranked sixth in value of stone output and third in lime; some sand and gravel also was produced. Limestone was quarried and crushed for aglime, roadstone, and miscellaneous uses by the Ash Grove Lime & Portland Cement Co., Conco Quarries, Inc., Graystone Quarry Co., and Griesemer Stone Co. Hydrated lime and quicklime were manufactured from limestone, quarried by Ash Grove Lime & Portland Cement Co. at the Galloway plant. Carthage Marble Corp. sawed and cut marble blocks at its Phoenix quarry for processing into commercial-grade building stone at its Carthage plant. Ash Grove Lime & Portland Cement Co. received a safety award from The National Lime Association for operating during 1965 without an accident. Paving gravel was produced for Missouri State Highway Department.

Henry. — The county ranked ninth in value of total mineral production and first in coal output. Three strip mines were active; two were operated by Peabody Coal Co. and one by Madole Bros. Coal Co. Limestone was quarried and crushed for aglime, riprap, and roadstone by Davis Rock Co., Williams Rock Co., Inc., and Williams Rock Mining Co., Inc.

Howell.—The county was the only producer of brown iron ore. Plateau Iron Ore Corp. mined and washed brown iron ores. Gravel for paving purposes was quarried by Doss & Harper Gravel Co. near Peace Valley.

Iron.—Mineral value increased 39 percent owing to appreciable increases in production of lead, zinc, and stone. St. Joseph Lead Co.'s Viburnum No. 28 mine produced nearly 700,000 tons of lead ore for beneficiation in the Viburnum mill. The Heyward Granite Co. quarried and processed dimension granite near Graniteville for rough construction and monumental stone. Roofing granules were manufactured at the Ruberoid Co. plant in Annapolis, the first such production in Missouri. Felsite came from a company-operated quarry.

Jackson.—Jackson County ranked fifth in value of mineral output, third in cement and miscellaneous shale and second in stone production. Due to a heavy demand by residential and industrial construction in the Kansas City area, stone and cement contributed the greatest dollar value. Missouri Portland Cement Co. manufactured masonry and portland cement at its Sugar Creek plant near Independence; limestone and shale were obtained from company-operated quarries.

Limestone was quarried by 10 commercial and 1 Government-and-contractor operation for aglime, roadstone, and miscellaneous purposes; Beyer Crushed Rock Co., Stewart Sand & Material Co., and Union Construction Co. were the principal producers. Stewart Sand & Material Co. processed sand for building and paving. Miscellaneous clay was mined for manufacture of heavy clay products by Acme Brick Co. Crude vermiculite, shipped from Libby, Mont., was exfoliated at the Zonolite Co., Kansas City plant; sales increased significantly over those in 1964. A small quantity of crude oil was produced from 52 wells.

Jasper.—The county ranked fourth in valued stone and sand and gravel output. Carthage Crushed Limestone Co., Inde-

pendent Gravel Co., Nelson quarries, Valentine Supply, and Joplin Stone Co. quarried and crushed limestone for aglime, roadstone, and miscellaneous purposes. Carthage Marble Corp. prepared commercial-grade marble for rough building stone, dressed building stone, and monumental stone.

Jefferson. — Mineral value more than tripled owing to initial production of cement and clay and increased output of stone and sand and gravel. Unground, high-purity silica sand for use in plate glass manufacturing, molding, grinding, and polishing was mined by Pittsburgh Plate Glass Co., Masters Bros. Silica Sand Co., and Manley Sand, Division of Martin-Marietta Corp. Sand and gravel for building was produced by Ficken Material Co., and paving gravel was produced by Jefferson County Highway Department and contracted by Missouri State Highway Department. Five commercial operators quarried and crushed limestone for aglime, riprap, railroad ballast, and roadstone; Bussen Quarries, Inc., was the largest producer. Commercial-grade marble was quarried for terrazzo by Marble Products Co. of Georgia. For the first time, the county reported cement production. River Cement Co. began manufacturing cement at its new plant near Selma; raw material came from company-operated limestone and shale quarries. Dimension limestone was prepared for building stone by Paul H. Guidicy.

Johnson.—Limestone was quarried and crushed for aglime and roadstone at six locations, three operated by Deitz-Hill Development Co.

Lafayette.—Limestone was quarried and crushed for aglime, riprap, and roadstone by Deitz-Hill Development Co. and Red Stone Co. Sand for building, paving, and other purposes was processed by Glasgow Sand Co. and Raymond Drivers Sand Co.

Lawrence.—Limestone was quarried and crushed for roadstone and riprap by L. J. Menefee Construction Co. Dimension limestone was prepared for rough agricultural and dressed purposes by Republic Stone Co. Paving gravel was produced for the Missouri State Highway Department.

Lewis. — The county ranked sixth in value of sand and gravel output. Missouri Gravel Co. processed sand and gravel for building purposes south of LaGrange. Hamill Lime Co. and Missouri Gravel Co. quarried and crushed limestone for aglime and roadstone.

Lincoln.—Kimaterials and Glacial Sand & Gravel Co. processed sand and gravel for building, paving, fill, and other purposes. Paving gravel was also produced for Missouri State Highway Department. Watson Quarry, Inc., and R & B Rock Co. quarried and crushed limestone for aglime, riprap, and roadstone. Harbison-Walker Refractories Co. mined fire clay near Whiteside for processing into firebrick and block, high-alumina brick, and mortar.

Livingston. — Limestone was quarried and crushed for aglime, riprap, and roadstone by Farmers Rock & Lime, Inc., Fred McVey Quarry, and two others. Midland Brick & Tile Co. mined and processed miscellaneous clays for brick, tile, and other heavy clay products. Cooley Gravel Co. processed sand for building and fill purposes, and paving sand was contracted by Missouri State Highway Department.

Macon.—The county ranked second in coal output, principally because of production from the Bee-Veer strip mine, the State's largest, operated by Peabody Coal Co.

Maries.—A. P. Green Refractories Co. and Kaiser Refractories mined fire clay for processing into firebrick and block, high-alumina brick, and other refractories. Paving gravel was produced for Missouri State Highway Department.

Miller.—C. W. Roweth Co., Elam Construction Co., Inc., and Kagee Mining Co., Inc., processed sand and gravel for building, paving, and railroad ballast. Missouri State Highway Department contracted for paving gravel.

Monroe. — Christy Firebrick Co. and Gilliam Mining Co. mined fire clay for use in horizontal zinc retorts; Walsh Refractories Corp. mined fire clay for firebrick and block. Hamilton Lime Co. and Popkess & Norman quarried and crushed limestone for aglime and roadstone. Wilkerson Bros. produced paving gravel.

Work was initiated on the Clarence Cannon Dam & Reservoir (formerly Joanna) as $1 million of the $63 million needed for construction was authorized by the Federal Congress. The multipurpose reservoir is located on the Salt River. It is expected to have a compacted earth embankment 1,965 feet long and rise 106 feet above the valley floor. The power-

plant will have an annual capacity of 50,000 kilowatts.

Montgomery.—The county ranked fourth in value of clay output. General Refractories Co., Kaiser Refractories, and Wellsville Fire Brick Co. mined fire clay for manufacturing firebrick and block, high-alumina brick, and other refractories. Limestone was quarried and crushed for aglime and roadstone by McClain Lime Quarry and Edwin Bebermeyer. Two Rivers Sand & Gravel Co. produced, and Montgomery County Highway Department and Missouri State Highway Department contracted for sand for building and paving.

Newton.—The Southwest Lime Co. and Howard Miller quarried and crushed limestone for aglime and roadstone. American Tripoli Division of The Carborundum Co. processed tripoli ores at its Seneca plant for use as abrasives and foundry facings; sales approximated those of 1964. Tripoli ores came from company-operated mines in Oklahoma and Missouri. Paving sand and gravel was produced for Missouri State Highway Department.

Nodaway.—Concrete Materials and Construction Co. mined and crushed limestone for aglime and roadstone. Earl Wilson Sand Co. processed sand and gravel from the Platte River for building purposes and other uses near Conception Junction.

Perry.—Bunker Hill Co. initiated shaft-sinking operations in Higdon lead-zinc ore deposit in southwest Perry County.

Phelps.—Two pits, both mined by A. P. Green Refractories Co., supplied fire clay for processing into firebrick and block. Grisham Sand & Gravel Co. processed sand and gravel for building and paving purposes and gravel for fill. The Missouri State Highway Department contracted for paving gravel.

Pike.—Dundee Cement Co. was building a $55 million cement plant on the Mississippi River near Clarksville. The facility is expected to be highly automated but would provide employment for 200 production, clerical, supervisory, and sales workers. The rotary cement kiln is expected to produce 7 million barrels annually. Hercules Powder Co. was expanding its anhydrous ammonia and nitric acid production at the Louisiana facility. Output of anhydrous ammonia will be increased by 200 tons per day and nitric acid by 800 tons per day. The nitric acid will be used to manufacture fertilizer. Completion is scheduled for the spring of 1966 and will nearly double employment.

Platte.—Miscellaneous clay was mined and processed into lightweight aggregate by Carter-Waters Corp. near New Market. Everett Quarries, Inc., mined and crushed limestone at two locations for aglime and concrete aggregate. Sandstone was quarried for riprap by Mid-Continent Stone & Construction Co. A small quantity of petroleum was produced from six wells.

Putnam.—The county ranked fourth in value of coal output. Two underground mines operated by Henry T. Clark Coal Co. and Veach & Haines Coal Co. and two strip mines operated by Husted Coal Co. and Kirksville Coal Co., Inc., produced coal. Limestone was quarried and crushed for aglime, roadstone, and riprap by Putnam County Stone Co.

Ralls.—Total mineral production value in Ralls County was ranked eighth in the State. Also, the county ranked fourth in cement and miscellaneous clay production. Masonry and portland cement were manufactured by Universal Atlas Cement Division of U.S. Steel Corp.; clay and limestone came from company-operated quarries. Central Stone Co. quarried and crushed limestone for aglime, railroad ballast, and concrete aggregate. Paving gravel was processed by Edward B. Cooper near New London. Expansion and modernization of Universal Atlas Cement Co.'s cement facility was on schedule.

Reynolds.—Development of the St. Joseph Lead Co.'s Fletcher mine east of Bunker continued; production at the facility is expected to be initiated late in 1966. Ozark Lead Co., northwest of Ellington, completed its exploratory shaft and mined some ore for mill testing purposes.

St. Charles.—The county ranked third in sand and gravel output. Pennsylvania Glass Sand Corp. produced sand for use in manufacturing glass, molding, ferrosilicon, and other industrial sands. Paving gravel was produced for Missouri State Highway Department. Consumers Stone & Supply Co., Joerling Bros., O'Fallon Quarry & Supply Co., St. Charles Quarry Co., and Schiermeier Quarry mined and crushed limestone for aglime, riprap, and roadstone. General Refractories Co. mined fire clay at the Kilker mine for firebrick

and block. Miscellaneous clay was mined for porcessing into building brick by Highland Fire Clay Co.

St. Clair.—Output was below the 1964 level because of lower coal and sand and gravel production. The A. L. Childer's mine produced coal near Osceola. George M. Baker Co. and Hunt Limestone Co. quarried and crushed limestone for aglime, railroad ballast, and concrete aggregate. Paving sand and gravel was produced for Missouri State Highway Department.

St. Francois.—St. Francois County mineral production value was third highest in the State. The county ranked first in copper, lead, and silver, and second in lime and iron ore.

The Federal mine of St. Joseph Lead Co. produced nearly 3 million tons of lead ore. The Hanna Mining Co., Missouri Division, mined iron ore at the Iron Mountain mine; its entire production went to Granite City Steel Co. Dead-burned dolomite for refractory purposes was produced by the Valley Dolomite Corp.; the company also reported sales of aglime and concrete aggregate. St. Joseph Lead Co. sold mill tailing for aglime. Chat, derived from lead and iron ore milling, was used principally for road surfacing material, railroad ballast, and fluxing; producers were St. Joseph Lead Co. and Trap Rock Material & Engineering Co. St. Louis University has established a strain seismometer station underground in the St. Joseph Lead Co.'s No. 10 mine near Flat River.

St. Louis. — St. Louis County mineral production, valued at $32.7 million, was second highest in the State. The county ranked first in cement, sand and gravel, and stone, and fifth in clay output. Alpha Portland Cement Co. and Missouri Portland Cement Co. manufactured portland and masonry cement; limestone and shale came from company-operated quarries. Limestone was quarried and crushed at 12 commercial operations for use as aglime, concrete aggregate, flux, riprap, and asphalt filler; Vigus Quarries, Inc., was the largest producer. Dimension limestone was prepared for building purposes by West Lake Quarry & Material Co. Sand and gravel was produced by 14 operators for building, paving, fill, engine sand, abrasive sand, blast sand, and miscellaneous purposes. Unground and ground industrial sand was mined for glass, molding, grinding, polishing, and other industrial uses by Pioneer Silica Products Division of Pennsylvania Glass Sand Corp. Miscellaneous clay and fire clay were mined at six pits for processing into heavy clay products. H. K. Porter Co., Inc., and Alton Brick Co. mined fire clay for firebrick and block. Crude perlite, shipped from Colorado and New Mexico, was expanded at the plant of J. J. Brouk & Co. in St. Louis; output approximated that of 1964. Vermiculite was exfoliated for plaster, concrete, and loose-fill insulation by Zonolite Division of W. R. Grace & Co.; valued output was higher than in 1964. The Florrissant pool produced petroleum from 38 wells.

Ste. Genevieve. — The county ranked fourth in total value of mineral output, first in lime, and third in stone production. Hydrated lime and quicklime were produced by Mississippi Lime Co. at its Ste. Genevieve plant; limestone came from a company-operated quarry. The company also sold crushed limestone for glass, whiting, poultry grit, rubber filler, asphalt filler, coal mine dusting, flux, aglime, and roadstone. Menefee Crushed Stone Co., Inc., quarried and crushed limestone for riprap. Dimension limestone was cut for building stone, curbing, and flagging by Roth Building Stone Co. Commercial-grade marble was prepared for rough building purposes by Tennessee Marble Co. and Weiler Marble Co. Ed L. Bauman Material Co. processed sand and gravel for building and paving near Ste. Genevieve.

Saline.—Limestone was quarried and crushed for aglime and concrete aggregate by Gilliam Rock, Inc. Mid-Continent Stone & Construction Co. mined sandstone for riprap.

Shannon.—Limestone was quarried and crushed for aglime by Crider Bros. Lime Co. Dimension sandstone was prepared for building purposes by Ozark Stone Products, Inc. Paving gravel was produced for Missouri State Highway Department.

Vernon.—The county ranked fifth in coal production. Nichols Coal Co. and Ellis Coal Co. strip mined coal for local markets. Limestone was quarried and crushed for aglime and concrete aggregate by Jones Coal & Rock Co. Dimension sandstone was prepared for building purposes by Missouri Native Stone Corp. Two small pools produced oil from 20 wells. The first production of native asphalt in Vern-

on County was reported by Midwest Silica Rock Co. The material was used for road surfacing.

Warren.—Harbison-Walker Refractories and Kaiser Refractories mined fire clay for firebrick and block, high-alumina brick, and mortar. Limestone was quarried and crushed for aglime and concrete aggregate by Joerling & Narup and Sprick Quarry. Paving gravel was produced and contracted by Warren County Department of Roads and Missouri State Highway Department.

Washington.—Washington County mineral production value was the highest in the State; Meramec Mining Co. iron ore pellet production contributed significantly to the output. The county ranked first in iron and zinc, and second in lead and silver output. Washington County accounted for 27 percent of the recovered lead metal produced in Missouri; production came from the Indian Creek and Viburnum No. 29 mines of St. Joseph Lead Co. Zinc and copper concentrates were recovered in milling lead ores; silver metal in smelting operations. Barite was mined at 16 pits by 10 companies; leading producers were Milchem, Inc., Magnet Cove Barium Corp., General Barite Co., National Lead Co., and Chas. Pfizer & Co., Inc. Building, paving, and miscellaneous sand and gravel were produced for paving by Chas. Pfizer & Co., Inc., and Mount Sand & Gravel Co. Paving gravel was produced for Missouri State Highway Department.

Wayne. — Limestone was quarried and crushed for aglime by Harris Lime Co. Williamsville Stone Co. processed sand and gravel for building purposes near Poplar Bluff.

The Mineral Industry of Montana

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the Montana Bureau of Mines and Geology for collecting information on all minerals except fuels.

By Ronald P. Collins,[1] William N. Hale,[2] and Richard W. Knostman [2]

The value of mineral production, $229 million, eclipsed the previous record high, $213.8 million in 1956, and mounted an 8.4-percent increase over the comparable 1964 figure. The value was largely influenced by production from a selected group of mineral commodities—copper, lead, zinc, and petroleum—which together contributed 76 percent of the total production value.

Copper production and value were the largest since 1944, due mainly to increased market demand and the impact of The Anaconda Company Butte concentrator completed in 1964. Higher grade zinc ores processed at the Anaconda zinc concentrator largely accounted for a 54-percent increase in lead and a 16-percent increase in zinc output.

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Table 1.—Mineral production in Montana [1]

Mineral	1964		1965	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays [2] thousand short tons	49	$59	76	$98
Coal (bituminous and lignite) do	346	925	364	1,050
Copper (recoverable content of ores, etc.) short tons	103,806	67,682	115,489	81,766
Gold (recoverable content of ores, etc.) troy ounces	29,115	1,019	22,772	797
Iron ore (usable) thousand long tons, gross weight	15	99	9	71
Lead (recoverable content of ores, etc.) short tons	4,538	1,189	6,981	2,178
Lime thousand short tons	136	1,385	159	1,512
Manganese ore and concentrate (35 percent or more Mn) short tons, gross weight	20,264	W	23,621	W
Manganiferous ore and concentrate (5 to 35 percent Mn) do	3,638	W	1,968	W
Natural gas million cubic feet	r 25,051	1,965	28,105	2,305
Petroleum (crude) thousand 42-gallon barrels	30,647	74,621	32,778	79,624
Sand and gravel thousand short tons	16,017	17,840	12,048	13,587
Silver (recoverable content of ores, etc.) thousand troy ounces	5,290	6,840	5,207	6,733
Stone thousand short tons	7,345	8,477	5,512	5,971
Zinc (recoverable content of ores, etc.) short tons	29,059	7,904	33,786	9,866
Value of items that cannot be disclosed: Barite, cement, clay (bentonite) fluorspar, gem stones, gypsum, natural gas liquids, peat, phosphate rock, pumice (1964), talc, uranium ore (1964), vermiculite, and values indicated by symbol W	XX	r 21,447	XX	23,834
Total	XX	211,452	XX	229,392

W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed." r Revised. XX Not applicable.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Excludes bentonite; included with "Value of items that that cannot be disclosed."

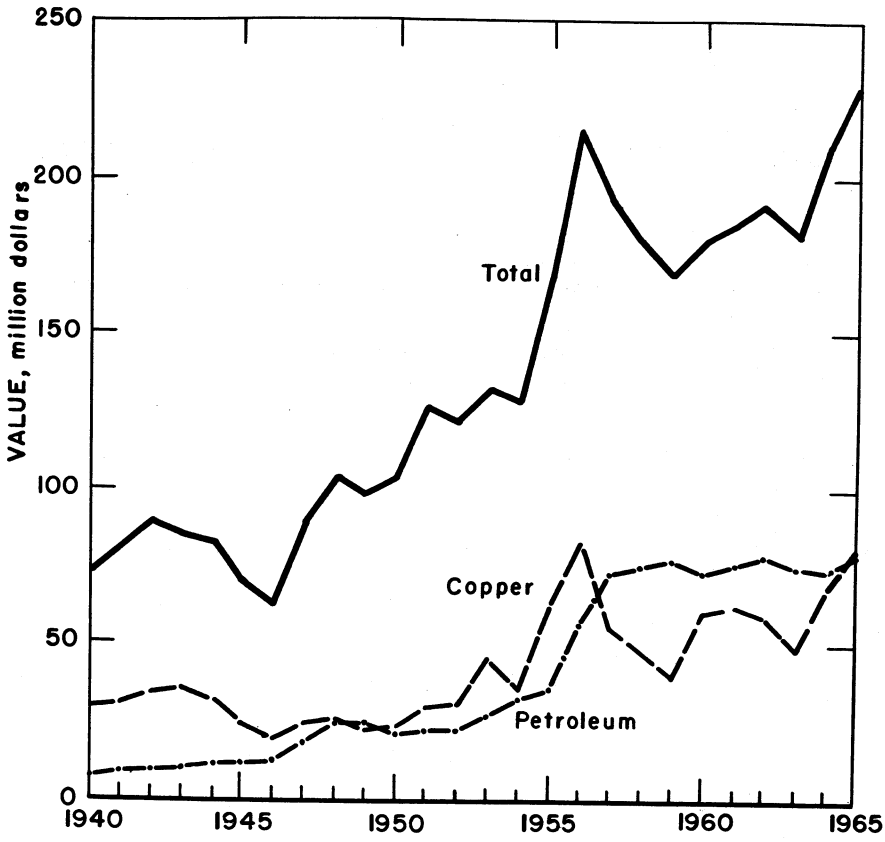

Figure 1.—Value of copper, petroleum, and total value of mineral production in Montana.

Record high production was reached at the Columbia Falls plant of Anaconda Aluminum Company with the August completion of the third of four potlines scheduled to be operational by 1968.

The State's petroleum and natural gas industries accounted for 36 percent of total mineral production value. Recovery of crude oil and natural gas increased 7 and 12 percent, respectively, over that of 1964.

Output of many nonmetal commodities fluctuated in minor ways from 1965, but notable increases (greater than 10 percent) were made for clays, barite, lime, and phosphate rock. Declines were registered in the production and value of sand and gravel and stone owing largely to decreased usage for State highway construction.

Consumption, Trade, and Markets.—The business indicators of table 3 pointed out consistent gains over 1964 figures in personal income and employment. Some construction trends were negative, but a steadying influence was the 54-percent increase in heavy construction contracts. Construction activities at the Yellowtail Dam and missile installations were nearing the phaseout mark, but oilfield and major commercial building projects sustained activity. Extended adverse weather conditions in the early months cut deeply into the upswing that had carried through from 1964 and somewhat limited activity in the lumber and mining industries.

Employment.—Expansion of both underground and open pit mining operations at Butte created a demand for experienced miners and continued a nationwide search for qualified men. Tied closely to expansion of metal-mining operations, active hiring trends were in evidence at the Ana-

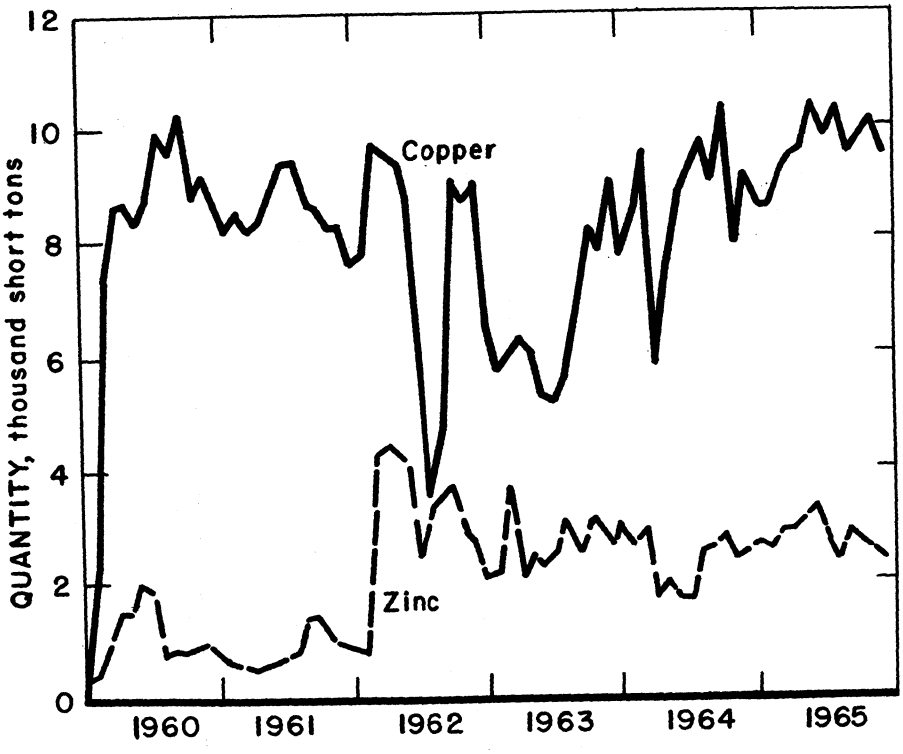

Figure 2.—Mine production of copper and zinc in Montana, by months, in terms of recoverable metals.

Table 2.—Value of mineral production in constant 1957–59 dollars
(Millions)

Year	Value
1956	$189
1957	188
1958	182
1959	166
1960	172
1961	181
1962	184
1963	r 176
1964	r 199
1965	206

r Revised.

conda smelter and the Great Falls refinery. Since 1962, The Anaconda Company had added 1,400 jobs in mining and allied operations in Butte. Total Anaconda employment during 1965 was more than 4,600 at Butte and 1,800 at Anaconda. The firm employed nearly 10,000 people in Montana during the year and offered summer employment to 600 college students.

Government Programs.—The Office of Minerals Exploration (OME) approved three new contracts and continued three 1964 contracts already in effect. American Mining Co. received a $61,880 contract to begin work in 1966 at a Granite County gold property (Nancy Hanks mine). Mascot Silver-Lead Mines, Inc., gained approval of a $28,200 Jefferson County silver project to begin in 1966 at the Meadow mine. Work in Beaverhead County was conducted by Spokane National Mines, Inc., at a silver ore property (New Departure mine) under a $33,880 agreement.

Table 3.—Indicators of Montana business activity

		1964	1965 p	Change, percent
Personal income:				
Total	million dollars	1,611.0	1,701.0	+5.6
Per capita	dollars	2,295.0	2,409.0	+5.0
Construction activity:				
Building permits	million dollars	32.2	33.6	+4.3
Heavy engineering awards	do	83.3	128.1	+53.8
Highway construction contracts awarded	do	66.7	41.6	−37.6
Cement shipments to and within Montana	thousand 376-pound barrels	1,613.1	1,493.3	−7.4
Cash receipts from farm marketings	million dollars	394.4	419.5	+6.4
Mineral production	do	211.4	229.3	+8.5
Annual average employment:				
Total nonagricultural industries	thousands	176.2	180.0	+2.2
Total manufacturing	do	21.5	22.1	+2.8
Lumber and timber industries	do	8.4	8.7	+3.6
Metal-mining and primary-metal industries	do	8.1	8.2	+1.2
Contract construction	do	11.4	12.0	+5.3
Transportation and utilities	do	17.4	17.6	+1.1

p Preliminary.

Source: Survey of Current Business, Construction Review, Pacific Builder & Engineer, Montana Highway Commission, The Farm Income Situation, Montana Labor Market, and Bureau of Mines.

Table 4.—Employment for selected mineral industries

Year	Total mining	Metal mining	Nonmetals, including coal	Petroleum and natural gas	Processing	
					Primary metals	Petroleum refining
1956–60 (average)	9,500	6,100	800	2,600	4,100	1,000
1961	7,100	4,200	700	2,200	3,600	1,000
1962	6,800	3,800	800	2,200	3,500	1,000
1963	7,100	4,100	900	2,100	3,200	1,200
1964	7,600	4,800	900	1,900	3,300	1,200
1965 p	7,300	4,600	1,000	1,700	3,600	1,000

p Preliminary.

Source: Montana State Employment Service, Montana Labor Market. Excludes proprietors and self-employed. Industry groups may vary from those in the Bureau of Mines canvass.

Table 5.—Hours and earnings data in mining and related industries

Industry	1961	1962	1963	1964	1965
Mining:					
Average weekly earnings	$108.14	$111.24	$113.85	$114.76	$119.12
Average weekly hours	40.2	41.2	41.2	38.9	38.8
Average hourly earnings	$2.69	$2.70	$2.77	$2.95	$3.07
Metal mining:					
Average weekly earnings	$106.52	$107.25	$110.76	$111.97	$114.39
Average weekly hours	39.6	39.0	39.0	37.7	36.9
Average hourly earnings	$2.69	$2.75	$2.84	$2.97	$3.10
Primary-metals processing:					
Average weekly earnings	$102.40	$102.82	$105.74	$110.40	$116.40
Average weekly hours	40.0	39.7	39.9	40.0	40.7
Average hourly earnings	$2.56	$2.59	$2.65	$2.76	$2.86

Source: Montana State Employment Service, Montana Labor Market. Hours and earnings data exclude administrative and salaried personnel. Average weekly and hourly earnings include overtime and other premium pay.

Table 6.—Employers, wage earners, and wages in mining

Fiscal year	Average number of employers	Average number of wage earners	Wages (thousands)	Average annual wage
1956-60 (average)	482	9,719	$52,144	$5,365
1961	480	7,453	44,092	5,916
1962	464	6,882	41,800	6,075
1963	421	6,837	43,107	6,316
1964	433	7,163	45,225	6,314
1965	421	7,456	49,048	6,578

Source: Unemployment Compensation Commission of Montana, Montana Labor Market. Industries and employment covered under unemployment insurance laws of Montana.

Table 7.—Employment and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1964:								
Coal and peat	105	133	14	110	1	16	154.55	57,591
Metal	3,748	285	1,068	8,547	5	207	24.81	4,810
Nonmetal	863	279	241	1,919	1	40	21.37	6,020
Sand and gravel	974	203	198	1,593	-------	31	19.47	683
Stone	715	222	159	1,273	-------	20	15.71	352
Total	6,405	262	1,680	13,442	7	314	23.88	4,503
1965: p								
Coal and peat	102	158	16	122	-------	17	139.34	2,926
Metal	3,810	290	1,106	8,772	7	221	25.99	5,750
Nonmetal	870	266	231	1,837	2	32	18.51	7,183
Sand and gravel	820	204	167	1,341	-------	26	19.39	136
Stone	570	207	118	948	-------	24	25.32	439
Total	6,172	265	1,638	13,020	9	320	25.27	4,960

p Preliminary.

REVIEW BY MINERAL COMMODITIES

METALS

Aluminum.—According to The Anaconda Company annual report to shareholders, aluminum production from The Anaconda Aluminum Co. plant at Columbia Falls was 80,843 tons, an increase of 12,008 tons over the 1964 total. The increase was made possible by the August completion of a third potline which raised annual ingot capacity to slightly over 100,000 tons. The firm began constructing a fourth potline, scheduled for completion in 1968 at a cost of $25 million, that would provide an additional 35,000 tons of capacity.

A study of regional aluminum mill product trends was released. [3]

Copper.—Output of copper increased because The Anaconda Company continued to expand and modernize operations in the Butte district. Production, the largest since 1944, rose 11 percent over the 1964 total as the Butte concentrator processed 14.5 million tons of ore.

Nearly 13 million tons of ore from the Berkeley pit yielded 59,821 tons of copper (52 percent of the State total), and 46,978 tons of copper came from 1.5 million tons of ore from the Butte Hill mines (Mountain Con, Steward, and Leonard). Precipitates from mine water percolated through leach dumps accounted for 7,838 tons of metal. Recovery by precipitation increased from less than 1 million pounds of copper in January to 1.8 million pounds in December.

Gold.—Output of gold, mostly a by-product of copper and zinc ores, declined 22 percent below the 1964 total despite significant copper and zinc production

[3] Fulkerson, Frank B., and Jerry J. Gray. Economic Trends in the Pacific Northwest Aluminum Mill Products Industry. BuMines Inf. Circ. 8267, 1965, 36 pp.

Table 8.—Mine production of gold, silver, copper, lead, and zinc in terms of recoverable metals [1]

Year	Mines producing		Material sold or treated [2] (thousand short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Troy ounces	Value (thousands)	Troy ounces (thousands)	Value (thousands)
1956–60 (average)	125	12	10,456	34,273	$1,200	4,720	$4,272
1961	135	17	12,792	35,377	1,238	3,490	3,227
1962	107	5	11,835	24,387	854	4,561	4,948
1963	117	8	9,506	18,520	648	4,242	5,426
1964	110	8	14,872	29,115	1,019	5,290	6,840
1965	121	11	15,634	22,772	797	5,207	6,733
1862–1965	------	------	NA	17,752,572	405,793	852,196	646,885

Year	Copper		Lead		Zinc		Total value (thousands)
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	
1956–60 (average)	87,301	$56,853	10,585	$2,908	38,935	$9,493	$74,726
1961	104,000	62,400	2,643	544	10,262	2,360	69,770
1962	94,021	57,917	6,121	1,126	37,678	8,666	73,511
1963	79,762	49,133	5,000	1,080	32,941	7,576	63,864
1964	103,806	67,682	4,538	1,189	29,059	7,904	84,634
1965	115,489	81,766	6,981	2,178	33,786	9,866	101,340
1862–1965	8,077,038	2,797,698	939,720	148,717	2,804,885	539,623	4,538,717

NA Not available.
[1] Includes recoverable metal content of gravel washed (placer mines), ore milled, and ore, old slag, copper precipitates, and cleanings shipped to smelters during the calendar year indicated. Owing to rounding, individual items may not add to totals shown.
[2] Does not include gravel washed.

increases. Recovery from Butte Hill copper and zinc mines of The Anaconda Company remained about the same as in 1964. Output dropped sharply at the Gold Bug operation in the Little Rockies district, Phillips County, the second largest producer in the State during 1964.

Placer production of 171 ounces was from 11 mines in 6 counties. The largest individual output (66 ounces) was from a dragline dredge operation on the Nugget claim, Nine Mile district, Missoula County.

American Mining Co. received an OME loan for drilling at claims in the Garnet mining district of Granite County. The Federal agency was to furnish 50 percent of the $61,880 contract value.

Iron Ore.—Production of iron ore declined 37 percent from the 1964 total because of reduced requirements at a cement plant in Gallatin County. All production was by R & S Iron Co. from the Iron Cross mine near Radersburg, Broadwater County.

Lead.—Production of lead was 54 percent above the 1964 total because of a higher average content in Butte ores extracted from the Badger State and Anselmo mines. Dump slag from Anaconda's slag-fuming facility, adjacent to the East Helena lead smelter of American Smelting and Refining Company, continued to be a major source of the metal. The largest individual portion of the 1,277 tons not produced by The Anaconda Company came from the Nancy Lee mine, Mineral County.

National Cylinder Gas Division of Chemtron Corp. announced plans to build an oxygen-producing facility adjacent to the lead smelter and slag-fuming plant at East Helena. The new facility, expected to be completed in the fall of 1966 with a 42-ton-per-day capacity, was to supply oxygen for furnace operations at both the smelter and fuming plant.

Manganese.—The Anaconda Company used manganese nodules to produce 6,674 tons of ferromanganese at the Anaconda Reduction Works, but no nodules were made during the year. Taylor-Knapp Co. continued to ship battery- and chemical-grade manganese averaging 37.8 percent manganese to dry cell battery manufacturers and other users. Manganiferous ore

Table 9.—Mine production of gold, silver, copper, lead, and zinc in 1965, by classes of ore or other source materials, in terms of recoverable metals

Source	Number of mines [1]	Material sold or treated (short tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Lode ore:							
Dry gold	12	1,833	1,262	41,184	1,400	----------	23,700
Dry gold-silver	18	9,521	900	30,932	23,600	66,800	84,400
Dry silver	38	30,456	445	164,540	74,100	88,400	217,600
Total	68	41,810	2,607	236,656	99,100	155,200	325,700
Copper	5	14,460,366	15,985	3,318,664	213,604,000	----------	----------
Lead	20	20,465	569	77,526	277,600	2,200,100	580,000
Lead-zinc	13	1,123	92	6,029	4,400	137,800	125,600
Zinc	4	1,006,871	2,440	1,500,033	1,289,300	9,234,000	51,876,800
Total	42	15,488,825	19,086	4,902,252	215,175,300	11,571,900	52,582,400
Other lode material:							
Dry gold and gold-silver old tailings [2]	5	5,733	694	20,066	8,200	----------	----------
Silver old tailings	5	6,245	144	21,863	18,800	----------	----------
Cleanings	2	96	69	86	500	9,000	2,700
Copper precipitates	1	----------	-----	----------	15,675,500	----------	----------
Zinc slag	2	90,828	1	26,098	600	2,225,900	14,661,200
Total lode material	121	15,633,537	22,601	5,207,021	230,978,000	13,962,000	67,572,000
Placer	11	([3])	171	10	----------	----------	----------
Total	132	15,633,537	22,772	5,207,031	230,978,000	13,962,000	67,572,000

[1] Detail will not necessarily add to total, because some mines produce more than one class of material.
[2] Combined to avoid disclosing individual company confidential data.
[3] 94,257 cubic yards.

Table 10.—Gold production at placer mines

Year	Mechanical and hydraulic methods [1]			Small-scale hand methods			Total [2]		
	Number of mines	Material treated (thousand cubic yards)	Gold (troy ounces)	Number of mines	Material treated (thousand cubic yards)	Gold (troy ounces)	Number of mines	Material treated (thousand cubic yards)	Gold (troy ounces)
1956–60 (average)	6	161	858	[3] 5	3	47	11	164	905
1961	5	30	82	12	4	50	17	34	132
1962	3	7	64	2	4	46	5	11	110
1963	2	2	16	6	5	40	8	8	56
1964	5	27	270	3	2	22	8	29	292
1965	[4] 7	93	161	4	1	10	11	94	171

[1] Combined to avoid disclosing individual company confidential data.
[2] Owing to rounding, individual items may not add to totals shown.
[3] Includes surface and underground (drift)placers.
[4] Includes four dragline dredges, one power rocker, and two hydraulic operations.

and concentrate shipments were sold mostly by Taylor-Knapp, but small quantities of stockpiled crude ore were sold by Anaconda.

Taylor-Knapp mined 12,189 tons of manganese ore from which 5,223 tons of concentrate was produced. Anaconda had not mined manganese ore since 1959 but had processed stockpiled ore. The firm completed processing material from a Government stockpile purchased in 1962. Nearly 15,000 tons of low-grade stockpile material was discarded because of its high-phosphorus content.

Silver. — Byproduct silver from Butte district copper and zinc mines accounted

Table 11.—Mine production of gold, silver, copper, lead, and zinc in 1965, by counties, in terms of recoverable metals

County	Mines producing		Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Troy ounces	Value (thousands)	Troy ounces	Value (thousands)
Beaverhead	10	----------	358	$13	42,849	$55
Broadwater	3	----------	W	W	W	W
Deer Lodge	5	----------	168	6	48,389	63
Fergus	3	----------	W	W	190	(1)
Granite	22	----------	914	32	123,702	160
Jefferson	20	1	545	19	41,732	54
Lewis and Clark	10	----------	209	7	42,176	55
Madison	18	----------	619	22	12,096	16
Powell	6	1	71	2	584	1
Silver Bow	8	2	18,420	645	4,790,382	6,194
Undistributed [2]	16	7	1,468	51	104,931	136
Total [3]	121	11	22,772	797	5,207,031	6,733

County	Copper		Lead		Zinc		Total value (thousands)
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	
Beaverhead	11	$8	294	$92	69	$20	$188
Broadwater	W	W	W	W	W	W	19
Deer Lodge	4	3	(1)	(1)	--------	----------	71
Fergus	--------	----------	7	1	2	1	3
Granite	39	28	23	7	304	89	315
Jefferson	13	9	89	28	107	31	141
Lewis and Clark	5	3	1,200	374	7,394	2,159	2,599
Madison	3	2	4	1	8	2	43
Powell	(1)	(1)	5	2	2	1	6
Silver Bow	115,279	81,618	4,594	1,433	25,629	7,484	97,373
Undistributed [2]	134	95	766	239	271	79	581
Total [3]	115,489	81,766	6,981	2,178	33,786	9,866	101,340

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] Less than ½ unit.

[2] Includes values and quantities that cannot be shown separately for Cascade, Flathead, Gallatin, Lincoln, Meagher, Mineral, Missoula, Park, Phillips, and Sanders Counties, and items indicated by symbol W.

[3] Owing to rounding, individual items may not add to totals shown.

Table 12.—Mine production of gold, silver, copper, lead, and zinc, in 1965, by types of material processed and methods of recovery in terms of recoverable metals

Type of material processed and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Lode:					
Amalgamation	23	3	----------	----------	---------
Concentration and smelting of concentrates	18,687	4,883,899	215,158,500	10,749,300	52,359,700
Total	18,710	4,883,902	215,158,500	10,749,300	52,359,700
Direct smelting:					
Ore	2,989	255,007	115,900	977,800	548,400
Old tailings	838	41,929	27,000	----------	----------
Precipitates	--------	----------	15,675,500	----------	----------
Old slag	1	26,098	600	2,225,900	14,661,200
Cleanings and assay sweeps [1]	63	85	500	9,000	2,700
Total	3,891	323,119	15,819,500	3,212,700	15,212,300
Placer	171	10	----------	----------	----------
Grand total	22,772	5,207,031	230,978,000	13,962,000	67,572,000

[1] Combined to avoid disclosing individual company confidential data.

for 92 percent of the State total. The amount recovered from Butte district copper ore was about the same as in the previous year, but zinc ore yielded an additional 168,000 ounces. Only 237,251 ounces came from ores mined and processed mainly for the silver or combined gold and silver values; the comparable 1964 figure was 637,238 ounces.

Interest in locating and developing silver deposits was continued in mining regions throughout the State. Exploration and development of possible major significance were conducted in Beaverhead, Flathead, and Jefferson Counties.

Thorium.—No production was reported, but interest continued in the Lemhi Pass area thorium deposits. Lemhi Minerals Co. contracted to process ore mined from a 100-acre segment of Sawyer Petroleum Company's property (Beaverhead County) in its mill at Baker, Idaho.

Zinc.—The Anaconda Company accounted for most of the 16-percent increase in zinc output by processing higher grade ore from Butte mines at the Anaconda zinc concentrator. Butte ores supplied 76 percent of the State total, and production by The Anaconda Company's slag-fuming operation at East Helena accounted for an additional 22 percent. Most of the ore mined in the Butte district was from the Badger State block-caving operation; some higher grade ore was extracted from the Anselmo mine until its closure in July.

Taylor-Knapp Co. completed an agreement whereby its property (Moorlight group) in the Philipsburg district was to be combined with those of Contact Mining Co. (Scratch Awl mine) and Trout Mining Co. (Algonquin mine) and operated as a single mining unit by Taylor-Knapp. Development ore shipments were made to both the Anaconda zinc concentrator and The Bunker Hill Co. mill at Kellogg, Idaho.

Zirconium.—A report appraising the zircon resource and market potential of Montana and other Western States was published.[4]

NONMETALS

Asbestos.—Superior Asbestos Co., Inc., Libby, discontinued tests for recovering short-fiber tremolite asbestos as a coproduct with vermiculite. Assessment work continued at the Karst property, Gallatin County, by Galaxy Mining Co., Billings.

Barite.—The quantity of barite sold or used by producers increased 60 percent over the 1964 total. Output, mined and processed near Greenough, Missoula County, by Baroid Division, National Lead Co., was marketed as a weighting agent in oil-well drilling mud.

Cement.—The quantity of cement shipments from plants of Kaiser Cement & Gypsum Corp. (Jefferson County) and Ideal Cement Co. (Gallatin County) declined 9 percent from the 1964 total. Destinations within the State accounted for about 68 percent of the cement sales, and shipments also were made to Colorado, Idaho, North Dakota, Oregon, Utah, and Wyoming.

Of the total portland cement shipped from the one dry and one wet process plant, 61 percent was transported by rail and 39 percent by truck. The ratio of bulk to paper bag shipments was about 6:1. About 57 percent of the portland cement produced was distributed to firms manufacturing commercial concrete products, such as ready-mixed concrete companies (43 percent), concrete product manufacturers (6 percent), and building material dealers (8 percent). The remaining 43 percent was sold to highway (8 percent) and other contractors (32 percent), miscellaneous customers (3 percent), and to Federal, State, and local Government agencies (less than 1 percent).

The seasonal nature of construction and the demand for many types of cement made it necessary for Kaiser Cement & Gypsum Corp. to add storage space for 150,000 barrels of cement at the Montana City plant.

Clay.—Output of miscellaneous clay and shale increased 56 percent, and bentonite production advanced 11 percent over the 1964 total. Miscellaneous clay for making heavy clay products was mined in Fergus and Yellowstone Counties. Shale was produced and expanded at plants in Cascade and Yellowstone Counties for use as lightweight aggregate. Bentonite dug in Carter and Phillips Counties was used as

[4] Kauffman, A. J., Jr., and Dean C. Holt. Zircon: A Review, With Emphasis on West Coast Resources and Markets. BuMines Inf. Circ. 8268, 1965, 69 pp.

oil-well drilling mud and for lining irrigation canals.

Fluorspar. — Roberts Mining Co. continued mining fluorspar at the Crystal Mountain mine in Ravalli County and trucked it to the company-owned processing plant at Darby. The steel industry was the largest consumer of the metallurgical-grade fluorspar.

Gem Stones.—Montana moss agate, collected from areas in the Yellowstone River drainage system, comprised the bulk of the value. Sapphires from Granite County and mineral specimens from Silver Bow County contributed to the value. The recreation-mining industry was organized into 19 mineral and gem societies that were served by 24 dealers.

Gypsum.—Output and value of gypsum mined decreased 9 percent compared with the 1964 totals. Two mines in Fergus County furnished the production; some was calcined and sold as ground gypsum. Uncalcined material was used as a retarder in portland cement.

Late in the year, Ideal Cement Co. ceased operations at its mine in Fergus County. Sunshine Mining Co. conducted exploration at deposits in Judith Basin County.

Lime.—Primary open-market lime was manufactured in Powell County. Captive lime output for interplant use resulted from burning limestone at a metallurgical operation in Deer Lodge County, and at four sugar-refining operations in Big Horn, Missoula, Richland, and Yellowstone Counties. A kraft pulping operation regenerated lime sludge in kilns, but the recycled lime was not included in the State total.

Phosphate Rock. — The quantity and value of marketable phosphate rock produced increased 25 and 40 percent, respectively, over the corresponding 1964 figures. Mining was conducted in Beaverhead, Granite, Powell, and Silver Bow Counties. Elemental phosphorus was made at Silver Bow from Beaverhead and Silver Bow County rock. Low-grade rock from Granite and Powell Counties was upgraded at a flotation concentrator in Powell County, and the concentrate was shipped to fertilizer manufacturing plants in Canada. Some rock mined in Powell County went directly to fertilizer plants in Canada. Phosphate rock was defluorinated to make animal-feed products at a plant in Powell County.

Mining and processing of phosphate rock in Montana were described.[5] The report included descriptions of phosphate districts in the State, evaluations of resources and the potential of these districts, and descriptions of individual phosphate deposits, mines, and prospects.

A report prepared for Northern Pacific Railway in 1958, describing areas of minable phosphate rock and individual mines and prospects in Montana, was placed on open file at the library of the Montana College of Mineral Science and Technology.[6]

Sand and Gravel.—Sand and gravel output declined 25 percent from the 1964 total because of smaller requirements by the State highway department in road construction and less tonnage used by the Bureau of Reclamation at the Yellowtail dam construction project.

Commercial sand and gravel output came from 51 operations and comprised 28 percent of the State total output. Government-and-contractor production (largely for roads and dam construction by Federal, State, and local Government agencies) was from 144 facilities and represented 72 percent of total sand and gravel output. Commercial production came from 24 stationary, 21 portable, and 6 semiportable plants. Government-and-contractor output was from 4 stationary, 134 portable, and 6 semiportable operations.

Sand and gravel was produced in 47 of the 56 counties. Output exceeded 1 million tons in Gallatin and Yellowstone Counties.

Distribution of output by use was road construction, 83 percent; building, 7 percent; and miscellaneous uses, including fill and railroad ballast, 10 percent.

Stone.—Output of stone declined 25 percent largely because of smaller requirements at State highway department projects. Stone was produced in 41 counties, and output exceeded 1 million tons in Yellowstone County.

Miscellaneous stone (unclassified as to

[5] Popoff, C. C., and A. L. Service. An Evaluation of the Western Phosphate Industry and Its Resources (in Five Parts). Part 2. Montana. BuMines Rept. of Inv. 6611, 1965, 146 pp.

[6] Luft, S. J. Phosphate Deposits of Montana. Prepared for Northern Pacific Railway, 1958. Open file report, Montana College of Mineral Science and Technology.

Table 13.—Sand and gravel sold or used by producers, by classes of operations and uses
(Thousand short tons and thousand dollars)

Class of operation and use	1964		1965	
	Quantity	Value	Quantity	Value
Commercial operations:				
Building	801	$1,121	828	$1,227
Road material	1,519	1,440	2,135	1,746
Fill	291	209	231	202
Railroad ballast	39	35	W	W
Other [1]	114	78	139	169
Total	2,764	2,883	3,333	3,344
Government-and-contractor operations:				
Building	1,274	1,615	-------	-------
Road material	11,291	12,940	7,914	9,403
Fill	671	393	293	177
Other [1]	17	9	508	663
Total	13,253	14,957	8,715	10,243
All operations:				
Building	2,075	2,736	828	1,227
Road material	12,810	14,380	10,049	11,149
Fill	962	602	524	379
Railroad ballast	39	35	W	W
Other [1]	131	87	647	832
Grand total	16,017	17,840	12,048	13,587

W Withheld to avoid disclosing individual company confidential data.
[1] Sand and gravel used for miscellaneous and unspecified purposes and items indicated by symbol W.

type by producers), granite, limestone, marble, and sandstone were produced. Miscellaneous stone, largely for use in construction, was quarried in 35 counties, and output totaled 4.1 million tons valued at $3.5 million. Limestone output for agricultural purposes, riprap, metallurgical uses, and for making cement and lime totaled 1 million tons valued at $1.4 million. It was produced in Broadwater, Carbon, Deer Lodge, Gallatin, Jefferson, and Powell Counties. Output of 136,647 tons of silica-bearing materials valued at $422,590 came from sandstone, quartz, and quartzite operations in Beaverhead, Deer Lodge, Gallatin, and Jefferson Counties. The material was used as an abrasive, as a silica component in manufacturing cement, as a flux at phosphate and copper reduction plants, and some was shipped out of the State for use in making ferrosilicon. Granite came from quarries in Carbon, Flathead, Gallatin, Glacier, and Missoula Counties, and output totaled 126,952 tons valued at $267,178. Marble quarries were operated in Carbon, Madison, and Park Counties.

Sulfur.—Production of high-purity sulfur from refinery gases increased compared with the 1964 total. Two oil refineries near Billings, Yellowstone County, furnished the raw material to a Montana Sulphur & Chemical Co. plant.

A report prepared by the Bureau of Mines Albany Office of Mineral Resources giving sulfur and sulfuric acid consumption in the Pacific Northwest with projections through 1985 was released by the Bonneville Power Administration. [7]

Talc.—The quantity of talc produced increased 4 percent, and value was up 7 percent compared with the 1964 totals. Mining was by four companies at one underground and stripping operation in Beaverhead County and at six open pit mines in Madison County. Material from the seven mines was ground at plants within the State in Beaverhead, Gallatin, and Lewis and Clark Counties. Some was shipped out of the State for grinding to plants at Grand Island, Nebr.; Ogden, Utah, and Los Angeles, Calif.

The use distribution of talc by industry was paper, 33 percent; paint, 28 percent; ceramics, 26 percent; and exports and mis-

[7] Hale, William N., and Norman S. Petersen. Sulfur Consumption in the Pacific Northwest. Report prepared for Bonneville Power Administration, Portland, Oreg., by the Bureau of Mines Mineral Resource Office, Area VII, Albany, Oreg., 1965, 51 pp.

cellaneous uses, including insecticides, textiles, toilet preparations, refractories, rice polishing, and rubber, 13 percent.

Vermiculite.—Output of crude vermiculite advanced 13 percent over the 1964 total. The principal source of vermiculite in the United States continued to be the open pit mine near Libby, Lincoln County, of Zonolite Division, W. R. Grace & Co. Large tonnages of the material were shipped out-of-State to be expanded. Some was exfoliated by a company in Great Falls, Cascade County.

MINERAL FUELS

Coal.—Output of bituminous coal and lignite from 13 mines (10 underground and 3 open pit) in 8 counties increased 5 percent over the 1964 total. Bituminous coal was produced from 10 mines in 5 counties. Most of the output came from six underground mines in Musselshell County and one underground mine in Carbon County. Some was produced at strip mines in Big Horn and Rosebud Counties, and at an underground mine in Blaine County.

Lignite came from three mines—two underground mines in Custer and Powder River Counties and one open pit mine in Richland County. The average unit value of bituminous coal was $7.24 per ton, f.o.b. mines; lignite averaged $1.96 per ton, f.o.b. mines.

Petroleum and Natural Gas [8].—Recovery of crude oil was a record alltime high of 32.8 million barrels valued at $79.6 million. In terms of value of mineral production, crude oil ranked second and represented 35 percent of the total value of mineral output in Montana. About 41 percent of the crude oil recovered came from four fields, the Pine and Cabin Creek fields in the Williston Basin, the Elk Basin field in south-central Montana, and the Cut Bank field in northern Montana. Each field had output exceeding 3 million barrels. Other oilfields exceeding 1 million barrels were Lookout Butte, Pennel, Poplar, and Weldon in the Williston Basin and the Fred and George Creek field in northern Montana.

Marketed production of natural gas totaled 28.1 billion cubic feet, and withdrawals continued to be highest in the Cut Bank-Reagan field with output of 8.3 billion cubic feet. Over 3 billion cubic feet was withdrawn from the Cedar Creek and Keith Block fields, and output in excess of 1 billion cubic feet was withdrawn from the Big Coulee, Bowdoin, Cabin Creek, Dry Creek, and Whitlash fields.

Exploratory drilling totaled 214 wells; 14 were oil discoveries, 1 was a gas well, and 199 were dry. Development drilling totaled 293 wells; 177 yielded oil, 9 were gas wells, and 107 were dry. Exploratory and development drilling was greatest in Toole County, largely in the vicinity of the Fred and George Creek field, where 124 wells were drilled; 49 were oil producers, 8 were gas wells, and 67 were dry holes. The average well depth in the county was less than 2,500 feet. Development drilling continued in the Flat Lake and Goose Lake fields in Sheridan County where 53 wells were drilled; 39 were oil wells, and 14 were dry. The average well depth in the county was 6,850 feet. Exploratory and development activities also continued in the Weldon field in McCone County where 48 wells were drilled; 15 were oil producers, and 33 were dry holes. The average well depth in the county was 6,858 feet.

Nine refineries processed 33 million barrels of crude oil, 1 million barrels more than in 1964. Montana wells furnished 36 percent of the total, and the remainder came from Wyoming wells (50 percent) and Canadian wells (14 percent).

Secondary recovery of crude oil was from 3 gas injection and 30 waterflooding projects. Six waterflooding projects for secondary recovery of crude petroleum were started and included operations in the Cut Bank, Kevin-Sunburst, Little Beaver East, Mosby Dome, Red Creek, and Richey Southwest fields.

Seven companies received authorization to dispose of salt or brackish water to subsurface formations in the Mineral Beach, Outlook, Pondera, Ragged Point, and Weldon fields. Most of the contaminated water was injected to Lower Cretaceous sands at depths between 3,700 and 5,000 feet. Some was returned to the Madison Limestone formation at depths of over 6,000 feet. An example of saline water disposal to abandoned wells in the Williston Basin was the brine-disposal system in the Lookout Butte field

[8] Montana Oil and Gas Conservation Commission. Montana Oil and Gas Statistical Bulletin and Annual Review. V. 9, 1965.

of Continental Oil Co., Shell Oil Co., Pan American Petroleum Corp., and Northern Pacific Railway. The brine-disposal system utilized an abandoned well at the edge of Lookout Butte field. The well, plugged back to the Madison Formation at a depth of 7,200 feet, received about 2,500 barrels of saline water daily from the operation of over 100 producing wells in the field. The Montana Oil and Gas Conservation Commission became concerned with the problem of salt or brackish water disposal in various fields in Montana. The large expense that petroleum operators incurred and the number of hearings on salt water disposal caused the Commission to review its policy regarding laws, rules, and regulations. The Commission determined that formal hearings would not be required for salt water disposal by petroleum operators; however, all other laws must be complied with regarding application submissions, notices, and receipt of authorization approvals.

REVIEW BY COUNTIES

Mineral production for 1965 was reported from 55 of the State's 56 counties. Silver Bow County accounted for 43 percent of the total mineral output value. Only counties with significant metal, nonmetal, or fuel developments are discussed in the following review.

Beaverhead. — Metal production value from 10 mines was less than in 1964, largely because of sharply reduced silver output at the New Departure mine. Gold and lead output from the Maulden mine (Ida B. Hand) increased to 314 ounces and 268 tons, respectively; 7,482 ounces of silver and 52 tons of zinc also were recovered from 2,820 tons of ore shipped to the East Helena lead smelter. The largest silver output came from the Polaris mine operated by Lee M. James.

Spokane National Mines, Inc., announced completion of 980 feet of drifting under a $33,880 (75-percent Government participation) OME contract. A drilling project was initiated to check the downward extent of a vein exposed by the work.

American Smelting and Refining Company leased from Earl Chilcott and Leonard Lively all former holdings of Hecla Consolidated Mining Co. in the Hecla mining district, including the Hecla mine, and began diamond drilling in search of ore zones peripheral to the area of past mining operations. Wayne Erickson terminated operations at the Comet mine in the Elkhorn district. He had received an OME contract in 1964 for work in the district.

Phosphate rock produced at the Canyon Creek and East La Marche underground mines by Stauffer Chemical Co., Industrial Chemical Division (formerly Victor Chemical Works), was shipped to the company elemental phosphorus plant at Silver Bow. Silica-bearing material produced at the Maiden Rock placer by Stauffer Chemical Co. was used as a flux in company elemental phosphorus furnaces at Silver Bow. Talc was mined at the Smith-Dillon and Crown stripping and underground operation by Tri-State Minerals Co. Some of the output was ground at the company Barretts mill.

Big Horn.—Crude oil was recovered from four fields, and natural gas was withdrawn at the Hardin field. Limestone was calcined for use at the Holly Sugar Corp. Hardin plant. Sand and gravel requirements at the Bureau of Reclamation Yellowtail dam project declined to 490,000 tons.

Broadwater.—Iron ore (magnetite) containing 45 percent iron was trucked to a cement plant at Trident from the Iron Cross mine of R & S Iron Co. near Radersburg. Gold, silver, copper, lead, and zinc were recovered from 339 tons of ore, extracted at three mines.

Limestone was produced for riprap at the Eustis quarry by the Chicago, Milwaukee, St. Paul, & Pacific Railroad Co.

Carbon.—The county ranked second in value ($9.4 million) of nonmetal and fuel output. Production increases were reported for coal, natural gas, and sand and gravel. Recovery of crude oil from the Elk Basin field was 3.4 million barrels, and natural gas withdrawals from the Dry Creek field totaled 1.6 billion cubic feet. Coal was mined by Brophy Coal Co. at the Brophy No. 2 mine, which was the principal source of bituminous coal in Montana. Limestone output from the Warren quarry by Big Horn Limestone Co. was used at sugar

Table 14.—Value of mineral production in Montana, by counties

(Thousand dollars)

County	1964	1965	Minerals produced in 1965, in order of value
Beaverhead	W	W	Phosphate rock, sand and gravel, stone, lead, talc, silver, zinc gold, copper.
Big Horn	$1,943	$1,015	Sand and gravel, petroleum, lime, coal, natural gas, stone.
Blaine	495	356	Petroleum, natural gas, coal.
Broadwater	107	540	Sand and gravel, natural gas, iron ore, zinc, lead, stone, silver, gold, copper.
Carbon	9,563	9,410	Petroleum, stone, coal, sand and gravel.
Carter	1,695	443	Clays, petroleum.
Cascade	942	834	Sand and gravel, stone, clays, lead, silver.
Chouteau	540	26	Stone, sand and gravel.
Custer	265	1,461	Sand and gravel, stone, coal.
Daniels	6	203	Sand and gravel, stone.
Dawson	4,198	3,752	Petroleum, sand and gravel, stone.
Deer Lodge	1,077	1,694	Lime, stone, sand and gravel, silver, gold, copper, lead.
Fallon	20,544	19,049	Petroleum, natural gas.
Fergus	W	727	Sand and gravel, gypsum, clays, stone, lead, zinc, silver, gold.
Flathead	744	1,326	Sand and gravel, stone, silver, lead, zinc, copper, gold.
Gallatin	W	W	Cement, sand and gravel, stone, clays, lead, zinc, silver.
Garfield	(1)	279	Sand and gravel, stone.
Glacier	2,356	1,881	Petroleum, sand and gravel, stone.
Golden Valley	22	------	
Granite	3,132	W	Phosphate rock, manganese ore, silver, sand and gravel, stone, zinc, gold, manganiferous ore, copper, lead.
Hill	84	719	Sand and gravel, stone.
Jefferson	W	W	Cement, stone, silver, zinc, lead, gold, copper, clays.
Judith Basin	24	35	Sand and gravel, stone.
Lake	265	64	Sand and gravel, stone, peat.
Lewis and Clark	3,538	3,437	Zinc, sand and gravel, lead, stone, silver, gold, copper.
Liberty	1,810	1,908	Petroleum, natural gas, sand and gravel, stone.
Lincoln	W	W	Vermiculite, stone, sand and gravel, zinc, lead, silver.
McCone	659	3,008	Petroleum, sand and gravel.
Madison	2,231	1,324	Talc, stone, sand and gravel, gold, silver, zinc, copper, lead.
Meagher	310	W	Lead, gold, silver.
Mineral	997	1,073	Sand and gravel, stone, lead, copper, silver, zinc, gold.
Missoula	1,937	808	Sand and gravel, stone, barite, lime, gold, zinc, silver, lead, copper.
Musselshell	3,086	3,163	Petroleum, coal, sand and gravel, stone.
Park	W	W	Stone, sand and gravel, gold, zinc, copper, silver, lead.
Petroleum	42	48	Sand and gravel, stone.
Phillips	W	W	Natural gas, silver, gold, sand and gravel, stone, zinc, clays, copper.
Pondera	324	365	Sand and gravel, petroleum, stone.
Powder River	17	102	Sand and gravel, petroleum, coal, stone.
Powell	W	W	Phosphate rock, lime, sand and gravel, stone, gold, lead, silver, zinc, copper.
Prairie	9	159	Sand and gravel, stone.
Ravalli	W	W	Fluorspar, sand and gravel, peat, stone.
Richland	1,149	1,155	Coal, petroleum, lime, sand and gravel.
Roosevelt	6,045	6,643	Petroleum, sand and gravel.
Rosebud	3,279	W	Petroleum, coal.
Sanders	82	W	Lead, zinc, silver, copper, gold.
Sheridan	3,771	5,276	Petroleum, sand and gravel.
Silver Bow	81,973	99,517	Copper, zinc, silver, lead, manganese ore, sand and gravel, gold, phosphate rock, manganiferous ore, stone.
Stillwater	--------	16	Natural gas.
Sweet Grass	--------	12	Sand and gravel.
Teton	62	385	Sand and gravel, stone, petroleum.
Toole	4,360	4,709	Petroleum, natural gas, sand and gravel, stone.
Treasure	39	8	Sand and gravel.
Valley	1,139	212	Sand and gravel, stone.
Wheatland	352	483	Do.
Wibaux	169	6	Sand and gravel.
Yellowstone	2,899	3,310	Sand and gravel, stone, petroleum, lime, clays.
Combined counties [2]	17,584	21,055	
Undistributed [3]	r25,587	27,396	
Total	r211,452	229,392	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
r Revised.
[1] Less than ½ unit.
[2] Petroleum and natural gas production from fields underlying two or more counties. See "Combined counties."
[3] Includes value of mineral production that cannot be assigned to specific counties and values indicated by symbol W.

refineries. Marble came from operations of Montana Marble, Inc., at the Dead Man quarry.

Carter.—Bentonitic clay was produced by National Lead Co., the leading producer of clay in the State, for use in oil-well drilling mud.

Cascade.—As part of a continuing modernization program at the Great Falls Reduction Department, The Anaconda Company increased its monthly copper refining capacity from 12,500 tons to 15,000 tons by regrouping electrolytic cells and improving solution lines and solution-heating facilities. Refined copper production at the refinery rose to 165,242 tons, and a new monthly record of 16,124 tons was set in December.

Increased concentrate receipts from both foreign and domestic sources raised production at the electrolytic zinc plant to 143,927 tons. As at the copper refinery, a new monthly production record (14,107 tons) was established in December. Cadmium production at the zinc plant rose to 651 tons, a 31-percent increase over that of 1964.

Shale from pits near Great Falls was expanded for lightweight aggregate by Treasurelite, Division of Treasure State Industrial Products, Inc.

Dawson.—Crude oil recovery from six oilfields totaled 1.2 million barrels, slightly less than the 1964 output. The Gas City field continued to be the principal source.

Deer Lodge.—Gold and silver output was higher than in 1964 largely because production was initiated at the Champion mine by Champion Mining Co. The operation shipped 3,676 tons of ore containing 133 ounces of gold and 35,218 ounces of silver to the copper smelter at Anaconda.

Copper concentrates and precipitates from company operations at Butte and Yerington, Nev., were smelted at the Anaconda Reduction Works at Anaconda. Copper anodes cast for shipment to the refinery at Great Falls totaled 145,000 tons. Arsenic recovery operations at the reduction works were terminated early in the year; only 106 tons was recovered, compared with 1,516 tons in 1964.

The Anaconda Company completed the first phase of its electrolytic-beryllium-refining pilot plant at Anaconda. Planned improvements in the process were designed for treating beryllium concentrates from Spor Mountain, Utah.

An underground pipeline was installed in the mountainous area west of Anaconda to carry water from company reservoirs to the city of Anaconda, the reduction works, and the Butte concentrator. A 60-inch-diameter pipe replaced the 46-year-old flume that had been formerly used.

Limestone quarrying continued at Brown's quarry; the material was burned to lime by The Anaconda Company for metallurgical uses. Silica-bearing material produced at the Luke quarry by Montana Ores, Inc., was used as a silica component in making cement and refractories, and was used as a flux at metallurgical operations.

Fallon.—Crude oil recovery continued to decline; output totaled 7.8 million barrels compared with 8.4 million in 1964. The Cabin Creek field contributed 3.1 million barrels, and the Pennel and Lookout Butte fields accounted for 2.4 and 1.4 million barrels, respectively. The remaining output came from six other fields.

Fergus. — Three operations furnished small quantities of gold, silver, lead, and zinc.

There was a substantial decline in the tonnage of gypsum mined near Heath by United States Gypsum Co. and near Hanover by Ideal Cement Co. Late in the year, Ideal Cement Co. closed the Hanover gypsum mine; underground rock movement at the property compelled the company to close the mine for safety reasons. Sand and gravel output increased, but less clay and stone were produced than in 1964.

Flathead. — Waino Lindbom continued ore shipments from the West Flathead mine. Midnite Mining Co. terminated exploration in the Hog Heaven district after completing a $50,000 drilling program conducted under an agreement with Lindy Mining Co. After completing a reexamination of its Flathead mine property, The Anaconda Company granted a long-term lease on its holdings in the district to Waino Lindbom, who had leased the property on a year-to-year basis for many years. Construction of a mill and an open pit mining operation was planned. The Montana Bureau of Mines

and Geology published the results of a geochemical survey of the Flathead area.[9]

Anaconda Aluminum Co. requested the Bonneville Power Administration to supply power for a fourth potline to be placed in operation in 1968.

Gallatin.—The Trident plant of Ideal Cement Co. continued to be the leading mineral industry operation in the county. The Trident quarry was the source of limestone and the silica used at the cement plant came from a deposit several miles east of Trident. The county ranked second in output of sand and gravel (1.3 million tons) because of increased requirements for road construction at State highway department projects. Talc mined in Madison County was ground at the Three Forks plant of Sierra Talc & Chemical Co., Division of Cyprus Mines Corp.

Glacier.—Crude oil output declined to 684,000 barrels from 860,000 barrels in 1964. Seven fields contributed to the production.

Granite.—The value of gold, silver, copper, lead, and zinc production declined slightly despite an increase in the number of mines being operated from 11 in 1964 to 22 in 1965. Larger output by Taylor-Knapp Co. from the Moorlight group accounted for nearly all of the lead and zinc produced and 28,587 ounces of the silver total. Gold-silver tailings from the Rumsey mine (R. Tunstill) accounted for a large part of the gold output. Siliceous tailings (Ben Walkup) and silver ore (John C. Bork & Sons) from the Black Pine mine supplied important amounts of silver. The discovery by geochemical methods of an ore body at the Brooklyn mine was described in a technical journal.[10]

Taylor-Knapp Co. began driving a drift southward from its True Fissure shaft that was to eventually connect the three properties comprising the unitized area. The initial goal was to intersect and begin east-west development of the Cliff vein at a depth of approximately 280 feet below all previous workings on the structure. Pumps were installed at the Algonquin shaft to dewater the mine, which flooded after operations were terminated in 1962. Extensive exploration of the three properties, involving diamond drilling to depths 2,000 feet below existing workings, was begun.

Near full-capacity output was recorded for the Douglas Creek mine flotation plant by Cominco American, Inc. (formerly Montana Phosphate Products Co.). Low-grade rock, from the Douglas Creek mine and from mines in Powell County, was upgraded at the plant to a concentrate containing over 31 percent P_2O_5, which was shipped to fertilizer manufacturing plants at Trail and Kimberley, British Columbia, Canada. Sapphires came from the American Sapphire Gem mine near Philipsburg.

Jefferson.—The production value from 20 metal mines was lower than in 1964. The largest individual mine output of gold, silver, and copper was from the Basin Jib mine at Basin, where 4,461 tons of siliceous ore yielded 147 ounces of gold, 10,289 ounces of silver, 7 tons of copper, 1 ton of lead, and 3 tons of zinc before the opencut operation was terminated late in the year. The largest lead and zinc production came from the Boulder Engineering Co. operation at the Nellie Grant mine.

Ruby Silver Mines, Inc., extracted and stockpiled a small quantity of ore while continuing underground exploration of the Ruby mine in the Lowland district. After United Buffadison Mines, Ltd., discontinued work begun in 1964 at the Crystal property in the Cataract (Basin) district, Delbert Bullock resumed shipping siliceous gold-silver ore from an opencut mine to the East Helena lead smelter. Shipman Mining & Exploration Co. continued exploring and developing properties in the Boulder-Basin area with work centered at the Romero mine. The properties, consisting of 68 patented claims and including the Comet and Gray Eagle mines, were purchased for $300,000 on an annual payment basis. Mascot Mines, Inc., was granted a $28,200 OME loan for underground work at the Meadow mine in the Clancy district; Government participation was to be 75 percent of the contract value.

The Kaiser Cement & Gypsum Corp. Montana City cement plant was the county's leading nonmetal mineral industry operation. Limestone for the plant came from the Montana City quarry. Quartz

[9] Sahinen, U. M., W. M. Johns, and D. C. Lawson. Geochemical Reconnaissance Stream-Sediment Sampling in Flathead and Lincoln Counties, Montana. Montana Bureau of Mines and Geol. Bull. 48, 1965, 16 pp.

[10] Engineering & Mining Journal. Geochemistry Yields Silver Bonanza. V. 166, No. 8, August 1965, pp. 109–110.

produced from the Katie quarry by Pacific Silica Co. was used in manufacturing abrasives, cement, and ferrosilicon. Limestone produced by Maronic Construction Co. at the McClellan Creek quarry was used as a flux at metallurgical operations.

Judith Basin.—Sunshine Mining Co. conducted diamond drilling and trenching exploration on gypsum deposits in the Kibbey formation, 8 miles south of Raynesford. Late in the year, the company announced plans to develop the deposit.

Lewis and Clark.—Production from the slag-fuming plant at East Helena continued to dominate metal production statistics. Lead and zinc recovered from cold slag declined to 1,110 tons and 7,328 tons, respectively. Several truckloads of crude ore were processed at the fuming plant to test the economics of processing ore in addition to slag. The planned use of oxygen in the fuming furnace, following completion of a nearby plant by National Cylinder Division of Chemtron Corp., was expected to significantly increase the capacity of the operation.

The largest individual gold production output was from the Franklin & Sam Gaty mine (Helena Minerals Co.) in the Ten Mile district. Eight other operations mined small quantities of gold and silver ores.

Production of lead bullion at the American Smelting and Refining Company lead smelter at East Helena declined 7 percent from that of 1964 despite the October termination of Government restrictions on imports of foreign lead ores. A new sintering complex being installed was to be operational by September 1966.

The Anaconda Company operated up to four drills throughout the year at a property in the Heddleston mining district near the Mike Horse mine. The firm reported intersecting encouraging sections of low-grade copper and molybdenum mineralization.

Liberty.—Recovery of crude oil from four fields in the county totaled 602,000 barrels. Natural gas withdrawals increased to 6.5 billion cubic feet from 4.8 billion cubic feet in 1964. Principal gasfields were Keith Block (3.4 billion cubic feet), the second largest source of natural gas in the State, and Whitlash (1.5 billion cubic feet).

Lincoln.—Missouri-Montana Mining Co. leased the Snowstorm mine and adjacent properties in the Troy district and shipped zinc ore to the Bunker Hill concentrator at Kellogg, Idaho.

Madison.—Most of the gold, silver, and lead output came from the Pacific mine (Pacific Mines, Inc.) in the Virginia City district. Fourteen other mines supplied gold and silver ore, and four yielded small quantities of lead ore. The second largest output was 95 ounces of gold and 1,472 ounces of silver from the St. Lawrence mine in the Virginia City district.

Milton Pulver, Seattle, Wash., secured an option on the Cornucopia-Cabin group in the Virginia City district from Frank E. Blair and began development at the property. Highland-Surprise Consolidated Mining Co. secured a lease and option on the Alameda claim group near Virginia City.

Talc mining, from six open pit mines by three companies, continued to be the principal nonmetal mineral industry in the county. Talc was mined by American Chemet Corp. at the Bozo Lobo, Madison, and Mary Williams mines; by Sierra Talc & Chemicals Co., Division of Cyprus Mines Corp. at the Yellowstone open pit; and by Tri-State Minerals Co. at the Regal and Treasure State mines.

American Chemet Corp. completed a plant at Sheridan to make stone products from a marble deposit in Dry Gorge Gulch in the Tobacco Root Mountains. Marble from the White Angel quarry, at an elevation of about 6,500 feet, was selectively mined from two pits, processed at the plant, and used for terrazzo for building aggregate in precast decorative panels and for making roofing and garden chips. Waste fines were sold as marble whiting for use in terrazzo, plaster, and other products. Boulders were hauled separately to the plant to make split rock for walls and fireplaces. Some of the broken stone was screened at the quarry and sold for roadstone.

McCone.—Crude oil recovery from four fields totaled 1.3 million barrels, compared with 277,000 barrels in 1964. Production from the Weldon field increased from 36,000 barrels in 1964 to 1.1 million barrels in 1965. Exploratory drilling was high in the county; 26 exploratory test holes were drilled, and 1 was an oil discovery. Development drilling included 22

wells; 14 were oil producers, and 8 were dry holes.

Meagher. — United Nuclear Corp. announced plans to begin open pit mining and to build a $500,000 concentrator at the Cumberland property. Surface work and diamond drilling were conducted in search of lead-silver-zinc ore bodies.

Mineral.—The value of gold, silver, copper, lead, and zinc output increased sharply over that of 1964 because of production from the Nancy Lee mine by E. G. Smith, lessee. A sizable ore zone between the 790 and 940 levels was discovered and blocked out.

Missoula.—Production from the Charcoal mine in the Coloma (Potomac) district accounted for most of the metal output in the county. The Bunker Hill Co. conducted a drilling program at the Ward mine (Ward Development Co.) before terminating its lease.

Barite from the Elk Creek mine, 9 miles southeast of Greenough, was trucked to the Baroid Division, National Lead Co. plant at Greenough for processing. Material was gravity concentrated by jigs to remove waste, dewatered, dried, and ground in standard roller mills. Some of the sized material was packaged; it was used in oil-well drilling mud.

American Crystal Sugar Co. calcined limestone in kilns for use at its sugar refinery.

Musselshell.—Crude oil recovery from 12 fields remained at 1.1 million barrels. Most of the output continued to be furnished by the Big Wall, Ivanhoe, and Keg Coulee fields. Sumatra Gasoline Co. installed a natural gasoline plant at Melstone to recover LP gases from about 80 producing natural gas wells in the Sumatra, Stensvad, Ivanhoe Dome, and Keg Coulee fields. Propane, butane, and natural gasoline were produced at the plant with capacity to process 6 million cubic feet of natural gas per day. Products were trucked from the plant to distributing points throughout the State. Bituminous coal output by six companies from six underground mines near Roundup totaled 32,230 tons.

Park.—Bear Creek Mining Co., a subsidiary of Kennecott Copper Corp., conducted diamond drilling and other exploration at New World mining district properties purchased from McLaren Gold Mines Corp. in 1962.

Marble was produced by Livingston Marble and Granite Works from the Lawrence quarry on Northern Pacific Railway Co. property near Gardiner.

Phillips. — Northern Continental, Inc., produced considerably less gold and silver from the Gold Bug mine in the Little Rockies district than in 1964.

Powell.—Metal production by six small operations was considerably less than in 1964. The largest gold output was from old gold tailings at the Watseca mine in the Nigger Hill district. The largest individual production of silver, lead, and zinc was from the Hidden Hand claim group.

Phosphate rock production was higher than the 1964 total. Cominco American, Inc., (formerly Montana Phosphate Products Co.) and George Relyea furnished the output. Most of the material was exported to the Consolidated Mining & Smelting Company of Canada, Ltd., plant at Trail, British Columbia, for use in manufacturing phosphate fertilizers. Rocky Mountain Phosphates, Inc., continued to be involved with litigation over alleged responsibility by the company for air pollution in the Garrison area. The company, defluorinating phosphate rock to make animal-feed products, installed gas-scrubbing facilities at the plant in Garrison to remove fluoride compounds from waste gases. Twenty-five stations were installed by the company to determine fluoride-waste material emitted to the atmosphere.

Limestone from the Elliston quarry was calcined and marketed as quicklime and hydrated lime by Elliston Lime Co.

Richland.—Lignite production by Knife River Coal Mining Co. at the Savage mine increased moderately. The company, a subsidiary of Montana-Dakota Utilities Co. that furnished coal to the parent company coal-fired steam-electric plant at Sidney, started an experimental tree-planting program at areas disturbed by surface mining for lignite near Savage. Several thousand trees, capable of growing in arid and semiarid climates, were planted in May in an attempt to evaluate possibilities of growth in the area. About 10 acres of land are disturbed annually by the company at its eastern Montana strip mining operation.

Crude oil recovery declined 3,000 barrels from the 1964 total. Initial production from the Fairview field did not offset declines in output from the Sidney-Brorson and Spring Lake fields.

Roosevelt.—Thirteen oilfields yielded a total of 2.5 million barrels of crude oil; a large part of the production, 1 million barrels, came from the Poplar field.

Rosebud.—Crude oil recovery was 961,000 barrels, compared with 1.3 million in 1964. Most of the production, 956,000 barrels, was from the Sumatra field.

Sanders.—Increased production from the Jack Waite mine by lessees accounted for a significant rise in the value of metal output compared with the 1964 total. Ke Jo Mining Co. extracted 8 tons of lead-zinc development ore while sinking a shaft at the Blue Creek property in the Blue Creek district. Silver Mountain Exploration Co. began drifting at the Eddy Creek property to check the downward extension of an outcropping vein.

Bear Creek Mining Co. staked two large claim blocks following reconnaissance exploration during the summer months. Approximately 190 claims were located in the Rock Greek area north of Noxon, and 210 claims were staked in the Beaver Creek drainage between Thompson Falls and Trout Creek. Examination of the rugged terrain was aided by the use of helicopters.

Sheridan.—Oilfields in the county produced 2.4 million barrels or about 900,000 barrels more than the 1964 total. Most of the production (1.5 million barrels) was from the Flat Lake and Goose Lake fields. Exploratory and development drilling was highest for any county in the State in terms of total footage drilled (363,054 feet). One oil discovery resulted from exploratory drilling of 6 wells, and 38 oil producers came from development drilling of 47 wells, largely in the Flat Lake and Goose Lake fields.

Silver Bow.—Production by The Anaconda Company from Butte district mines supplied 95 percent of the State's gold, silver, copper, lead, and zinc output value. These mines furnished 81 percent of the gold, 92 percent of the silver, 99.8 percent of the copper, 66 percent of the lead, and 75 percent of the zinc.

Summit Valley (Butte) District.—Production from district metal mines was virtually uninterrupted throughout the year, and the 42,000-ton-per-day Butte copper concentrator was operated at near capacity. A concentrator addition, on which construction was to begin in 1966, was scheduled for completion early in 1967. Completion of the addition, designed for recovering acid-soluble copper in the ore slimes, was to increase copper recovery by 500 tons monthly. The Butte concentrator operation was described in a technical journal.[11]

The Kelley No. 1 centralized hoisting shaft, an important sector of the Butte deep-level program to develop high-grade ore at depth, was readied for operation by the completion of ore pockets and attendant equipment necessary for hoisting ore. A 4600-level haulageway from the Mountain Con mine to the shaft was completed, and a haulageway from the 4200 level of the Steward mine was nearly completed. A similar connection from the Leonard mine to the shaft was planned.

Sinking and concreting of the Kelley No. 2 shaft, which was to replace the High Ore as the main pump shaft, were continued. Upon completion of the shaft, the mine water collection system was to remain the same as before except that water flowing to the High Ore sump was to be routed to the Kelley No. 2 shaft where about 6,000 gallons per minute would be pumped to the surface in a single lift via new pumps and columns. Anaconda's continued efforts to increase the amount of copper recovered by precipitation were described.[12]

Haulage efficiency at the Berkeley pit was increased by discontinuing use of trucks with capacities of less than 85 tons and by purchasing nineteen 85-ton and fifteen 100-ton capacity diesel, electric wheel trucks. Plans were made to test a 120-ton diesel, electric wheel truck in 1966. A description of haulage practices at the Berkeley pit was included in an article summarizing truck usage at open pit operations in the United States.[13]

Production from the Badger State and Anselmo mines was 2,424 ounces of gold,

[11] Metal Mining and Processing. Automatic Controls Keep Things Humming at Anaconda's New Mill. V. 2, No. 2, February 1965, pp. 34–36.

[12] Engineering & Mining Journal. Anaconda Aims at More Cement Copper. V. 166, No. 4, April 1965, pp. 84–85.

[13] Murphy, J. Emmett. Trends in Truck Haulage. Min. Cong. J., v. 51, No. 5, May 1965, pp. 39–40.

Table 15.—Mine production of gold, silver, copper, lead, and zinc in Silver Bow County, in terms of recoverable metals

Year	Mines producing		Material sold or treated [1] (thousand short tons)	Gold, lode and placer (troy ounces)	Silver, lode and placer (thousand troy ounces)
	Lode	Placer			
1956-60 (average)	17	1	10,332	23,250	4,254
1961	11	1	12,635	18,391	2,765
1962	9	1	11,654	17,657	4,027
1963	10	2	9,346	14,287	3,951
1964	10	-------	14,694	20,999	4,614
1965	8	2	15,462	18,420	4,790
1882-1965	-------	--------	[2] 321,184	2,402,219	638,315

Year	Copper (short tons)	Lead (short tons)	Zinc (short tons)	Total value (thousands)
1956-60 (average)	87,161	7,289	32,068	$71,307
1961	103,788	435	1,384	65,881
1962	93,845	4,319	28,636	70,176
1963	79,636	3,185	24,140	60,850
1964	103,600	2,678	20,239	80,455
1965	115,279	4,594	25,629	97,373
1882-1965	8,037,087	412,950	2,383,718	3,864,910

[1] Does not include gravel washed.
[2] Complete data not available: 1904-65.

1.47 million ounces of silver, 642 tons of copper, 4,594 tons of lead, and 25,629 tons of zinc. A reduction in future zinc output from the district was indicated, as Anaconda did not undercut new ore blocks at the Badger State mine during 1965.

Phosphate rock production increased from the Maiden Rock mine near Melrose by Stauffer Chemical Co., Industrial Chemical Division. Elemental phosphorus was produced at the company's Silver Bow plant. Stauffer Chemical Co. added facilities for making superphosphoric acid to the elemental phosphorus plant at Silver Bow. The acid, used for fertilizer and industrial purposes, was marketed to consumers in the Rocky Mountain area, Pacific Northwest, and western Canada.

Toole.—Production of crude oil increased from 1.7 to 1.9 million barrels. A large part (1.5 million barrels) came from the Fred and George Creek field. Exploratory and development drilling was highest in the State in terms of number of wells drilled, but most wells were drilled at shallow depths (less than 2,500 feet), and the area ranked second in total footage drilled (303,294 feet). Exploratory drilling of 46 wells resulted in 1 gas and 2 oil discoveries. Development drilling of 78 wells, largely in the vicinity of the Fred and George Creek field, resulted in 47 oil and 7 gas producers.

Yellowstone. — Recovery of crude oil from the Mosser and Wolf Springs fields totaled 205,000 barrels, 6,000 barrels less than in 1964. Elemental sulfur was recovered by Montana Sulphur & Chemical Co. from waste gases supplied by the Continental Oil Co. and Humble Oil & Refining Co. oil refineries. Humble Oil & Refining Co. completed installing a refining-operations control center, additional water control equipment, and a hydrocracking unit (the first unit of this type installed by the company in the United States) at its Billings refinery. The county continued to rank first as a source of sand and gravel, and it ranked first in stone output. Increased requirements of the materials in road construction by the State highway department led to output of 1.6 million tons of sand and gravel and over 1 million tons of stone. Near Billings, clay dug by Lovell Clay Products Co. was used to make heavy clay products, and shale was expanded for lightweight aggregate by Montana Lightweight Aggregate Co. Limestone was calcined to lime by the Great Western Sugar Co. for use at its Billings refinery.

Combined Counties. — The following counties have been combined into areas as indicated because a major oilfield or gasfield underlies parts of more than one county, and its production cannot be assigned to a single county.

Dawson, Fallon, Prairie, and Wibaux.— The Pine field, the largest source of crude oil in the State, yielded 4 million barrels of crude oil, compared with 3.9 million barrels in 1964. The same field produced 736 million cubic feet of gas, compared with 699 million cubic feet in 1964.

Fallon and Wibaux.—Natural gas withdrawals from the Cedar Creek field, the third largest source of natural gas in the State, totaled 3.2 billion cubic feet, compared with 3.5 billion cubic feet in 1964.

Glacier and Toole.—Recovery of crude oil from the Cut Bank field increased from 1.9 million barrels in 1964 to 3.0 million barrels in 1965. The increase was largely due to successful waterflooding projects that augmented response to secondary production. Natural gas withdrawals from the Cut Bank-Reagan field, the leading gas source in the State, totaled 8.3 billion cubic feet compared with 7.5 billion cubic feet in 1964.

Golden Valley and Stillwater.—Withdrawals of natural gas from the Big Coulee field remained at the 1964 figure of 1 billion cubic feet.

Phillips and Valley.—Natural gas withdrawals from the Bowdoin field totaled 2.2 billion cubic feet, compared with 2 billion cubic feet in 1964.

Pondera and Teton.—Recovery of crude oil from the Pondera and Pondera Coulee fields was 364,000 barrels, about 42,000 barrels less than 1964 production.

The Mineral Industry of Nebraska

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the Nebraska Geological Survey for collecting information on all minerals except fuels.

By Matthew J. Sheridan [1] and William C. Henkes [2]

Nebraska mineral production, valued at $83.8 million, was $8.2 million, or 9 percent below that of 1964. This was the third annual consecutive decline for the State, following a record high of $108.4 million in 1962. The 1965 decrease was due to a $5.8 million drop in the value of crude petroleum and a $2.1 million drop in sand and gravel.

The combined values of petroleum, natural gas, and natural gas liquids, $48.7 million, comprised 58 percent of the mineral output.

Mineral production was reported from 77 of the State's 93 counties; Kimball, Banner, and Cheyenne Counties had 18, 16, and 12 percent, respectively, of the value of mineral commodities.

Employment and Injuries.—Table 3, compiled from data collected by the Federal Bureau of Mines, shows employment and injuries in the mineral industries for 1964 and 1965, excluding mineral fuels.

Government Programs.—Road construction and maintenance projects financed by Federal, State, county, and municipal funds provided markets for much of the output of cement and sand and gravel. State highway construction contracts awarded during the year increased slightly to $44.9 million. This sum included $26.2 million for the National System of Interstate and Defense Highways, $17.7 million for the Federal-Aid Primary and Secondary Highway System, and $959,000 for 100-percent State-financed

[1] Mining engineer, Bureau of Mines, Denver, Colo.
[2] Petroleum engineer, Bureau of Mines, Denver, Colo.

Table 1.—Mineral production in Nebraska[1]

Mineral	1964		1965	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays ---thousand short tons--	143	$143	106	$106
Gem stones	NA	5	NA	5
Natural gas (marketed) --million cubic feet--	11,094	1,707	10,720	1,565
Natural gas liquids:				
LP gases ---thousand gallons--	24,556	1,092	16,946	847
Natural gasoline and cycle products --do--	9,587	627	7,822	516
Petroleum (crude) thousand 42-gallon barrels--	19,113	51,605	17,216	45,796
Sand and gravel ---thousand short tons--	14,641	15,748	11,993	13,697
Stone ---do--	3,779	6,417	4,198	6,637
Value of items that cannot be disclosed: Cement, lime, and pumice	XX	14,615	XX	14,622
Totals	XX	91,959	XX	83,791

NA Not available. XX Not applicable.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Value of mineral production in constant 1957–59 dollars

(Thousands)

Year	Value
1956	$75,088
1957	82,582
1958	90,156
1959	99,621
1960	103,733
1961	104,543
1962	106,518
1963	97,584
1964	r 91,460
1965	83,206

r Revised.

projects.[3] By yearend, 241 of 478 miles designated in the Interstate System had been opened to traffic; 58 miles was under construction; and 179 miles was in the design or right-of-way acquisition categories.[4]

The Federal Bureau of Reclamation built concrete structures for distributing irrigation water at the Bostwick and Frenchman-Cambridge Divisions and the Ainsworth and Farwell units of the Missouri River Basin project and at the North Platte River project.

The Nebraska legislature unanimously passed a law of great significance to the mineral fuels industry; one requiring compulsory unitization of oil and gas fields when official agreement of 75 percent of the working-interest and royalty-interest owners is obtained.

[3] Engineering News-Record. State Highway Contracting Plans: 1966 Will Be a Record Breaker. V. 176, No. 14, Apr. 7, 1966, pp. 74–76.

[4] Bureau of Public Roads. Quarterly Report on The Federal-Aid Highway Program, Dec. 31, 1965. Press Release BPR 66–5, Feb. 9, 1966.

Table 3.—Employment and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1964:								
Nonmetal	13	231	3	23	—	—	—	—
Sand and gravel	1,156	220	254	2,228	5	29	15.26	14,287
Stone	603	294	177	1,469	1	12	8.85	4,313
Total	1.772	245	434	3,720	6	41	12.63	10,260
1965: p								
Nonmetal	15	200	3	25	—	—	—	—
Sand and gravel	1,025	219	225	1,978	4	26	15.17	12,646
Stone	615	268	165	1,370	1	19	14.60	5,543
Total	1,655	237	393	3,373	5	45	14.82	9,667

p Preliminary.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Mineral fuels comprised 58 percent of the total value of mineral production in the State. Crude petroleum, 54 percent of the total value of mineral output, was valued at $45.8 million.

Natural Gas.—Marketed natural gas decreased 3 percent, largely because of increased dry gas output. As in the past, Cheyenne County was the principal gas producer with 61 percent, followed by Deuel and Kimball Counties. No new-field gas discoveries were made. At yearend, 39 dry-gas wells were on production; 11 were shut in.

Natural Gas Liquids.—The four natural gas processing plants were operated at 80-percent capacity. The Antelope Gas Products Co. plant in the Long field, Kimball County, was shut down for 4 months because of a fire. Total natural gas liquids production was 24.8 million gallons, 27 percent less than in 1964. Natural gasoline was down 18 percent; liquefied petroleum gases decreased 31 percent.

Petroleum.—Production of crude oil dropped 10 percent below that of 1964. Accounting for most of the State decline, Kimball County production was nearly 1.1

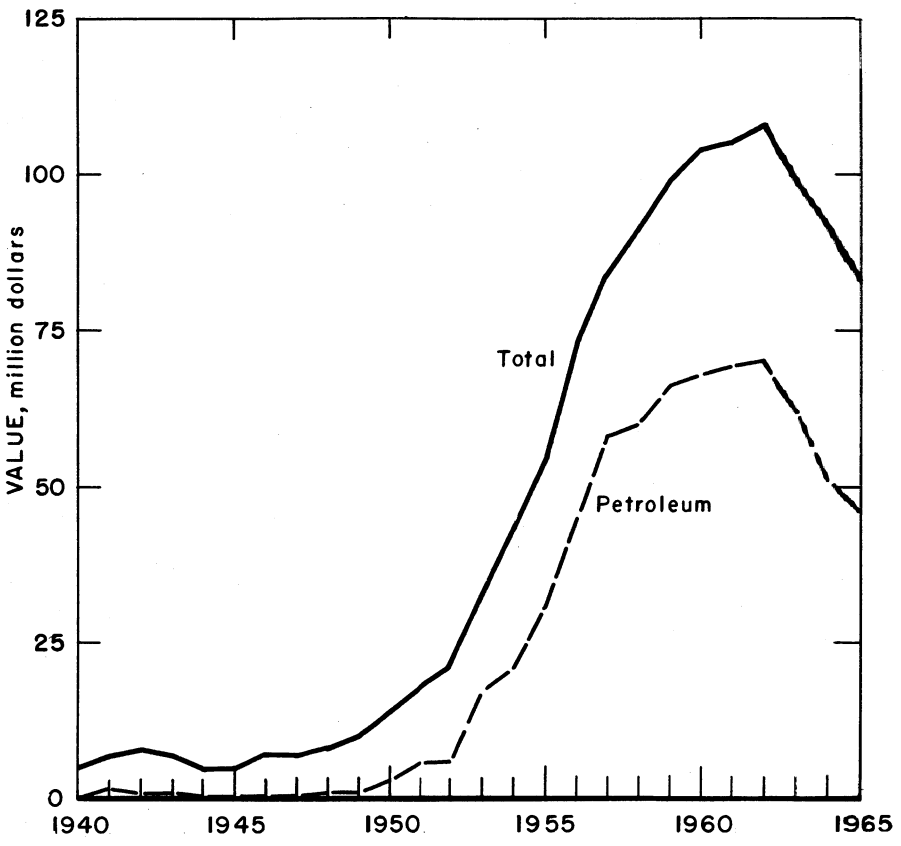

Figure 1.—Value of petroleum and total value of mineral production in Nebraska.

million barrels less than in the previous year, a decrease of 17 percent.

Sleepy Hollow and Singleton again were the leading fields, yielding 1.2 million and 1 million barrels of oil, respectively. Production at Sleepy Hollow declined by 500,000 barrels, and at Singleton by 179,000 barrels. Willson Ranch field moved up to third place, displacing Sloss field which dropped to fourth position. Production at the Juelfs-Gaylord field increased by 140,206 barrels to 475,670 barrels to move from 10th to 5th place; this increase resulted from waterflooding of the eastern part of the field (waterflooding in the western part was begun in 1961).

The Nebraska Oil and Gas Conservation Commission reported that production from the three fields in the Forest City basin, southeastern Nebraska, declined 17 percent. The only producing well drilled in the basin in the last 5 years was completed in December.

At yearend, 1,611 oil wells were on production; 556 oil wells were temporarily abandoned or shut in.

Drilling activity continued to decline—down 9 percent from that of 1964; however, inasmuch as average well depth was increased to 5,380 feet, total footage drilled was down only 5 percent. Exploratory drilling dropped from 239 wells in 1964 to 209 wells; the success ratio was 3.8 percent, compared with 10.5 percent for the previous year.

Sun Oil Co. continued its exploratory

Table 4.—Crude petroleum production, by counties

(Thousand 42-gallon barrels)

County	1964	1965	Principal fields in 1965
Banner	4,985	4,836	Singleton, Willson Ranch, Vedene, Vowers, Olsen [1], Harrisburg, Kenmac, Lewis.
Cheyenne	3,081	3,192	Juelfs-Gaylord, Reimers, Doran, Southwest Potter.
Dundy	16	14	Indian Creek, Pierce Lake, Rock Canyon.
Frontier	--	(2)	Spring Creek.
Furnas	1	3	Wilsonville, Beaver Creek.
Garden	10	10	Richards, McCord.
Harlan	41	32	South Alma, Prairie Dog Creek.
Hayes	5	3	Blackwood Creek.
Hitchcock	220	213	Reiher, Dry Creek, Bush Creek.
Kimball	6,313	5,218	Sloss, Kimball, Enders, Long, Heidemann, Aue. Griffith, Houtby.
Lincoln	14	9	Red Willow Creek.
Morrill	950	708	Lindberg, Dunlap, Waitman.
Red Willow	2,707	1,966	Sleepy Hollow, Silver Creek, Ackman.
Richardson	72	59	Dawson, Falls City, Barada.
Scotts Bluff	698	953	Stage Hill [3], Cedar Valley, Minatare.
Total	19,113	17,216	

[1] Partly in Morrill County.
[2] Less than ½ unit.
[3] Partly in Banner County
Source: Nebraska Oil and Gas Conservation Commission.

Table 5.—Drilling for petroleum in 1965, by counties

County	Oil	Gas	Dry	Total	Footage
Exploratory completions:					
Banner	2	--	33	35	210,520
Box Butte	--	--	6	6	25,182
Buffalo	--	--	1	1	3,970
Chase	--	--	5	5	25,658
Cheyenne	3	--	28	31	154,569
Dawes	--	--	1	1	3,205
Deuel	--	--	2	2	9,341
Frontier	--	--	5	5	19,756
Furnas	--	--	1	1	3,481
Gage	--	--	1	1	521
Grant	--	--	2	2	6,141
Greeley	--	--	1	1	3,431
Hayes	--	--	1	1	4,351
Hitchcock	1	--	5	6	26,304
Johnson	--	--	1	1	220
Kearney	--	--	1	1	4,400
Keya Paha	--	--	1	1	2,565
Kimball	--	--	33	33	218,301
Lincoln	--	--	5	5	23,314
Morrill	1	--	29	30	133,580
Red Willow	1	--	1	2	7,334
Scotts Bluff	--	--	29	29	148,196
Sherman	--	--	1	1	3,680
Sheridan	--	--	3	3	12,158
Sioux	--	--	5	5	25,815
Total	8	--	201	209	1,075,993
Development completions:					
Banner	21	--	28	49	305,821
Cheyenne	17	1	24	42	202,092
Frontier	--	--	1	1	3,991
Furnas	1	--	--	1	3,547
Hitchcock	3	--	6	9	39,278
Kimball	27	--	39	66	421,805
Lincoln	--	--	2	2	9,622
Morrill	2	--	6	8	37,589
Red Willow	7	--	4	11	42,735
Scotts Bluff	7	--	14	21	111,782
Sioux	--	--	2	2	10,846
Total	85	1	126	212	1,189,108
Total all drilling	93	1	327	421	2,265,101

Source: Oil and Gas Journal.

program in the Central Nebraska basin. The company drilled four remote Precambrian wildcat wells in this as yet unproductive basin; the tests were in Buffalo, Greeley, Kearney, and Sherman Counties.

Probably the most important new-field discovery of the year was that of Petroleum, Inc., No. 1 Buhrdorf, sec 30, T15N, R52W, Cheyenne County. Completed in January, the well initially pumped 145 barrels of oil per day from "J" Sandstone (Cretaceous) at 5,474 feet. The field, Filon, had produced more than 85,000 barrels of oil from four wells by yearend.

Kaneb Pipe Line Co. built a 166-mile, 8-inch, petroleum-products pipeline between Geneva and Yankton, S. Dak., paralleling an existing 6-inch line. Together with an extension from South Dakota to North Dakota, this new line increased the company market outlets for liquefied petroleum gases, jet fuel, and gasoline.

NONMETALS

Cement.—Portland and masonry cements were produced by Ash Grove Lime & Portland Cement Co. and by Ideal Cement Co. Shipments of masonry cement increased 7 percent in quantity and value; portland cement shipments increased 2 percent in quantity and 1 percent in value. In addition to cement sold within Nebraska, shipments were made to consumers in Iowa, Kansas, Minnesota, and South Dakota.

Clays.—Production of clay by Endicott Clay Products Co., Omaha Brick Works, Western Brick and Supply Co., and Yankee Hill Brick Manufacturing Co. totaled about 106,000 tons, 26 percent below that of 1964. The entire output was used in manufacturing brick.

Lime.—Production of lime decreased 32 percent in quantity and 38 percent in value. The entire output—produced and consumed by the Bayard, Gering, Mitchell, and Scottsbluff plants of The Great Western Sugar Co.—was used as milk of lime in refining beet-sugar liquors. The decrease in lime requirements paralleled a decline in sugar output resulting from an abnormally low yield of the 1965 beet crop. Another contributing factor was the closing of the Grand Island plant of American Crystal Sugar Co.

Perlite.—The Omaha plant of Western Mineral Products Co. processed crude perlite from out-of-State sources for use as lightweight aggregate in concrete and plaster, in loose fill insulation, and for litter.

Pumice.—LaRue-Axtell Pumice Co. at Callaway treated crude pumicite produced at the LaMaster mine in southeastern Lincoln County. The processed material was used in scouring and polishing compounds and as a paint additive.

Sand and Gravel.—Production of sand and gravel from 74 of Nebraska's 93 counties declined 18 percent or 2.6 million tons. Decreased output from Lincoln and Platte Counties accounted for a substantial portion of the loss. Of 12 million tons produced, highways and associated structures consumed 64 percent, buildings 30 percent, and other uses 6 percent. The six leading suppliers were Behrens Construction Co., Christensen Sand & Gravel Co., Luther & Maddox Gravel Co., Lyman-Richey Sand & Gravel Corp., McCann Sand & Gravel Co., and Western Sand & Gravel Co.

Stone.—Production of crushed and broken and dimension limestone attained a record 4.2 million tons. Forty-two percent of the output was used as aggregate in concrete and as base course and road surfacing material. Most of the remainder was used in the cement industry and as riprap in public-works facilities, and for agricultural purposes. Minor quantities were used in manufacturing lime, for whiting and poultry grit, and in various products as mineral fillers. The major producers were Ash Grove Lime & Portland Cement Co., Fort Calhoun Stone Co., Hopper Bros. Quarries, United Rock Construction, Inc., and Midwest Construction Co. as a contractor for the U.S. Army Corps of Engineers.

Talc.—Sierra Talc and Chemical Co. of Grand Island processed crude talc produced in California and Montana. The processed material was used in manufacturing paper, paint, cosmetics, ceramics, rubber, and textiles.

Vermiculite.—Western Mineral Products Co., Omaha, exfoliated vermiculite from out-of-State sources for use as plaster aggregate and loose fill insulation.

Table 6.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1964		1965	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Construction:				
Building	2,407	$2,492	2,267	$2,606
Paving	1,333	1,410	981	1,179
Railroad ballast	--	--	[1] 570	[1] 646
Fill	455	416	(1)	(1)
Total	4,195	4,318	3,818	4,431
Gravel:				
Construction:				
Building	1,153	1,400	1,265	1,519
Paving	4,837	5,651	5,079	5,923
Railroad ballast	[2] 48	[2] 46	[2] 209	[2] 240
Fill	(2)	(2)	(2)	(2)
Other	1	1	--	--
Miscellaneous	--	--	50	61
Total	6,039	7,098	6,603	7,743
Total sand and gravel	10,234	11,416	10,421	12,174
Government-and-contractor operations:				
Sand:				
Paving	1,840	1,822	483	482
Gravel:				
Building	--	--	12	13
Paving	2,567	2,510	1,077	1,028
Total	2,567	2,510	1,089	1,041
Total sand and gravel	4,407	4,332	1,572	1,523
All operations:				
Sand	6,035	6,140	4,301	4,913
Gravel	8,606	9,608	7,692	8,784
Total	14,641	15,748	11,993	13,697

[1] Railroad ballast and fill sand combined to avoid disclosing individual company confidential data.
[2] Railroad ballast and fill gravel combined to avoid disclosing individual company confidential data.

METALS

The American Smelting and Refining Co. (Asarco) refinery in Omaha recovered lead, gold, silver, antimony, and bismuth from lead bullion and other smelter products shipped from Asarco plants outside of Nebraska.

REVIEW BY COUNTIES

Banner.—Ranked second in production of petroleum, the county contained 9 of the 25 largest oilfields in the State; of these, the Singleton field had production of slightly over 1 million barrels. Banner County was ranked first in number of exploratory wells drilled; these resulted in two new-field discoveries. One, the Casey field, was found by Stuarco Oil Co., Inc., and others, No. 2 Warner, sec 34, T20N, R57W, which was completed for 140 barrels of oil per day from the "J" Sandstone (Cretaceous) at 6,149 to 6,155 feet; the Heath field, was discovered by the Ring-West Petroleum Corp. and Delta Petroleum, Inc., No. 1 Johnson, sec 33, T19N, R54W, completed for 100 barrels of oil per day from the "J" Sandstone (Cretaceous) at 5,452 to 5,454 feet.

Production of sand and gravel by crews of the Banner County Highway Department was five times the 1964 output.

Table 7.—Sand and gravel production in 1965, by counties

(Thousand short tons and thousand dollars)

County	Quantity	Value	County	Quantity	Value
Adams	W	W	Keith	212	$257
Antelope	167	$171	Kimball	12	12
Banner	42	21	Knox	216	217
Blaine	8	8	Lincoln	348	346
Boone	W	W	Logan	2	2
Boyd	25	25	Loup	8	7
Brown	79	76	Madison	241	296
Buffalo	440	502	Merrick	W	W
Butler	140	164	Morrill	82	101
Cass	W	W	Nance	W	W
Cedar	88	91	Nemaha	33	32
Chase	9	9	Nuckolls	W	W
Cherry	7	7	Pawnee	20	15
Clay	W	W	Perkins	62	62
Colfax	86	100	Phelps	142	117
Cuming	238	271	Pierce	103	98
Custer	165	163	Platte	W	W
Dawson	339	417	Polk	W	W
Deuel	161	171	Red Willow	121	149
Dixon	32	37	Richardson	W	W
Dodge	923	1,015	Saline	230	256
Douglas	1,327	1,532	Sarpy	524	635
Dundy	17	17	Saunders	1,112	1,383
Fillmore	14	18	Scotts Bluff	156	166
Franklin	254	305	Seward	116	115
Frontier	23	23	Sherman	76	84
Furnas	52	62	Sioux	18	8
Gage	110	109	Stanton	W	W
Garden	37	40	Thayer	179	187
Hall	779	1,058	Thomas	22	26
Hamilton	120	133	Valley	46	57
Harlan	W	W	Washington	5	5
Hayes	W	W	Webster	47	55
Hitchcock	W	W	Wheeler	8	10
Holt	171	204	York	154	149
Howard	3	4	Undistributed	1,393	1,670
Jefferson	325	286			
Johnson	2	1			
Kearney	122	140	Total	11,993	13,697

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

Table 8.—Stone sold or used by producers, by uses

Use	1964		1965	
	Short tons	Value	Short tons	Value
Dimension stone: Rubble	12,432	$59,282	9,335	$48,869
Crushed and broken stone:				
Riprap	757,059	1,011,220	1,539,953	1,910,966
Concrete and roadstone	1,842,154	3,246,637	1,747,328	2,962,000
Agriculture	196,138	320,135	(1)	(1)
Other	[2] 971,321	[2] 1,779,782	[1]901,545	[1] 1,715,005
Total	3,766,672	6,357,774	4,188,826	6,587,971
Total stone	3,779,104	6,417,056	4,198,161	6,636,840

[1] Stone used for agriculture combined with "Other" to avoid disclosing individual company confidential data; combined data includes stone used in agriculture, asphalt filler, cement, lime, other filler, poultry grit, and rubber filler.

[2] Includes stone used in asphalt filler, cement, lime, other filler, poultry grit, and rubber filler.

Buffalo.—Nine commercial operators, crews of the Buffalo County Highway Department, and a contractor for the Custer County Highway Department produced sand and gravel valued in excess of $500,000. About 65 percent of the aggregate was used in road construction, 24 percent in buildings, and 11 percent as fill and railroad ballast.

Cass.—Cass County, ranked first in output of stone (62 percent of the State output), also produced important quantities of cement, sand and gravel, and clay. At its Louisville plant, Ash Grove Lime & Portland Cement Co. mined limestone and clay for use in portland and masonry cements. Other crushed and broken limestone producers were Heebner Quarries, Hopper

Table 9.—Value of mineral production in Nebraska, by counties[1]

County	1964	1965	Minerals produced in 1965 in order of value
Adams	$242,000	W	Sand and gravel.
Antelope	116,000	$171,000	Do.
Banner	r 13,609,000	13,010,000	Petroluem, natural gas, sand and gravel.
Blaine	--	8,000	Sand and gravel.
Boone	W	W	Do.
Boyd	--	25,000	Do.
Brown	254,000	76,000	Do.
Buffalo	625,000	502,000	Do.
Burt	2,000	--	
Butler	277,000	164,000	Sand and gravel.
Cass	14,487,005	9,240,079	Cement, stone, sand and gravel, clays.
Cedar	160,000	91,000	Sand and gravel.
Chase	78,000	9,000	Do.
Cherry	4,000	7,000	Do.
Cheyenne	r 10,105,000	10,051,000	Petroleum, natural gas, LP gases, natural gasoline.
Clay	166,000	W	Sand and gravel.
Colfax	117,000	100,000	Do.
Cuming	472,000	274,968	Sand and gravel, stone.
Custer	W	W	Sand and gravel, pumice.
Dawes	58,000	--	
Dawson	360,000	522,000	Sand and gravel, stone.
Deuel	r 356,000	478,000	Natural gas, sand and gravel, natural gasoline, LP gases.
Dixon	76,068	66,118	Sand and gravel, stone.
Dodge	791,000	1,015,000	Sand and gravel.
Douglas	1,271,811	1,608,097	Sand and gravel, stone, clays.
Dundy	91,000	88,000	Petroleum, stone, sand and gravel.
Fillmore	56,000	18,000	Sand and gravel.
Franklin	107,000	305,000	Do.
Frontier	80,000	23,000	Do.
Furnas	68,000	70,000	Sand and gravel, petroleum.
Gage	441,106	W	Stone, sand and gravel.
Garden	35,000	66,000	Sand and gravel, petroleum.
Garfield	7,000	--	
Gosper	19,000	--	
Greeley	29,000	--	
Hall	W	1,058,000	Sand and gravel.
Hamilton	174,000	133,000	Do.
Harlan	212,000	136,000	Petroleum, sand and gravel.
Hayes	66,000	87,000	Sand and gravel, petroleum.
Hitchcock	658,000	579,000	Petroleum, sand and gravel.
Holt	129,000	204,000	Sand and gravel.
Hooker	W	--	
Howard	49,000	4,000	Sand and gravel.
Jefferson	W	W	Sand and gravel, clays.
Johnson	--	1,000	Sand and gravel.
Kearney	141,000	140,000	Do.
Keith	230,000	257,000	Do.
Kimball	r 18,247,000	14,783,000	Petroleum, LP gases, natural gasoline, natural gas, sand and gravel.
Knox	197,000	217,000	Sand and gravel.
Lancaster	W	W	Stone, clays.
Lincoln	935,000	371,000	Sand and gravel, petroleum.
Logan	--	2,000	Sand and gravel.
Loup	23,000	7,000	Do.
Madison	360,000	297,350	Sand and gravel, stone.
Merrick	207,000	W	Sand and gravel.
Morrill	r 2,777,000	2,047,900	Petroleum, sand and gravel, lime, natural gas.
Nance	154,000	W	Sand and gravel.
Nemaha	W	W	Stone, sand and gravel.

See footnotes at end of table.

Table 9.—Value of mineral production in Nebraska, by counties[1]—Continued

County	1964	1965	Minerals produced in 1965 in order of value
Nuckolls	W	W	Cement, sand and gravel.
Otoe	W	$116,679	Stone, clays.
Pawnee	$124,500	171,130	Stone, sand and gravel.
Perkins	33,000	62,000	Sand and gravel.
Phelps	123,000	117,000	Do.
Pierce	171,000	98,000	Do.
Platte	703,980	W	Do.
Polk	W	W	Do.
Red Willow	7,486,000	5,379,000	Petroleum, sand and gravel, natural gas.
Richardson	362,267	167,027	Petroleum, sand and gravel, stone.
Rock	19,000	--	
Saline	344,192	256,000	Sand and gravel.
Sarpy	1,038,525	1,034,755	Sand and gravel, stone.
Saunders	1,195,049	1,383,000	Sand and gravel.
Scotts Bluff	r 2,571,000	2,997,350	Petroleum, lime, sand and gravel, stone, natural gas.
Seward	W	W	Sand and gravel, stone.
Sheridan	5,000	--	
Sherman	50,000	84,000	Sand and gravel.
Sioux	139,390	11,348	Sand and gravel, stone.
Stanton	149,000	W	Sand and gravel.
Thayer	139,000	187,000	Do.
Thomas	W	26,000	Do.
Thurston	W	--	
Valley	53,000	57,000	Sand and gravel.
Washington	W	W	Stone, sand and gravel.
Wayne	31,000	--	
Webster	97,000	55,000	Sand and gravel.
Wheeler	13,000	10,000	Do.
York	173,000	149,000	Do.
Undistributed[2]	r 7,819,431	13,117,681	
Total	91,959,000	83,791,000	

r Revised. W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] The following counties are not listed because no production was reported: Arthur, Box Butte, Dakota, Grant, Keya Paha, and McPherson.

[2] Includes gem stones that cannot be assigned to specific counties, and values indicated by symbol W.

Bros. Quarries, Tanner & Lockhart, United Mineral Products Co., and United Rock Construction, Inc. Midwest Construction Co. produced limestone for riprap for the U.S. Army Corps of Engineers. Jones & Jones Wallstone and Tanner & Lockhart produced dimension limestone for rubble.

Lyman-Richey Sand & Gravel Corp. and Fedde Sand & Gravel produced aggregate for construction use.

Cheyenne.—Maintaining third place in crude oil production, the county again was ranked first in natural gas yield, with output of 6.5 billion cubic feet. Of the 25 largest oilfields 4 were in Cheyenne County; the largest, Juelfs-Gaylord, had an increased production of 140,206 barrels, bringing the total output to 475,670 barrels. In July, Marathon Oil Co. commenced waterflooding in the Gurschke field "D" Sandstone (Cretaceous). The county was ranked third in number of both exploratory and development wells drilled. The Filon field was possibly the most significant new-field discovery in the State.

Dawson.—Six commercial operators and contractors for the Nebraska Department of Roads, the Dawson County Highway Department, and the Custer County Highway Department produced 339,000 tons of sand and gravel used in constructing Interstate 80 and other highways and buildings. The Richardson County Highway Department produced and shipped crushed rock from Dawson County.

Deuel.—Deuel County was ranked second in natural gas output, with 1.6 billion cubic feet, and produced 1.4 million gallons of natural gas liquids. Two unsuccessful wildcat wells were drilled.

Gayman Sand & Gravel and crews of the Deuel County Highway Department produced aggregate for road construction.

Dodge.—Christensen Sand & Gravel Co., Christensen Gravel, Inc., Lincoln Sand & Gravel Co., Lyman-Richey Sand & Gravel Corp., Lux Sand & Gravel Co., Cowles Gravel Co., and a contractor for the Nebraska Department of Roads produced

923,000 tons of aggregate used principally in highway and building construction.

Hall.—Production of sand and gravel in Hall County increased 40 percent, to 779,000 tons. Ten commercial producers and a contractor for the Adams County Highway Department supplied the aggregate.

Hitchcock.—Oil production declined 3 percent. Six exploratory wells were drilled; one, considered an extension of the Reiher field, found oil in the Lansing formation (Pennsylvanian). Nine development wells were drilled, resulting in three new oil wells.

Stratton Gravel Co. produced aggregate for use in road construction.

Kimball.—The county maintained its leading position in oil production and was third in gas output. The county had 7 of the 25 largest oilfields in the State; chief of these were Sloss field which produced 695,042 barrels (down nearly 30 percent), Kimball 332,648 barrels, and Enders 331,808 barrels. Kimball County was ranked first in number of development wells drilled and second in number of wildcat wells.

Sand and gravel produced by Wilson Bros., Inc., and by crews of the Kimball County Highway Department was used in construction.

Lincoln.—Output of sand and gravel declined 58 percent, to 348,000 tons. Producers included Gayman Sand & Gravel, James E. Simon Co., Lyman-Richey Sand & Gravel Corp., and contractors for the Nebraska Department of Roads.

Pumicite produced at its LaMaster mine was processed by LaRue-Axtell Pumice Co. in Callaway, Custer County.

The Red Willow Creek field yielded 9,452 barrels of crude oil.

Morrill.—Although petroleum production decreased 25 percent, marketed natural gas was up 5 percent, to 159 million cubic feet. Thirty exploratory wells resulted in one oil discovery; the Duggers Springs field discovery well, Banner Oil Co., Inc., and others, No. 1 Harless, sec 17, T18N, R50W, was completed pumping 90 barrels of oil per day from the "J" Sandstone (Cretaceous) at 4,351 to 4,352 feet.

Lyman-Richey Sand & Gravel Corp., East Ashton Sand Co., crews of the Morrill County Highway Department, and a contractor for the Nebraska Department of Roads produced 82,000 tons of aggregate for construction.

The Bayard plant of The Great Western Sugar Co. produced lime and carbon dioxide used in refining beet-sugar liquors.

Nuckolls.—The Ideal Cement Co. Superior plant produced portland and masonry cements from raw materials mined in Kansas. Output was 133 percent greater than that of 1964.

Sand and gravel was produced by C. F. Bondegard Sand and Gravel and Warner & Son. The output was used entirely in road construction.

Platte.—Sand and gravel production was substantially less than in 1964; the number of producers dropped from five to two. Lyman-Richey Sand & Gravel Corp. and a contractor for the Nebraska Department of Roads accounted for the 1965 output which was used in building and highway construction.

Red Willow.—Petroleum accounted for 97 percent of the value of minerals produced in the county; however, oil production declined 27 percent to 1,965,820 barrels. Most of the output was from three large fields: Sleepy Hollow (1.2 million barrels), Silver Creek (323,673 barrels), and Ackman (211,287 barrels). Development drilling declined from 41 wells to 11 wells; and wildcat drilling declined from 8 to 2 wells. The single discovery well, J. O. Farmer, Inc., No. 1 Osborn, sec 34, T1N, R27W, pumped 51 barrels of oil per day from the Lansing formation (Pennsylvanian) from a depth of 3,304 to 3,310 feet. The discovery was named Sinks field.

Used mainly for roads and buildings, sand and gravel produced by Davidson Gravel Co., Midwest Sand & Gravel Co., and McCook Sand & Gravel totaled 121,000 tons.

Richardson.—Production from the Dawson, Falls City, and Barada oilfields was 40,913, 14,734, 3,837 barrels, respectively. The Falls City field was the site of the first producing well completed in the county during the past 5 years. The well, the Ivan Joy No. 1 Zorn, sec 7, T1N, R6W, was completed pumping 20 barrels of oil per day.

Production of sand and gravel and crushed stone decreased because construction projects by the Richardson County Highway Department and the Nebraska Department of Roads were completed.

Sarpy.—Combined production of sand and gravel and stone was valued at over $1 million. City Wide Rock & Excavation Co. and Welsh Stone Co., Inc., produced crushed stone for aggregate and riprap; Adolph Fedde produced stone for rubble. Richfield Sand and Gravel Co., Sorensen Sand and Gravel, Johnson Sand and Gravel, and four operations of Lyman-Richey Sand & Gravel Corp. produced 524,000 tons of aggregate and fill.

Saunders.—Ashland Ready Mix, Lyman-Richey Sand & Gravel Corp., Morse Bluff Sand and Gravel Co., Western Sand & Gravel Co., and Wolf Sand & Gravel Co., collectively, produced aggregate and fill valued over $1.3 million.

Scotts Bluff.—Mineral fuels, petroleum and natural gas, comprised 85 percent of the value of mineral production. Scotts Bluff was the only county to record an appreciable increase in petroleum and natural gas output. Production of crude oil increased 255,000 barrels (37 percent), and natural gas was up 98 million cubic feet. Expansion of production from the Stage Hill (partly in Banner County), Minatare, and North Minatare fields more than compensated for declines in other fields. Production at Stage Hill was up 278,667 barrels to a total of 421,512 barrels; at Minatare, production increased 165,643 barrels to 253,185 barrels; and output from North Minatare rose 106,870 barrels to 153,046 barrels. The Cooperative Refining Association, Inc., operated its refinery at Scottsbluff throughout the year.

Eisele Concrete Products Co., Willis Young Sand & Gravel, Kembel Sand and Gravel Co., Inc., Young Sand & Gravel, and contractors for the Scotts Bluff County Highway Department and the Federal Bureau of Reclamation produced 156,00 tons of aggregate and fill used mainly in construction.

The Gering, Mitchell, and Scottsbluff plants of The Great Western Sugar Co. produced lime and carbon dioxide for use in beet-sugar refining.

Washington.—The value of mineral output increased. Contractors for the Nebraska State Highway Department produced sand and gravel and crushed stone. Fort Calhoun Stone Co. produced limestone for riprap, aggregate, and soil conditioning.

The Mineral Industry of Nevada

This chapter has been prepared under a cooperative agreement for the collection of mineral data, except mineral fuels, between the Bureau of Mines, Department of the Interior, and the Nevada Bureau of Mines.

By L. E. Davis [1]

Results of mineral exploration during recent years—primarily for gold, silver, copper, and mercury—became evident in 1965 as the value of the yield from Nevada's mines in 1965 approached $100 million for the first time since 1956. Metals represented over 68 percent of the total value, nonmetals 31 percent, and mineral fuels less than 0.5 percent.

Increases were reported for all metals except tungsten, and antimony, highlighted by the pouring in May of the first gold bar by Carlin Gold Mining Co. The Carlin mine had become the Nation's second largest gold producer at yearend. In contrast, declines were reported for half the

[1] Physical scientist, Bureau of Mines, San Francisco, Calif.

Table 1.—Mineral production in Nevada [1]

Mineral	1964		1965	
	Short tons (unless otherwise stated)	Value (thousands)	Short tons (unless otherwise stated)	Value (thousands)
Antimony ore and concentrate short tons, antimony content	33	$20	26	$19
Barite	148,974	1,261	91,000	583
Copper (recoverable content of ores, etc.)	67,272	43,861	71,332	50,503
Gem stones	NA	100	NA	100
Gold (recoverable content of ores, etc.) troy ounces	90,469	3,166	229,050	8,017
Gypsum	799,057	2,894	710,000	2,518
Iron ore (usable) long tons, gross weight	911,238	5,048	1,141,000	5,330
Lead (recoverable content of ores, etc.)	809	212	2,277	710
Mercury 76-pound flasks	3,262	1,027	3,333	1,902
Perlite	15,603	135	13,780	121
Petroleum (crude) thousand 42-gallon barrels	255	W	209	W
Pumice thousand short tons	W	W	68	187
Sand and gravel	14,142,000	14,427	9,455,000	11,796
Silver (recoverable content of ores, etc.) thousand troy ounces	172	223	507	656
Stone	788,007	1,396	1,248,000	2,247
Sulfure ore long tons	274	5	336	6
Talc and soapstone	5,322	58	3,592	31
Zinc (recoverable content of ores, etc.)	582	158	3,858	1,127
Value of items that cannot be disclosed: Brucite (1965), cement (1965), clays, diatomite, fluorspar, lime, magnesite, molybdenum concentrate (content), peat, salt, tungsten concentrate, uranium ore, and values indicated by symbol W	XX	11,146	XX	14,063
Total	XX	85,137	XX	99,916

W Withheld to avoid disclosing company confidential data.
NA Not available.
XX Not applicable.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

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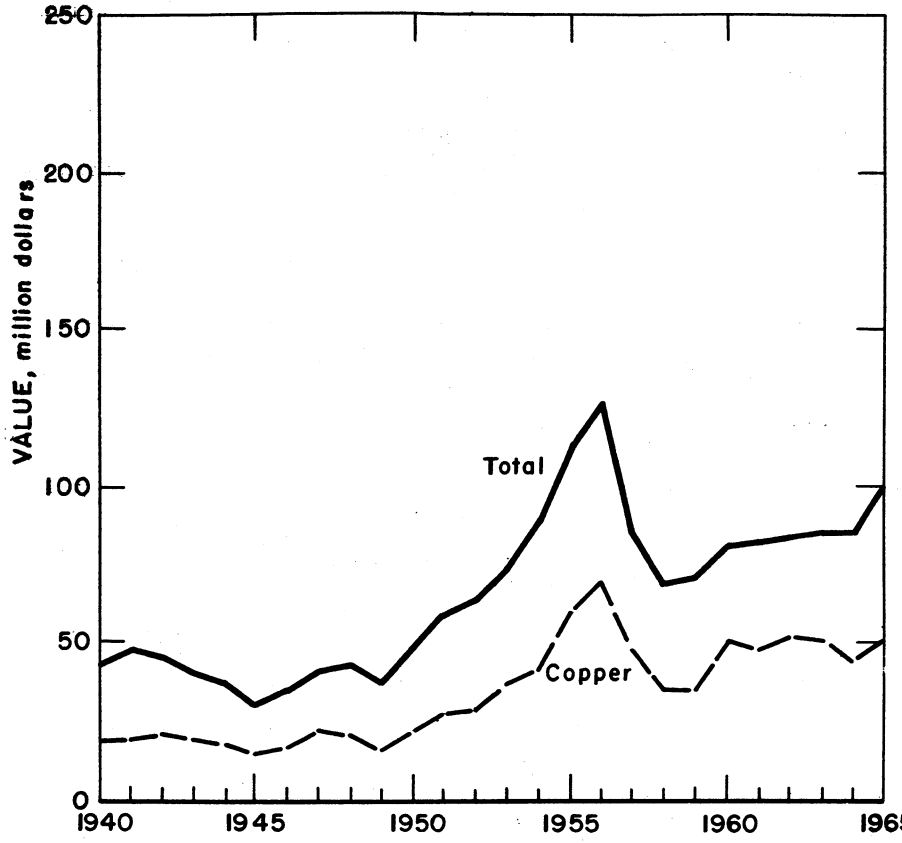

Figure 1.—Value of copper and total value of mineral production in Nevada.

Table 2.—Value of mineral production in constant 1957–59 dollars

(Thousands)

Year	Value
1956	$109,506
1957	84,585
1958	71,989
1959	69,094
1960	75,360
1961	79,505
1962	79,521
1963	r 81,304
1064	r 78,063
1965 p	86,563

p Preliminary. r Revised.

nonmetalic minerals produced in 1964, although cement was produced and shipped for the first time. A lower petroleum yield resulted from lack of transportation and refining facilities despite new well completions in Nevada's only oilfield.

Consumption, Trade, and Markets.—Out-of-State processors supplied Nevada with all its mineral fuels and metals requirements and virtually all its nonmetallic mineral needs other than construction materials. Most of the barite, perlite, and sulfur and some of the gypsum produced was shipped out of the State in crude form. Some limestone and much of the lime output went to consumers in California and Washington. All crude petroleum production was consigned to refineries in California and Utah. With few exceptions, metal ores, concentrates, precipitates, and residues were processed in out-of-State mills and smelters. The one smelter (copper) in the State was dependent on Nevada ores. All usable iron ore was exported or shipped to steel plants outside Nevada. In Clark County, an electrolytic manganese dioxide plant operated on ore mined in New Mex-

ico and a titanium plant used imported minerals as a raw material source. A tungsten carbide plant in Mineral County utilized purchased tungsten concentrates, principally from foreign countries.

Trends and Developments.—Exploration for gold was in progress in Clark, Esmeralda, Lander, Lyon, Nye, and Pershing Counties. The Carlin gold mine was in production early in the year and the first gold bar was poured in May. Stripping of overburden and ore stockpiling were on schedule at the Atlanta gold mine, Lincoln County, and the first 500-ton-per-day unit of the cyanide plant neared completion at yearend. Exploration and development at the Silver State silver mine, Pershing County, was terminated, but exploration for silver ore continued in Pershing, Lander, Eureka, and Esmeralda Counties. Exploration for copper was in progress in Churchill and Esmeralda Counties. The Duval Corp. began stripping overburden at Copper Basin and Copper Canyon, Lander County, and was constructing a flotation plant near Copper Canyon. A leaching and precipitation operation was begun at the Rio Tinto copper mine, Elko County. The Pan American mine, Lincoln County, was placed in production and treatment of the low-grade lead-zinc-silver ore commenced at the Caselton mill near Pioche, where plant capacity of 1,500-tons-per-day was reached by yearend. In Esmeralda County the completion of a new vertical shaft at the Simon lead-silver mine has facilitated underground exploration and development; in addition, the Sally Louise lead-zinc mine was reopened. Exploration for lead-zinc-silver ore was conducted in Eureka, Lincoln, Nye, and White Pine Counties. A multiple-hearth furnace was installed at the B & B mercury mine, Esmeralda County, and other mercury deposits in Esmeralda, Humboldt, Mineral, Nye, and Pershing Counties were under development. A 10-year exploration project on a large, low-grade molybdenite deposit in the San Antone mining district, Nye County, was completed.

Nevada Cement Co. completed its first year of operation and established a distribution center in Sacramento, Calif. A California cement producer opened a distribution center at Sparks, Washoe County. The diatomite deposits and processing plant of Aquafil Co. in Churchill and Lyon Counties, respectively, were acquired by Sierra Talc and Chemical Co., Division of Cyprus Mines Corp. Fibreboard Paper Products Corp. completed and placed on stream its gypsum wallboard plant near Apex, Clark County. Kenway Enterprises, Inc., an affiliate of Western Chemical and Manufacturing Co., Los Angeles, Calif., purchased the Panaca pozzolan plant (Lincoln County) from J. C. Shotwell, Inc., and leased the nearby Lori Free pumicite deposit. Perliteco, Inc., purchased the Las Vegas perlite expanding plant of Nevada Perlite Co. Perliteco processes crude perlite received from California producers. Foote Mineral Co. developed the lithium-bearing brine deposits in Clayton Valley, Esmeralda County, and converted the Silver Peak cyanide plant to chemical processing.

New wells completed in the Eagle Springs oilfield, Nye County, failed to extend the field, and production was hampered by lack of transportation and refining facilities.

Legislation and Government Programs.—Public land orders withdrew about 30,000 acres of land from mineral location under U.S. mining laws. Over 21,000 acres were withdrawn by the Atomic Energy Commission (AEC) in Nye County and nearly 3,500 acres in Lyon County and about 3,100 acres in Elko County, by the Bureau of Land Management. Land orders also restored about 565,000 acres to mineral location and leasing, 519,000 acres of which was the former U.S. Naval Gunnery Range in Pershing County. Nearly 15,000 acres were restored by the Bureau of Land Management in Washoe and Pershing Counties, combined, and about 12,000 acres by the Bureau of Reclamation in Clark County, along the Colorado River. Nevada received a U.S. Treasury check for $519,207.17 in bonuses, royalties, and rentals covering mineral leases and permits—$85,089.72 more than in 1964.

Of the 12 applications received from Nevada producers since enactment of the Lead-Zinc Stabilization Program in October 1962, 8 had been certified, 3 were denied, and 1 was withdrawn. Four of the eligible operators had not responded to amendment changes, leaving two current and two in process as of December 31, 1965. No payments were made on 1965 production.

The Bureau of Mines provided consult-

Table 3.—Employment and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1964:								
Metal	1,936	267	517	4,154	3	99	24.56	4,939
Nonmetal and peat	874	264	231	1,857	-------	40	21.54	1,380
Sand and gravel	999	215	215	1,720	-------	36	20.92	722
Stone	128	203	27	213	-------	2	9.37	642
Total	3,937	251	990	7,944	3	177	22.66	3,079
1965: p								
Metal	2,155	286	616	4,925	1	133	27.21	2,068
Nonmetal and peat	897	274	246	1,975	-------	44	22.28	685
Sand and gravel	810	215	174	1,395	-------	16	11.47	344
Stone	180	278	50	401	-------	7	17.46	426
Total	4,042	269	1,086	8,696	1	200	23.11	1,402

p Preliminary.

ing services to AEC during 1965 on two preshot and postshot surveys of selected mines and tunnels within and adjacent to the Nevada Test Site to determine the extent of structural damage that might be attributed to underground nuclear tests.

For the year ending December 31, 1965, the Reno Field Office of the Bureau's Area VI Mineral Resource Office received 65 requests for application forms from persons interested in exploring for Nevada minerals under the Office of Minerals Exploration (OME) program. Of these, 18 applications were processed, 4 contracts were let, and 4 contracts were in force at yearend.

REVIEW BY MINERAL COMMODITIES

METALS

Antimony.—Ore from the Last Chance mine and concentrate produced in the Stevens mill at Austin, Lander County, was shipped to the antimony smelter in Laredo, Tex. Ores from the Ubet mine, Churchill County, and the Burl property, Pershing County, were consigned to a customer in Dallas, Tex.

Copper.—A higher average unit price resulted in a production value for recoverable copper that returned to the 1963 level, but the quantity recovered was not appreciably above the 1964 figure. Again, The Anaconda Company, Lyon County, and Kennecott Copper Corp., White Pine County, dominated the Nevada copper industry. Only three other mines, one lead-zinc producer each in Esmeralda and Lincoln Counties and a silver-lead-zinc operation in White Pine County, contributed significantly to the total copper output. Lesser quantities of copper were recovered as a byproduct from complex lead, zinc, and silver ores.

Gold.—Production was reported at 11 lode gold mines, but only 2 contributed significantly to the total output. The Carlin mine and cyanide mill in Eureka County went on stream in May and was directly responsible for the marked increase over the 1964 total. The Getchell mine of Goldfield Corp., Humboldt County, was the only other major lode gold mine in production. Byproduct gold at other lode mines, principally copper mines, accounted for about 15 percent of the total lode gold recovered.

Placer gold recovery was almost insignificant by comparison, yielding a total of less than 500 ounces. Most of the recovered placer gold came from stream gravels worked in Nye County and as a byproduct at a sand and gravel washing plant in Douglas County.

Iron Ore.—Production and shipments of usable iron ore exceeded 1 million tons for the first time, surpassing the previous record high reported in 1956. Output was 25 percent more than in 1964. About 60

Table 4.—Mine production of gold, silver, copper, lead, and zinc, in terms of recoverable metals [1]

Year	Mines producing [2]		Material sold or treated [3] (thousand short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Troy ounces	Value (thousands)	Troy ounces	Value (thousands)
1956–60 (average)	96	9	10,933	84,302	$2,951	840,669	$761
1961	62	10	12,067	54,165	1,896	388,426	359
1962	39	4	13,121	62,863	2,200	245,164	266
1963	37	7	13,676	98,879	3,461	214,976	275
1964	38	6	13,383	90,469	3,166	172,447	223
1965	48	5	15,817	229,050	8,017	507,113	656
1904–65 [4]	------	------	NA	15,648,519	395,718	317,452,890	218,683

Year	Copper		Lead		Zinc		Total value (thousands)
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	
1956–60 (average)	71,914	$47,053	3,771	$1,046	2,702	$691	$52,502
1961	78,022	46,813	1,791	369	453	104	49,541
1962	82,602	50,883	771	142	281	65	53,556
1963	81,738	50,351	1,126	243	571	131	54,461
1964	67,272	43,861	809	212	582	158	47,620
1965	71,332	50,503	2,277	710	3,858	1,127	61,013
1904–65 [4]	3,031,754	1,251,056	396,633	63,595	488,365	94,904	2,023,956

NA Not available.

[1] Includes recoverable metal content of gravel washed (placer operations), ore milled, old tailings or slimes retreated, and ore and old tailings 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] The first satisfactory annual canvass of mine production was made in 1904.

Table 5.—Mine production of gold, silver, copper, lead, and zinc in 1965, by counties, in terms of recoverable metals

County	Mines producing [1]		Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Troy ounces	Value	Troy ounces	Value
Elko	7	----	26	$910	5,571	$7,203
Eureka	3	----	128,500	4,497,500	3,691	4,772
Lander	1	----	7	245	810	1,048
Lincoln	3	----	171	5,985	194,239	251,151
Mineral	1	----	----	----	20	26
Nye	9	3	645	22,575	5,449	7,046
Pershing	5	----	30	1,050	2,613	3,378
Washoe	1	1	22	770	48	62
Undistributed [2]	18	1	99,649	3,487,715	294,672	381,011
Total	48	5	229,050	8,016,750	507,113	655,697

	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Elko	6,400	$2,266	112,900	$17,612	22,400	$3,270	$31,261
Eureka	3,900	1,381	52,100	8,128	780,400	113,938	4,625,719
Lander	100	35	200	31	400	58	1,417
Lincoln	29,800	10,549	2,882,300	449,638	5,655,200	825,659	1,542,982
Mineral	----	----	100	16	----	----	42
Nye	200	71	30,000	4,680	8,600	1,256	35,628
Pershing	400	142	12,400	1,934	1,000	146	6,650
Washoe	----	----	800	125	100	15	972
Undistributed [2]	142,623,200	50,488,612	1,463,200	228,260	1,247,900	182,194	54,767,792
Total	142,664,000	50,503,056	4,554,000	710,424	7,716,000	1,126,536	61,012,463

[1] Excludes itinerant prospectors, "snipers," "high-graders," and others who gave no evidence of legal rights to property.
[2] Includes Churchill, Clark, Douglas, Esmeralda, Humboldt, Lyon, and White Pine counties.

Table 6.—Mine production of gold, silver, copper, lead, and zinc in 1965, by classes of ore or other source materials, in terms of recoverable metals

Source	Number of mines [1]	Material sold or treated (short tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Lode ore:							
Gold	11	892,362	193.774	7,683	----	----	----
Silver	20	53,990	216	142,904	105,700	785,600	646,000
Copper	2	14,700,678	34,220	130,104	142,482,100	----	----
Lead	9	1,427	26	9,223	7,100	383,800	49,500
Lead-zinc	3	166,721	188	214,130	62,600	3,332,600	6,231,000
Zinc	3	1,489	----	1,712	6,500	52,000	789,500
Total	48	15,816,667	228,424	505,756	142,664,000	4,554,000	7,716,000
Other lode material:							
Gold (slag)	(2)	3	201	1,167	----	----	----
Old tailings	(2)	400	8	3	----	----	----
Total	(2)	403	209	1,170	----	----	----
Total lode material	48	15,817,070	228,633	506,926	142,664,000	4,554,000	7,716,000
Placer	5	(3)	417	187	----	----	----
Total all sources	53	15,817,070	229,050	507,113	142,664,000	4,554,000	7,716,000

[1] Details will not necessarily add to totals shown, because some mines produce more than 1 class of material.
[2] From property not classed as a mine.
[3] 3,025 cubic yards.

Table 7.—Mine production of gold, silver, copper, lead, and zinc, in 1965, by types of material processed, and methods of recovery in terms of recoverable metals

Type of material processed, and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Lode:					
Amalgamation and cyanidation: Ore	193,663	8,451			
Concentration and smelting of concentrates: Ore	33,792	452,519	139,383,000	3,594,500	6,195,700
Direct smelting:					
Old tailings	8	3			
Ore	969	44,786	3,281,000	959,500	1,520,300
Slag	201	1,167			
Total	1,178	45,956	3,281,000	959,500	1,520,300
Placer	417	187			
Grand total	229,050	507,113	142,664,000	4,554,000	7,716,000

percent of all shipments were direct-shipping-grade ore, and over 93 percent of the total output was exported. All properties were worked by open pit except the underground Iron King mine, Humboldt County. Only one operator, Standard Slag Co. in Douglas County, produced other than direct shipping grade ore. Standard Slag produced a concentrate, principally for export, with a relatively small tonnage consigned to a domestic cement plant.

Lead.—Two lead-zinc mines and one silver mine were credited with the marked increase in recoverable lead production. The Pan American lead-zinc mine and Caselton mill, Lincoln County, were activated by Grand Panam Joint Venture; shipments of concentrate began in June. By yearend the mine had become Nevada's major lead producer. Cordillera Co. reactivated the Sally Louise lead-zinc mine, Esmeralda County, and began shipping ore to a Utah custom mill in February. The tonnage of lead recovered from ores of the Ward Group of silver claims by Silver King Mines, Inc., White Pine County, was quadruple the 1964 figure. Lead-zinc ores contributed 73 percent of the State's lead production, silver ores 17 percent, lead ores 9 percent, and zinc ores 1 percent.

Mercury.—Mercury production rose only slightly despite an average unit price of $570.75 per flask, $256 above the previous alltime high of 1964. The number of producing properties doubled, yet only 4 producers reported yields of more than 100 flasks each, and 30 operators produced less than 10 flasks each. The Cordero mine, Humboldt County, the State's major producer, was hampered by an underground fire, and output was 27 percent below the 1964 figure. However, mercury shipments from this property represented 68 percent of the State total, which was 23 percent lower than in 1964.

Molybdenum.—Kennecott Copper Corp. recovered molybdenite in its McGill concentrator, White Pine County, as a byproduct in treating copper ore mined in the nearby Robinson District. Production and shipments were well above 1964 figures.

The Anaconda Company announced that a large-tonnage, low-grade molybdenum ore reserve had been confirmed at the Hall molybdenum prospect north of Tonopah. Studies were underway to determine mining and treatment methods.

Silver.—Production of recoverable silver nearly tripled the 1964 output. Although increases were reported in the tonnage of silver ores treated and in byproduct recovery from copper ores, the major silver source was from the ores of reactivated lead-zinc mines. The Pan American lead-zinc mine, Lincoln County, was Nevada's major producer of recoverable silver. Lead-zinc ores yielded 42 percent of the total lode silver, silver ores 28 percent, copper ores 26 percent, and all other ores 4 percent.

Silver recovery at placer gold operations was insignificant by comparison. Less than 200 ounces of silver was recovered from all placer deposits in Nevada.

Tungsten.—Activity at tungsten mines was limited to the production and shipment of a few hundred pounds of concentrate

Table 8.—Mercury production, by methods of recovery

Year	Direct-furnaced		Retorted		Unclassified [1] flasks	Total		Operating mines
	Ore (short tons)	Flasks	Ore (short tons)	Flasks		Flasks	Value [2]	
1956-60 (average)	40,751	5,975	8,282	911	11	6,897	$1,607,728	34
1961	103,088	13,705	26,013	353	1	7,486	1,479,308	21
1962						6,573	1,256,823	14
1963	42,768	4,908	356	36	------	4,944	936,641	11
1964	42,635	3,181	653	81	------	3,262	1,026,845	21
1965	48,197	2,877	3,575	456	------	3,333	1,902,310	42

[1] Includes mercury recovered from miscellaneous dump material.
[2] Value calculated at average New York price.

from a property near Imlay, Pershing County, to a California paratungstate plant. Kennametals, Inc., purchased foreign concentrate, and small quantities from producers in Arizona and Washington, for its tungsten carbide plant near Rawhide, Mineral County. The company also operated a plant at Fallon, Churchill County, where finished tungsten carbide powder blends were prepared for use in a variety of manufactured products.

Uranium.—Apex Minerals Corp. mined uranium ore from the Rundberg mine (Early Day claims), Lander County, and shipped to a processing plant at Moab, Utah. Total shipments increased almost fourfold over those in 1964, but the grade of ore was appreciably lower. All other uranium properties were idle throughout the year.

Zinc.—Three zinc mines were active during the year, but only the Mountain View mine in Eureka County yielded an appreciable quantity of recoverable zinc. The more than sixfold increase in recoverable zinc produced over 1964 production was credited to the outputs from reactivated lead-zinc mines. The Pan American lead-zinc mine, Lincoln County, produced more recoverable zinc than all other sources combined. Lead-zinc ores yielded 81 percent of the total zinc recovered, zinc ores 10 percent, silver ores 8 percent, and all other ores, residues, and slags 1 percent.

NONMETALS

Barite.—Primary barite production was 24 percent below the 1964 figure; sales, including tonnages used by producers, dropped 39 percent. Four mines in Lander County yielded 97 percent of the total. The major producers were FMC Corp. (Mountain Springs mine), D. A. Mining Co. (D. A. deposits), and Magnet Cove Barium Corp. (Greystone group).

Magnet Cove ground barite in its plant at Battle Mountain, and National Lead Co. operated its Elko County grinding plant on barite mined in previous years. All other producers shipped to grinding plants in California and Utah.

Cement.—Nevada Cement Co. began production and shipments of portland cement from its Lyon County plant in January. The company installed a cement storage and distribution terminal at Sacramento, Calif., early in the year. Shipments were made to consumers in Nevada and northern California.

In October, Calaveras Cement Co. installed a portland cement storage and distribution terminal at Sparks, Washoe County, to improve service to Nevada customers.

Clays.—Silicates Corp. mined bentonite from company-owned deposits in Esmeralda and Nye Counties. In both instances the mineral was prepared and sold for use in ceramics, cosmetics, and pharmaceuticals. Industrial Minerals & Chemical Co. mined fuller's earth from its Lyon County deposit and prepared the material for use chiefly as a pelletizing agent. Nevada Cement Co. obtained clays from a Washoe County deposit for use in its Lyon County cement facility. A White Pine County deposit was the source for clay used by Kennecott Copper Corp. at its McGill smelter.

Diatomite.—Sales of prepared diatomite rose only slightly above the 1964 figure, whereas crude sales, though relatively small, showed a marked increase owing to use of the material as a source for silica at the Nevada Cement Co. plant, Lyon County. Six deposits were worked—two

in Churchill County and one each in Esmeralda, Lincoln, Pershing, and Storey Counties. Major processing plants were operated by Eagle-Picher Co. in Pershing and Storey Counties, and by Great Lakes Carbon Corp. in Esmeralda County. During the year, the mine (Churchill County) and plant (Lyon County) owned by Aquafil Company, Division of Kohl Enterprises, was sold to Sierra Talc & Chemical Co., Division of Cyprus Mines Corp. Assessment work only was reported by owners of the King claims, Mineral County.

Fluorspar.—In Nye County, metallurgical grade fluorspar was shipped from the Crowell mine to a west coast steel plant and lower-grade material was shipped from the Goldspar deposit of Monolith Portland Cement Co. to the producer's California cement plant. Shipments were slightly below 1964 figures. Wells Cargo, Inc., made no shipments from stockpile at its Lincoln County property and, as in 1964, the mine remained idle.

Gypsum.—Crude gypsum output was 11 percent below that in 1964, and the tonnage calcined at board plants declined 9 percent. Sales of uncalcined gypsum for agricultural use also were lower. Although production of crude gypsum was principally from one deposit in Pershing County and two in Clark County, a test shipment was made from a Lincoln County deposit to an out-of-State wallboard plant. The latter deposit had been previously reported to be in northeastern Clark County. U.S. Gypsum Co. mined gypsum in Pershing County for use in its Washoe County products plant. The Flintkote Co. mined gypsum and produced lath, plaster, and wallboard in Clark County. The new wallboard plant of Fibreboard Paper Products Corp. near Apex, Clark County, was completed and placed on stream in August.

Lime.—The Flintkote Co., Nevada's only lime producer, operated three lime plants in Clark County—at Apex (quicklime), Sloan (hydrated lime), and Henderson (quicklime and hydrated lime). Total output declined from that of 1964. Although increased sales were reported for chemical and industrial uses, they did not offset the loss in sales for construction use. Although shipments were principally to southern California customers, appreciable sales also were made to other customers throughout the Western States.

Lithium Compounds.—Adverse weather conditions hampered operations and delayed production of lithium compounds by Foote Mineral Co. in Clayton Valley, Esmeralda County. The company has 11 solar-evaporation ponds ranging in size from 20 to 500 acres and 5 brine wells. Late in the year trial runs were made in a pilot chemical plant, with lithium production and shipments planned for early 1966. The company also planned to produce sodium and potassium chlorides.

Magnesite and Brucite.—Basic, Inc., operated open pit magnesite and brucite mines near Gabbs, Nye County. In nearby plants the company upgraded the ore and produced special products and refractory materials. During the year Basic operated a pilot plant and developed a process for making dolomite and magnesite grains with higher refractory values than any heretofore produced at Gabbs. The company scheduled construction of a plant for making extremely high-thermal-shock refractory grains for early 1966.

Perlite.—Sales of crude perlite continued a decline begun in 1959. Four properties were active, two in Lincoln County and one each in Esmeralda and Pershing Counties. Crude perlite from the latter deposit was expanded at a Washoe County wallboard plant. A Clark County expanding plant purchased crude perlite from a California producer and sold the plant product for concrete and plaster aggregate and for use as a soil conditioner.

Pumice (Volcanic Cinder).—The Naturalite pumice property, Storey County, was operated throughout the year. Output from the property was prepared for concrete aggregate. Pumicite was produced and processed near Panaca, Lincoln County, and sold for pozzolanic concrete admixture in the Los Angeles, Calif., area. Aggregate, primarily for use in making concrete block, was produced from two volcanic cinder deposits, one each in Nye and Ormsby Counties. The Nye County material was marketed in the Las Vegas area, the Ormsby County cinder in the Reno-Sparks area. A small quantity of pumicite was mined in Mineral County and used in concrete by the producer.

Salt.—Solar-evaporated salt was harvested from the surface of a dry lakebed near Sand Springs, Churchill County. The entire output was sold to Nevada customers, principally State, county, and municipal agencies, for use on icy streets and roads. Lesser quantities were used by meatpackers, dairies, and water-softener services.

Sand and Gravel.—Nevada had 100 active sand and gravel operations, 11 fewer than in 1964. Of these, 43 were classified as commercial and 57 as Government-and-contractor. Three of the commercial operators produced over 500,000 tons each, 11 produced between 100,000 and 500,000 tons each, and 29 less than 100,000 tons each. Nearly 78 percent of the total output was produced using portable equipment. Production in portable plants was 4.5 million tons less than in 1964; the production at stationary plants was virtually unchanged at 2.1 million tons.

Dollar volume in highway projects continued at record levels, however, projects neared completion and others had only begun so that few highway projects required large tonnages of aggregate. This explained the marked decline in overall production from 1964.

Aggregate requirements rose for paving use in Pershing County, and for both building and paving in Washoe County, but declined in Clark County where building construction slumped noticeably.

Stone.—Overall stone production rose nearly one-half million tons from 1964, due chiefly to the start of new limestone quarries in Lyon and Washoe Counties for use in cement, and to increased requirements for stone in road construction and other base material needs in Elko, Ormsby, Washoe, and White Pine Counties.

Basalt and decomposed granite were quarried for roadstone in Churchill County; limestone for lime and metallurgical flux, quartz for dimension building stone, and miscellaneous stone for roofing granules in Clark County; miscellaneous stone for road construction and repair in Douglas County; granite for riprap and asphalt paving, and quartz for exposed aggregate in Elko County; miscellaneous stone for railroad ballast in Eureka County; sandstone for dimension building use in Humboldt County; granite for riprap in Lincoln County; limestone for cement and miscellaneous stone for riprap and roads in Lyon County; marble for terrazzo in Mineral County; calcareous marl for filler use and opaline silica for use in refractories in Nye County; decomposed granite for road construction in Ormsby County; decomposed granite for road construction, limestone for cement, and calcareous marl for mineral filler in animal feeds in Washoe County; and limestone for road repair and quartz for dimension building stone in White Pine County.

Table 9.—Sand and gravel production in 1965, by counties

(Thousand short tons and thousand dollars)

	Quantity	Value
Churchill	32	$24
Clark	3,927	5,122
Douglas	29	38
Elko	703	388
Eureka	346	280
Humboldt	99	145
Lander	281	223
Lincoln	107	89
Lyon	183	256
Mineral	142	106
Nye	367	698
Ormsby	89	98
Pershing	376	305
Washoe	2,682	3,946
White Pine	92	78
Total	9,455	11,796

Sulfur.—The Crofoot sulfur deposit, Humboldt County, was idle throughout the year. However, some sulfur was shipped from stocks for use as soil aid. The Anaconda Company used stockpiled sulfur ore, mined in previous years from a California deposit, to make acid in its copper-leaching plant, Lyon County. The company estimated the stockpile would supply plant requirements through 1967. Several hundred tons of native sulfur, however, was purchased in 1965.

Talc and Soapstone.—All talc and soapstone production came from deposits in Esmeralda County. Four talc and three soapstone deposits were worked, compared with three talc and two soapstone in 1964, but production and shipments declined 32 percent. The entire output was shipped to grinding plants in California.

Water.—A Bureau of Mines study, "Water Requirements and Uses in Nevada Mineral Industries," was published as Information Circular 8288.

Sierra Pacific Power Co. completed feasibility studies of the Beowawe Geyser Basin,

Table 10.—Sand and gravel sold or used by producers, by classes of operations and uses

Class of operation and use	1964		1965	
	Short tons	Value	Short tons	Value
Commercial operations:				
Sand:				
Glass	W	W	W	W
Molding	W	W	W	W
Building	807,000	$1,354,000	700,000	$1,484,000
Paving	74,000	207,000	238,000	402,000
Fill	32,000	28,000	22,000	16,000
Other	W	W	W	W
Gravel:				
Building	754,000	1,170,000	947,000	1,704,000
Paving	2,409,000	2,827,000	2,612,000	3,706,000
Railroad Ballast	5,000	11,000	W	W
Fill	297,000	314,000	419,000	376,000
Other	W	W	W	W
Miscellaneous	----------	----------	129,000	245,000
Undistributed sand and gravel [1]	412,000	1,107,000	441,000	914,000
Total sand and gravel	4,790,000	7,018,000	5,508,000	8,847,000
Government-and-contractor operations: [2]				
Sand:				
Building	13,000	13,000	27,000	27,000
Paving	230,000	134,000	72,000	63,000
Fill	----------	----------	5,000	5,000
Other	16,000	11,000	----------	----------
Total	259,000	158,000	104,000	95,000
Gravel:				
Building	70,000	70,000	25,000	25,000
Paving	8,991,000	7,148,000	3,633,000	2,636,000
Fill	10,000	10,000	185,000	193,000
Other	22,000	23,000	----------	----------
Total	9,093,000	7,251,000	3,843,000	2,854,000
Total sand and gravel	9,352,000	7,409,000	3,947,000	2,949,000
All operations:				
Sand	1,491,000	2,659,000	1,446,000	2,860,000
Gravel	12,651,000	11,768,000	8,009,000	8,936,000
Grand total	14,142,000	14,427,000	9,455,000	11,796,000

W Withheld to avoid disclosing individual company confidential data.
[1] Includes items indicated by symbol W.
[2] Includes figures for State, counties, municipalities, and other Government agencies.

Eureka County, and terminated its investigations in the area. No work was done in development of thermal energy in any other area.

MINERAL FUELS

Peat.—A peat bog in the Amargosa Desert, Nye County, near Death Valley Junction, Calif., was the source of reed-sedge peat sold for use as a soil improvement agent. The producer used a scraper with a ripper bar, belt conveyor, hammer mill, grinder, and screens to prepare the material for shipment.

Petroleum.—Nine wildcat wells drilled in 1965 failed to find new oilfields or to extend the State's only field, the Eagle Springs field, Nye County, discovered by Shell Oil Co. in 1954. Six new wells were completed to production. The fourth well

Table 11.—Stone [1] production in 1965, by counties

County	Short tons	Value
Churchill	50,000	$31,000
Clark	W	W
Douglas	30	30
Elko	39,493	88,736
Esmeralda	800	400
Eureka	104,032	380,757
Humboldt	650	22,750
Lincoln	780	741
Lyon	W	W
Mineral	W	W
Nye	858	1,101
Ormsby	117,257	101,606
Washoe	79,785	66,376
White Pine	37,220	70,250
Other counties	816,964	1,482,757
Total	1,247,869	2,246,504

W Withheld to avoid disclosing individual company confidential data, included with "Other counties."
[1] Includes stone used in cement and lime.

had production capacity exceeding 1,000 barrels per day from Eocene sands at a depth of 6,800 feet. Crude oil production dropped 18 percent below the high of 1964, principally because of the lack of adequate transportation to refineries in California and Utah. Cumulative production from the field through 1965 was 1,181,212 barrels. At yearend several major oil companies held substantial acreage under lease, although only one, Gulf Oil Corp., did any exploratory drilling during 1965.

REVIEW BY COUNTIES

Each of Nevada's 17 counties reported production of two or more mineral commodities. However, output in four counties—Clark, Eureka, Lyon, and White Pine—represented 74 percent of the total mineral value in 1965. These four counties yielded most of the State's copper, gold, gypsum, and stone, and about one-half its silver and sand and gravel.

In addition, all lime production was from Clark County, and all cement from Lyon County. Other counties also reported exclusive production figures. All Nevada's salt came from Churchill County, all talc and soapstone from Esmeralda County, all sulfur from Humboldt County, all uranium from Lander County, all tungsten from Pershing County, and all brucite and magnesite, peat, and petroleum from Nye County. Nye also yielded all of the 1965 fluorspar production although shipments were made from stockpile in Lincoln County. Pertinent information on these commodities, and all references to sand and gravel and stone used in the construction industry, will be found in the "Review by Mineral Commodities" section.

Churchill.—Diatomite was mined from a deposit in the northeast corner of the county and processed in a plant at Fernley, Lyon County. A contractor mined the material near Brady's Hot Springs for use as a source of silica in the Lyon County cement plant.

A few tons of antimony ore was mined and shipped from the Ubet mine in the Bernice mining district. A small quantity of silver ore, that also contained recoverable gold, was mined and shipped from the Summit King group of claims in the Sand Springs district.

Clark.—Crude gypsum was mined at Blue Diamond and calcined in a nearby plant to make plaster and wallboard products. Some crude gypsum was shipped to the producer's wallboard plant at Fremont, Calif. Southeast of Apex, crude gypsum was mined and calcined in a new wallboard plant at the mine site. The latter producer also shipped crude gypsum to its wallboard plants in California. Industrial sands were produced in the Overton area for glass manufacture and foundry use. The major producer operated two pits and plants in the area. Overall output was somewhat below that in 1964.

Gold ore mined from the Capitol group of claims in El Dorado Canyon also contained recoverable silver. A few tons of lead ore mined from the Iron Gold properties in the Yellow Pine district was shipped to a Utah smelter for recovery of gold, silver, copper, lead, and zinc. Stream gravels on the Gresh group of claims in El Dorado Canyon were worked by small-scale hand methods and a small quantity of placer gold was recovered.

Douglas.—The Minnesota open pit iron mine in the Buckskin district was operated throughout the year. The ore was upgraded in the producer's concentrator near Wabuska, Lyon County. This mine was Nevada's major source of usable iron ore, and production increased 12 percent above that in 1964. The plant output was shipped for export except for relatively small tonnages sold to cement and refractories producers.

Silver ore produced from the Danite mine, Gardnerville district, was shipped to a California smelter for recovery of gold and silver.

Elko.—Lead ores from the Gold Note group of claims in the Delno district, and from the Silver Star property near Contact, were shipped to a California smelter for recovery of silver, copper, lead, and zinc. The Silver Star ore also contained recoverable gold. Silver ores from the Annex mine and Eagle claims, Merrimac district, and gold ore from the Dixie gold property, Gold Circle district, were shipped to a Utah smelter for extraction of recoverable metals. Zinc ores from prospects

Table 12.—Value of mineral production in Nevada, by counties

County	1964	1965	Mineral produced in 1965 in order of value
Churchill	$425,517	$85,521	Stone, sand and gravel, salt, diatomite, antimony, silver gold.
Clark	13,811,757	12,219,180	Sand and gravel, lime, gypsum, stone, lead, gold, zinc, silver, copper.
Douglas	2,154,885	2,347,112	Iron ore, sand and gravel, silver, gold, stone.
Elko	1,273,068	507,997	Sand and gravel, stone, lead, silver, zinc, copper, gold.
Esmeralda	660,649	883,094	Diatomite, zinc, lead, mercury, talc and soapstone, silver, copper, clays, perlite, gold, stone.
Eureka	1,437,530	6,494,722	Gold, iron ore, stone, sand and gravel, zinc, barite, lead, silver, copper.
Humboldt	5,445,283	4,440,740	Gold, mercury, iron ore, sand and gravel, stone, silver, sulfur ore, barite, lead, copper.
Lander	1,792,036	825,269	Barite, sand and gravel, uranium, antimony, silver, gold, zinc, copper, lead.
Lincoln	157,814	1,726,004	Zinc, lead, silver, perlite, sand and gravel, copper, gold, diatomite, pumicite, stone, gypsum.
Lyon	25,722,203	28,879,245	Copper, cement, sand and gravel, stone, diatomite, gold, silver, clays.
Mineral	129,559	123,481	Sand and gravel, barite, mercury, stone, pumice, silver, lead.
Nye	3,123,118	3,694,866	Magnesite, sand and gravel, brucite, petroleum, fluorspar, mercury, volcanic cinder, peat, gold, silver, lead, clays, zinc, stone, copper.
Ormsby	240,443	W	Stone, sand and gravel, volcanic cinder.
Pershing	3,807,650	5,002,103	Diatomite, iron ore, gypsum, mercury, sand and gravel, perlite, silver, lead, gold, antimony, tungsten, zinc, copper.
Storey	1,581,699	W	Diatomite, pumice.
Washoe	2,559,054	4,044,129	Sand and gravel, stone, clays, pumice, gold, lead, silver, zinc.
White Pine	20,714,015	26,598,818	Copper, gold, molybdenum, silver, lead, zinc, sand and gravel, stone, clays.
Undistributed [1]	100,720	2,043,719	
Total	85,137,000	99,916,000	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] Includes gem stones, mercury, gold, and silver that cannot be assigned to specific counties and values indicated by symbol W.

near Wells and Montello were shipped to the same smelter.

Crude barite, mined in previous years, was ground for use in compounding well-drilling muds in the producer's Dunphy plant. The company mine was idle throughout the year.

Esmeralda.—Diatomite was mined from a deposit near Basalt and processed in the producer's plant to meet the specifications of paint, paper, and insecticide manufacturers. Bentonite was mined from the Blanco pit northwest of Coaldale and sold to manufacturers of cosmetics and pharmaceuticals. A small tonnage of crude perlite was obtained from the Hurry Up claims near Crow Springs, northwest of Tonopah, and sold for use as aggregate.

Lead-zinc ore from the reactivated Sally Louise mine, Lone Mountain district, was shipped to a Utah mill and smelter for recovery of precious and base metals. Ores from this mine contributed appreciably to the State's silver, lead, and zinc production. Lead ore mined at the Hoot Owl property and silver ore from the Sylvania (Four Aces claims), Hornsilver district, were shipped to a California smelter to recover silver, lead, and zinc. Mercury ore from the reopened B&B mine, Fish Lake Valley district, was furnaced to yield over 100 flasks of the metal. Also, a few flasks of mercury were obtained in furnacing ore from the Poor Boy mine in the same district.

Eureka.—The Carlin mine and cyanide mill, Lynn district, was in production early in 1965 and in May the first gold bar was poured. By yearend this mine had become the State's leading gold producer, and the Nation's second largest. Zinc ore produced at the Mountain View mine was shipped to a Utah smelter for recovery of silver, copper, lead, and zinc. Some silver ore mined at the Dorsey property, Stafford district, was shipped to the same smelter. The latter ore also contained recoverable copper and lead. Hematite ore was produced from the Barth open pit iron mine near Carlin and the entire output shipped

for export. The Barth was the State's major source for direct-shipping-grade iron ore.

Crude barite was mined and shipped from the Queen Ann deposit near Carlin to the Dunphy mill, Eureka County, and to a California grinding plant.

Humboldt.—The Getchell gold mine and cyanide treatment plant operated throughout the year. The mine was Nevada's second-largest gold producer. Gold ore from the Epex mine, Awakening district, and a few tons of silver ore mined at the Black Arrow prospect near Denio were shipped to the Selby, Calif., smelter for recovery of precious and base metals. Ore produced at the Cordero mine, McDermitt district, was furnaced to yield more than 2,000 flasks of mercury. The mine was the State's major mercury source, with more than 65 percent of the total output. Mercury also was produced by retorting ores from the Cahill and Hapgood properties, Poverty Peak district, and the Cinnabar Canyon (White Peaks) mine, Bottle Creek district. Direct-shipping-grade iron ore was produced at the Iron King underground mine in the Jackson Mountains. The lump ore was shipped to domestic steel plants in the Midwest and the fines were exported.

Crude barite from the Horton claims near Golconda was shipped to a California grinding plant.

Lander.—Barite mines in the county yielded about 97 percent of the State production. Four properties were active, all in the Battle Mountain area. Crude barite from the Greystone group of claims was ground by the producer in the company mill at Battle Mountain; crude ore from the D. A. deposits and the Norris property were consigned for the most part to Utah and California grinders. A small tonnage from the Norris deposit was ground in the Dunphy mill, Eureka County. Crude barite produced at the Mountain Springs mine was shipped to the producer's plant in Modesto, Calif.

Two operators worked the Last Chance antimony mine, Battle Mountain district, and shipped about 44 tons of ore. Antimony concentrates, produced in the Stevens mill at Austin from ores mined in previous years, also were shipped. All shipments went to a Texas smelter. Only one other lode mine was active during the year. At the Bentley property, in the same district, a relatively small tonnage of silver ore was mined that also contained recoverable copper, lead, and zinc. A few ounces of placer gold and silver were recovered from stream gravels at various locations in Lander County.

Lincoln.—Activation of the Pan American mine, Comet District, was the highlight of the year for Lincoln County. The producer also reactivated the Caselton mill and produced both lead and zinc concentrates. The lead was shipped to a Utah smelter, the zinc to one in Montana. By yearend the Pan American had become Nevada's leading lead and zinc producer and had contributed appreciably to the total 1965 silver output. Ore produced at the Bristol Silver mine, Jack Rabbit district, was shipped to a Utah smelter for recovery of gold, silver, copper, lead and zinc. A ton of material shipped to the same smelter from the Tempiute mine, Tempiute district, contained recoverable silver, copper, lead, and zinc.

Crude perlite mined at the Hollinger pit near Pioche and at the Mackie deposit near Caliente was shipped to California expanding plants. Crude diatomite was produced from the Robin claims at Panaca and shipped to a processing plant in Los Angeles, Calif. Pumicite was mined from the Lori Free pit near Cathedral Gorge and processed in a Panaca plant for use as pozzolan. Crude gypsum was mined at the Snow Flake claims near Carp and several carloads were shipped to an eastern wallboard plant for testing.

Lyon.—Copper ores from the Yerington open pit mine were treated in the oxide-leaching plant or sulfide concentrator at Weed Heights. Plant products, precipitates, and concentrates were shipped to the producer's Montana smelter, although most of the sulfide concentrate was shipped to a smelter in Tacoma, Wash. The concentrates contained recoverable gold and silver. Silver ore produced at the Lorraine group of claims, Yerington district, was treated by amalgamation to recover gold and silver. About 1 ton of gold ore was shipped from a prospect near Dayton to the Selby, Calif., smelter for gold and silver recovery. A Dayton sand and gravel washing plant recovered byproduct placer gold and silver.

A Fernley plant processed diatomite,

received from the owner's Churchill County property, for customers outside the State. Fuller's earth was mined from the Jupiter pit near Weeks and sold for use in pelletizing and as a filtering and clarifying agent.

Mineral.—Crude barite was mined and shipped from the Columbus deposit south of Mina and from the Williams property near Candelaria to a processing plant at Harbor City, Calif. Pumice was obtained from the Pumco pit east of Mina and used for lightweight concrete aggregate.

Ores from three prospects in the Mina area were retorted to recover a few flasks of mercury. A few tons of silver ore produced from the Vulture mine, Whiskey Flat district, was shipped to the Selby, Calif., smelter. Some lead also was recovered from the Vulture mine ore.

Nye.—Five mercury properties were active in 1965. Ore from the Ione mercury mine, Union district, was furnaced to recover the metal; ores from the other properties were retorted. The Horse Canyon mine, Manhattan district, had two operators during the year. The Red Bird mine, Belmont district, and the Sentinel and Danberg prospects, in unnamed districts, also reported mercury recovery. Only the Ione mine produced more than 25 flasks.

Nine other lode mines were worked during the year. Gold ores from the Crown-Point Globe property, Johnnie district, and the Nevada Porphyry mine, Round Mountain district, were treated by amalgamation to recover gold and silver, as was silver ore produced at the Silver King (Silver View) mine, Manhattan district. Silver ores from four mines, Millett and Morey districts, were shipped to smelters in California and Utah for recovery of precious and base metals. Lead ores produced from the Tybo and Victory mines, Tybo district, were smelted in Utah. The ores also contained recoverable gold, silver, copper, and zinc. Placer gold and silver also were recovered from bench gravels on the Nevada Porphyry property. A dragline was used to work ancient riverbed gravel on the Georgie No. 1 claim, and small-scale hand methods were used to mine stream gravels at the Middle Gulch claims, Manhattan district. Placer gold and silver were recovered.

Volcanic cinder was hauled from the Cinder Cone deposit near Beatty to a block plant in Las Vegas for use as lightweight aggregate. Bentonite was mined on the New Discovery claims in the Beatty area and shipped to California manufacturers of cosmetics and pharmaceuticals.

Ormsby. Volcanic cinder was obtained from the Cinderlite deposit near Carson City and used for concrete and asphalt aggregate and as decorative stone.

Pershing.—Diatomite was produced from the Tunnel Hill deposit, Velvet district, and processed in a plant at Colado, principally for filtration uses. Crude gypsum was quarried at Empire to supply a gypsum products plant near Gerlach, Washoe County. The plant also used perlite hauled from the Pearl Hill quarry near Lovelock.

The Southern Pacific lease in section 29 was worked for direct-shipping iron ore, all of which was exported. The Nevada Iron property in section 30 also yielded direct-shipping grade ore that was consigned to domestic steel plants. Of the 13 mercury mines and prospects active in 1965, 3 had more than 1 operator during the year. Seven mines yielded 10 flasks or more but only one, the Kitten Springs mine, Relief district, had production in excess of 100 flasks. However, mercury recovered at the Eastern Star mine, Relief district, the Gold Banks mine, Gold Banks district, and the Loretta mine, Antelope Springs district, contributed substantially to the county total. Ores from the Kitten Springs and the Loretta were furnaced. All other operators used retorts to recover the metal. Silver ores from the Good View mine, Wild Horse district, Keyrock claims, Ceneral district, and Wabash mine, Rochester district, were smelted in Utah to recover precious and base metals. Material from the Thompson pit and the dump of an abandoned mine, were treated by amalgamation to recover several ounces of gold and silver. About 1 ton of antimony ore was mined and shipped from the Burl property near Lovelock.

Storey.—Diatomite was produced from the Celatom mine and processed in the nearby Clark Station plant. The product was sold to domestic and foreign customers for a wide variety of uses. Pumice was mined from the Naturalite deposit near the Lyon County line, northeast of Dayton, for use as concrete aggregate.

Washoe.—Clay was mined from a pit near Flanigan for use in making cement at

a Lyon County plant. Volcanic cinder (scoria) was obtained from the Sierra Aggregates pit near Sparks, by a contractor for the Bureau of Land Management, and used for concrete aggregate.

Dump material from an abandoned mine was shipped to the Selby, Calif., smelter where silver, lead, and zinc were recovered. Old tailings at the Slip claim, Sand Pass district, were amalgamated to recover a few ounces of gold and silver. Stream gravels were worked on the Williams property, Olinghouse district, where some placer gold and silver were recovered.

White Pine.—Copper ores from the Liberty pit, Robinson district, were treated in the concentrator and smelter at McGill. In addition to copper, the ores yielded considerable gold and silver and all of the State's molybdenum. Lead ore from the Hamilton mine, White Pine district, was smelted in Utah for recovery of precious and base metals. Silver ore mined from the Ward group of claims, Ward district, was concentrated in an East Ely mill. The concentrate was shipped to a Utah smelter to recover gold, silver, copper, lead, and zinc.

Clay was dug from the McDonough clay beds near Ely for use as a fluxing agent in the McGill copper smelter.

The Mineral Industry of New Hampshire

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the New Hampshire Department of Resources and Economic Development for collecting information on all minerals except fuels.

By Stanley A. Feitler [1]

The annual value of New Hampshire mineral production continued to increase as a greater output of sand and gravel and clay offset a large decrease in the value of stone. More than 98 percent of the mineral output, as measured by value, was used in highway and building construction.

Table 1.—Mineral production in New Hampshire [1]

Mineral	1964		1965	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays---short tons	45,620	$40	53,200	$47
Sand and gravel---do	8,768,000	4,996	10,584,000	5,559
Stone---do	202,164	2,138	153,397	1,932
Value of items that cannot be disclosed:				
Feldspar and gem stones	XX	128	XX	127
Total	XX	7,302	XX	7,665

XX Not applicable.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

REVIEW BY MINERAL COMMODITIES

NONMETALS

Clays.—Miscellaneous clay was recovered from pits operated in conjunction with brickyards in Grafton, Rockingham, and Strafford Counties. Production was greater than in 1964 because of a strong demand for irregular bricks produced in scove kilns.

Feldspar.—Usable crude feldspar was produced from pegmatites by selective mining and hand-sorting in Cheshire and Grafton Counties. Golding-Keene Co. trucked ore from the Surry and Pearson mines to its mill in Alstead Township. The material was finely ground for use in pottery, enamel, and cleaning compounds. The prin-

Table 2.—Value of mineral production in constant 1957–59 dollars
(Thousands)

Year	Value
1956	$3,393
1957	3,384
1958	3,938
1959	4,625
1960	5,450
1961	5,426
1962	6,011
1963	6,199
1964	r 7,438
1965	7,816

r Revised.

[1] Mining engineer, Bureau of Mines, Pittsburgh, Pa.

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Table 3.—Employment and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1964:								
Nonmetal	46	152	7	55		1	18.17	1,272
Sand and gravel	411	197	81	672		9	13.40	289
Stone	274	208	57	457		13	28.48	887
Total	731	198	145	1,184		23	19.43	565
1965: p								
Nonmetal	45	178	8	63		1	15.87	143
Sand and gravel	370	197	73	607		8	13.18	329
Stone	275	185	51	419		8	19.09	105
Total	690	191	132	1,089		17	15.61	232

p Preliminary.

cipal destinations for the ground product were New York, Connecticut, and Massachusetts. Lump feldspar produced at the Ruggles mine by Ruggles Mining Co. was trucked to a feldspar grinding mill at West Paris, Maine.

Gem Stones.—Much mineral specimen material and some gem stones were collected by amateurs from pegmatites and other mineral localities in Grafton, Carroll, and Cheshire Counties. A large number of collectors visited the Ruggles mine in Grafton County to collect a variety of uranium and phosphate minerals, beryl, feldspar, muscovite, rose quartz, and other minerals. An admission fee was charged.

Mica.—The grinding plant of Concord Mica Co. at Penacook was destroyed by fire in January, and operations were discontinued. The company did not plan to rebuild.

Perlite.—Crude perlite, mined in the Western States, was expanded for use in acoustical plaster by the National Gypsum Co. at its Portsmouth plant.

Sand and Gravel.—Most of the 1.8-million ton increase in production, compared with that of 1964, was for highway construction and maintenance, although output of sand and gravel for building increased 22 percent. Commercially produced sand and gravel increased 19 percent in quantity and 4 percent in value compared with the previous year. The value of washed and screened material from commercial plants decreased 3 cents to $1.08 per ton. Of the 27 recognized commercial operations, 10 sold more than 100,000 tons, 10 plants handled 25,000 to 100,000 tons, and 7 plants had an output of less than 25,000 tons. Commercially produced material was shipped; 82 percent by truck and 18 percent by railway. All Government-and-contractor output was delivered by truck. Bank run material sold by commercial producers amounted to 27 percent of their

Table 4.—Sand and gravel, and stone production by government-and-contractor operations, by counties

County	Sand and gravel (thousands short tons)		Stone (short tons)	
	1964	1965	1964	1965
Belknap	416	911	127	21,108
Carroll	101	180	----	183
Cheshire	466	462	42,024	6,812
Coos	495	584	2,283	2,498
Grafton	464	1,387	7,335	5,538
Hillsboro	471	160	10,955	80
Merrimack	1,085	453	7,229	----
Rockingham	1,317	1,043	1,066	741
Strafford	295	135	59	----
Sullivan	168	266	846	1,917
Unspecified	607	1,582	----	----
Total	5,885	7,163	71,924	38,877

total. Crews of the Concord Commissioner of Public Works, Merrimack County, produced sand and gravel for highway construction and maintenance.

Stone.—Total stone production was significantly lower than in 1964. Dimension stone, which accounted for most of the value, was produced for architectural stone, curbing, and monumental stone at the Kitledge quarry in Hillsboro County and at the Swenson Gray quarry in Merrimack County. Quarry blocks from these and out-of-State quarries were processed at nearby finishing plants. Crushed granite for fill and riprap was produced by the New Hampshire Department of Public Works and Highways in all counties except Merrimack and Strafford. Miscellaneous stone mined in Rockingham County was used for riprap, concrete aggregate, and roadstone. Quartz was mined and crushed for use as exposed aggregate in decorative concrete at one operation in Hillsboro County and two operations in Sullivan County.

REVIEW BY COUNTIES

Sand and gravel and stone produced by Government-and-contractor operations are shown in table 4 and are not included under the individual county reports that follow.

Table 5.—Value of mineral production in New Hampshire, by counties

County	1964	1965	Minerals produced in 1965 in order of value
Belknap	W	W	Sand and gravel, stone.
Carroll	W	W	Sand and gravel, stone, gem stones.
Cheshire	$664,085	$657,700	Sand and gravel, feldspar, stone, gem stones.
Coos	W	W	Sand and gravel, stone.
Grafton	639,352	947,734	Sand and gravel, feldspar, clays, stone, gem stones.
Hillsboro	1,832,884	1,767,869	Stone, sand and gravel.
Merrimack	1,303,108	W	Sand and gravel, stone.
Rockingham	1,164,309	1,273,567	Sand and gravel, stone, clays.
Stafford	219,773	253,250	Sand and gravel, clays.
Sullivan	242,143	188,625	Sand and gravel, stone.
Undistributed [1]	1,236,169	2,576,011	
Total	7,302,000	7,665,000	

W Withheld to avoid disclosing individual company confidential data.
[1] Includes value of sand and gravel and gem stones not assigned to specific counties and values indicated by symbol W.

Belknap.—Sand and gravel for building, paving, and fill was produced by Tilton Sand & Gravel, Inc., Tilton.

Carroll.—Alvin J. Coleman & Son, Inc., produced paving sand and gravel from a pit near Madison. Sparks Construction Co. produced bank run sand and gravel for fill from a pit near Ossipee.

Cheshire.—Sand and gravel for building, paving, and fill was produced by Cold River Sand & Gravel Corp., North Walpole, and Keene Sand & Gravel, Inc., Keene. Most of the output was washed and screened and all was delivered by truck. Crude mixed feldspar, recovered at the Surry and Pearson pegmatite mines by Golding-Keene Co., was delivered by truck to the company's Alstead mill. The crude feldspar was finely ground for use in manufacturing insulators, enamel, floor tile, and pottery. Part of the feldspar was used as an abrasive in cleaning compounds. Gem and mineral specimens were recovered from pegmatite mine dumps.

Coos.—Building and paving sand and gravel was recovered near Gorham by Lessard Sand & Gravel Co. The Gray Construction Corp., Colebrook, and Brown Company, Berlin, produced bank run sand and gravel for road construction and fill.

Grafton.—Sand and gravel produced from pits near West Campton, Littleton, West Lebanon, and Plymouth was used mainly for building, paving, and fill. Most of the output was washed and screened. All was shipped by truck. Crude potash feldspar produced at the Ruggles mine was shipped to a grinding mill at West Paris, Oxford County, Maine. Ruggles mine dumps were available to mineral collec-

tors for an admission fee. A wide variety of pegmatite minerals were recovered at the Ruggles and other mine dumps in Grafton County. Miscellaneous clay, recovered from a pit near Lebanon by Densmore Brick Co., was used for making building brick.

Hillsboro.—Quarry blocks of granite were mined by wire saw and flame cutting at Kitledge Granite Corp. quarry near Milford. The stone was finished at the Barretto Granite Co. mills located at the quarry and in the town of Milford. The company produced stone for construction, architectural uses, monuments, and curbing. Paving blocks and durax blocks were also produced. Sand and gravel used chiefly for building and paving was produced by J. J. Cronin Co. and Robie Construction Co., Inc., both near Manchester; Merrimack Sand & Gravel Corp., Merrimack; The Harris Construction Co., Inc., Peterborough; and Robert L. Robichard, Townsend. Mineral Materials, Inc., South Lyndeboro, crushed and screened quartz for use as exposed aggregate.

Merrimack.—Manchester Sand, Gravel & Cement Co., Inc., Hooksett, produced sand and gravel chiefly for building and paving. A small quantity of engine and filtration sand was also produced. The John Swenson Granite Co., Inc., Concord, quarried granite at the Swenson Gray quarry and produced dressed architectural stone and curbing at its nearby finishing mill. Part of the output was rough stone for construction and monuments. Quarry blocks from the John Swenson Granite Co.'s Maine and Vermont quarries also were finished at the Concord mill.

Rockingham.—Bank run gravel, used chiefly for fill, was produced by Thomopoulis Sand & Gravel Pit, Londonderry, and L. Chester & C. W. Simpson, Exeter. Most of the sand and gravel produced by Manchester Sand, Gravel & Cement Co., Inc., Raymond, was processed for building and paving. Part of the output of the Raymond plant was shipped by railroad to Boston, Mass., for use in ready-mixed concrete. Iafolla Crushed Stone Co., Inc., Portsmouth, produced sand and gravel for paving and crushed miscellaneous stone for riprap, concrete, and roadstone. Eno Brick Corp., Exeter, and W. S. Goodrich, Inc., Epping, mined miscellaneous clay for use in manufacturing building brick. W. S. Goodrich, Inc., used three scove kilns and one beehive kiln.

Stafford.—Dover Sand & Gravel Co., Inc., Dover, produced sand and gravel for use principally in ready-mixed concrete. Sand and gravel for paving and fill was produced by Iafolla Crushed Stone Co., Inc., at its Madbury pit. James S. Pike, Durham, produced bank run sand and gravel, used principally for fill. Part of the output was used in building. The Kane-Gonic Brick Corp., Gonic, mined miscellaneous clay for manufacturing building brick.

Sullivan.—Sand and gravel for building and paving were produced near Newport by Eaton Jones Sand & Gravel Co., Inc. Most of the output was washed and screened. All was shipped by truck. Crushed quartz for exposed aggregate in decorative concrete was produced at Beryl Mountain, South Acworth, by Quartz, Inc., and at the Globe mine near New London by Mineral Materials, Inc.

The Mineral Industry of New Jersey

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the New Jersey Division of Resource Development, Bureau of Geology and Topography, for collecting information on all minerals except fuels.

By Joseph Krickich [1]

Mineral production in New Jersey continued to climb and established a record high value of $80.2 million, 3 percent greater than that of 1964. The increase was attributed chiefly to the continuing high demand for zinc ore, the State's leading metallic mineral. Increased output of magnesium compounds (refractory magnesia) also was a major contributing factor. Demand for construction materials, clay, stone, and sand and gravel, remained relatively stable and offset declines in output of iron ore, manganiferous residuum, and ilmenite.

[1] Mineral specialist, Bureau of Mines, Pittsburgh, Pa.

Table 1.—Mineral production in New Jersey [1]

Minerals	1964 Quantity	1964 Value (thousands)	1965 Quantity	1965 Value (thousands)
Clays ---thousand short tons	500	$1,441	506	$1,388
Gem stones	NA	10	NA	10
Peat ---short tons	W	W	40,480	431
Sand and gravel---thousand short tons	17,661	27,079	17,389	28,646
Stone ---do	12,326	28,461	12,232	27,247
Zinc [2] (recoverable content of ores, etc.) ---short tons	32,926	8,935	38,297	11,106
Value of items that cannot be disclosed: Iron ore, lime, magnesium compounds, manganiferous residuum, greensand marl, titanium concentrate (ilmenite), and items indicated by symbol W	XX	12,246	XX	11,330
Total	XX	78,172	XX	80,158

W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed."
NA Not available.
XX Not applicable.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Recoverable zinc valued at yearly average price of prime western slab zinc, East St. Louis market. Represents value established after transportation, smelting, and manufacturing charges have been added to the value of ore at the mine.

Table 2.—Value of mineral production in constant 1957–59 dollars

(Thousands)

Year	Value	Year	Value
1956	$64,748	1961	$58,857
1957	65,499	1962	65,414
1958	50,640	1963	r 72,702
1959	58,291	1964	r 76,711
1960	55,917	1965	77,552

r Revised.

Table 3.—Employment and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injured rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1964:								
Peat	8	250	2	14	---	---	---	---
Metal	592	238	141	1,131	2	40	37.14	12,119
Nonmetal	374	283	106	849	1	19	23.57	7,916
Sand and gravel	1,201	234	281	2,310	---	52	22.51	935
Stone	962	248	239	1,920	1	39	20.83	3,536
Total	3,137	245	769	6,224	4	150	24.74	4,719
1965: p								
Peat	16	259	4	33	---	---	---	---
Metal	460	254	117	942	---	55	58.39	5,700
Nonmetal	395	281	111	888	---	27	30.41	1,170
Sand and gravel	1,055	259	274	2,252	---	47	20.87	417
Stone	1,220	249	304	2,465	---	62	25.15	602
Total	3,146	257	810	6,580	---	191	29.03	1,342

p Preliminary.

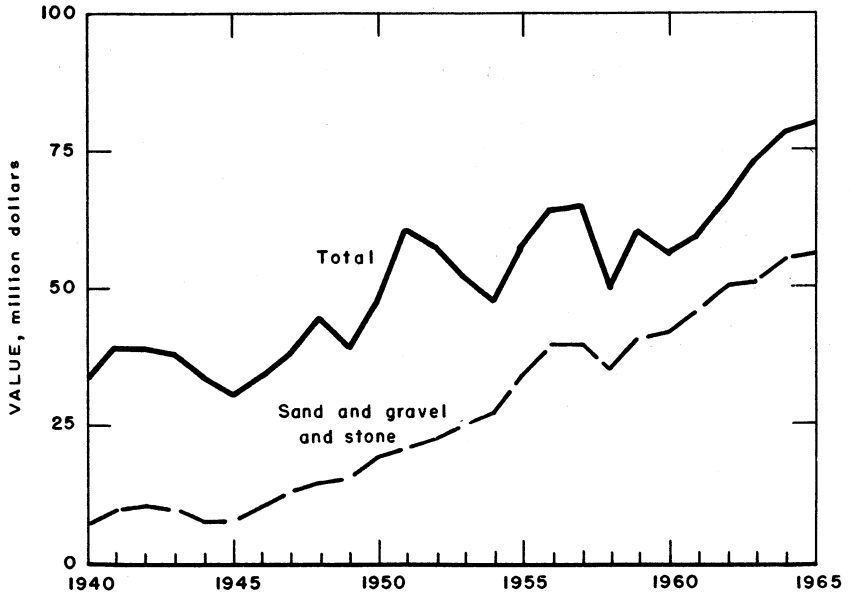

Figure 1.—Value of sand and gravel, and stone, and total value of mineral production in New Jersey.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Cement.—Cement distribution terminals were operated at Bayonne, Elizabethport, Jersey City, and Newark. Over 10.6 million barrels of portland cement and 684,000 barrels of masonry cement were shipped into New Jersey, primarily from Pennsylvania and New York. Quantities of portland cement also were shipped from Maryland. Some masonry cement came from producers in Virginia and West Virginia.

Clays.—A slight increase in total production was recorded for the year. Compared with the 1964 output, miscellaneous clay increased 4 percent, but fire clay production dropped 8 percent. Miscellaneous clay accounted for 78 percent of the total tonnage but only 36 percent of the total value. Fire clay, recovered in Cumberland and Middlesex Counties, was used chiefly for refractories, but quantities also were used for pottery and stoneware, floor and wall tile, and architectural terra cotta, and as rotary drilling mud and filler material in linoleum and insecticides. Miscellaneous clay was used in manufacturing heavy clay products such as brick and sewer pipe. Production was from five counties with the bulk of the output from Middlesex and Somerset Counties.

Gem Stones.—Thousands of mineral collectors obtained various mineral specimens (gem stones) from stone quarries throughout the State and from the old mine dumps at Franklin, Sussex County. Value of the minerals collected was estimated at the same level as that of 1964.

Gypsum.—Crude gypsum from other States and imported was calcined at plants in Bergen, Burlington, and Camden Counties. Calcined gypsum was used in manufacturing plaster, lath, sheathing, wallboard, and other building materials. Kaiser Gypsum Co., Inc., continued construction of its calcining and fabricating plant at Delanco Township, Burlington County. Production was expected to start early in 1966.

Iodine.—Consumption of organic and inorganic iodine totaled 597,000 pounds, compared with 516,000 pounds the previous year. Plants reported consumption of iodine and iodine compounds for use in manufacturing medicine, sanitation products, and other chemicals. Companies used mostly imported crude material.

Lime.—Compared with that of 1964, hydrated lime production by one company in Sussex County was slightly higher but value declined. Hydrated lime was sold for use in construction, agricultural applications, for sewage treatment, and for water purification.

Magnesium Compounds.—Production and value of refractory magnesia increased, but a lower average unit value was reported. The refractory magnesia was produced from sea water and out-of-State dolomite at a plant in Cape May County. One plant in Warren County refined various magnesium compounds from purchased material.

Marl, Greensand.—Greensand marl production was limited to one operation in Gloucester County. Output and value was greater than that of 1964. The material, natural zeolite, was used for softening water.

Mica.—Sheet mica (muscovite block and film) was fabricated at four plants in the State. Molecular Dielectrics, Inc., Clifton, and Synthetic Mica Co., Division of Mycalex Corp. of America, produced synthetic flake mica used in glass-bonded ceramic Materials. Molecular Dielectrics, Inc., also produced high quality synthetic mica crystals for splitting and punching.

Perlite.—In comparison with that of 1964, production and value of expanded perlite decreased 4 and 17 percent, respectively. The average unit value also decreased. Crude perlite, mined in other States, was shipped for processing to plants in Middlesex, Passaic, Somerset, and Union Counties. The expanded perlite was used in acoustical plaster, ultra-lightweight concrete, soil conditioning, as loose-fill insulation, filler material, and other uses.

Pigments.—Metal-base pigments, used chiefly for manufacturing paint, were produced at New Jersey plants. Two plants in Middlesex County and one each in Essex and Mercer Counties produced iron oxide pigments. Lead pigments were produced in Middlesex and zinc pigments in Bergen County. Titanium dioxide was produced at two plants, one each in Camden and Middlesex Counties.

Sand and Gravel.—Output of sand and gravel declined, but value was greater than that of 1964. The increased value was attributed primarily to a greater demand for higher priced industrial sands. Ground sand production also increased. Virtually the entire State's production was by commercial operators; limited quantities were produced by Government-and-contractor operations in Atlantic County. Seventy percent of the total commercial output was used for building and paving. Most of the industrial sand was used in foundries and by the glass industries. Ground sand was produced in Cumberland, Middlesex, and Ocean Counties and was marketed principally for use in foundries and in glass and ceramic manufacturing.

Production of sand and gravel was reported in 14 of the State's 21 counties. Morris County led in tonnage, and Cumberland ranked first in value because of higher priced industrial sands. Other major producing areas with production exceeding 1 million tons were, in decreasing order, Ocean, Burlington, Middlesex, and Camden Counties. Of the 97 active operations (96 commercial and 1 Government-and-contractor) only 2 operations were classified as portable, and the remainder were classified as stationary plants or bank-run operations. Two commercial producers had production in the 900,000 to 1,000,000 ton range and three operators produced between 700,000 and 800,000 tons. Only 17 operations had production below 25,000

Table 4.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1964		1965	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	5,013	$5,173	4,940	$5,911
Paving	2,756	2,439	2,906	2,790
Fill	1,074	478	720	354
Glass	773	2,901	843	3,139
Molding	1,672	5,262	1,740	5,454
Blast	139	649	151	699
Ground	153	1,377	191	1,513
Other [1]	976	1,623	907	1,579
Total	12,556	19,902	12,398	21,439
Gravel:				
Building	2,839	4,829	2,868	5,090
Paving	1,517	1,731	1,416	1,533
Fill	498	312	485	325
Other [2]	248	303	220	258
Total	5,102	7,175	4,989	7,206
Total sand and gravel	17,658	27,077	17,387	28,645
Government-and-contractor operations:				
Sand:				
Paving	1	1	---	---
Other	2	1	2	1
Total	3	2	2	1
All operations:				
Sand	12,559	19,904	12,400	21,440
Gravel	5,102	7,175	4,989	7,206
Total	17,661	27,079	17,389	28,646

[1] Includes fire or furnace, engine, filtration, and other sand.
[2] Includes other and miscellaneous gravel.

tons, and the majority of producers had tonnages ranging from 25,000 to 300,000 tons. Commercial producers processed 85 percent of their output compared with 84 percent in 1964. Over 14.5 million tons were shipped to consumers by truck and 1.9 million tons were shipped by rail.

Stone.—Although the total quantity of stone was 1 percent less than that of 1964, output for concrete aggregate and roadstone increased 4 percent to 10.7 million tons. Stone was quarried in 11 counties, led by Somerset, Passaic, Sussex, and Hudson Counties, in decreasing order of value. Basalt (traprock) was quarried in seven counties accounting for 86 percent of the tonnage and 81 percent of the value of all stone produced in the State. Output of crushed basalt for concrete aggregate roadstone was greater than that of 1964, but the average value for these uses decreased $0.09 to $2.05 per ton. Other uses for basalt included quantities for riprap, roofing granules, and railroad ballast. Limestone, produced at two quarries in Sussex County, continued to rank second in value. The principal uses for limestone were as agricultural stone (agstone), concrete aggregate, filler material, additive in livestock feed, and raw material for manufacturing lime.

Granite production from Hunterdon and Morris Counties was slightly less than that of 1964, but the average value increased from $1.91 to $1.96 per ton. Most of the output was crushed and sized for use as concrete aggregate and roadstone; some was used for riprap and fill. Miscellaneous stone was produced in two counties. Crushed gneiss from Passaic County was used for concrete aggregate and roadstone. Argillite from Hunterdon County was quarried for building applications. Quantity and value were greater than that of 1964. Crushed marble, used exclusively in terrazzo, was produced in Warren County. Production of dimension sandstone was reported in Hunterdon County. Oystershell from Gloucester County was used in making lime and poultry grit.

Sulfur.—Byproduct sulfur shipments decreased 13 percent below that of 1964 and totaled 47,000 long tons valued at $1.2 million. The average unit value increased by $2.45 to $25.86 per ton, resulting in only a moderate decline in total value. Elemental sulfur was recovered as a byproduct of gas purification at four plants, two in Gloucester County and one in Middlesex and Union Counties. Part of the sulfur was captive tonnage used for various chemical processes, and the remainder was marketed for use in manufacturing sulfuric acid. Hydrogen sulfide was recovered at a refinery in Union County. Liquid sulfur storage and transshipment terminals were operated by Freeport Sulphur Co. at Warners, Pan American Sulphur Co. at Newark, and Texas Gulf Sulphur Co. at Carteret and Paulsboro. Total storage capacity remained at 72,500 long tons.

Vermiculite.—Vermiculite was exfoliated at plants in Essex and Mercer Counties from crude material shipped from other States and imported. Exfoliated vermiculite was used as loose-fill insulation, plaster and concrete aggregate, and for miscellaneous uses.

METALS

Smelters and foundries throughout the State continued to process ferrous and nonferrous metals. Metal processors conducted active research programs for new products and production methods. Electric furnace steel was produced in Burlington and Essex Counties. In the metropolitan northeast, ferrous scrap dealers were particularly active, collecting and processing material for both the domestic and export market.

Ferroalloys.—Shieldalloy Corp., Newfield, Gloucester County, produced chiefly ferroalloys of titanium, vanadium, boron, columbium, and columbium-tantalum. The company utilized a thermite furnace for ferroalloy production.

Iron Ore.—Production of iron ore from the State's only remaining active mine in Morris County was steady throughout the year. However, output and value decreased below that of 1964, continuing a downward trend for the sixth consecutive year. The ore was beneficiated and shipped for consumption to company-owned blast furnaces at Conshohocken, Pa. Quantities of iron ore concentrates also were sold to other steel producers.

Titanium.—Ilmenite concentrate production and value was greater than that of 1964, but the average unit value continued to decline. Material from a titanium-bear-

ing sand deposit in Ocean County was processed and concentrated for shipment to a company-owned titanium dioxide plant in Baltimore, Md. The titanium dioxide was used as a white paint pigment.

Zinc.—Production and value of manganiferous zinc ore from the Sterling Hill mine increased for the fourth consecutive year since the mine was reopened late in 1961. Higher unit values also were recorded because of the continuing heavy demand for zinc metal products. This demand raised the price of prime Western slab zinc. Ore from the underground mine in Sussex County was crushed and shipped directly to a company-owned smelter at Palmerton, Pa.

MINERAL FUELS

Coke and Coal Chemicals.—Koppers Co., Inc., operated a merchant oven-coke plant at Kearney, Hudson County. Coal chemical coproducts, including monoammonium phosphate, crude coal tar, crude light oil, intermediate light oil, and crude naphthalene, were recovered from the 120 slot-type ovens.

Natural Gas.—Construction continued on the frozen earth underground liquid natural gas storage facility at Carlstadt, Bergen County. J. F. Pritchard & Co. of Kansas City, Mo., was building the $7 million facility for Transcontinental Gas Pipe Line Corp. When completed the storage facility, 165-feet deep, will be capable of storing 1 billion cubic feet of natural gas at −259° F for use during peak demand periods in the metropolitan New York area. It will be the first facility of its kind in the United States.

Peat.—Peat production and value was greater, primarily, because of increased coverage of the State's industry. Production was from bogs in Passaic, Sussex, and Warren Counties. Humus and reed-sedge varieties of peat were produced for sale, mostly as a soil conditioner. The material was marketed both in bulk form and in packages.

Petroleum.—Seven active petroleum refineries as of January 1, 1965, reported a total crude oil capacity of 508,900 barrels per day, less 7,050 previous year barrels than the 1964 capacity. Gasoline output capacity per day increased slightly to 155,600 barrels per day. Refineries were operated by California Oil Co., Perth Amboy; Cities Service Co., Linden; Hess Oil & Chemical Co., Sewaren; Humble Oil & Refining Co. Bayonne and Linden; Mobil Oil Co., Paulsboro; and Texaco Inc., Westville. Petroleum companies continued to operate research laboratories at Cranbury, Florham Park, Linden, and Paulsboro. As reported in 1963 and 1964, no exploratory drilling for petroleum was conducted in the State.

REVIEW BY COUNTIES

Mineral production was reported for all counties except Salem. Increased value was reported for 10 counties; the greatest increase was in Sussex County because of a continuing high demand for manganiferous zinc ore produced in the county. Sussex, Somerset ,Cumberland, and Morris Counties, in decreasing order of value, continued as the leading mineral-producing areas. Output of sand and gravel by Government-and-contractor operations was limited to Atlantic County. Value of mineral specimens (gem stones) was not assigned to specific counties.

Atlantic.—Commercial sand and gravel output decreased sharply compared with that of 1964. The decline was attributed primarily to decreased demand for construction materials. Quantities of molding sand also were produced. Mays Landing Sand & Gravel Co., Inc. at Mays Landing, was the leading producer. Other production was reported from operations near Bargaintown, Folsom, Hammonton, Cedar Lake, and Somers Point. Government-and-contractor sand was produced at Pleasantville for the Atlantic County Road Department.

Bergen.—Output of processed construction sand and gravel was greater than that of 1964. Producers were Braen Sand & Gravel Co., Wyckoff; Samuel Braen & Co., Mahwah; and McKee Bros., Inc., Ramsey. Clay for manufacturing building brick was produced near Moonachie by Tri-County Brick Corp. Calcined gypsum and fabri-

Table 5.—Value of mineral production in New Jersey by counties [1]

County	1964	1965	Minerals produced in 1965 in order of value
Atlantic	$433,000	$858,000	Sand and gravel.
Bergen	1,530,000	1,712,565	Sand and gravel, clays.
Burlington	2,367,286	2,265,000	Do.
Camden	1,948,000	1,805,000	Do.
Cape May	W	W	Magnesium compounds, sand and gravel.
Cumberland	9,423,126	9,998,696	Sand and gravel, clays.
Essex	W	W	Stone.
Gloucester	578,500	475,500	Sand and gravel, greensand marl, stone.
Hudson	W	W	Stone.
Hunterdon	1,337,386	1,394,573	Do.
Mercer	W	W	Do.
Middlesex	2,391,327	2,588,033	Sand and gravel, clays.
Monmouth	956,000	915,000	Sand and gravel.
Morris	9,794,088	9,738,676	Sand and gravel, iron ore, stone.
Ocean	5,561,030	4,945,546	Sand and gravel, ilmenite.
Passaic	5,763,602	5,760,267	Stone, sand and gravel, peat.
Somerset	12,961,942	11,563,844	Stone, clays.
Sussex	13,727,188	15,463,277	Zinc, stone, manganiferous residuum, sand and gravel, lime, peat.
Union	W	W	Stone.
Warren	634,882	617,627	Sand and gravel, peat, stone.
Undistributed [2]	8,764,811	10,056,474	
Total	78,172,000	80,158,000	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] No production reported in Salem County.
[2] Includes value of gem stones and values indicated by symbol W.

cated gypsum building products were produced at the South Kearney plant of Barrett Division, Allied Chemical Corp.

Burlington.—Nearly 2 million tons of sand and gravel were produced, 8 percent below that of 1964. Most of the material was reported from six operations and was processed for use in construction. Principal producers were Amico Sand & Gravel Co., Riverside; American Dredging Co., Burlington; Asphtar, Inc., Hainesport; Lockhart, Inc., Riverton; and Warner Co., Philadelphia, Pa. Miscellaneous clay for manufacturing building brick was produced near Fieldsboro. National Gypsum Co., Burlington, produced calcined gypsum.

Camden.—Sand and gravel production totaled 1.4 million tons compared with 1.5 million tons in 1964. Output consisted mostly of processed construction sand and gravel, but substantial quantities of molding sand also were produced. Tri-Borough Sand & Stone, Inc., Gibbsboro, continued as the leading producer. Other producers were George F. Pettinos, Inc., with plants at Grenloch, Penbryn, and Williamstown Junction; Taggart Brimfield Co., Hayville; Ward Sand and Materials Co., Pennsauken Township; Con-Agg, Inc., Chews Landing; and Triangle Silica Sand Corp., Pine Hill. Miscellaneous clay for building brick was recovered at Winslow Junction by The Alliance Clay Product Co. Flintkote Co., Camden, imported crude gypsum from Newfoundland for calcining and processing into plaster and gypsum building products. New Jersey Zinc Co. produced titanium dioxide from ilmenite concentrate at its Gloucester City plant.

Cape May.—Northwest Magnesite Co. produced refractory magnesia from purchased dolomite and sea water at its Cape May plant. Sand and gravel used for construction was produced by Cortland Sand & Gravel Co., Cape May Court House; John F. Gandy, Marmora; Matalucci Bros., Dennisville; and Tuckahoe Sand & Gravel, Tuckahoe.

Cumberland.—The county continued to rank second in tonnage and to lead in value as a sand-and-gravel-producing area. Output totaled 2.9 million tons, 8 percent greater than that of 1964. Value increased 7 percent. Output was mostly sand used for manufacturing glass and for molding purposes. Blast, engine, filter, and furnace, sand as well as building and paving and other construction sand and gravel, also were produced. Most of the industrial sands were recovered from operations near Millville, Vineland, Mauricetown, Dorchester,

and Port Elizabeth. Construction material was recovered mainly near Cedarville and Port Norris. The entire county output was processed material. Pennsylvania Glass Sand Corp. and National Glass Sand Corp., both near Millville, produced ground sand for use for special applications. Daniel Goff Division, Jesse S. Morie & Son, Inc., Millville, produced plastic fire clay.

Essex.—Basalt, used chiefly for concrete aggregate and roadstone, was produced by Orange Quarry Co., West Orange, and M. L. Kernan Quarry, South Orange. Orange Quarry Co. also produced limited quantities of riprap stone. Exfoliated vermiculite was produced by Vermiculite Industrial Corp. at Port Newark. E. I. du Pont de Nemours & Co., Inc., produced iron oxide pigments (hydrated ferric oxide) at Newark.

Gloucester.—Output of sand and gravel total 275,000 tons compared with 338,000 tons in 1964. Most of the material was used in construction and was recovered from operations near Bridgeport, Gibbstown, and Austinville. Furnace sand was recovered near Downer, and foundry sand was recovered near Grenloch. Greensand marl was produced near Sewell by Inversand Co. The material was sold to water treating equipment manufacturers to soften water. Joseph Bauder & Sons, processed oystershell for poultry grit and lime at Franklinville. Freeport Sulphur Co. recovered byproduct sulfur in the liquid purification of gas at its Eagle Point (Westville) plant. Mobil Oil Corp., using the Claus process, recovered sulfur at its Paulsboro refinery.

Hudson.—Basalt was quarried and processed at the Laurel Hill plant of Callanan Traprock Corp. near Secaucus. The material was used for aggregate and roadstone.

Hunterdon.—Basalt, used mainly for concrete aggregate and roadstone, was produced by Lambertville Quarry Co., Lambertville, and Houdaille Construction Materials, Inc., Oldwick. Output at the Lambertville Quarry Co. operations was affected by a 7-week labor dispute. Anthony Ferrante & Sons produced granite for aggregate and riprap near Clinton. Dimension miscellaneous stone (argillite) was produced by Delaware Quarries. H. W. Lindblad produced dimension sandstone for construction and flagging near Lambertville.

Mercer.—Diabase (traprock) was quarried for riprap, concrete aggregate, roadstone, and railroad ballast by Pennington Quarry Co., Pennington. Production was affected by a 7-week labor dispute. Basalt for concrete aggregate and roadstone was produced by the inmates of the Mercer County Workhouse, Trenton. Columbian Carbon Co., Trenton, produced black, brown, red, and yellow iron oxide pigments. Zonolite Division, W. R. Grace & Co., Trenton, produced exfoliated vermiculite. The company did not produce expanded perlite as in previous years.

Middlesex.—Production of sand and gravel totaled 1.7 million tons, 10 percent greater than that of 1964. Most of the material was used in building and highway construction and maintenance, but quantities of industrial sands also were produced. South River Sand Co. produced industrial and ground sand at its Old Bridge plant. Other leading producers were Crossman Co. and Sayre & Fisher Co., both near Sayreville; Dallenbach Sand Co.. Milltown; Herbert Sand Co., Inc., and Buck Bros., both near East Brunswick. Fifty-eight percent of the county output was processed material.

Clay production totaled 249,000 tons and the county continued as the leading clay-producing area. Output of fire clay and miscellaneous clay and shale increased. Most of the fire clay was used for manufacturing refractory products, but quantities also were used for pottery and stoneware, floor and wall tile, architectural terra cotta, rotary drilling mud, and as a filler material. Fire clay was produced by Almasi Clay Co., Woodbridge; Crossman Co., South Amboy; McHose Clay Co., Fords; Such Clay Co., Sayreville; H. C. Perrine & Son, Inc., Matawan; A. P. Greene Refractories Co. at Perth Amboy and Woodbridge; and Marcus S. Wright, Inc., Milltown. Sayre & Fisher Co., Sayreville, produced both plastic fire clay and miscellaneous clay. Natco Corp. at Perth Amboy and New Brunswick, and Oschwald Brick Works at Cliffwood produced miscellaneous clay. Miscellaneous clay was used primarily for manufacturing build-

ing brick and other heavy clay products.

The Anlin Co. of New Jersey, Perth Amboy, recovered sulfur by the Amine gas purification and the modified Claus processes. Red iron oxide pigments (calcined copperas) were produced by Columbian Carbon Co., Monmouth Junction, and Stabilized Pigments, Inc.. New Brunswick. Coralux Perlite Corp. of New Jersey, Metuchen, produced expanded perlite. National Lead Co. manufactured lead pigments and titanium dioxide at Perth Amboy.

Monmouth.—Output of sand and gravel was 691,000 tons, 15 percent below that of 1964. Most of the material was processed for building and highway construction. Producers were Bennett Sand & Gravel Co., Manasquan; Fary's Gravel Pit, Inc., New Shrewsbury; Hause Gravel Co., Allenwood; New Jersey Gravel & Sand Co., Farmingdale; Joseph Scarano, Wayside; Frank Z. Sindlinger Inc., Wall Township; and Walling & Son, Hazlet.

Morris.—The Scrub Oaks iron ore mine of Alan Wood Steel Co., Dover, continued as the State's only active iron ore mine. Magnetite ore from the mine was magnetically beneficiated, and most of the concentrate was shipped to the company steel plant at Conshohocken, Pa. Mine wastes and mill tailings (granite), recovered from the beneficiation plant, were crushed and processed for sale as concrete aggregate and fill. The company also produced sand for building, paving, and other uses at Dover. No shipments of stockpiled iron ore from the Mt. Hope mine of Shahmoon Industries Inc. was reported. However, the company quarried granite at Mt. Hope for use as concrete aggregate and roadstone. Braen Industries Inc., Riverdale, produced substantial tonnages of granite for aggregate and roadstone.

The county continued to lead in sand and gravel production but ranked second in value. Output totaled 3.4-million tons, slightly below that of 1964. Output was from 12 operations and consisted mainly of processed material used for construction. Houdaille Construction Materials, Inc., with plants at Kenvil and Riverdale, was the largest producer. Other leading producers were Conklin Bros., Montville; T. Landi & Sons, Inc., Morristown; and Pequannock Sand & Gravel Division, Union Building & Construction Corp., Pequannock. Other operations were located at Montville Township, Whippanny, Pequannock, Jefferson Township, Mount Olive Township, and Stanhope.

Ocean.—Production of sand and gravel was 2.4 million tons valued at $3.2 million, an increase of 11 and 6 percent, respectively, in tonnage and value compared with that of 1964. Most of the material was processed for use in building and highway construction and maintenance, but substantial quantities of industrial sand, ground and unground, also were produced. Houdaille Construction Materials, Inc., Lakewood, was the leading producer of construction sand and gravel. Industrial sands were produced by New Jersey Pulverizing Co. at Pinewald. Other construction sand and gravel was produced at operations near Barnegat, Forked River, Lakewood, Staffordville, and Toms River. The Glidden Co. produced ilmenite concentrate at its Lakehurst mine and concentrating plant near Jackson. The concentrate was shipped to Baltimore, Md. for conversion to titanium dioxide for use in manufacturing paint.

Passaic.—Output of crushed stone decreased 2 percent below that of 1964, but the county continued to rank second among the State's stone-producing areas. Output was basalt and miscellaneous stone, used mostly for concrete aggregate and roadstone. Basalt producers were Samuel Braen's Sons, Haledon and North Haledon; Great Notch Corp., Little Falls; Houdaille Construction Materials, Inc., Montclair; Sowerbutt Quarries, Inc., Prospect Park; and Union Building & Construction Corp., Clifton. Passaic Crushed Stone Co., Inc., quarried miscellaneous stone (gneiss) near Pompton Lakes. Sand and gravel production totaled 464,000 tons, slightly above that of 1964. Producers were Herbert J. Hinchman & Son Inc., Van Orden Sand & Gravel Co., Inc., and Van Decker Bros., Inc., all near Wayne, and Van Orden Sand & Gravel, Ringwood. Horticultural Products, Inc., recovered humus peat from a bog near Newfoundland. Output was shredded and sold in packages. Peralex of New Jersey, Inc., produced expanded perlite at Paterson.

Somerset.—Somerset County continued as the leading stone-producing area with basalt

production of 5.2 million tons valued at $11.4 million. Tonnage and value was below that of 1964. Stone was used for aggregate, roadstone, riprap, railroad ballast, roofing granules, and as filler material. Producers were Houdaille Construction Materials, Inc., Millington and Bound Brook; Kingston Traprock Co., Kingston; Dock Watch Quarry Pit, Inc., Martinsville; Somerset Crushed Stone Division, Anthony Ferrante & Sons, Inc., Bernardsville; and Minnesota Mining & Manufacturing Co., Belle Mead. Miscellaneous shale for manufacturing heavy clay products was produced by New Jersey Shale Brick & Tile Manufacturing Co. and American Vitrified Products Co., both near Somerville, and Natco Corp., New Brunswick. Johns-Manville Products Corp., Building Products Division, produced expanded perlite at Manville.

Sussex.—Manganiferous zinc ore, recovered from the Sterling Hill mine near Ogdensburg, was crushed and shipped directly to a smelter at Palmerton, Pa., for recovery of zinc and byproduct manganiferous residuum. Development and production work at the underground mine continued at a high level. Limestone Products Corp. of America, Newton, and Farber White Limestone Co., Franklin, quarried and crushed limestone for a wide variety of uses. Limestone Products Corp. burned limestone at its Lime Crest plant and produced hydrated lime for construction and for agricultural and chemical applications. The company discontinued its sand and gravel operation near Lime Crest. Sand and gravel, however, was recovered from operations near Andover and Sparta. Reed-sedge peat was produced by Hyper-Humus Co., Newton, and Netcong Natural Products, Stanhope. Netcong Natural Products marketed its material in bulk form; Hyper-Humus Co. sold peat in bulk and in packages. Old mine dumps near Franklin continued to attract amateur gem and mineral collectors. The area was noted for its mineral specimens, chiefly fluorescent calcite, franklinite, willemite, and zincite.

Union.—Basalt for concrete aggregate and roadstone was quarried near Summit by Houdaille Construction Materials, Inc. Sulfur was recovered at the Bayway plant of General Chemical Division, Allied Chemical Corp., Humble Oil & Refining Co. recovered hydrogen sulfide by amine absorbtion at its Bayway refinery. Certified Industrial Products, Inc., produced expanded perlite at Hillside.

Warren.—Sand and gravel production was below that of 1964. Output was used exclusively in construction. Producers were Houdaille Construction Materials, Inc., Carpenterville; Steckel Concrete Co., Phillipsburg; Van Horn Sand & Gravel Co., Belvidere; and Warren Paving Co., Inc., Stewartsville. Royal Green Marble Co., Phillipsburg, produced marble, used exclusively for terrazzo. Kelsey Humus Co. and Partac Peat Co. produced humus peat at Great Meadows. Output was shredded and sold in bulk and in packaged form. J. T. Baker Chemical Co., Phillipsburg, produced a variety of refined magnesium compounds, including chloride, sulfate, and trisilicate.

The Mineral Industry of New Mexico

By W. E. Burleson[1] and William C. Henkes[2]

Mineral production in New Mexico established a new high in 1965, reaching a total value of $773.3 million. The significant output of perlite, potassium salts, and uranium ore again placed the State as the leading producer of each in the Nation.

Mineral fuels accounted for a record $506 million, an increase of $21.5 million. Of the seven fuels commodities, all but one had an increase in value.

[1] Mining engineer, Bureau of Mines, Socorro, N. Mex.

[2] Petroleum engineer, Bureau of Mines, Denver, Colo.

Table 1.—Mineral production in New Mexico[1]

Mineral	1964 Quantity	1964 Value (thousands)	1965 Quantity	1965 Value (thousands)
Barite—short tons	W	W	200	$2
Carbon dioxide (natural)—thousand cubic feet	816,168	$61	833,819	62
Clays—thousand short tons	[2] 104	[2] 167	60	101
Coal (bituminous)—do	2,969	9,763	3,212	10,710
Copper (recoverable content of ores, etc.)—short tons	86,104	56,140	98,658	69,850
Fluorspar—do	137	3	----------	----------
Gem stones	NA	45	NA	45
Gold (recoverable content of ores, etc.)—troy ounces	6,110	214	9,641	337
Helium—thousand cubic feet	82,105	2,958	80,583	2,975
Lead (recoverable content of ores, etc.)—short tons	1,626	426	3,387	1,057
Lime—thousand short tons	25	352	33	465
Manganese ore (35 percent or more Mn) short tons, gross weight	5,794	149	5,637	156
Manganiferous ore (5 to 35 percent Mn)—do	46,657	300	50,090	328
Mica (scrap)—short tons	6,922	105	4,263	45
Natural gas (marketed)—million cubic feet	873,947	101,932	937,205	110,590
Natural gas liquids:				
LP gases—thousand gallons	739,190	21,641	759,311	25,817
Natural gasoline and cycle products—do	356,047	21,570	358,487	20,824
Perlite—short tons	286,329	2,568	331,011	2,905
Petroleum (crude)—thousand 42-gallon barrels	113,863	326,565	119,166	334,977
Potassium salts thousand short tons, K_2O equivalent	2,675	r 104,861	2,848	117,771
Pumice—thousand short tons	260	760	264	915
Salt—do	62	559	64	572
Sand and gravel—do	8,781	10,160	11,763	12,130
Silver (recoverable content of ores, etc.) thousand troy ounces	242	313	288	372
Stone—thousand short tons	2,760	4,244	1,911	3,020
Uranium ore—short tons	2,093,350	38,203	2,013,861	38,311
Vanadium—do	W	154	W	221
Zinc (recoverable content of ores, etc.)—do	29,833	8,115	36,460	10,646
Value of items that cannot be disclosed: Cement, gypsum, iron ore, molybdenum, tin, and values indicated by footnote 2 and symbol W	XX	r 7,802	XX	8,070
Total	XX	r 720,130	XX	773,274

r Revised. NA Not available. W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed." XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes fire clay, included with "Value of items that cannot be disclosed."

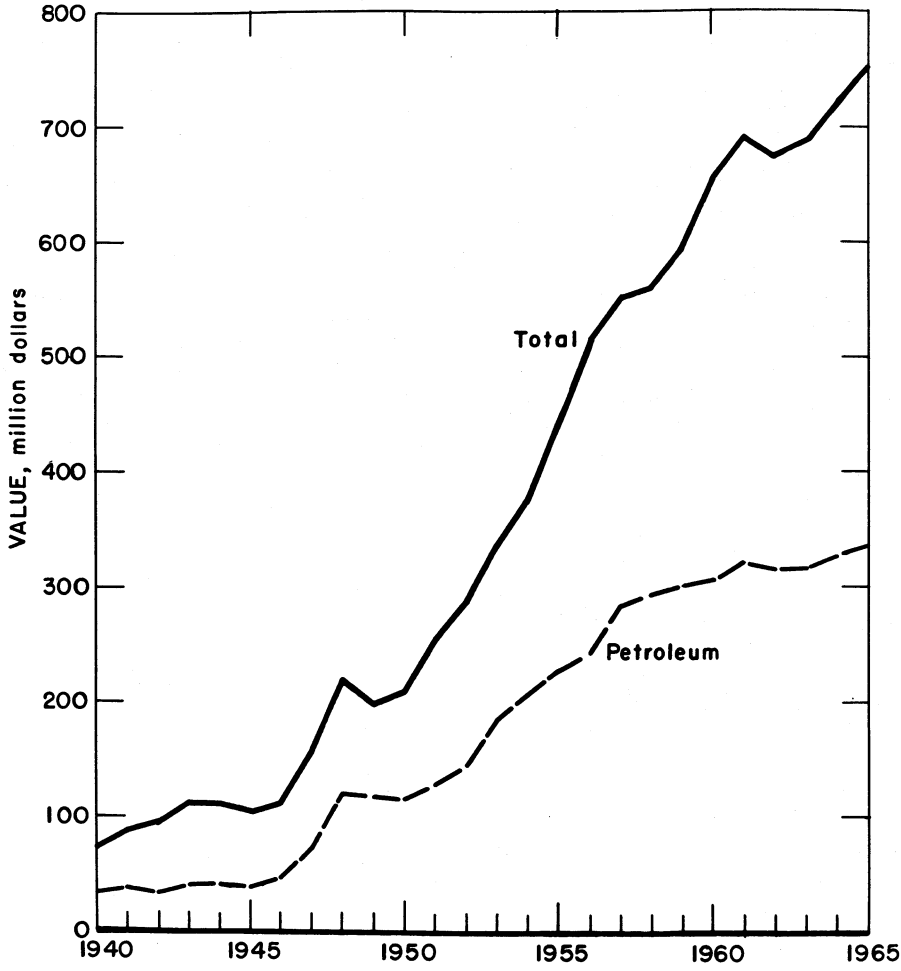

Figure 1.—Value of petroleum, and total value of all mineral production in New Mexico.

Nonmetals, ranked second in total mineral output, increased significantly in value of production, $14 million (11 percent).

Of the 15 nonmental minerals, barite, masonry cement, miscellaneous clay, fluorspar, g psum, mica, and stone declined in value of material produced.

Among metals—gaining $17.7 million (17 percent)—a 24-percent increase in copper output value and the 31-percent gain in that of zinc overshadowed other important increases that occurred in 10 of the 12 metals produced. The increased copper production generated byproduct output of gold, silver, and molybdenum.

Multimillion-dollar developments and expansions were nearing completion or completed at a new potash-refinery operation, a new copper mine and mill, a new molybdenum mine and mill, and a new coal mine and heavy-media-washer plant. Work at the State's only open-pit copper mine and related facilities was expanded. Of prime importance were increased coal needs for thermoelectric powerplants; the reopening of copper and lead-zinc mines,

Table 2.—Value of mineral production in constant 1957–59 dollars

(Millions)

Year	Value
1956	$521
1957	543
1958	563
1959	599
1960	650
1961	683
1962	660
1963	r 669
1964	r 694
1965	p 733

r Revised.

resulting in increased production; exploration for new potential copper deposits; the signing of stretchout uranium-purchase agreements with the U.S. Atomic Energy Commission (AEC); the renewed interest in uranium exploration; and the large-scale water-diversion and irrigation tunnels being bored by drilling "moles."

Employment and Injuries.—Final data for 1964 and preliminary data covering 1965 compiled by the Federal Bureau of Mines for employment and injuries in the New Mexico mineral industries, excluding all mineral fuels except coal, are reported in table 3.

Legislation and Government Programs.—When Dr. E. J. Workmen retired, Dr. Stirling A. Colgate succeeded him on January 1 as the 13th president of the New Mexico Institute of Mining and Technology at Socorro. A report[3] summarizing the mineral and water resources of New Mexico was published.

A Bureau report on fluorspar deposits in New Mexico will be published shortly.

Rock-mechanics feasibility studies on time-deformation characteristics of pillars and roof-floor closures were initiated by the Denver Mining Research Center, Federal Bureau of Mines, and International Minerals & Chemical Corp. (IMC) at the company potash mine in Carlsbad.

Contractors for the Federal Bureau of Public Roads and the State and county highway departments were awarded contracts totaling $60.5 million for use on the National System of Interstate and Defense Highways.[4] The projects consisted of $45.1 million for Interstate highway contracts, $14.7 million for Federal-aid Primary and Secondary contracts, and $790,000 for 100-percent State-financed work. Contracts planned for 1966 totaled $60 million, a 1-percent decrease. Major Interstate highway contracts included work in progress and newly begun on sections of the National System of Interstate and Defense

[3] U.S. Geological Survey, in cooperation with New Mexico Bureau of Mines and Mineral Resources, New Mexico Oil Conservation Commission, New Mexico State Engineer, and U.S. Bureau of Mines. Mineral and Water Resources of New Mexico. Prepared for the Committee of Interior and Insular Affairs, U.S. Senate. New Mexico BuMines and Miner. Res. and New Mexico Inst. of Min. & Technol., Bull. 87, 1965, 437 pp.

[4] Engineering News-Record. State Highway Contracting Plans: 1966 Will Be a Record Breaker. V. 176, No. 14, Apr. 7, 1966, pp. 74–76.

Table 3.—Employment and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries: Fatal	Number of injuries: Non-fatal	Injury rates per million man-hours: Frequency	Injury rates per million man-hours: Severity
1964:								
Coal	305	220	67	525	------	19	36.18	516
Metal	3,754	252	947	7,580	2	367	48.68	3,705
Nonmetal	3,087	330	1,019	8,148	5	223	27.98	4,931
Sand and gravel	887	193	171	1,362	3	28	22.77	13,769
Stone	272	221	61	485	------	20	41.24	916
Total	8,305	272	2,265	18,100	10	657	36.85	4,847
1965:p								
Coal	290	241	70	552	1	20	38.04	11,377
Metal	3,335	270	899	7,189	5	422	59.40	5,574
Nonmetal	2,945	342	1,007	8,058	------	263	32.64	2,341
Sand and gravel	1,030	193	198	1,578	------	32	20.28	385
Stone	270	356	96	780	1	24	32.05	8,210
Total	7,870	288	2,270	18,157	7	761	42.30	3,978

p Preliminary.

Highways consisting of Interstate 25, Interstate 40, and Interstate 10.

Azotea Contractors began boring a 13-mile-long Federal Bureau of Reclamation tunnel which will originate near Chama and cross under the Continental Divide into Colorado. A drilling "mole" advanced the 13-foot-3-inch-diameter tunnel 23,264 feet.

A contract between the United States—represented by the Bureau of Indian Affairs and the Bureau of Reclamation—and the Navajo Tribe initiated the Navajo section of the Navajo Indian Irrigation project; work was started on the $5.4 million Navajo No. 1 tunnel and headwork structures. The project was to cost a total of $135 million. First work on the 2-mile long, 19-foot-10-6-inch-diameter tunnel by contractor Fenix & Scisson, Inc., was begun at the outlet portal June 23; the first 700 feet was drilled by conventional methods. A Hughes Tool Co. 280-ton drilling "mole," equipped with an electronic-guidance laser beam for keeping on course "advanced the tunnel to a total of 6,282 feet, 5,582 by the "mole" method. Drilling of the No. 2 Navajo tunnel, a 20-foot rough-bore diameter, was begun on June 15. The contractor—Shea-Kaiser-Macco, a joint venture—started the 5-mile-long tunnel at the inlet-portal by conventional methods (jumbo-mounted drifters). The Navajo No. 2 tunnel was drilled and blasted for a total distance of 5,761 feet, at a cost of $8.6 million.

Stretchout negotiations were completed between AEC and the remaining three of the 5 uranium milling companies in the State. Revised stretchout agreements for producing uranium concentrates (U_3O_8) were signed with Homestake-Sapin Partners, Grants (June 23); United Nuclear Corp., Grants (August 5); and Vanadium Corporation of America (VCA), Shiprock (November 26). Under the agreements, the companies were to defer deliveries into 1967 and 1968 of a part of uranium concentrates scheduled for delivery by December 31, 1966; AEC was to purchase from each company an additional quantity during 1969 and 1970, equal to the amount deferred and delivered in 1967 and 1968.

The Federal Bureau of Mines published reports describing the water requirements in the mineral industries of the State,[5] and mining costs at Homestake-Sapin Partners.[6]

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Value of mineral fuels was 65 percent of the total value of mineral output. Mineral fuels, as a group, gained 4 percent in value over that of 1964.

Carbon Black.—The New Mexico Oil and Gas Engineering Committee, in its annual report, stated that Continental Carbon Co. and United Carbon Co. used 17.4 billion cubic feet of natural gas to produce 56.8 million pounds of carbon black. Output was 4 percent greater than in 1964.

Carbon Dioxide.—The three Harding County operators increased production of carbon dioxide 2 percent, to 833.8 million cubic feet valued at $62,000.

Coal (Bituminous).—Coal output (3.2 million tons) surpassed all previous production highs in the State since the peak year in 1918 (4 million tons), except for 1920 (3.7 million tons). The increasing demand for coal used at thermal powerplants—the principal consumers—and steel plants stimulated the rise in output.

Coal was produced from eight mines in three counties: Five underground mines and three strip mines, compared with eight underground and three strip mines in five counties in 1964. The principal mines were the Koehler underground mine, Kaiser Steel Corp., in Colfax County; the McKinley strip mine, The Pittsburg & Midway Coal Mining Co., McKinley County; and the Navajo strip mine, Utah Construction & Mining Co., San Juan County. The Koehler and Navajo mines each accounted for increased production; that of the McKinley mine, however, decreased slightly.

Following the completion of experimental testing, begun in 1963, of the high-grade metallurgical coal seam at the York Canyon coal mine, Kaiser Steel Corp. started multimillion-dollar construction and

[5] Gilkey, M. M., and Ronald B. Stotelmeyer. Water Requirements and Uses in New Mexico Mineral Industries. BuMines Inf. Circ. 8276, 1965. 113 pp.

[6] Young, W. E., and D. T. Delicate. Mining Methods and Costs at Section 23 Uranium Mine, Homestake-Sapin Partners, McKinley County, N. Mex. BuMines Inf. Circ. 8280, 1965, 48 pp.

development projects at the company mine, about 35 miles west of Raton. Preproduction construction projects consisted of a transportation roadway; an electric utility powerline; a telephone service line; a 37½-mile railroad spur; and shops, warehouses, and office buildings. A coal-washer and heavy-media-separation plant were being built by McNally-Pittsburgh of Pittsburg, Kans., the contracting firm. Installation of the mine conveyor-belt system was contracted to Goodman Manufacturing Co. of Chicago, Ill. The plant was expected to go on stream in mid-1966; coal was to be transported at 4-day intervals to the company Fontana, Calif., steel mill by a unit train, hauling eighty-six 100-ton-capacity cars. Coal output to exceed 700,000 tons annually or nearly double the production of recent years.

The Pittsburg & Midway Coal Mining Co. produced coal at the McKinley mine for the 110-megawatt thermal-electric generating plant of Arizona Public Service Co. at Joseph City, Ariz. The company obtained approval from the Acoma Pueblo Tribal Council to explore 245,800 acres of land for coal.

The Navajo coal mine of the Utah Construction & Mining Co. in San Juan County supplied the total coal requirements of the Arizona Public Service Co. 575-megawatt Four Corners thermal powerplant near Farmington, for the first full year.

Bechtel Corp. of San Francisco was selected as the contracting firm to engineer and construct two 750-magawatt coal-fired powerplant units near the Four Corners plant for Western Energy Supply and Transmission Associates (WEST). Construction was scheduled to begin in the spring of 1966. Negotiations to supply 6 million tons of coal needed annually for the plants were being concluded with Utah Construction & Mining Co. at yearend.

Helium.—The Navajo helium plant of the Federal Bureau of Mines at Shiprock, San Juan County, produced 80.6 million cubic feet of grade A helium (purity 99.995 percent), and shipped 85 million cubic feet valued at $2.975 million during the year. The slight decrease in production was attributable to declining productivity of the Table Mesa field, the source of helium-bearing natural gas for the plant. Helium produced at the Navajo plant was shipped from a rail terminal at Gallup to Federal and commercial customers on the west coast. The plant was operated on a 24-hour-per-day schedule throughout the year.

Natural Gas.—Slightly more than one-half of the natural gas production was from the southeastern part of the State; the remainder was from the northwestern part.

The New Mexico Oil & Gas Engineering Committee[7] and the Oil and Gas Conservation Commission reported that the State had 8,010 producing gas wells and 156 gas pools; in addition, casing head gas was obtained from some of the 17,971 oil wells in 605 oil pools. The 40 natural gas liquids extraction plants processed 868.6 billion cubic feet of natural gas; of this amount 760.6 billion cubic feet was returned to pipelines as dry gas.

Annual estimates by American Petroleum Institute (API) and American Gas Association showed that in 1965 New Mexico gas reserves had a net gain of 20.1 billion cubic feet to a total of 15.4 trillion cubic feet at yearend. New discoveries accounted for 79.1 billion cubic feet; extensions and revisions accounted for 879.5 billion cubic feet.

Events of great interest to the New Mexico gas industry involved access to southern California's gas market and a court delay in setting price ceilings on Permian basin gas. The huge gas market in southern California was sought by El Paso Natural Gas Co. and Transwestern Pipeline Co., both tied to the two New Mexico gas areas. Tennessee Gas Transmission Co. and Humble Oil Co., using gas from Texas, also applied for pipeline approval to the southern California market. At yearend, the Federal Power Commission (FPC) had reached no decision.

FPC fixed price ceilings on Permian basin gas (affecting southeastern New Mexico), an action that New Mexico and Texas gas producers claimed would cost them approximately $20 million per year in lost revenue; a U.S. court in January 1965 ruled that the enactment of the FPC order be delayed, pending final court action.

A major gas development was the continued expansion of the Indian Hills Basin gasfield in Eddy County. Approximately

[7] New Mexico Oil & Gas Engineering Committee. Annual Report, V. 1-2, 1965, p. 2.

50 gas wells with a combined potential of 100 million cubic feet of gas per day had been completed by yearend. The field had reserves estimated at between 500 billion and 1,000 billion cubic feet of gas. Southern Union Gas Co. built 40 miles of gathering system at a cost of $30 million. A natural gas liquids plant was being constructed to extract liquids from the gas before it was piped to markets in southern California.

El Paso Natural Gas Co. proposed to AEC that a nuclear test shot be fired underground in a low-permeability natural gasfield 55 miles east of Farmington. To increase permeability by fracturing, a 10-kiloton device was to be detonated in the Pictured Cliffs formation at a depth of about 4,200 feet. Costs were to be shared by El Paso and AEC.

Natural Gas Liquids.—The New Mexico Oil & Gas Engineering Committee annual report stated that the 40 natural gas liquids extraction plants processed 868.6 billion cubic feet of natural gas and recovered 27.4 million barrels of natural gas liquids. Of that total, 32 plants were in the southeastern part of the State (Permian basin) and the remaining 8 were in the northwestern part (San Juan basin). Recovered liquids included 10.4 million barrels of natural gasoline, 4 million barrels of butane, 4.2 million barrels of propane, and 8.8 million barrels of composite liquids.[8]

API reported the State natural gas liquids reserves at 542.8 million barrels, third ranked in the Nation.

Three plants commenced operations during 1965: Shell Oil Co. Antelope Ridge plant at Eunice and Warren Petroleum Corp. Caliche plant went on stream in March; Southern Union Gas Co. Huerfano plant in San Juan County began operations in mid-November.

At yearend, Marathon Oil Co. Indian Hills Basin gas plant was nearly completed. The $4 million installation was designed to process 180 million cubic feet of gas daily from gas wells in the Indian Hills basin. After natural gasoline, butane, and propane were extracted from the raw gas, the residual gas was to be put into the gas-transmission system of Transwestern Pipeline Co. for shipment to the west coast.

Petroleum.—Again, petroleum production in the State reached a new high, 5 percent higher than in 1964. And again, the State was sixth in the Nation in oil and condensate production.

Petroleum was produced from 17,971 wells in 605 pools; 16,042 of the wells and 559 of the pools were in the Permian basin; the remainder were in the northwestern counties. With 68 percent of the production, Lea County continued its leading place among counties.

Drilling declined 24 percent. Of the wells, 18 percent were exploratory and resulted in 28 oil and 14 gas discoveries; the success ratio was 20.6 percent compared with 13.5 percent for the national average. Footage drilled totaled 6.7 million feet.

One of the most significant oil-and-gas lease sales of the year was held on August 19 for Navajo Indian lands. A bonus of $226,239 was offered for 29,178 acres for an average bid of $7.75 per acre; high bid of the sale was $156.25 per acre.

A major event during the year was the development of the Chaveroo oilfield in Roosevelt County; by yearend, 166,896 barrels of oil was produced from 45 wells. The San Andres formation (Permian) reportedly had 40 feet of porous pay section.

At yearend, a significant wildcat drilling block was nearing unitization. San Augustin Plains Unit in Catron and Socorro Counties, one of the largest drilling blocks in the United States, comprised 404,293 acres. Located in an area of little petroleum interest in the southwestern part of the State, the first well, to be drilled to 10,500 feet, was to be 110 miles from the nearest exploratory well.

NONMETALS

Nonmetals comprised 19 percent of the of the total mineral output value of the State, an increase of 11 percent over that of 1964. The principal commodities produced, in declining rank of value, were potassium salts, sand and gravel, cement, stone, and perlite.

Barite.—Socorro County continued to produce all of the barite which was crushed, sized, bagged, and distributed to consumers in the State. The product was for use as a constituent in heavy drilling muds in oilwell drilling.

Cement.—Shipments of portland cement manufactured at the Tijeras plant, Ideal

[8] Work cited in footnote 8, p. 122.

Table 4.—Crude petroleum production by counties

(Thousand 42-gallon barrels)

County	1964	1965	Principal fields (those producing more than 1 million barrels) in 1965, in order of production
Chaves	6,723	7,579	Caprock.
Eddy	15,270	16,663	Empire, Loco Hills, Lusk, Grayburg Jackson.
Lea	79,752	80,999	Vacuum, Monument, Justis, Denton, Hobbs, Lusk, Maljamar, Lovington, Blinebry, Eunice, Gladiola, Crossroads.
McKinley	121	179	
Rio Arriba	1,585	1,409	
Roosevelt	2,124	2,343	Milnesand.
Sandoval	12	10	
San Juan	8,276	9,984	Horseshoe, Bisti.
Total	113,863	119,166	

Source: New Mexico Oil & Gas Engineering Committee. Annual Report 1965. V. 1–2, 1965, 650 pp.

Table 5.—Drilling for petroleum in 1965, by districts and counties

District and county	Oil	Gas	Dry	Total	Footage
East New Mexico:					
Exploratory completions:					
Chaves	2	1	36	39	95,117
Curry	-------	-------	1	1	7,538
Eddy	-------	5	23	28	219,397
Guadalupe	-------	-------	2	2	6,394
Lea	24	5	43	72	687,081
Roosevelt	1	-------	12	13	80,799
Santa Fe	-------	-------	1	1	2,703
Sierra	-------	-------	1	1	7,346
Torrance	-------	-------	2	2	3,754
Total	27	11	121	159	1,110,129
Development completions:					
Chaves	34	2	17	[1] 56	315,633
Eddy	75	26	31	[2] 143	725,646
Lea	262	12	71	[3] 356	2,369,417
Roosevelt	67	9	8	84	387,758
Total	438	49	127	[4] 639	3,798,454
West New Mexico:					
Exploratory completions:					
Colfax	-------	-------	1	1	1,800
McKinley	1	-------	10	11	20,162
Rio Arriba	-------	1	-------	1	4,654
Sandoval	-------	-------	3	3	4,751
San Juan	-------	2	27	29	110,009
Total	1	3	41	45	141,376
Development completions:					
McKinley	10	-------	2	12	17,155
Rio Arriba	2	73	6	81	463,691
Sandoval	-------	3	2	5	12,434
San Juan	17	167	12	196	1,183,192
Total	29	243	22	294	1,676,472
Total all drilling	495	306	311	[4] 1,137	6,726,431

[1] Includes 3 service wells.
[2] Includes 11 service wells.
[3] Includes 11 service wells.
[4] Includes 25 service wells.

Source: Oil and Gas Journal.

Cement Co., Bernalillo County, increased slightly; however, sales of masonry cement decreased. Cement used by ready-mix firms, miscellaneous contractors, and Federal and State agencies increased, but that used by highway contractors decreased. Portland cement was sold to consumers in Arizona, Colorado, Kansas, New Jersey, North Carolina, Oklahoma, Texas, and Utah; the principal market, however, was within the State.

Clays.—The quantity of miscellaneous clay produced from mines in the State declined 46,000 tons (44 percent); that of fire clay increased substantially. The decline in output of miscellaneous clay was because of a curtailment in the building industry and reduction of activities at a brick plant in Grant County. Increased demand for fire clay products used in smelter furnaces accounted for more production. The output of miscellaneous clay came from two operations in Bernalillo County and one each in Dona Ana, Grant, and McKinley Counties.

Two clay mines, one each in Hidalgo and Luna Counties, produced all of the fire clay in the State. Miscellaneous clay was used principally in manufacturing cement and building materials, and for a sealing constituent in rotary drilling.

Gem Stones.—The value of gem and ornamental stones, collected principally in Luna County, remained virtually the same as that in 1964. Agate headed the list of stones sold; others were petrified wood, Mexican onyx, amethyst, quartz crystal, jasper, chalcedony, aragonite, turquoise, and smithsonite.

Gypsum.—The 27-percent decrease in tonnage of gypsum mined resulted from a 25-percent decline in new housing construction in the Southwest. Principal users of gypsum were the Albuquerque plant, American Gypsum Co.; the Rosario plant, Kaiser Gypsum Co., Inc.; and the Tijeras plant, Ideal Cement Co. White Mesa Gypsum Co. supplied gypsum for American Gypsum Co.

The output was calcined for making wallboard lath and other building products. Susquehanna Corp. approved a merger with American Gypsum Co.; Susquehanna was to be the surviving corporation. Gypsum mined by Duke City Gravel Products Co., Albuquerque, for Ideal Cement Co. was used as a retarder in cement. Two of the open-pit mines were in Sandoval County; the other was in Santa Fe County.

Lime.—The volume of lime—produced and used by Chino Mines Division, Kennecott Copper Corp., Grant County, the only producer of lime in the State—increased 32 percent. Output was obtained from the company limekiln, which was operated the full year. The product was used in processing ore at the copper concentrator and for purifying water.

Mica.—Scrap mica—produced from four mines in Rio Arriba County and one mine in Taos County—decreased 38 percent in output and 57 percent in value, with the declines attributed mostly to the reduced demand of the building industry. Dry-ground-processed mica was used principally in paints; some was used for roofing.

Perlite.—For the ninth consecutive year, the State was the leading producer of perlite in the Nation, supplying 84 percent of the total output. Production and value of output gained 16 and 13 percent, respectively. The No Agua area, Taos County, was the principal source, where open-pit mines and crushing-screening plants were operated. The product was truck transported to railroad-loading plants near Antonito, Colo. Perlite mined by United States Gypsum Co. from an open pit in Valencia County was crushed and screened at a mill at Grants. All producers shipped sized products to company-owned or other expanding plants outside the State. Perlite was used in plasters, insulation, filter aids, fire-resistant materials, soil additives, lightweight aggregates, and cementing material for oil well drilling.

Potash.—The State supplied the Nation with 91 percent of the total output of potassium salts. Mine production of potash-bearing ores (sylvinite and langbeinite) established new highs for output and total value. The average K_2O content of the ore mined in the State increased slightly, from 18 percent in 1964 to 18.1 percent. By yearend, total stocks of potash products held by producers increased 66 percent to a total of 440,342 tons (K_2O equivalent). The average price for salts sold rose from $23 to $23.97 per ton. Of the total salts sold, 20 percent went to foreign countries.

In the fourth quarter, the Kermac Potash Co. multimillion-dollar refinery and shaft mine in Eddy County went on stream.

Table 6.—Crude perlite sold or used by producers

Year	Short tons	Value (thousands)
1961	245,654	$2,159
1962	258,164	2,143
1963	259,113	2,212
1964	286,329	2,568
1965	331,011	2,905

Expansions and developments, in progress or recently completed, were by Duval Corp., IMC, National Potash Co., Potash Company of America (PCA), Southwest Potash Corp., and United States Borax & Chemical Corp., at the 10 shaft mines and 7 refineries in Eddy and Lea Counties.

Pumice.—Crude and processed scoria, volcanic cinders, and pumice sold or used increased 2 percent. Scoria and volcanic cinders constituted 72 percent of the total output of pumice, representing 54 percent of the value of the products. Output came from 10 mines and 9 plants operated by 11 companies; production was obtained from Bernalillo, Dona Ana, Rio Arriba, Sandoval, Santa Fe, and Union Counties.

Pumice, scoria, and volcanic cinders were sold for use as lightweight concrete aggregate, insulating material, roadway ballast, athletic-track material, and filtering agent and in paints and matches.

Salt.—Most of the salt was recovered as a byproduct of refining potash salts near Carlsbad. The remainder was produced by solar evaporation of brine at Salt Lake, north of Quemado, Catron County. Shipments to consumers in the State was 79 percent of the total; salt also was sold to users in Arizona, Colorado, and Texas. Markets for the products were the livestock industry, feed dealers and mixers, State and county highway departments, water-softener establishments, and the oil-gas exploration and development industry.

Sand and Gravel.—Output value of sand and gravel was the third highest in the history of the State, exceeded only by the output of $13.3 million in 1959 and $12.8 million in 1963. The average price per ton varied from $1.07 in 1959 to $1.53 per ton in 1963 and dropped to $1.03 per ton in 1965. Although sand and gravel output increased 34 percent, the commodity had only a 19-percent gain in value over the 1964 figure. Sand and gravel used for road construction and maintenance increased 54 percent; however, that used for building construction declined 12 percent.

Sand and gravel was produced from 166 operations in 29 counties, a gain of 33 operations. Of the total number of operations, 89 were by commercial operators and 77 were by Government crews and contractors. Of the 6.1 million tons produced by Government crews and contractors, 4.9 million tons was for the State highway department, 833,000 tons for Federal agencies, 210,000 tons for municipalities, and 112,000 tons for county governments.

All counties except Curry, Harding, and Mora reported production. Dona Ana County led the State in the output of sand and gravel, replacing Bernalillo County which led the State for several years.

The U.S. Department of Commerce reported [10] that of a total of 1,003 miles designated as a part of the Interstate Highway System in the State, 517.4 was open to traffic. Of this 517.4 miles, 434.8 miles

Table 7.—Potassium salts production and sales

(Thousand short tons)

Year	Crude salts, mine production		Marketable potassium salts					
			Production			Sales		
	Gross weight	K_2O equivalent	Gross weight	K_2O equivalent	Value (thousands)	Gross weight	K_2O equivalent	Value (thousands)
1961	15,653	2,934	4,281	2,523	$96,380	3,882	2,281	$87,415
1962	14,115	2,619	3,758	2,208	85,124	4,206	2,476	95,851
1963	16,414	3,083	4,504	2,643	101,458	4,213	2,484	94,925
1964	17,356	3,122	4,585	2,675	r 104,861	4,815	2,814	110,772
1965	18,557	3,363	4,919	2,848	117,771	4,607	2,677	110,424

r Revised.

Table 8.—Sand and gravel production in 1965, by counties

(Thousand short tons and thousand dollars)

County	Quantity	Value
Bernalillo	1,643	$1,820
Catron	75	79
Chaves	256	274
Colfax	445	525
De Baca	W	W
Dona Ana	2,006	2,052
Eddy	W	W
Grant	224	230
Guadalupe	W	W
Hidalgo	356	355
Lea	W	W
Lincoln	221	233
Los Alamos	100	100
Luna	400	427
McKinley	731	791
Otero	619	648
Quay	310	352
Rio Arriba	689	465
Roosevelt	9	11
Sandoval	283	335
San Juan	425	465
San Miguel	825	770
Santa Fe	359	436
Sierra	216	214
Socorro	431	433
Taos	221	231
Torrance	287	172
Union	122	136
Valencia	211	215
Undistributed	299	361
Total	11,763	12,130

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

was completed to full and acceptable standards; 82.6 miles was improved to standards adequate for present traffic. Work in progress on December 31 included 69.8 miles under construction and 308.2 miles in the engineering planning stage; 107.6 miles remained in preliminary status or not yet in progress.

Stone.—Tonnage and value of stone quarried decreased 31 percent and 29 percent, respectively. Production of basalt climbed 97 percent; crushed limestone rose 15 percent; miscellaneous crushed stone dropped 78 percent (1.4 million tons to 316,442 tons). Commercial operators used 51 percent of the total crushed limestone; of this amount, 23 percent was used as concrete aggregate and highway material. The State highway commission reported 691,007 tons of crushed limestone used as concrete aggregate and road metal.

Limestone constituted 76 percent of the production; miscellaneous stone 17 percent; and basalt, sandstone, granite, and dimension marble 7 percent. All stone was produced from quarries and pits worked at 49 operations in 19 counties, an increase of 1 operation but a decrease of 4 counties. Important uses of the broken and crushed stone were for concrete aggregate, making cement, riprap material, making lime, and flux material.

Finished dimension stone was produced from quarries in Luna, San Miguel, and Valencia Counties.

Sulfur.—Byproduct elemental sulfur, recovered from sour gases at natural gas plants, was extracted by a modified Claus process at four plants, two each in Eddy and Lea Counties. Production totaled 11,141 long tons of sulfur, a 4-percent gain. Of the total sulfur, 10,540 long tons was shipped at a value of $197,856. Sulfur was used in producing muriatic and sulfuric acids, and in stock feeds.

Vermiculite.—Southwest Vermiculite Co. exfoliated vermiculite from Montana deposits at its plant in Albuquerque. The processed material was used principally for lightweight concrete aggregate. Sales declined slightly.

METALS

The metals group, in descending order of rank in value, were copper, uranium ore, zinc, molybdenum, lead, silver, and gold; other metals included iron ore, manganese and manganiferous ores, tin, and vanadium. Demand for copper was strong throughout the year.

Copper.—Copper output value exceeded the previous high reached in 1956 ($63.2 million). With this total output, the State was again ranked fourth in the Nation. A worldwide demand for copper effected a market price increase from 33.725 cents to 35.931 cents per pound at yearend; the price increase, tied directly to the added production of copper ores, accounted for a gain of 12,554 tons (15 percent) in output and $13.7 million (24 percent) in value.

Output of copper came from 40 operations at 26 mines, including 15 leaching operations, in 7 counties, a decline of 2 operations. The Chino and Continental mines (Grant County), and the Bonney-Miser's Chest and Eighty-Five ("85") mines (Hidalgo County) supplied over 98 percent of the copper output of the State.

[10] Bureau of Public Roads. Quarterly Report on The Federal-Aid Highway Program, Dec. 31, 1965. Press Release BPR 66-5, Feb. 9, 1966.

Table 9.—Sand and gravel sold or used by producers, by classes of operations and uses
(Thousand short tons and thousand dollars)

Class of operation and use	1964		1965	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Construction:				
Building	1,024	$1,223	949	$1,105
Paving	210	269	480	556
Railroad ballast	----	----	48	16
Fill	[1] 47	[1] 48	40	34
Industrial: Engine	(1)	(1)	----	----
Other (unground sand only)	----	----	2	1
Total	1,281	1,540	1,519	1,712
Gravel:				
Construction:				
Building	973	1,298	1,106	1,397
Paving	2,256	3,069	2,963	3,246
Railroad ballast	6	4	20	24
Fill	130	68	88	66
Miscellaneous	14	21	----	----
Total	3,379	4,460	4,177	4,733
Total sand and gravel	4,660	6,000	5,696	6,445
Government-and-contractor operations:				
Sand:				
Building	20	19	----	----
Paving	21	12	682	679
Fill	101	87	60	41
Other	----	----	6	6
Total	142	118	748	726
Gravel:				
Building	285	306	----	----
Paving	3,604	3,660	5,282	4,924
Fill	90	76	37	35
Total	3,979	4,042	5,319	4,959
Total sand and gravel	4,121	4,160	6,067	5,685
All operations:				
Sand	1,423	1,658	2,267	2,438
Gravel	7,358	8,502	9,496	9,692
Total	8,781	10,160	11,763	12,130

[1] Fill and engine sand combined to avoid disclosing individual company confidential data.

Of the total copper production, 68 percent was recovered from copper ore; 30 percent was recovered by leach-precipitate operations; the remainder was extracted from ore mined principally for gold, silver, lead, and/or zinc.

Chino Mines Division continued to expand by adding new facilities and equipment at the Chino mines; United States Smelting Refining and Mining Co. (USS-R&M Co.) continued its multimillion-dollar projects at its new Continental mine near Fierro; John H. Trigg Co. built a new cement-copper plant near Tyrone (Grant County); and Banner Mining Co. and Diversified Mines, Inc., further developed their mines near Lordsburg (Hidalgo County).

A short-duration labor strike in September temporarily interrupted work schedules of mining companies served by Atchison, Topeka and Santa Fe Railway (AT&SF).

Gold.—Production of gold in 6 counties, up 3,531 ounces or 58 percent, came from 21 lode mines, 2 placer mines, and 1 cleanup. Compared with activity in 1964, these totals represented a gain of one placer mine and three lode mines. Hidalgo County produced 49 percent of the total gold and Grant County accounted for 48 percent; the remaining 3 percent was pro-

Table 10.—Stone production in 1965, by counties

County	Short tons	Value
Bernalillo	W	W
Chaves	35,282	$52,923
Colfax	3,072	4,608
Dona Ana	224,664	338,196
Eddy	W	W
Grant	196,659	292,433
Guadalupe	W	W
Hidalgo	113,794	170,692
Lea	261,285	391,928
Lincoln	11,640	22,710
Luna	240,878	361,911
Mora	W	W
Otero	W	W
Quay	392	588
Rio Arriba	17,278	26,247
San Juan	472	708
San Miguel	11,224	40,483
Union	361	542
Valencia	W	W
Undistributed	794,162	1,315,594
Total	1,911,163	3,019,563

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

duced from mining operations in Catron, Santa Fe, Sierra, Socorro, and Taos Counties. More than 66 percent of the gold production was a byproduct of copper produced from the Bonney-Miser's Chest, Chino, and "85" mines. The placer mines were in Santa Fe and Sierra Counties.

Iron Ore.—Output of magnetite ore—produced only by Dotson Minerals Corp.—from the Jones open-pit mine in Socorro County decreased 8 percent. All of the ore was concentrated before shipment. Approximately 17 percent of the output was used in making sponge iron; the remainder was used as an additive in manufacturing cement.

Lead.—Lead increased 108 percent in production and 148 percent in value compared with that of 1964. Reactivation of the Ground Hog mine of American Smelting and Refining Co. (Asarco) at yearend 1964, a lead-zinc mine, and a firm market price for lead at 16 cents per pound accounted for the substantial increases. Total production was derived from 19 mines in 5 counties, a gain of 3 mines but a loss of 1 county. Nine Grant County mines yielded 75 percent of the total lead output; five Socorro County mines yielded 21 percent; and five mines in Hidalgo, Lincoln, and Luna Counties contributed the remaining 4 percent.

In order of rank the leading contributors were the Ground Hog mine (Grant County); Linchburg mine of The New Jersey Zinc Co. (Socorro County) operated by L. A. Patten, lessee; Kearney mine of American Zinc, Lead and Smelting Co. (Grant County); and Denver mine operated by Gene Galassini (Grant County); cumulatively they accounted for 84 percent of the total lead output. The Ground Hog mine was affected by a labor strike, stopping all output on July 16.

Table 11.—Stone sold or used by producers, by kinds

Year	Basalt and related rocks (traprock)		Granite		Limestone		Marble	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1961	2,025	$2,025	--------	--------	1,164,575	$1,516,250	80	$11,029
1962	148,858	201,758	--------	--------	918,483	1,298,410	W	W
1963	6,716	8,211	996	$25,997	1,264,243	2,017,667	W	W
1964	42,941	81,376	190	4,140	1,260,898	1,936,041	W	W
1965	84,490	248,500	3,445	17,130	1,452,401	2,084,281	W	W

Year	Sandstone		Other stone		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1961	115,331	$87,587	571,098	$588,775	1,853,109	$2,205,666
1962	95	1,125	936,336	1,280,947	2,003,772	2,782,240
1963	W	W	1,236,783	2,184,264	2,508,738	4,236,139
1964	[1] 6,724	[1] 10,086	1,449,331	2,212,383	2,760,084	4,244,026
1965	[2] 88	[2] 2,036	370,739	667,616	1,911,163	3,019,563

W Withheld to avoid disclosing individual company confidential data; included with "Other stone."
[1] Excludes dimension sandstone; included with "Other stone."
[2] Excludes crushed sandstone; included with "Other stone."

Table 12.—Mine production of gold, silver, copper, lead, and zinc, in terms of recoverable metals [1]

Year	Mines producing		Material sold or treated [2] (thousand short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Troy ounces	Value (thousands)	Troy ounces (thousands)	Value (thousands)
1956–60 (average)	44	----------	7,035	3,689	$129	265	$240
1961	39	1	7,751	6,201	217	283	261
1962	22	----------	7,687	7,529	264	302	327
1963	25	----------	7,404	7,805	273	256	328
1964	41	1	7,882	6,110	214	242	313
1965	34	2	9,006	9,641	337	288	372
1848–1965	NA	NA	NA	2,266,765	52,671	73,711	58,696

	Copper		Lead		Zinc		Total value (thousands)
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	
1956–60 (average)	60,867	$40,119	3,056	$866	19,026	$4,727	$46,081
1961	79,606	47,764	2,332	480	22,900	5,267	53,989
1962	82,683	50,933	1,134	209	22,015	5,063	56,796
1963	83,037	51,151	1,014	219	12,938	2,976	54,947
1964	86,104	56,140	1,626	426	29,833	8,115	65,208
1965	98,658	69,850	3,387	1,057	36,460	10,646	82,262
1848–1965	2,690,322	1,181,282	342,443	48,726	1,333,480	259,324	1,600,699

NA Not available.
[1] Includes recoverable metal content of gravel washed (placer operations), ore milled, old tailings or slimes retreated, and ore, old tailings, old slag, or copper precipitates shipped to smelters during the calendar year indicated.
[2] Does not include gravel washed or tonnage of precipitates shipped.

Manganese Ore.—At the Luck mine, Grant County, Luck Mining Co. produced ferruginous manganese ore containing 11 percent manganese and 35 percent iron. Ore mined at the open pits and shipped to The Colorado Fuel and Iron Corp. (CF&I) steel plant at Pueblo, Colo., increased.

Manganese ore, in excess of 48 percent contained mineral, continued to be produced at the Black Canyon underground mine, Socorro County, and upgraded to meet sales specifications for markets in the United States and Canada. The total output had a small increase in value; production decreased slightly.

Molybdenum. — Molybdenum concentrate was recovered principally by Chino Mines Division in the Chino concentrator at Hurley, Grant County, as a byproduct of copper concentrate produced from the Chino copper ore. Byproduct molybdenum was also recovered by Kerr-McGee Corp., formerly Kermac Nuclear Fuels Corp., from uranium ores of the Ambrosia Lake mines, McKinley County. The recovery of byproduct molybdenum from uranium ores of New Mexico origin, and that contained in uranium-bearing lignite ash from South Dakota was necessary because the higher content of molybdenum in the lignite ash produced a uranium concentrate containing more molybdenum than was permissible. The quantity of molybdenum in New Mexico ores had not been sufficient to result in contamination of the uranium oxide delivered to AEC. Kermac Nuclear Fuels Corp. was merged with Kerr-McGee Oil Industries, Inc., into a new organization, Kerr-McGee Corp., on December 31, 1964. The Questa mine, Molybdenum Corporation of America (Molycorp), Taos County, produced a small quantity.

Total molybdenum recovered increased 26 percent or 209,000 pounds in output and 34 percent or $407,000 in value compared with 1964 figures.

Following a 3-year period of intensive exploration, development, and construction

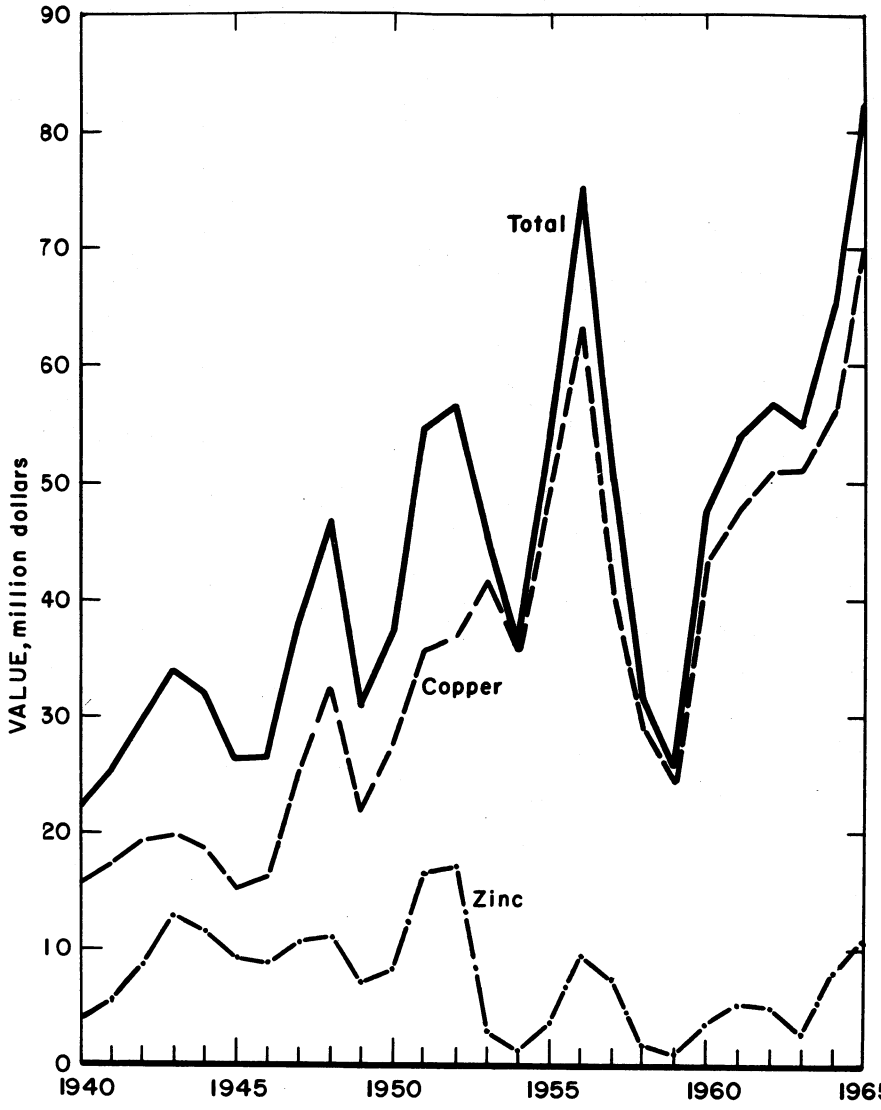

Figure 2.—Value of mine production of copper and zinc and total value of gold, silver, copper, lead, and zinc in New Mexico. The value of gold, silver, and lead produced annually has been relatively small.

Table 13.—Mine production of gold, silver, copper, lead, and zinc in 1965, by counties, in terms of recoverable metals

County	Mines producing [1]		Lode material sold or treated [2] (short tons)	Gold		Silver	
	Lode	Placer		Troy ounces	Value	Troy ounces	Value
Catron	1	------	[3] 258	[3] 174	[3] $6,090	[3] 5,386	[3] $6,964
Grant	17	------	8,847,844	4,642	162,470	196,235	253,732
Hidalgo	5	------	99,970	4,752	166,320	59,154	76,486
Lincoln	1	------	(3)	(3)	(3)	(3)	(3)
Luna	2	------	168	----------	----------	345	446
Santa Fe	-----	1	----------	17	595	1	1
Sierra	1	1	(3)	(3)	(3)	(3)	(3)
Socorro	5	------	18,094	56	1,960	26,376	34,104
Taos	1	------	(3)	(3)	(3)	(3)	(3)
Valencia	1	------	15	----------	----------	12	16
Total:							
1965	34	2	8,966,349	9,641	337,435	287,509	371,749
1964	41	1	7,881,619	6,110	213,850	242,405	313,430

	Copper		Lead		Zinc		Total value
	Short tons	Value	Short tons	Value	Short tons	Value	
Catron	[3] 1	[3] $744	[4]	[3] $47	[4]	[3] $44	[3] $13,889
Grant	96,928	68,625,236	2,524	787,285	35,099	10,248,893	80,077,616
Hidalgo	1,706	1,207,600	132	41,168	140	40,895	1,532,469
Lincoln	(3)	(3)	(3)	(3)	(3)	(3)	(3)
Luna	----------	----------	7	2,293	2	555	3,294
Santa Fe	----------	----------	-----	----------	------	----------	596
Sierra	(3)	(3)	(3)	(3)	(3)	(3)	(3)
Socorro	22	15,399	724	225,951	1,219	355,933	633,347
Taos	(3)	(3)	(3)	(3)	(3)	(3)	(3)
Valencia	1	885	------	----------	------	----------	901
Total:							
1965	98,658	69,849,864	3,387	1,056,744	36,460	10,646,320	82,262,112
1964	86,104	56,139,808	1,626	426,012	29,833	8,114,576	65,207,676

[1] Operations at plants leaching runoff water and old mill or miscellaneous cleanups not counted as producing mines.
[2] Does not include tonnage of precipitates shipped or gravel washed.
[3] Production of Catron, Lincoln, Sierra, and Taos Counties combined to avoid disclosing individual company confidential data.
[4] Less than ½ unit.

that involved an investment of $40 million, the new Questa open-pit mine and 10,000-ton-per-day mill of Molycorp were placed on stream at yearend, and was expected to reach a production rate of 10 million pounds early in 1966. Molycorp was affected by labor strikes lasting from August 16 to 17 (1 day) and August 26 to September 3 (8 days).

Silver.—Silver production and value were each 19 percent greater than in 1964. Leading silver-producing mines, in descending order of production, were Chino, Ground Hog, and Princess, Grant County; Bonney-Miser's Chest, Hidalgo County; Kearney, Grant County; Linchburg, Socorro County; and "85" mine, Hidalgo County. These mines yielded 91 percent of the total output, which was from 30 lode and 2 placer mines in 10 counties, compared with 32 lode mines in 12 counties in 1964. Of the silver recovered 32 percent was from copper ore, 57 percent from lead, lead-zinc, and zinc ores, 10 percent from silver and gold-silver ores, and the remainder from miscellaneous material and placer mines.

Tin.—The quantity of tin concentrate recovered from deposits in the Black Range district, mainly in Catron and Sierra Counties, declined. The entire shipment was processed by Tinco, Inc., at the company jigging plant in Catron County.

Anommco, Inc., developed its placer deposits and constructed a jig concentrator in Sierra County for shipments planned to start in 1966.

Uranium Ore.—New Mexico, for the

Table 14.—Mine production of gold, silver, copper, lead, and zinc in 1965, by classes of ore or other source materials, in terms of recoverable metals

Source	Number of mines[1]	Material sold or treated (short tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Lode ore:							
Dry gold-silver	3	31,709	2,506	22,220	1,264,800	----------	500
Dry silver	5	302	51	5,647	2,100	1,000	300
Total	8	32,011	2,557	27,867	1,266,900	1,000	800
Copper	9	8,470,639	6,365	92,602	135,161,000	400	500
Lead	6	1,210	10	3,909	1,300	692,300	4,400
Lead-zinc	5	59,436	137	76,041	374,500	4,578,100	13,152,600
Zinc	4	402,641	434	84,850	747,900	1,451,200	59,735,600
Total	23	8,933,926	6,946	257,402	136,284,700	6,722,000	72,893,100
Other lode material:							
Silver tailings	1	200	------	125	----------	500	200
Copper precipitates	2	39,384	------	--------	59,764,000	----------	----------
Lead-zinc cleanup	(2)	62	3	1,837	400	37,600	22,100
Lead-zinc tailings	1	150	------	241	----------	12,900	3,800
Total	4	39,796	3	2,203	59,764,400	51,000	26,100
Total "lode" material	34	9,005,733	9,506	287,472	197,316,000	6,774,000	72,920,000
Placer	2	----------	135	37	----------	----------	----------
Total all sources	36	9,005,733	9,641	287,509	197,316,000	6,774,000	72,920,000

[1] Detail will not necessarily add to totals because some mines produce more than one class of material.
[2] From property not classed as a mine.

Table 15.—Mine production of gold, silver, copper, lead, and zinc in 1965, by types of material processed and methods of recovery, in terms of recoverable metals

Type of material processed and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Lode:					
Concentration and smelting of concentrates: Ore	6,935	253,289	135,976,300	6,044,500	72,892,200
Direct-smelting:					
Ore	2,568	32,346	1,404,500	691,900	5,700
Cleanup	3	1,837	400	37,600	22,100
Copper precipitates	-------	--------	59,764,000	----------	----------
Total	2,571	34,183	61,168,900	729,500	27,800
Leaching of copper ore	-------	--------	170,800	----------	----------
Placer	135	37	----------	----------	----------
Grand total	9,641	287,509	197,316,000	6,774,000	72,920,000

seventh consecutive year, was the principal producer of uranium ore and concentrate in the United States. Although production declined for the fifth straight year, there was a $108,000 increase in value. The average grade of ore shipped from mines, 0.23 percent U_3O_8, was 0.01 percent greater than in 1964.

Uranium concentrates were produced at four mills: The Anaconda Company at Bluewater, Kerr-McGee Corp. (formerly Kermac Nuclear Fuels Corp.) at Grants, Homestake-Sapin Partners at Grants, and VCA at Shiprock. All mills had signed stretchout agreements with AEC for delivery of uranium concentrate through December 31, 1970; the last two milling companies signed the agreement during the year, as did United Nuclear Corp. at Grants whose mill continued on standby. From 2 million tons of uranium ore processed at mills in the State and in Colorado, 9 million pounds of uranium oxide (yellowcake) was recoverable, at an estimated

value of $71.9 million.

Major production of uranium ores continued to come from McKinley and Valencia Counties; only a small quantity was produced in San Juan County. Of the 50 producing operations, 41 were in McKinley County, 4 in San Juan, and 5 in Valencia.

Kerr-McGee Corp. established a milestone when the 1,000th lot of yellowcake was shipped from its mill May 28. Each lot consisted of 36,000 pounds of uranium oxide.

Vanadium.—Vanadium oxide was recovered as a byproduct from uranium ores processed at mills with vanadium recovery units. Other uranium mills produced vanadium-rich solutions in the process of milling uranium ores. The solutions were further processed at plants equipped for recovering vanadium. The value of vanadium oxide from ores of New Mexico origin increased substantially, 44 percent or $67,000.

The byproduct vanadium contained in the uranium oxide concentrate was produced by eight uranium operations, two in McKinley County and six in San Juan, and was processed at one uranium mill in the State and two in Colorado. The concentrate was recovered by VCA at Shiprock; Climax Uranium Co., a unit of Climax Division, American Metals Climax, Inc., at Grand Junction (Colo.); and Union Carbide Corp. at Rifle (Colo.).

Zinc.—Output of zinc reached the highest output and value since 1952.

Zinc, one of the few metal commodities valued in excess of $10 million, increased substantially, 22 percent in quantity and 31 percent in value. Of the total zinc produced, mines in Grant County contributed 96 percent.

Zinc was produced at 17 mines in 5 counties, 3 less than in 1964. The Hanover mine of The New Jersey Zinc Co. (Grant County) led the State in zinc output. Other leading mines, in order of production, were the Princess of USS-R&M Co. (Grant County); Oswaldo of The New Jersey Zinc Co. (Grant County); Kearney; Ground Hog; and Linchburg. Following reactivation in 1964, the Ground Hog and Princess mines were important contributors to the total zinc produced.

REVIEW BY COUNTIES

Mineral production was reported in 31 of the 32 counties; Curry County had no output. Only those counties with significant production or mineral industry activity are detailed; additional details are cited in table 16.

Bernalillo.—The value of mineral production in Bernalillo County decreased about 2 percent, because of production drops in clays, pumice, and stone. Almost all of the output was used in construction. All of the crushed limestone was used in manufacturing portland and masonry cements at the Ideal Cement Co. Tijeras plant east of Albuquerque.

The volcanic scoria quarried at the Blackbird mine, near Isleta, was used in manufacturing building block and other products by Edgar D. Otto & Son, Inc. Miscellaneous clay mined at the Kinney mine was used for manufacturing building brick by Kinney Brick Co., Inc., near Albuquerque.

Twenty operations, 12 commercial and 8 Government-and-contractor, produced a total of 1.6 million tons of sand and gravel: 969,000 tons was used for building construction, 563,000 tons for highway paving, and 111,000 tons for filling. Most important was the work in progress on Interstate Highways 25 and 40 in Albuquerque. Albuquerque Gravel Products Co., Springer Transfer Co., and A. J. Giannini were the principal commercial producers. Universal Constructors used 22,000 tons of basalt rock for a riprapping project for the U.S. Army Corps of Engineers.

In addition to the four existing plants, at midyear, Albuquerque Gravel Products Co. dedicated a highly automated batch plant.

At yearend, American Gypsum Co., an important producer of wallboard-gypsum building material in the Albuquerque area, merged with Susquehanna Corp. (the surviving company).

Catron.—The value of sand and gravel output accounted for 76 percent of the total county output value. Production was by a contractor for the Federal Forest Service and crews of the State highway

Table 16.—Value of mineral production in New Mexico, by counties

County	1964	1965	Minerals produced in 1965 in order of value
Bernalillo	$8,765,430	$8,614,631	Cement, sand and gravel, stone, clays, pumice.
Catron	94,622	102,931	Sand and gravel, tin, silver, salt, gold, copper.
Chaves	20,773,059	22,062,923	Petroleum, natural gas, sand and gravel, stone.
Colfax	3,743,559	W	Coal, sand and gravel, stone.
Curry	285,723	----	
De Baca	154,000	W	Sand and gravel.
Dona Ana	748,769	W	Sand and gravel, stone, pumice, clays.
Eddy	r 152,620,637	171,633,511	Potassium salts, petroleum, natural gas, natural gasoline, LP gases, salt, stone, sand and gravel.
Grant	65,328,281	82,809,703	Copper, zinc, molydbenum, lead, lime, manganiferous ore, stone, silver, sand and gravel, gold, clays.
Guadalupe	1,634,085	W	Sand and gravel, stone.
Harding	60,602	61,562	Carbon dioxide (natural).
Hidalgo	W	2,069,024	Copper, sand and gravel, stone, gold, silver, lead, zinc, clays.
Lea	r 307,186,779	309,517,995	Petroleum, natural gas, natural gasoline, LP gases, potassium salts, stone, sand and gravel.
Lincoln	W	W	Sand and gravel, stone, lead, zinc, silver.
Los Alamos	121,000	100,000	Sand and gravel.
Luna	W	793,795	Sand and gravel, stone, lead, clays, zinc, silver.
McKinley	34,004,601	33,090,084	Uranium ore, coal, sand and gravel, petroleum, molybdenum, vanadium, clays.
Mora	----	W	Stone.
Otero	342,481	W	Sand and gravel, stone.
Quay	102,000	352,588	Do.
Rio Arriba	13,843,482	13,898,172	Natural gas, petroleum, LP gases, sand and gravel, natural gasoline, pumice, mica (scrap), stone.
Roosevelt	7,993,056	8,351,000	Petroleum, natural gas, LP gases, natural gasoline, sand and gravel.
Sandoval	1,027,809	782,121	Gypsum, sand and gravel, petroleum, pumice.
San Juan	r 84,963,602	95,625,629	Natural gas, petroleum, LP gases, coal, natural gasoline, helium, sand and gravel, vanadium, uranium ore, stone.
San Miguel	295,858	810,483	Sand and gravel, stone.
Santa Fe	1,052,520	860,912	Sand and gravel, pumice, gypsum, gold, silver.
Sierra	W	W	Sand and gravel, gold, silver, copper.
Socorro	W	W	Sand and gravel, zinc, lead, manganese ore, iron ore, silver, copper, barite, gold.
Taos	2,444,765	2,787,611	Perlite, sand and gravel, mica (scrap), molybdenum, copper, silver, gold.
Torrance	272,000	172,000	Sand and gravel.
Union	W	W	Pumice, sand and gravel, stone.
Valencia	W	W	Uranium ore, perlite, sand and gravel, stone, copper, silver.
Undistributed [1]	r 12,270,832	18,776,866	
Total	r 720,130,000	773,274,000	

r Revised. W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] Includes gem stones that cannot be assigned to specific counties, and values indicated by symbol W.

commission and county highway department for use on paving projects. Thomas Consolidated Mines, Inc., continued to produce a small amount of ore from the Bearup mine near Glenwood. Near year-end 1964, Tinco, Inc., acquired tin-bearing placers, including a jig plant. A tin concentrate was produced until August when the mill was stopped for remodeling. Curtis Salt Co. produced salt at its solar-evaporation facilities near Salt Lake. The salt was sold in New Mexico and Arizona.

Chaves.—A significant 59-percent gain in natural gas output and 13 percent in petroleum, although partially offset by decreases in sand and gravel and stone production, accounted for a $1.3 million increase in mineral output. Petroleum comprised 97 percent of the total value. Producing petroleum wells increased from 818 in 1964 to 833 in 1965; the output rose from 6.7 to 7.6 million barrels. Seven gas wells produced throughout 1965.

Although exploratory drilling increased 34 percent, the success ratio declined from 28 to 8 percent. Development drilling declined, and resulted in only 36 producers, compared with 63 in 1964.

Sand and gravel was produced at 10 operations. Of the sand and gravel, 49 percent was used for building, 44 percent for paving, and the remainder for filling;

98 percent of the total was processed. Crushed limestone and miscellaneous stone from two operations was used for road projects for the State highway commission.

Colfax.—The value of mineral output increased because of a small increase in the output of coal, a fivefold increase in the use of sand and gravel, and a small volume of stone quarried for the first time since 1963.

The underground Koehler mine of Kaiser Steel Corp. continued to yield a coking coal from the Raton seam near Raton. Mechanically washed and cleaned at the Koehler preparation plant near the mine, all of the output was mined by continuous mining machines. Of the total processed coal, 95 percent was shipped by rail to the Fontana steel plant of Kaiser Steel Corp. in California.

A multimillion-dollar expansion was underway at the York Canyon mine.

The York Canyon mine coal seam was to be mined with continuous mining machines and the coal transported to surface by a conveyor-belt system. Shipments to the Fontana, Calif., steel plant of the company were to supplement production of other company coal mines at Sunnyside, Utah. Production, totaling about 700,000 tons annually was to begin about mid-1966.

Julius Seidel and Talbott Coal Co. each reported an increase in production of coal mined from the underground Yankee seam of the Franks No. 1 mine and the underground seam at the Talbott mine, respectively. All of the coal was trucked to markets.

Three commercial operators produced and processed all of the sand and gravel; the material was used in highway paving projects; about 73 percent of the total was gravel. Joseph C. Hastings was the principal producer. Crushed sandstone for riprapping was supplied by two contractors for the State highway commission.

Dona Ana.—Leader of all counties in output and total value of sand and gravel in the State, Dona Ana produced 2 million tons of the 11.8-million-ton total. The significant increases in output of sand and gravel and stone production, along with gains in clays and pumice, were significant in the rise of total mineral output.

Of the total sand and gravel, approximately 175,000 tons was used for building, 1.8 million tons for paving, and 12,000 tons for filling. Thirteen operations—6 commercial and 7 Government-and-contractor—supplied sand and gravel for work on Interstate Highways 10 and 25.

Contractors for the State highway commission were the principal producers, supplying 71 percent of the total sand and gravel output. Atlas Land Co. and Broce Construction Co., Inc., were the principal commercial producers of sand and gravel. All of the crushed limestone was produced by Broce Construction Co., Inc., and Wayne Lowdermilk, contractors for highway construction for the State highway commission; some miscellaneous crushed stone also was supplied by Builders Block & Stone.

Builders Block and Supply Co., Inc., extracted cinders from the Volcano No. 1 mine and Volcanic Cinder Co. from the Klinker mine, both near Las Cruces. Clay for manufacturing building bricks was quarried at the Brickland pit by Nu-Tex Brick Co. of El Paso, Tex.

Eddy.—Eddy County continued to dominate the Nation in potash mining and refining and potash products produced. The county again was second in the State in value of petroleum produced and in value of total mineral output. The $19 million gain in total mineral output resulted from proportionate individual increases in all eight commodities except natural gas and gasoline, which declined slightly.

Potash mines were operated by Duval Corp., IMC, Kermac Potash Co., National Potash Co., PCA, Southwest Potash Corp., and United States Borax & Chemical Corp. All seven potash companies had geared their operations to maximum production levels. Mine and refinery expansion continued to increase mine production and improve the quality of salts produced.

Duval Corp. produced muriate of potash, sulfate of potash-magnesia, and sulfate of potash from its Nash Draw, Saunders, and Wills-Weaver mines. The refining plants used washer, flotation, and crystillization methods for recovery of potassium salts.

IMC continued to expand and improve facilities and to set new records in the output and sales of potash. The company extracted the 75-millionth ton of potash ores from its mine. Further accomplishments included the increased ore-hoisting

facilities to 15,000 tons per day and continued replacement of standard mining equipment with low-height equipment; minor equipment and process changes were made in the refinery and chemical plant to improve efficiency as well as increase production of potassium sulfate and refined potassium chloride; several major changes in the finished product-storage area were made to facilitate direct loading, storage of additional products, and improved quality control. A highlight of the year was a newly perfected process for growing potassium sulfate crystals. The new process accelerates crystal growth developing larger crystals which provide a cleaner more acceptable product. The potassium sulfate is a product of a chemical reaction between potassium chloride and sulfate of potash magnesia—made from two ores, sylvite and langbeinite. The refinery used both flotation and crystallization processes in recovering potassium salts.

Kermac Potash Co. placed its new multimillion-dollar potash mine and crystallization refinery on stream during the fourth quarter of 1965. At daily peak output, 6,500 tons of crude potash ore was to be mined. Only one of the six crystallizers had production. With all five units on stream—one on standby—1,500 tons of potassium salts were to be turned out daily. Maximum output was expected by early 1966. A premium-grade muriate (potassium chloride) concentrate was to be the major potassium salt recovered.

The plant had storage for 138,000 tons of potassium salts and modern loadout equipment to facilitate prompt delivery. The mine was the first in the State to use 4,160-volt electrical current underground. Construction at surface facilities was hampered by a 1-week labor strike.

National Potash Co., following completion of the company new Eddy mine (yearend 1964) in Eddy County, reached near-capacity output of sylvite ore at the mine. Output supplemented other ore purchased under contract to meet recovery needs at its Lea refinery in Lea County and was transported by rail.

Production of potash ore and sales of potassium salts by PCA set new records; in its company annual report, PCA stated that potash reserves were estimated to be sufficient to maintain the current rate of production for 14 years. The company continued to improve its low-bed continuous mining machines and placed two new units in service. No decision had been reached by the U.S. district court with respect to a plan under which Standard Oil Co. (New Jersey) would acquire all the assets of PCA for a transfer of capital stock of Standard Oil Co.

Southwest Potash Corp. completed a multimillion-dollar project begun in 1964; the project expanded output of the mine and refinery and enlarged capacity for producing granular muriate for shipment. Company production of crude potash contracted to National Potash Co. was processed at its refinery. Potassium salts were recovered principally by flotation. Southwest Potash Corp. continued to be the principal producer of potassium salts in the basin. At the close of the year it was announced that the activities of Southwest Potash Corp. and Amax Petroleum Corp. would come under the jurisdiction of Amax Chemical & Petroleum Division, a division recently formed by American Metal Climax, Inc.

United States Borax & Chemical Corp. continued operational improvements at its potash mine and refinery. The pillar-extraction method designed and used by the company was proceeding with good pillar recovery. A milestone was reached by the company when in January the 50-millionth ton of potash ore was hoisted from the mine.

The Agency for International Development announced shipments by IMC and Duval of potassium salts to South Korea, South Viet-Nam, and Brazil.

Petroleum, natural gas, and natural gas products comprised 31 percent of the total mineral value. Small value decreases in natural gas ($66,000) and natural gasoline ($23,000) were greatly offset by the significant increases in liquid petroleum gases ($339,000) and petroleum ($3.1 million).

Exploratory drilling continued to decline; only 28 wells were drilled in 1965 compared with 65 in the previous year. Five gas discoveries were made. Development drilling also declined, in spite of development of the Indian Hills gasfield.

Southern Union Gas Co. completed its gathering system in the Indian Hills field; Marathon Oil Co. had almost completed its natural gas liquids plant for processing gas from the field.

Indications of sulfur in the Yeso formation about 18 miles west of Carlsbad were discovered during exploration for oil and gas. The indications were further explored by a "tight" drill hole.

Crude salt, a byproduct from refining potassium salts, was obtained from tailings at potash refineries. Salt output handled by the seven operators increased slightly in total value and quantity. Of the seven operators, New Mexico Salt Co. and The Salt Supply Co. were the principal processors and suppliers of the crude product. Salt sales, in rank of quantity sold, were to livestock-feed mixers, highway and street departments, and water-softener establishments, and feed dealers. Salt brine was sold only by Pioneer Salt Co.; the firm was completing its new crude salt plant for production in 1966.

Sand and gravel was produced by two commercial operators for building and paving projects. Slightly increased output of crushed limestone was supplied by three commercial operators for highway construction.

Grant.—Important gains occurred in 10 of the 11 mineral commodities produced. Uranium ore was not produced. Copper output, representing 83 percent of the value of all mineral production in the county, was 56 percent of the total value of all metals produced in the State. Copper output gained 25 percent in value compared with 1964. Production of copper and other metals was significant in the county, being ranked fourth in total mineral output of the State, and in placing the State fourth in output of copper in the Nation.

Most of the copper, molybdenum, and gold, and part of the silver came from ore produced from the Chino open-pit copper mine near Santa Rita, operated by Chino Mines Division. Molybdenum, gold, and silver were recovered as byproducts from the copper ore. Except for a short labor strike by the AT&SF trainmen in September, work proceeded as scheduled, directed toward the 25-percent increase in production set for 1966. As in recent previous years, production of copper ores attained a new high. In its annual report the company stated that Chino Mines expansion of precipitate-copper production to 50,000 tons per year, or approximately 50 percent of the division's planned copper output, originally scheduled for 1965, was delayed until early 1966. The company also reported that 7.9 million tons of ore was mined, compared with 7 million tons in 1964; the average grade of ore milled was 20.8 pounds of copper per ton, compared with 19.6 pounds per ton in 1964; the total copper production from all sources at Chino was 90,943 tons, compared with 81,372 tons in 1964. Precipitating facilities for the recovery of copper from waste dumps was expanded because of the lower content of copper in the solutions. Important multimillion-dollar improvements and expansions either recently completed or in progress included equipment and new facilities at the precipitating plant; the installation of a new rotary kiln to dry copper concentrate and precipitate copper, thereby providing an increase in reverberatory-smelting capacity; the addition of supplementary facilities to assure more water flow at the leach dumps; the addition of three 85-ton-capacity trucks at the pit; and the removal of houses at Santa Rita to permit the onset of mining operations in 1966.

At its new Continental mine near Fierro, USSR&M Co. continued its multimillion-dollar new mine development and construction projects, started in 1964. Three shafts were sunk: Shaft No. 2 (two-compartment service shaft) and Shaft No. 4 (a circular vertical ventilation shaft) reached the planned depths of 1,272 feet and 875 feet, respectively; and Shaft No. 3 (four-compartment vertical production shaft) was below the 1,242-foot depth of the planned 1,500-foot objective. Crosscuts from the bottom of both of the completed shafts toward the main production shaft were in progress. Mine development proved good values in zinc and copper. Construction of surface-plant installations at the No. 3 Shaft site were in progress, to be completed in 1966. Design of the copper-zinc flotation mill was completed; the contractor, Stearns-Roger Corp., was proceeding with mill-construction details; construction was scheduled to begin in early 1966, with production planned to commence mid-1967. The construction of the access road to the plant and grading of the railroad spur to the mill site, near the No. 3 Shaft, was nearly completed.

The total quantity of copper produced from the Continental mine of USSR&M Co. by lessee L. A. Patten Associates, who

worked a small part of the mine, placed the mine as the second largest source of copper in both the county and the State. In its annual report the company stated that about 70,000 tons of 2-percent copper ore was produced by the lessee, about the same output as in 1964; all, including zinc ore from the Princess mine, was milled at the company-owned Bayard flotation mill at Vanadium. The mill operated at full capacity on ores from company mines, which increased from about 103,000 tons in 1964 to about 142,600 tons in 1965. The copper and zinc concentrates were shipped to the Asarco smelter at El Paso, Tex., and to the National Zinc Co. smelter at Bartlesville, Okla., respectively

The New Jersey Zinc Co. Hanover mine and the Oswaldo mine leased by the company from Kennecott Copper Corp., contributed importantly to the total production of zinc. The Hanover was ranked as the principal zinc-producing mine in the State; the Oswaldo was placed third in order of output. Other ores concentrated at the Hanover mill included production of the company Linchburg and Kelly mines, Socorro County. The New Jersey Zinc Co. and Gulf & Western Industries, Inc., approved a merger in September, for the approval of the shareholders; The New Jersey Zinc Co. was to become the subsidiary company of Gulf & Western.

The second principal zinc-producing mine in the county and the State was the Princess mine of USSR&M Co. which was operated by Frank M. Van Cleave, contractor. As reported in the company annual report, it yielded about 72,500 tons of zinc ore compared with about 32,600 tons in 1964. In addition to zinc output, the mine was ranked third in production of silver. The contractor also developed sufficient ore to maintain reserves.

The Kearney mine, owned and operated by American Zinc, Lead and Smelting Co., yielded 19,433 tons of mostly zinc-contained concentrate, compared with 19,238 tons in 1964, as reported in the company annual report. With this production, the mine was ranked fourth in zinc and fifth in silver in the State. All output, including other ores, was shipped for treatment to the company mill near Deming, Luna County. The mine was further developed and explored by drilling, drifting, and raising.

Activity at the Star shaft mine of the Ground Hog unit of Asarco near Vanadium, reactivated in November 1964, led to an output of contained lead-zinc ore which placed the mine as the principal producer of lead, second largest in silver, and fifth in zinc in the county and in the State. A labor strike, begun on July 16, stopped all operations at the mine.

At yearend 1964, John H. Trigg Co. acquired the Copper Mountain claim group near Tyrone from United States Lime and Mining Corp. and the Morgan and Ohio claim group from Copper Leaching Co. By yearend 1965, John H. Trigg Co. prepared a heap-leach operation, constructed a new four-cell cement copper plant, and began output at the Morgan and Ohio operation. The company commenced constructing an identical plant at the Copper Mountain operation. In addition, at 12 operations copper was recovered by precipitation from the water of Santa Rita Creek below the Chino open-pit copper mine. The Denver mine, operated by Gene Galassini, produced a small tonnage of lead ore.

Exploration drilling in the Bayard area by Kerr-McGee Corp. encountered some copper mineralization.

Ferruginous manganese ore was mined from open pits and shipped to CF&I, Pueblo, Colo.

Nonmetal production contributed $988,462 of the total mineral value, a 36-percent gain. Sand and gravel produced at six operations was used mostly in highway construction by crews and contractors of the State highway commission. The output of crushed limestone quarried and used by Chino Mines increased 32 percent. The product was used in making lime and as a smelter flux.

Elgin Block Co. produced some sand and gravel for resale and made a lightweight aggregate concrete block for decorative building needs. Mathis & Mathis mined and crushed white limestone for use as roofing chips and decorative material. Reese Mining and Manufacturing Co. ceased operations at its open-pit clay mine and brick plant near Silver City to reorganize the company for anticipated production.

Harding.—A total of 833.8 million cubic feet of carbon dioxide gas was produced by Carbonic Chemical Corp., Schwartz Carbonic Co., and R. W. Adams. The

county supplied all of the gas in the State. The product was used as a liquid refrigerant, and in food processing, fog seeding, missile firing, and firefighting.

In February, Edmunds Chemical Co., Inc., merged with Carbonic Chemical Corp.; Carbonic will be the parent company with Edmunds operating as a wholly owned subsidiary.

Hidalgo.—The value of copper was 79 percent of the total value of metals recovered. Banner Mining Co., at its Bonney-Miser's Chest mines was the third largest copper and gold producer and the fourth largest silver producer in the State. According to the company annual report, the mines yielded 66,201 tons of ore, a decrease of 181 tons. Metal content of the 4,906 tons of concentrate recovered from the ore milled was 2,253.3 ounces of gold, 35,010 ounces of silver and 2.2 million pounds of copper.

Exploration and development work included 4,653 feet of drifting and crosscutting, 5,089 feet of diamond drilling, 888 feet of rotary-drill reaming and 485 feet of longhole drilling. For ventilation at the north workings of the Bonney mine, the company completed the drill hole, reamed to 36 inches in diameter. Development work opened an ore shoot along the Oro vein on the 1,500-foot level of the Bonney mine; additional development was to be done for full evaluation of the deposit.

Diversified Mines, Inc., following rehabilitation of the "85" mine of Phelps Dodge Corp. in 1964, produced a copper-content byproduct gold-silver ore for flux used at the El Paso smelter. Although capacity production was not reached, the "85" mine was the second largest in gold production, the fourth largest in copper production, and the seventh largest in silver production in the State.

In addition to the Bonney-Miser's Chest and "85" mines, which contributed the major portion of the mineral value of the county, three other metal mines were operated: the Don Still Crystal mine and Ruth dump; and the Frecor Copper Co., Ltd., Happy Promise No. 1 mine. Phelps Dodge Corp. continued to mine fire clay from its Pratt mine.

Nearly all of the output of sand and gravel, 356,000 tons, was produced by crews and contractors of the State highway commission, 136,000 tons below that of 1964. The quantity of crushed stone (limestone) increased from 3,601 to 113,794 tons; the principal producer was J. W. Jones Construction Co., a contractor for the county highway department.

Lea.—The county again dominated the State in value of mineral output; value of petroleum and natural gas produced in Lea County comprised 63 percent of such production in the State.

Although development drilling declined 31 percent, exploratory drilling increased slightly. Of the 72 wildcat wells, 29 (40 percent) were successful.

The Ranger Lake unit of Phillips Petroleum Co. had 16 producing wells and 8 injection wells at yearend and yielded 145,959 barrels of oil and 181.8 million cubic feet of gas during the year.

National Potash Co. operated its Lea mine at maximum production. Sylvite ore produced at the company new Eddy shaft mine in Eddy County was moved by railroad to the company Lea refinery. All ore was blended with the Lea mine ore before being processed at the Lea flotation refinery.

Sand and gravel was produced by Lea County Concrete Co. and contractors of the State highway commission. The quantity of sand and gravel, used for building and road construction, increased substantially. Crushed stone was produced principally by the State and county highway departments for highway construction. The quantity and value of stone used decreased slightly.

Lincoln. — E. A. Johnson produced a small quantity of silver ore from the Old Red Fox mine. Contractors quarried limestone for the State highway commission for road construction. Sand and gravel output contributed the bulk of the total mineral value.

Luna.—The value of mineral production increased substantially. Most of the total value of output came from nonmetals. Some silver, lead, and zinc was recovered from ore shipped by Lane & Nunez and from test work conducted by International Resources, Inc., on the Mahoney mine tailings dump. Fire clay for use at ceramic plants was mined by Mathis & Mathis at the Lucretia mine. Of the three sand and gravel producers, a contractor and crews for the State highway commission produced 74 percent of the total used. All

of the sand and gravel output was processed; most of it was used on Interstate 10. Smith Sand and Gravel was the principal commercial operator. Wylie Bros., a contractor for the State highway commission, produced crushed limestone used for highway construction. Eddie Lindburg was the principal collector and supplier of gem stones .

McKinley.—The county was ranked first in uranium mining and processing output and fifth in the State in total value of all minerals produced. Although the output value of molybdenum, petroleum, and vanadium increased, that of coal, sand and gravel, and uranium ore decreased; thus there was an overall 3-percent decrease in county mineral value.

Of the 41 operations from which 1.7 million tons of uranium ore was shipped —85 percent of the State total quantity— the major operators were Homestake-Sapin Partners, Kerr-McGee Corp., and United Nuclear Corp. Although uranium production increased by 15,059 tons, the total value decreased $330,286. A stretchout purchase agreement was signed between AEC and United Nuclear Corp. for deliveries of uranium concentrate through December 31, 1970. At all operations, production rates were aligned with the lower requirements for uranium, as specified in AEC contracts. All output of uranium ore was processed at mills owned by Kerr-McGee Corp.; by VCA, San Juan County; and by The Anaconda Company and Homestake-Sapin Partners, both in Valencia County; the United Nuclear Corp. mill continued on standby.

On May 28, Kerr-McGee Corp. shipped the 1,000th lot of yellowcake; each lot consisted of 36,000 pounds of uranium oxide concentrate.

Vanadium in some of the uranium ores was concentrated in a vanadium-rich solution which was shipped to other processing plants for recovery.

Coal output from one underground and two strip mines was 13 percent less than that of 1964. It was produced from the Window Rock underground mine of Window Rock Coal Mine—formerly Navajo Tribal Enterprises; McKinley strip mine of The Pittsburg & Midway Coal Mining Co.; and the Sundance strip mine of Sundance Coal Co. Most of the coal was crushed and processed; all was sold in the open market; all of the quantity produced at the McKinley mine was shipped by railroad to supply the thermoelectric powerplant of Arizona Public Service Co. at Joseph City, Ariz.

Sand and gravel was produced by two commercial operators and by crews and contractors working for the Federal Bureau of Indian Affairs and the State highway commission. The quantity of sand and gravel declined from 1 million to 731,000 tons; of the total, 330,000 tons was used for Federal road construction and 128,000 tons for State highway projects.

Increased drilling in the county was about equally divided between exploratory and development wells. Ten of the development wells were successful. Only one wildcat found oil, a small Gallup sand (Cretaceous) discovery that initially pumped 24 barrels of oil per day.

Clay for rotary-exploration drilling was produced by U.S. Mining Corp.

Rio Arriba.—Petroleum and other related mineral fuels comprised 95 percent of the total mineral value. Of the mineral fuels, liquefied petroleum gases and natural gas output increased and natural gasoline and petroleum decreased. The county was one of two in the State that produced scrap mica.

Crude oil production decreased 11 percent. Total drilling declined 31 percent: the number of exploratory wells dropped from 6 in 1964 to 1 in 1965; development wells from 112 to 81. Of the 81 development wells, 75 were productive.

Scrap mica was mined by C. A. Morris & Co., Inc., at the Cribbenville mines; Mineral Industrial commodities of America, Inc. (M.I.C.A., Inc.), at the Joseph mine; and John W. Moran at the Globe group and the Blowout mines. C. A. Morris & Co., Inc., and M.I.C.A., Inc., processed crude mica at company plants in Taos and Santa Fe Counties, respectively. Pumice mined by General Pumice Corp. from its Cullum mine was used by building-block manufacturers and for making cleansing and scouring compounds and hand soap; some pumice was sold to a grinding plant at Santa Fe.

A more than threefold increase occurred in the quantity and value of sand and gravel used for road construction by commercial operators and by crews and con-

tractors for the Federal Forest Service and the State highway commission. Crews and contractors working for the State used 438,000 tons of the total 689,000 tons of sand and gravel consumed. Contractors for the Federal Bureau of Reclamation produced 75 percent of the total stone output for riprap and road building; limestone was produced by a contractor for the State highway commission and miscellaneous stone was quarried by a contractor for the Federal Bureau of Public Roads. From its Tip Top quarry, Petaca Mining Corp. mined sandstone for roofing granules.

Giant drilling "moles" were used to bore water-diversion tunnels at the San Juan-Chama project and at the Navajo Indian Irrigation project in the northern part of the county.

Roosevelt.—Mineral fuels contributed all but $11,000 of the total $8.4 million output. All mineral fuels except natural gasoline gained in value; the value of sand and gravel declined from $193,000 to $11,000.

Largely because of development of the Chaveroo field in the southwestern part of T 7 S, R 33 E, crude oil production in the county increased 10 percent. Development drilling was up 24 wells (40 percent increase) and exploratory drilling increased 44 percent.

Sandoval. — White Mesa Gypsum Co. continued to mine crude gypsum from its San Ysidro mine for delivery by truck to the American Gypsum Co. plant near Albuquerque. Duke City Gravel Products Co. produced gypsum for Ideal Cement Co. Pumice quarried at the Big Chief mine by Big Chief Mining Co. was hauled to Albuquerque for making building blocks.

The value of sand and gravel decreased $129,000. Of the total output, mostly used for paving, contractors produced 63,000 tons for the U.S. Army Corps of Engineers, and crews produced 16,000 tons for the State highway commission; two commercial operators supplied 163,000 tons.

The county had the largest decrease in petroleum and natural gas production: crude oil output was down 17 percent; gas production was down nearly 34 percent.

San Juan.—The county was ranked second in the State in natural gas and third in crude oil production. Output of crude oil increased 21 percent to 9,984,098 barrels. Drilling, however, was considerably less than in 1964: Overall drilling declined 22 percent; exploratory drilling was down 40 percent; and development drilling declined 19 percent. The success ratio for exploratory wells was 7 percent, compared with 15 percent in 1964.

Helium from natural gas was extracted by the Federal Bureau of Mines at its Shiprock helium plant.

In its annual report, Utah Construction & Mining Co. cited an increase in production of coal from the Navajo strip mine for the Four Corners generating plant of Arizona Public Service Co. near Farmington. The 2.5-million-ton fuel requirement for the 575-megawatt generating units was supplied by Utah under a 35-year fuel agreement. Construction was to begin in 1966 on a new 1.5-million-kilowatt powerplant to be owned by members of WEST Associates. Utah was to supply from its Navajo coal mine the 6 million tons needed at the new plant. At the Hogback No. 13 underground mine of the Hogback Coal Co. continued to mine coal for local use.

Uranium ore produced at four operations—a decrease of two operations—was less than that mined in 1964. AEC and VCA signed a uranium purchase-stretchout agreement on November 26 to replace an interim agreement under which the company had been operating. VCA recovered byproduct vanadium that occurred with uranium ores at its Navajo mill at Shiprock and extracted vanadium from vanadium-rich solutions from other uranium mills. The company acquired all the Colorado uranium-vanadium properties and equipment of Dulaney Mining Co.; all output was to be processed at the Navajo mill.

Eight operations yielded 425,000 tons of sand and gravel—a 73,000-ton increase—used in building construction and road and paving projects. Most of the sand and gravel, produced by the four commercial operators, by crews and contractors for the State highway commission, and by crews of the San Juan County Highway Department, was supplied for highway construction. A small quantity of sandstone was used for riprapping.

San Miguel.—Value of total mineral output increased almost twofold. Three commercial operators produced 468,000 tons of

sand and gravel, and contractors and crews for the State highway commission furnished 357,000 tons. Except for a small quantity of sand and gravel used for building, the output was for paving and highway construction. New Mexico Granite produced dressed dimension stone; crushed and broken limestone and sandstone also were produced.

Santa Fe.—Production value of minerals declined 18 percent.

Most of the sand and gravel was produced by four commercial operators: Santa Fe Sand & Gravel Products was the principal producer. Crews of the State highway commission and the Santa Fe Board of City Commissioners produced 59,000 tons of the total 359,000 tons used.

Adjacent to its Rosario wallboard plant, Kaiser Gypsum Co. mined crude gypsum. Copar Pumice Co., Inc., the major producer, continued to mine pumice; its crushing and screening plant was near Espanola. Crego Block Co., Inc., mined and used scoria in manufacturing building blocks. James H. Rhodes & Co. operated its Santa Fe grinding plant, using crude pumice mined by General Pumice Corp. in Rio Arriba County.

At the company Pojoaque mica mill, scrap mica mined by M.I.C.A., Inc., in Rio Arriba County, was processed with ore purchased from other producers; the product was used in paints and building materials.

A placer operation in the Ortiz Mining Grant yielded a small quantity of gold and silver, recovered from the black sands associated with the gravels.

Sierra.—Sand and gravel output registered a 91-percent increase over that of 1964. Of the total sand and gravel production, 214,000 tons was produced and processed for highway paving projects by two contractors for the State highway commission. Some gold and silver was produced at the Bigelow mine and the Wicks placer, both in the Las Animas mining district; in addition, some copper also was recovered from the gold-silver ore of the Bigelow mine.

Anommco, Inc., acquired the placer deposits of M. & W. Mining Co. and further developed the properties for processing at the new jig plant being built by the company, which was expected to start shipments in 1966. Although no tin was sold, some tin concentrate was recovered from test work done on placer deposits and trial operations of the plant.

Socorro.—Output of the metals group represented 67 percent of the mineral value and registered an increase of $61,046, with lead and zinc accounting for a total gain of $68,366; the output value of manganese ore increased; however, the value of gold, silver, copper, and iron ore decreased slightly. Base-metal ores were mined at five mines in and near the Magdalena mining district.

L. A. Goret & Valente Aguilar of Socorro continued to operate the Black Canyon manganese mine (the only manganese-producing mine in the State) and mill near Socorro. All ore was stockpiled prior to shipment.

Dotson Minerals Corp. produced and shipped graded magnetite ore from the Jones Iron mine, principally for use as an additive in cement manufacturing.

A. B. Baca Mining & Milling continued to be the only supplier of crushed barite in the State. It was produced at the Elaine mine near Socorro and used mostly in drilling muds.

Sand and gravel output, a decrease of 16 percent, was produced principally by crews and contractors for the Federal Forest Service and by contractors for the State highway commission. Most of the sand and gravel was used for highway paving on Interstate 25. Skousen, Isbell & Johnson, a joint venture, was the leading commercial producer of sand and gravel.

Taos.—Perlite from the No Agua area operations of Great Lakes Carbon Corp., Johns-Manville Perlite Corp., and United Perlite Corp. supplied most of the mineral production in Taos County. It was quarried at open-pit mines near each plant, and was crushed, dried, and screened prior to delivery to railroad loading facilities outside the State.

Scrap mica mined at company mines in Rio Arriba County was processed by C. A. Morris & Co., Inc., at its mica mill near Ojo Caliente. Great Western Mining Co. also mined scrap mica at the To-Jo Nos. 1, 2, and 3 mines.

Silver ore was mined at the Copper Hill mine by New Mexico Metals Corp.

Sand and gravel production by four commercial producers and at two Govern-

ment-and-contractor operations increased the total output value by 28 percent. Of the total output of 221,000 tons, 123,000 tons was supplied for the Federal Bureau of Public Roads, 37,000 tons for the State highway commission, 58,000 tons for building construction, and the remainder for miscellaneous uses.

Molycorp, following intensive developments begun in late 1962 and involving multimillion-dollar expenditures, was nearing completion of its new 10,000-ton-per-day molybdenum concentrator scheduled to go on stream in early 1966. Western Contracting Corp. had completed preliminary stripping at the new open-pit mine, and Western-Knapp Engineering Co. was finishing construction at the mill. The mine was developed to use 40-foot-high benches and an overall stripping ratio of 2.5 to 1. It was equipped with three 10-yard-capacity shovels and twelve 100-ton-capacity Lectra-haul trucks. Blastholes were drilled with two 9-inch- diameter electric drills. The mill was designed to use three stages of crushing. Primary grinding was to be done by four 11-foot-6-inch by 14-foot ball mills each in closed circuits with four 20-inch cyclones. The cyclone material was to flow to a bank of 108 flotation cells. Regrinding was to be done in Hardinge discharge tube mills, each of which was ceramic lined and used ceramic balls. The concentrate was to be recleaned in 26 flotation cells which were to recover a final concentrate of 90 percent molybdenum disulfide. After being dried, the concentrate was to be packed in 8,000-pound containers (Tote Bins) and trucked to Alamosa, Colo., for rail shipment to Washington, Pa. Tailings were to be pumped through two 10-inch-diameter pipelines to an earth-fill dam 9½ miles from the millsite.

Power was to be provided by four engine-generator units having a total capacity of 15,000 kilowatts.

Molycorp was affected by labor strikes on August 16 to 17 (1 day) and from August 26 to September 3 (8 days).

Union.—An increase of over 100 percent in mineral production was caused by gains in the output of sand and gravel, stone, and scoria. Scoria was mined by Patterson Mining Co. at the Red Rock mine and by Twin Mountain Rock Co. at the Twin Mountain mine.

Valencia.—The value of mineral production increased 6 percent.

The county continued to rank second in the State in the production of uranium ore. The Anaconda Company shipped uranium ore from the Jackpile-Paguate Unit open-pit mines, Rare Metals Corp. from the Section 30 mine, United Nuclear Corp. from the San Mateo mine, and Mesa Mining Co. from the Mesa No. 1 mine. Mills of The Anaconda Company and of Homestake-Sapin Partners processed uranium ores. A stretchout purchase agreement between AEC and Homestake-Sapin Partners for deliveries of uranium concentrate through December 31, 1970, was signed June 23.

Ultra Marbles, Inc., quarried marbleized travertine at its Desert Gold, Mescarlero, and Temple Creme quarries; the stone was finished and sold for use as decorative and building slab marble, and also as a rough dimension marble.

A small quantity of copper ore was shipped by M. Mirabal.

One commercial operator, a contractor for the Federal Forest Service, and a contractor and crews of the State highway commission produced 211,000 tons of sand and gravel.

All of the sand and gravel produced for the Federal and State agencies was used for paving; commercial products were used for building construction.

United States Gypsum Co. operated its Grants perlite mine and crushing-screening plant; the product was shipped to company-owned expanding plants outside the State.

The Mineral Industry of New York

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the New York State Museum and Science Service for collecting information on all minerals except fuels.

By Stanley A. Feitler [1]

Table 1.—Mineral production in New York [1]

Mineral	1964 Quantity	1964 Value (thousands)	1965 Quantity	1965 Value (thousands)
Clays ---thousand short tons--	1,499	$1,993	1,354	$1,717
Emery ---short tons--	9,214	172	10,720	204
Gem stones	NA	10	NA	10
Gypsum ---thousand short tons--	653	3,321	662	3,511
Lead (recoverable content of ores, etc.) ---short tons--	732	192	601	188
Natural gas ---million cubic feet--	r 3,108	963	3,340	1,029
Peat ---short tons--	32,574	261	25,098	232
Petroleum (crude) ---thousand 42-gallon barrels--	1,874	8,321	1,632	7,246
Salt ---thousand short tons--	4,816	34,216	5,002	35,771
Sand and gravel ---do---	39,282	38,583	39,225	40,370
Silver (recoverable content of ores, etc.) thousand troy ounces--	13	17	11	15
Stone ---thousand short tons--	29,141	46,669	30,801	48,675
Zinc (recoverable content of ores, etc.) ---short tons--	60,754	16,525	69,880	20,405
Value of items that cannot be disclosed: Abrasive garnet, cement, iron ore, lime, talc, titanium concentrate, and wollastonite	XX	137,202	XX	130,684
Total	XX	288,445	XX	290,057

r Revised. NA Not available. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Value of mineral production in constant 1957–59 dollars

(Millions)

Year	Value
1956	$236
1957	246
1958	207
1959	236
1960	257
1961	236
1962	239
1963	258
1964	r 284
1965	284

r Revised.

Although the value of New York's mineral production increased in 1965, the gain was less than 1 percent—significantly below those achieved during the 3 preceding years. A 13-percent drop in the average value of portland cement and the decreased production of iron ore were largely responsible for the small overall increase during a year of general prosperity. The largest growths in dollar value were recorded for zinc, stone, sand and gravel, and salt. Value losses of more than $1 million were reported for portland cement, iron ore, and petroleum.

Trends and Developments.—Construction was started on Niagara Mohawk Power Corp.'s nuclear power plant at Nine Mile Point, 6 miles east of Oswego. The plant,

[1] Mining engineer, Bureau of Mines, Pittsburgh, Pa.

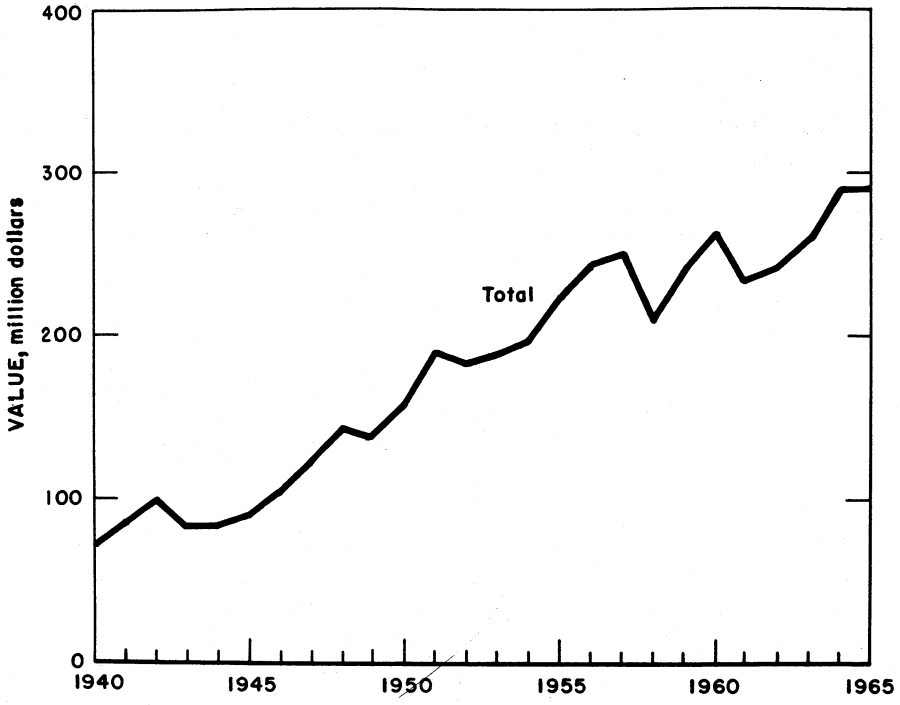

Figure 1.—Total value of mineral production in New York.

Table 3.—Employment and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1964:								
Peat	28	179	5	36	---	2	55.78	84
Metal	1,709	272	464	3,709	---	46	12.40	1,190
Nonmetal	2,464	258	636	5,217	1	141	27.22	2,146
Sand and gravel	2,553	195	497	4,021	2	78	19.89	3,593
Stone	4,073	240	977	7,938	2	88	11.34	1,858
Total	10,827	238	2,579	20,921	5	355	17.21	2,142
1965: p								
Peat	19	158	3	23	---	---	----	----
Metal	1,730	264	457	3,660	1	59	16.39	4,127
Nonmetal	2,455	250	614	5,036	---	157	31.18	1,340
Sand and gravel	1,995	195	388	3,141	3	61	20.38	6,666
Stone	3,710	253	937	7,630	---	91	11.93	1,262
Total	9,909	242	2,399	19,490	4	368	19.09	2,690

p Preliminary.

which will generate 500,000 kilowatts, is scheduled for completion late in 1968.

Pfaudler Co., Division of Pfaudler Permutit, Inc., completed construction of expanded facilities for metals and ceramic research near Rochester.

A cooperative program was instituted to reduce pollution of Lake Erie. The program, involving five States and the Federal Government, is intended to control discharge of untreated sewage and industrial wastes into the lake.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Cement.—Shipments of all types of cement increased 8 percent in quantity but decreased 5 percent in value, compared with those of 1964. Portland, masonry, and natural cements were produced. Portland cement accounted for 96 percent of the total value, but the average price declined $0.39 to $2.69 per barrel. This resulted in a lower value for portland cement shipped, although the quantity shipped increased. Shipments of masonry and natural cement increased 1 percent in tonnage and value. Utilization of portland cement plant capacity was 77 percent in eastern New York and 52 percent in western New York. Cement production was reported from 13 plants, 9 of which produced portland and masonry cements. Three plants produced portland cement exclusively, and one plant produced masonry and natural cement. Leading the State in value of cement shipments was Albany County, followed by Ulster, Columbia, and Greene Counties. Other cement-producing counties were Erie, Schoharie, Warren, and Onondaga.

The principal raw materials for manufacturing portland cement were cement rock and limestone, of which a total of 7.9 million tons was used. In addition, the following quantities of other raw material were consumed: Clay and shale, 310,000 tons; gypsum, 219,000 tons; sand and slag, 69,000 tons; and iron materials, 38,000 tons. Air-entraining compounds, grinding aids, fly ash, calcium chloride, and bauxite also were used. The cement industry consumed 691 million kilowatt-hours of electrical energy of which 97 percent was purchased and 3 percent was generated by recovering heat from stack gases.

Forty-two percent of the portland cement shipments was consumed within the State. Shipments of more than 1 million barrels each were made to Connecticut, Florida, Massachusetts, and New Jersey; shipments of more than 100,000 barrels also were made to consumers in 11 other States. Exports were less than 20,000 barrels. Shipments of portland cement by type of customer were as follows: Ready-mixed concrete companies, 67 percent; concrete product manufacturers, 11 percent; highway and other contractors, 11 percent; building material dealers, 8 percent; and miscellaneous customers including Federal, State, and local government agencies, 3 percent. Bulk shipments accounted for 92 percent of the total, and deliveries were by truck, 68 percent; railroad, 20 percent; and waterway, 12 percent.

Wet process plants accounted for 76 percent of the total capacity. Yearend stocks of portland cement were 20 percent lower than those of 1964.

Construction reached an advanced stage at Marquette Cement Manufacturing Co.'s Catskill (Greene County) 3.3-million-barrel-per-year cement plant. Completion of the work was scheduled for January 1, 1966. New silos were added to increase storage capacity to about 600,000 barrels of cement. Alpha Portland Cement Co.'s 3 million-barrel-per-year Catskill plant completed its first full year of operation. Rochester Portland Cement Co., a subsidiary of Lake Ontario Cement Co., Ltd., of Toronto, Ontario, optioned a site near Stoney Point on Lake Ontario, for a proposed cement manufacturing plant. The company also announced plans for a cement distribution center near Ithaca.

Clays.—Reduced demand for clay and shale by makers of brick, lightweight aggregates, and cement resulted in a 10-percent decrease in the quantity produced as compared with that of 1964. Although comparatively minor, the quantity produced for pottery and other uses was slightly higher than in 1964. The 11-percent decrease experienced by the brick and lightweight aggregate manufacturers was attributed to reduced activity in residential and non-residential construction. The quantity of clay and shale mined for cement decreased 6 percent largely because of inventory adjustments. Albany slip clay was used principally as a binder for artificial abrasive wheels and shapes and in art pottery. Production was reported by 24 companies, who prepared or used the material in 26 plants in 12 counties. The chief centers of clay production were in eastern and southeastern New York (Albany, Columbia, Orange, Schoharie, and Ulster Counties) and western New York (Erie County).

Emery.—Production of emery from three open pit mines in Westchester County increased 16 percent in quantity and 19 per-

cent in value as the average value increased 2 percent to $18.99 per ton. The output was used as aggregate for heavy-duty nonslip floors and pavements and for abrasive purposes. One mine in the Peekskill area was not operated as the lease on the property was not renewed.

Garnet.—Production and value of garnet were greater than those of 1964. Garnet from Warren County was precisely ground and sized for use in coated abrasives, grinding and polishing glass, and metal lapping. Byproduct garnet recovered in treating wollastonite ore in Essex County was used for sandblasting, wire sawing, and coated abrasives.

Gem Stones.—Except for the garnet produced commercially in Warren County, gem stones and mineral specimens were recovered from many localities, principally by amateur collectors.

Graphite (Manufactured).—Baked carbon, manufactured from petroleum coke, was converted to graphite by Speer Carbon Co., Division of Air Reduction Co., Inc., Carbon Products Division of Union Carbide Corp., Graphite Products Division of The Carborundum Co., and Graphite Products Division of Great Lakes Carbon Corp. in the Niagara Falls area. Products consisted of graphite powder, shapes, cloth, and fibers.

Gypsum.—The quantity of crude gypsum produced was 1 percent greater than in 1964, but the total value was 6 percent greater because the average price per ton increased $0.21 to $5.30. Gypsum was recovered from five underground mines, three in Erie County, and one each in Genesee and Monroe Counties. Most of the crude gypsum was calcined at company-owned plants for use in manufacturing building material; some crude gypsum was used as a retarder in portland cement. Calcining was done in 23 kettles and 5 rotary kilns at 7 plants located in Bronx, Erie (2), Genesee, Monroe, Richmond, and Rockland Counties. The principal use for calcined gypsum was in the manufacture of wallboard and lath and in the formulation of various types of plaster; other uses were in manufacturing plate glass, pottery plasters, industrial molding, and art and casting plasters.

Table 4.—Crude gypsum production

(Thousand short tons and thousand dollars)

Year	Active mines	Quantity	Value
1956–60 (average)	5	902	$4,205
1961	5	663	3,441
1962	5	601	3,122
1963	5	647	3,339
1964	5	653	3,321
1965	5	662	3,511

Lime.—Output of lime increased in quantity and value compared with that of 1964. Quicklime, which accounted for 91 percent of the total quantity of lime produced, was captive production for chemical uses. Hydrated lime was used for chemical processing (82 percent) and for construction (18 percent). Paper plants in Niagara and Essex Counties regenerated lime for use in paper manufacture.

Nitrogen Compounds.—E. I. du Pont de Nemours & Co. Inc. and Olin Mathieson Chemical Corp. made fertilizers, explosives, and other chemical products from atmospheric nitrogen recovered in plants at Niagara Falls.

Perlite.—Quantity, value, and average value per ton were lower than those of 1964. Crude perlite mined in Colorado and Nevada was expanded at five plants—three in Erie County and one each in Bronx and Genesee Counties. The principal use for expanded perlite was in acoustical building plaster; smaller quantities were used for soil conditioning, ultralightweight concrete aggregate, low temperature insulation, and filter aid.

Salt.—New York ranked third in value and fourth in tonnage among the salt-producing States. Rock salt, accounting for more than half the total tonnage, was used principally for highway ice control and in the manufacture of chemicals. Evaporated salt was used in manufacturing chemicals and a wide variety of industrial and food processes as well as seasoning. Most of the salt in brine was used for the manufacture of soda ash and other chemicals. Rock salt was mined in Livingston and Tompkins Counties, and salt was produced from wells in Onondaga, Schuyler, and Wyoming Counties.

Sand and Gravel.—The quantity of sand and gravel produced was about the same as that in 1964, because increased Government-and-contractor output offset the 6-

Table 5.—Salt sold or used by producers

(Thousand short tons and thousand dollars)

Year	Quantity	Value
1956–60 (average)	3,896	$29,575
1961	4,149	30,761
1962	4,456	32,236
1963	4,782	34,228
1964	4,816	34,216
1965	5,002	35,771

percent decrease in commercial production. Even though the tonnage of commercial sand and gravel decreased 6 percent, the value increased 1 percent because the average value was $1.16 per ton, $0.08 per ton higher than in 1964. Total tonnage of industrial sand for molding, engine, and filtration was only slightly greater than in 1964, but the average value increased $0.20 per ton to $3.70. Output by Government-and-contractor operations consisted chiefly of paving and fill material used for road construction, maintenance, and repair.

Commercially produced material was transported to consumers by truck, 73 percent; waterway, 26 percent; and railroad, 1 percent. Bank-run (unprocessed) sand and gravel amounted to 14 percent of the total output. Commercial production was reported from 305 operations of which 2 produced more than 1 million tons, 4 produced from 500,000 to 1 million tons, and 30 produced from 200,000 to 500,000 tons. Sand and gravel production was reported

Table 6.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1964		1965	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	8,820	$ 9,947	8,418	$10,073
Paving	4,886	5,003	4,644	5,004
Fill	859	383	649	356
Molding and ground	W	W	187	762
Engine	24	42	23	34
Filtration	W	W	9	15
Other	1,467	928	644	561
Undistributed	190	707	------	------
Total	16,246	17,010	14,574	16,805
Gravel:				
Building	4,237	5,982	4,512	6,507
Paving	3,649	4,111	3,476	4,239
Fill	1,811	1,027	1,920	1,175
Undistributed [1]	668	662	582	446
Total	10,365	11,782	10,490	12,367
Total sand and gravel	26,611	28,792	25,064	29,172
Government-and-contractor operations: [2]				
Sand:				
Building	78	135	92	138
Paving	579	394	618	433
Fill	2,459	1,025	2,851	1,177
Other	439	181	502	243
Total	3,555	1,735	4,063	1,991
Gravel:				
Building	3	2	------	------
Paving	5,312	5,637	5,672	6,373
Fill	3,801	2,417	4,390	2,816
Other	------	------	36	18
Total	9,116	8,056	10,098	9,207
Total sand and gravel	12,671	9,791	14,161	11,198
All operations:				
Sand	19,801	18,745	18,637	18,796
Gravel	19,481	19,838	20,588	21,574
Grand total	39,282	38,583	39,225	40,370

W Withheld to avoid disclosing individual company confidential data, included with "Undistributed."

[1] Includes railroad ballast and other gravel.

[2] Includes data for State, counties, municipalities, and other government agencies.

Table 7.—Sand and gravel production by Government-and-contractor operations, by counties
(Thousand short tons)

County	1964	1965	County	1964	1965
Broome	-----	13	Oneida	175	94
Cattaraugus	14	22	Onondaga	84	36
Cayuga	50	15	Ontario	16	86
Chautauqua	155	W	Orange	176	104
Chemung	25	16	Orleans	10	16
Chenango	-----	64	Oswego	81	62
Clinton	6	20	Otsego	62	54
Columbia	16	16	Rensselaer	59	-----
Delaware	8	21	St. Lawrence	246	163
Dutchess	48	88	Saratoga	111	82
Essex	3	3	Schenectady	15	-----
Franklin	32	W	Schuyler	38	48
Genesee	31	35	Steuben	116	116
Herkimer	48	W	Suffolk	47	50
Jefferson	45	140	Sullivan	-----	W
Lewis	12	24	Washington	-----	W
Livingston	-----	8	Wayne	140	117
Monroe	-----	2	Undistributed [1]	10,766	12,643
Montgomery	34	3			
Niagara	2	-----	Total	12,671	14,161

W Withheld to avoid disclosing individual company confidential data, included with "Undistributed."
[1] Includes data unspecified by counties and data indicated by symbol W.

Table 8.—Crushed and broken limestone sold or used by producers by uses
(Thousand short tons and thousand dollars)

Use	1964		1965	
	Quantity	Value	Quantity	Value
Riprap	75	$129	87	$175
Concrete aggregate and roadstone	15,344	26,622	17,026	29,514
Agricultural	338	1,224	379	1,353
Railroad ballast	477	815	557	910
Cement	7,290	6,021	7,299	5,994
Miscellaneous uses, including fluxing stone and lime	2,302	3,054	2,177	3,008
Total	25,826	37,865	27,525	40,954

from 51 of the State's 62 counties; more than 1 million tons each was reported from Suffolk, Nassau, Erie, and Monroe Counties in decreasing order of tonnage.

Stone.—Both tonnage and value of stone production were greater than in 1964, and stone continued to be the second most valuable mineral commodity produced in the State. Counties producing stone valued at more than $2.5 million during 1965 were Dutchess, Rockland, Onondaga, Erie, Ulster, Albany, and Monroe, in decreasing order of value. Production was reported from 39 counties in the State, but the 7 leading counties accounted for 57 percent of the total value.

Limestone was the predominant type in the State, accounting for 89 percent of the tonnage and 84 percent of the value of all stone produced. Limestone was mined in 31 counties of which 10 reported output exceeding 1 million tons each. Most of the limestone was crushed for use as concrete aggregate, roadstone, cement, and lime. Other uses included agstone (agricultural stone), railroad ballast, asphalt filler, riprap, fluxing stone, and whiting. A small quantity of dimension limestone was produced in Onondaga County.

Production of basalt (traprock), the State's second ranking stone, decreased in quantity and value as compared with that of 1964. Virtually all of the basalt was used for concrete aggregate and roadstone. Deliveries were 53 percent by waterway and 47 percent by truck.

Sandstone was quarried and marketed as dimension stone as well as crushed stone and continued to rank third in tonnage and value in the State. Output decreased 2 percent in tonnage and 5 percent in value as compared with that of 1964. Crushed sandstone was used for concrete aggregate, roadstone, and riprap; dimension sandstone was used principally for curbing and flagging, architectural uses, rough construction, and rubble.

Slate was mined and prepared for use as flagging, roofing, and structural stone in Washington County. Output was about the same as in 1964, but the value was lower. Miscellaneous stone was mined and crushed in Clinton and Rensselaer Counties for use as concrete aggregate, roadstone, and other purposes. Marble was mined in Dutchess, St. Lawrence, and Westchester Counties for use as a mineral filler, agstone, abrasive, and decorative aggregate.

Granite quarried and dressed in Essex and Westchester Counties was used for building stone. Crushed granite from Warren and Westchester Counties was used principally for concrete aggregate and roadstone.

Talc.—Talc shipments decreased 4 percent in quantity and 5 percent in value, but New York continued to be the leading talc-producing State. Two companies mined talc from three underground mines and one opencut mine in St. Lawrence County. The crude talc was ground in company-owned mills and marketed principally for use in ceramics. Ground talc also was sold for use as a lubricant and mineral pulp filler in paint and various other products.

Vermiculite.—Crude vermiculite mined in other States was exfoliated at a plant in Cayuga County. The expanded material was used for loose fill insulation, agriculture, ultralightweight concrete aggregate, and building plaster aggregate.

Wollastonite.—Wollastonite for use as a filler in paints and plastics and as an ingredient in ceramic products was mined and beneficiated in Essex County.

METALS

Aluminum.—Production of primary aluminum from the Massena plants of Aluminum Company of America and Reynolds Metal Co. increased 6 percent in quantity and 9 percent in value compared with that of 1964. New York continued to have 9 percent of U.S. primary aluminum capacity and ranked third in quantity and fourth in value among aluminum-producing States.

Iron Ore.—Magnetite was recovered from underground mines in Essex and Clinton Counties and from open pit operations in Essex and St. Lawrence Counties. The quantity of crude ore produced was 3 percent less than in 1964, but shipments of usable iron ore decreased 5 percent. Open pit operations supplied 82 percent of the crude ore. All of the ore was beneficiated and most of the concentrate was agglomerated. Shipments were principally for use in the manufacture of pig iron and steel, but quantities were also used for cement, dead-burned dolomite, heavy media, and ballast.

Iron and Steel.—According to the American Iron and Steel Institute steel production increased 17 percent over that of 1964 and totaled 7.1 million tons. Open-hearth and basic oxygen production represented 98 percent of the total; the remainder was electric furnace output. Production of pig iron was 6.1 million tons, 19 percent greater than in 1964. Shipments consisting principally of basic and malleable grades totaled 6.1 million tons, valued at $349 million. Yearend stocks at blast furnaces were lower than at the end of 1964. Pig iron was made at 3 plants in Erie County and 1 each in Niagara and Rensselaer Counties utilizing 13 blast furnaces.

Some of the iron ore used in the manufacture of pig iron was imported from Canada and Chile, but most was of domestic origin; receipts were greater than those of 1964. Other materials consumed in blast furnaces included limestone and dolomite, mill cinder and roll scale, coke, manganiferous ore, and scrap iron and steel.

Installation of continuous casting facilities was completed at the Cortland, N.Y., plant of Wickwire Bros. Inc. Construction of a new bar and rod mill at Crucible Steel Co.'s Syracuse plant was near completion at yearend.

Lead.—Output of lead from the Balmat mine in St. Lawrence County decreased 18 percent, but the total value was only 2 percent below that of 1964. The ore was mined underground and beneficiated by flotation. Concentrate was treated at the company's lead smelter at Herculaneum, Mo. Electric Auto-Lite Battery Corp. made black lead oxide at its Niagara Falls plant. National Lead Co. converted lead to red lead and litharge at its Brooklyn plant.

Silver.—Silver was recovered as a byproduct of zinc-lead ore from the Balmat mine in St. Lawrence County. The quantity recovered was lower than that of 1964. Silver

Table 9.—Mine production of silver, lead, and zinc, in terms of recoverable metals

Year	Mines producing	Material sold or treated (short tons)	Silver		Lead		Zinc		Total value (thousands)
			Troy ounces	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	
1956–60 (average)	2	604,339	63,138	$57	1,022	$282	57,322	$13,826	$14,165
1961	2	592,438	40,507	37	879	181	54,763	12,595	12,813
1962	3	596,452	19,451	21	1,063	196	53,654	12,340	12,557
1963	3	594,245	19,544	25	1,009	218	53,495	12,304	12,547
1964	2	683,494	13,306	17	732	192	60,754	16,525	16,734
1965	2	788,961	11,441	15	601	188	69,880	20,405	[1]20,607

[1] Data do not add to total due to rounding.

Table 10.—Mine production of silver, lead, and zinc, in 1965, by months, in terms of recoverable metals

Month	Silver (troy ounces)	Lead (short tons)	Zinc (short tons)
January	1,086	60	5,581
February	1,003	55	5,051
March	1,466	72	6,147
April	1,429	78	5,846
May	1,406	71	5,985
June	988	50	6,048
July	703	38	5,958
August	620	33	6,346
September	687	37	5,904
October	567	28	5,957
November	558	32	5,668
December	928	47	5,389
Total	11,441	601	69,880

recovery reflected the demand for silver-free lead rather than the silver content of the concentrate.

Titanium Concentrate (Ilmenite).—Ilmenite concentrate was recovered as a coproduct of magnetite from an opencut titaniferous-magnetite deposit near Tahawus, Essex County. Shipments and value were 2 percent lower than those of 1964. The output was used principally in the manufacture of titanium dioxide pigment.

Zinc.—Production of zinc increased substantially and New York continued to rank second in the Nation. The Balmat and Edwards mines in St. Lawrence County were the only producers of zinc in the State. Construction of expanded facilities, completed about midyear, at the Edwards mine was largely responsible for increased production. The principal items contributing to the expanded capacity were deepening a shaft and installing a new hoist and a new flotation circuit at the mill to take care of the increased mine production.

Zirconium.—Carborundum Metals Climax, Inc., Akron, produced zirconium ingot from sponge. Zirconium alloys was produced by Union Carbide Corp., Metals Division, at Niagara Falls. Zircon and zirconia (zirconium dioxide) refractories were made by Harbison-Carborundum Corp., Falconer, National Lead Co., Niagara Falls, and Corhart Refactories Co., Corning.

MINERAL FUELS

Natural Gas.—Quantity and value of natural gas production increased 9 percent to 3.6 billion cubic feet, according to the Geological Survey—New York State Museum and Science Service. Marketed production of natural gas, according to estimates of the Federal Bureau of Mines, increased 7.5 percent to 3.3 billion cubic feet. Estimated crude recoverable reserves of natural gas at yearend, according to the American Gas Association, Inc., were 135.7 billion cubic feet, 2.2 billion greater than at the end of 1964. Three wildcat gas wells and 32 dry holes were drilled in 1965, 24 fewer than in 1964. One new storage well was drilled in Cattaraugus County by Iroquois Gas Corp., and total underground storage capacity was estimated to be 103.4 billion cubic feet at yearend. Natural gas was stored in eight counties by five companies. Underground storage capacity for liquid petroleum gas was 1.2 million barrels. The LP gas was stored in salt beds in Steuben, Cortland, and Schuyler Counties.

Peat.—The quantity and value of peat sold were lower than those of 1964, but the average value per ton increased $1.21 to $9.23. This continued to be below the national average which was $10.07 per ton in 1965. The peat was used mainly for general soil improvement, but some was used for packing flowers, plants, etc. Production was reported from Cattaraugus, Orange, Seneca, and Westchester Counties, and 63 percent

Table 11.—Marketed production of natural gas
(Million cubic feet and thousand dollars)

Year	Quantity	Value	Average value (cents per thousand cubic feet)
1956–60 (average)	3,536	$1,053	$29.8
1961	5,742	1,694	29.5
1962	4,262	1,198	28.1
1963	3,962	1,169	29.5
1964	r3,108	963	31.0
1965	3,340	1,029	30.8

r Revised.

was shipped in bulk. Active operations involved 130 acres containing indicated reserves of 1.1 million tons.

Petroleum.—Production of crude oil decreased 13 percent compared with that of 1964. Wells in the Allegany field in Allegany and Steuben Counties yielded 45 percent of the total; the remainder of the production was from the Cattaraugus field in Cattaraugus County. Average prices for crude oil at the wellhead were $4.48 per barrel in the Cattaraugus oilfield and $4.40 per barrel in the Allegany field. Proved reserves of crude oil were 11,931,000 barrels at yearend, according to estimates of the American Petroleum Institute. Exploration for oil and gas by geophysical methods was conducted in western and central New York counties as far east as Madison County.

Table 12.—Petroleum production
(Thousand 42-gallon barrels and thousand dollars)

Year	Quantity	Value	Average value per barrel
1956–60 (average)	2,194	$9,795	$4.46
1961	1,658	7,892	4.76
1962	1,589	7,309	4.60
1963	1,679	7,707	4.59
1964	1,874	8,321	4.44
1965	1,632	7,246	4.44

Frontier Oil Refining Corp., Division of Ashland Oil and Refining Co., operated a refinery at Tonawanda having a daily crude capacity of 30,000 barrels, a cracking capacity of 12,000 barrels, and a reforming capacity of 8,000 barrels. Mobil Oil Co. operated a petroleum refinery in Brooklyn with a crude oil capacity of 27,300 barrels per day and a cracking capacity of 15,205 barrels per day. Mobil also operated a plant at Buffalo with a daily crude capacity of 35,700 barrels, a cracking capacity of 13,300 barrels, and a catalytic reforming capacity of 8,900 barrels per day.

Table 13.—Well completions and drilling footage for field wells and wildcats in 1965

Type of well	Field wells[1]		Wildcats[1]		Total	
	Well completions	Drilling footage	Well completions	Drilling footage	Well completions	Drilling footage
Crude	375	327,900	------	------	375	327,900
Gas	15	24,735	3	9,529	18	34,264
Dry	7	12,177	32	97,257	39	109,434
Service	162	169,740	------	------	162	169,740
Total	559	534,552	35	106,786	594	641,338

[1] Oil and Gas Journal. V. 64, No. 5, Jan. 31, 1966.

REVIEW BY COUNTIES

Sand and gravel produced by Government-and-contractor operations is shown in table 7 and is not included under the individual county reports that follow.

Albany.—Based on value of minerals produced, Albany County ranked second in the State. Atlantic Cement Co., Inc., Ravena, manufactured portland cement. The principal raw material was limestone which the company mined at a nearby quarry. Much of the output was delivered by ship to company-owned distribution centers along the Atlantic Coast.

The Callanan Road Improvement Co. quarried limestone at South Bethlehem for use as concrete aggregate, roadstone, railroad ballast, metallurgical flux, agricultural stone (agstone), and riprap. Bluestone was

Table 14.—Value of mineral production in New York, by counties [1,2]

County	1964	1965	Minerals produced in 1965 in order of value
Albany	$25,865,350	$22,071,114	Cement, stone, clays, sand and gravel.
Allegany	406,000	W	Sand and gravel.
Broome	1,298,029	1,294,001	Sand and gravel, stone, clays.
Cattaraugus	1,041,000	735,000	Sand and gravel, peat.
Cayuga	686,000	868,859	Stone, sand and gravel.
Chautauqua	150,000	96,000	Sand and gravel.
Chemung	W	W	Do.
Chenango	195,000	304,000	Do.
Clinton	W	W	Iron ore, stone, sand and gravel.
Columbia	W	W	Cement, stone, clays, sand and gravel.
Cortland	W	W	Sand and gravel.
Delaware	1,256,461	1,239,743	Stone, sand and gravel.
Dutchess	W	W	Stone, sand and gravel, clays.
Erie	14,931,499	15,212,084	Cement, stone, sand and gravel, gypsum, clays.
Essex	W	W	Iron ore, ilmenite, wollastonite, sand and gravel, peat, stone.
Franklin	145,462	184,224	Sand and gravel, stone.
Fulton	269,000	242,000	Sand and gravel.
Genesee	2,862,498	3,110,967	Stone, gypsum, sand and gravel.
Greene	12,260,447	14,496,706	Cement, stone, clays.
Hamilton	W	----------	
Herkimer	W	W	Stone, sand and gravel.
Jefferson	914,756	1,050,483	Do.
Lewis	W	W	Do.
Livingston	W	W	Salt, sand and gravel, stone.
Madison	712,691	699,381	Stone, sand and gravel.
Monroe	4,179,825	4,672,163	Stone, sand and gravel, gypsum.
Montgomery	864,000	653,800	Stone, sand and gravel.
Nassau	W	4,239,200	Sand and gravel, clays.
Niagara	3,757,379	W	Lime, stone.
Oneida	2,339,750	2,436,266	Stone, sand and gravel.
Onondaga	18,148,305	17,840,928	Lime, salt, stone, cement, sand and gravel, clays.
Ontario	1,219,000	1,152,200	Sand and gravel, stone.
Orange	1,768,055	1,508,350	Sand and gravel, clays, stone, peat.
Orleans	W	203,000	Sand and gravel.
Oswego	327,000	538,000	Do.
Otsego	202,459	226,367	Stone, sand and gravel.
Putnam	W	W	Sand and gravel.
Rensselaer	1,289,023	1,138,240	Sand and gravel, stone.
Rockland	W	W	Stone, sand and gravel.
St. Lawrence	39,788,203	42,364,191	Zinc, iron ore, talc, stone, sand and gravel, lead, silver.
Saratoga	1,148,453	1,112,131	Stone, sand and gravel.
Schenectady	244,000	369,000	Sand and gravel, clays.
Schoharie	W	W	Cement, stone, clays, sand and gravel.
Schuyler	W	W	Salt, sand and gravel.
Seneca	340,284	364,476	Stone, peat.
Steuben	W	682,000	Sand and gravel.
Suffolk	5,844,000	5,220,000	Do.
Sullivan	W	W	Stone, sand and gravel.
Tioga	327,000	493,000	Sand and gravel.
Tompkins	W	W	Salt, stone, sand and gravel.
Ulster	17,866,790	18,100,327	Cement, stone, clays, sand and gravel.
Warren	W	W	Cement, garnet, stone, sand and gravel.
Washington	840,987	981,753	Stone, sand and gravel.
Wayne	319,300	513,089	Do.
Westchester	930,278	923,573	Stone, sand and gravel, emery, peat.
Wyoming	W	W	Salt, stone.
Undistributed [3]	123,706,225	122,720,048	
Total	288,445,000	290,057,000	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] Bronx, Kings, New York, Queens, Richmond, and Yates Counties are not listed because no production was reported.

[2] Natural gas and petroleum not listed by counties; value included with "Undistributed."

[3] Includes natural gas and petroleum, gem stones, sand and gravel that cannot be assigned to specific counties, and values indicated by symbol W.

quarried and dressed for architectural purposes at East Berne by Heldeberg Bluestone, Inc.

Building brick was manufactured at Coeymans by Powell & Minnock Brick Works, Inc., from miscellaneous clay produced at the company's S. & S. pit and from shale mined at Coeymans Hollow. Northern Lightweight Aggregate, Inc., mined shale near Cohoes for use in manufacturing lightweight aggregate. At Albany, Industrial Mineral Products, Inc., mined

and dried slip clay for use in making pottery, stoneware, and as a bonding material for abrasive wheels and shapes. Whitehead Brothers Co. produced molding sand from its pit at Slingerlands. Sand and gravel was recovered by J. H. Maloy, Inc., at Albany and Albany Gravel Co., Inc., at Cedar Hill.

Allegany.—Alfred Atlas Gravel & Sand Corp. produced sand and gravel for building, paving, and highway ice control at Alfred. The Buffalo Slag Co., Inc., Alfred Station, and Thomas Moogan, Friendship, produced sand and gravel principally for construction.

Bronx.—National Gypsum Co. calcined crude gypsum and expanded perlite at its Bronx plant. The calcined gypsum and expanded perlite were used in manufacturing building products at the Bronx and other National Gypsum Co. plants.

Broome.—Sand and gravel was produced at Binghamton by Weber's Sand & Gravel and Binghamton Sand & Crushed Stone Corp., and at Vestal by Barney & Dickenson, Inc., Winne & Son, Inc., and Bob Murphy, Inc. Crushed sandstone for use as concrete aggregate, roadstone, and riprap was mined by Corbisello quarries at Binghamton and by Arborio & Arborio at Windsor. Dimension sandstone (bluestone) was produced in finishing plants of Paul Tompkins Estate at Hancock and W. R. Strong & Son at Deposit. Binghamton Brick Co., Inc., mined shale near Binghamton for use in the manufacture of building brick.

Cattaraugus.—E. F. Lippert & Co., The Buffalo Slag Co., Inc., and William J. Lippert & Son produced sand and gravel near Allegany for paving, building, and fill. Sand and gravel also was produced from pits at Franklinville, Onoville, Red House, and Gowanda. Humus peat recovered from bogs near Ischua by Sue Peat Co. was sold both in bulk and packaged form.

Cayuga.—General Crushed Stone Co. mined and crushed limestone for concrete aggregate, roadstone, and bituminous concrete at its Auburn quarry. J. J. Harrington produced sand and gravel at Auburn for building, paving, railroad ballast, and fill. Sand and gravel also was produced at Sennett by John W. Dougherty, Inc., and at Auburn by Jay W. Robinson & Son. Zonolite Division, W. R. Grace & Co., produced exfoliated vermiculite from crude material mined in other States.

Chautauqua.—Sand and gravel was produced from pits near Stow and Bemus Point for use principally in building, paving, and highway ice control.

Chemung.—Elmira Transit Mix, Inc., produced sand and gravel for building and paving at Horseheads. Sand and gravel also was recovered from operations at Big Flats, Elmira, and Breesport.

Chenango.—The Bundy Concrete Co., Sherburne, and B & B Builders Supplies, Inc., Greene, produced sand and gravel which was used principally for building and paving.

Clinton.—Republic Steel Corp. mined iron ore (magnetite) at its underground Chateaugay mine near Lyon Mountain. Mill concentrates were sintered at the company's agglomeration plant prior to shipment for use in the manufacture of pig iron and steel. Plattsburgh Quarries, Inc., Plattsburgh, quarried limestone for concrete aggregate and roadstone. Part of the output was sold for use as an additive in the iron ore sintering process. The Chazy Quarry of International Lime & Stone Corp. was idle, but shipments of limestone were made from stockpiles. Gneiss (mine waste) was sold for concrete aggregate, roadstone, and stone sand by Republic Steel Corp.

Columbia.—Cement production was lower than that of 1964, but continued to be the most valuable commodity produced in the county. Lone Star Cement Corp., Greenport, and Universal Atlas Cement Division, United States Steel Corp., Hudson, manufactured portland and masonry cement. Both companies produced limestone from nearby quarries to supply the kilns and the latter mined shale at its own quarry to supply alumina. A. Colarusso & Son, Inc., Greenport, mined limestone for use as concrete aggregate, roadstone, and agstone. Sand for building, paving, fill, and highway ice control was produced by F. H. Stickles & Son at Livingston.

Cortland.—Cortland Ready Mix, Inc., and Aggregate Materials Corp. produced sand and gravel from pits near Cortland for building, paving, fill, and other purposes.

Delaware.—Bluestone quarries accounted for most of the value of mineral production in the county. Bluestone was processed

for flagging, architectural work, rough and dressed building stone, and rubble by Willis Hankins and Paul Tompkins Estate, Hancock; American Blue Stone Co., Masonville; W. R. Strong & Son, Deposit; and Johnston & Rhodes Bluestone Co., East Branch. Cooney Bros., Inc., produced crushed sandstone for use as concrete aggregate and roadstone from a quarry near Hancock.

Dutchess.—Limestone was the principal mineral commodity produced in the county. New York Trap Rock of Delaware, Inc., a Division of Lone Star Cement Corp., Wappingers Falls, and Dutchess Quarry & Supply Co., Inc., Pleasant Valley, produced limestone for concrete aggregate, roadstone, and riprap. New York Limestone Corp. produced marble from the Wingdale Quarry, formerly operated by White Marble Corp., to produce floor tile filler, road asphalt filler, and agstone. Ten commercial sand and gravel operators reported production of 688,000 tons. The sand and gravel was used principally for building construction, paving, and fill. Miscellaneous clay and shale were produced near Beacon for the manufacture of building brick by Beacon Brick Corp. A site containing sand and gravel was purchased by Colonial Sand & Stone Co., Inc., and a processing plant was under construction.

Erie.—Penn-Dixie Cement Corp. and Lehigh Portland Cement Co. shipped portland and masonry cement from their Buffalo plants. Most of the output was sold to ready-mixed concrete companies, the remainder was shipped to contractors, building material dealers, and manufacturers of concrete products. Shipments of cement were less than those of 1964. Crushed limestone was produced from two quarries at Lancaster and one each at Akron and Cheektowaga. Most of the output was used for concrete aggregate, roadstone, and railroad ballast. Smaller quantities were used for agricultural purposes, asphalt filler, and riprap.

Sand and gravel production reported by nine commercial producers amounted to 1.7 million tons. The output was used principally for building, paving, fill, and highway ice control. Among the principal producers were Clarence Sand & Gravel Corp., Clarence; Pine Hill Concrete Mix Corp., Lancaster; and Dan Gernatt Gravel Products, Inc., Collins.

National Gypsum Co. and Bestwall Gypsum Division of Georgia-Pacific Corp. produced calcined gypsum from crude ore extracted from mines near Clarence Center. Crude gypsum for use as a retarder in cement was mined in the same district by Universal Atlas Cement Division, United States Steel Corp. The Bestwall operation received a citation from the National Safety Competition for having had no disabling injuries during 1965. Clay and shale were mined for the manufacture of cement by Penn-Dixie Cement Corp., but only shale was mined by Hamburg Shale Co., Inc. Acme Shale Brick Co., Inc., and Empire Clay Products, Inc., mined shale for use in the manufacture of building brick at Lake View and West Falls, respectively. Anchor Concrete Products, Inc., produced lightweight aggregate from shale mined near its Jewettville plant. Boston Valley Pottery Co. made flowerpots from clay mined near Hamburg.

Perlite was expanded by Buffalo Perlite Corp. at its Buffalo plant, for use as aggregate in ultra-lightweight concrete, loose fill insulation, soil conditioning, low-temperature insulation, building plaster, and filter aid. National Gypsum Co., Clarence Center, and Bestwall Gypsum Division of Georgia-Pacific Corp., Akron, expanded perlite for use in building plaster. Crude perlite, used by the three expanders, was mined in Western States. A 600-ton-per-day lime plant was under construction at Lackawanna by Bethlehem Steel Corp. Three 200-ton-per-day kilns will supply lime for basic oxygen steelmaking.

Essex.—Republic Steel Corp. produced magnetite from its underground Old Bed-Harmony mine near Mineville. Ore was beneficiated at the company's No. 7 concentrator and sintered before shipment. National Lead Co., Titanium Division, recovered ilmenite and magnetite from titaniferous magnetite ore at its MacIntyre open-cut mine at Tahawus. The ore was processed by heavy-medium separation, flotation, magnetic separation, and sintering. Ilmenite was used mostly in the manufacture of titanium dioxide pigments. Magnetite was used for pig iron, steel, cement, and as a heavy medium for mineral separation.

Cabot Minerals Division, Cabot Corp. mined wollastonite underground at its mine near Willsboro. The wollastonite was

finely ground for use in the manufacture of ceramics, paint, plastics, and certain building products. Byproduct garnet was sold for sandblasting, coated abrasives, wire sawing, and other uses. Cabot Corp.'s operation received a Joseph A. Holmes award from the Federal Bureau of Mines for having completed 1.2 million man-hours without experiencing a fatality or a permanent disability. The record was achieved during a 12-year period. Adirondack Development Corp. also mined wollastonite at its Lewis open pit near Willsboro. The material was processed and used for experimental purposes.

Sand and gravel, used chiefly for building, paving, and fill, was produced at two operations near Saranac Lake and two operations near Keesville. International Paper Co. regenerated lime for use in the manufacture of paper at its Ticonderoga mill. Rough granite blocks were quarried at Jay by Lake Placid Granite Co., Division of Cold Springs Granite Co. The blocks were shipped to Cold Springs Granite Co. plant at Saint Cloud, Minn., for fabrication.

Franklin.—Adirondack Stone Quarries, Inc., sawed and split sandstone for architectural applications and for flagging. Louis Paro and Malone Concrete Products Co., Inc., produced sand and gravel from pits near Malone.

Fulton.—Seven commercial operators produced 241,000 tons of sand and gravel for building, paving, fill, and ice control. Three of the operations were near Gloversville; the others were at Broadalbin, Ephrata, Johnstown, and Northville.

Genesee.—Crude gypsum mined underground was calcined by U.S. Gypsum Co. at its Oakfield plant. Production of crushed limestone was greater than that of 1964. Limestone quarries at LeRoy were operated by General Crushed Stone Co. and LeRoy Lime & Crushed Stone Corp. Genesee Stone Products Corp. mined limestone at its Stafford quarry. Crushed limestone produced in the county was used for construction, riprap, and railroad ballast. Sand and gravel was produced by Batavia Washed Sand and Gravel Co., Inc., and B. R. DeWitt, Inc. Gravel pits at Alexander were operated by Western N.Y. Concrete Corp. and Frey Sand & Gravel Corp.

Greene.—Portland and masonry cement were manufactured by Lehigh Portland Cement Co. and Marquette Cement Manufacturing Co. at Alsen and by Alpha Portland Cement Co. at Catskill. Limestone, the principal cement raw material, was mined at nearby quarries by each company. Marquette also mined clay for its own use. Crushed limestone was produced at Windham by Tri-County Stone Co., Inc., and at Catskill by Catskill Mt. Stone Corp. The stone was used for concrete aggregate, roadstone, and a small quantity for riprap. Whitehead Brothers Co. recovered molding sand at Coxsackie.

Herkimer.—The General Crushed Stone Co., Jordanville, mined limestone for use in construction and for agricultural purposes. At Middleville, Eastern Rock Products, Inc., produced crushed limestone for concrete aggregate and roadstone. Sand and gravel was produced by Material Sand & Gravel Co., Inc., at Gravesville, and sand was produced by Nash Sand Co., at Poland.

Jefferson.—Limestone for concrete aggregate, roadstone, and agstone was quarried and crushed at Watertown by General Crushed Stone Co. The highway department of the Town of Cape Vincent produced crushed limestone for concrete aggregate and roadstone. Multi-Color Sandstone Co. quarried and processed dimension sandstone for architectural use; part of the output was used for rubble and flagging. Sand and gravel was produced from three pits at Watertown and one each at Adams, Alexandria Bay, Antwerp, and Belleville.

Lewis.—Carbola Chemical Co., Inc., a subsidiary of International Talc Co., Inc., produced limestone from an underground mine at Diana. The stone was crushed and finely ground for use as a filler in paint, calcimine, rubber, putty, paper, and pottery. E. G. Delia & Son Construction Corp. produced limestone for concrete aggregate and roadstone at its Boonville quarry. The town of Lowville produced limestone for highway maintenance and construction.

Livingston.—International Salt Co. produced rock salt from its Retsof underground mine. Over half the output was consumed in New York; most of the remainder was shipped to New England and Middle Atlantic States. The salt was used

for chemical purposes, ice removal, and a wide variety of industrial applications. Sand and gravel was produced by Valley Sand & Gravel Corp. from pits at Wadsworth and Canawaugus. Chester L. McMaster, Dansville, and Cole Sand & Gravel Corp., Caledonia, also produced sand and gravel. Crushed limestone mined at Honeoye Falls by General Crushed Stone Co., was used for concrete aggregate and roadstone.

Madison.—Output of limestone, the principal mineral product in the county, totaled 418,000 tons. The crushed stone was used mainly for concrete aggregate and roadstone, but quantities also were used for agstone and riprap. The stone was recovered from quarries at Clockville, Munnsville, and Perryville. Cossitt Concrete Products, Inc., Earlville, produced sand and gravel for building, paving, and fill.

Monroe.—Crushed limestone accounted for the major part of the value of the county's mineral production. Dolomite Products Co. quarried and crushed limestone at Penfield and Gates for use as concrete aggregate, roadstone, railroad ballast, and agstone. Concrete Materials, Inc., operated a limestone quarry at Sweden to produce concrete aggregate and roadstone. Production of 1.6 million tons of sand and gravel was reported from 10 operators. The material, used mainly for building, paving, and fill, was obtained principally from pits at Mendon, Penfield, Pittsford, and Spencerport. The newly constructed Mendon plant of Don C. Russo Sand & Gravel Co. was operated for its second full season. The Ruberoid Co. produced crude gypsum at Wheatland for shipment to Caledonia (Livingston County), where it was converted to finished building products. The Wheatland mine was entered in the National Safety Competition, and it again received a citation for having operated without a disabling work injury during the year.

Montgomery.—Crushed limestone was produced at Amsterdam by Crushed Rock Products, Inc., and Cushing Stone Co., Inc. The material was delivered by truck for use in concrete aggregate and for roadstone. St. Johnsville Supply Co., Inc., produced sand and gravel for building, paving, and fill from a pit at St. Johnsville.

Nassau.—Nassau County continued to rank second in production of sand and gravel, producing 4.2 million tons valued at $4.1 million. Pits were operated by Colonial Sand & Stone Co., Inc., at Hempstead and Port Washington (2 pits); Penn Industries, Inc., at Roslyn; and Pine Hollow Sand & Gravel Co., Inc., at Oyster Bay. Nassau Brick Co., Inc., produced clay for the manufacture of building brick near Farmingdale.

Niagara.—Quicklime was made by Olefins Division of Union Carbide Corp. at Niagara Falls for use in manufacturing calcium carbide. Hydrated lime was shipped for use in construction, ore beneficiation, and trade-wastes treatment. International Paper Co., North Tonawanda, regenerated lime used in paper manufacture. Crushed limestone was mined by Niagara Stone Division, McLain Industries, Inc., Niagara Falls; Frontier Stone Products, Inc., Lockport; and Royalton Stone Corp., Gasport. Most of the output was used for construction, but quantities also were used for railroad ballast, agstone, metallurgical flux, and other purposes.

Oneida.—Crushed limestone was produced at Oriskany Falls by Eastern Rock Products, Inc. Output was used mainly for construction, agstone, and riprap. The value of commercial sand and gravel production increased substantially compared with that of 1964. Sand and gravel for construction was produced at Barneveld, Boonville, Clayville, and Rome. Foundry sand was produced at Barneveld by Eastern Rock Products, Inc., and at McConnellsville by Whitehead Brothers Co. and George W Bryant Core Sands, Inc.

Onondaga.—Solvay Process Division, Allied Chemical Corp., quarried limestone at its Jamesville mine. Quicklime for chemical uses was made from part of the limestone; the remainder of the stone was sold for concrete aggregate, roadstone, railroad ballast, agstone, and other uses. Brine from salt wells operated by Solvay was used with the quicklime to make soda ash at Syracuse. Some of the brine was evaporated in vacuum pans and sold for highway ice control and other uses.

General Crushed Stone Co., Jamesville, mined and crushed limestone for use in ready-mixed concrete and as roadstone. Slabs of limestone were produced at Man-

lius by Brickyard Falls Farm and sold for rough construction use. Alpha Portland Cement Co. produced portland and masonry cement at its Jamesville plant. Most of the portland cement output was used in ready-mixed concrete. Alpha mined shale at its nearby quarry and purchased limestone, sand, gypsum, and iron ore as cement raw materials.

Sand and gravel for building, paving, and fill was produced at nine pits, three each at Syracuse and Nedrow and one each at Clay, Fayetteville, and Marcellus. The entire output, 632,000 tons, was delivered by truck. Lightweight aggregate was produced by Onondaga Lightweight Aggregate Corp. at Warners by sintering shale mined at a nearby pit. Syracuse Pottery, Inc., mined miscellaneous clay for manufacturing art pottery and flowerpots at Camillus.

Ontario.—Ten producers of sand and gravel reported production of 592,000 tons valued at $725,000. The material was used mainly for building construction and paving; minor quantities were used for fill, filtration, and highway ice control. Transportation was by truck from pits located at Clifton Springs (3), Geneva (2), Oaks Corners, Phelps, and Victor (3). Crushed limestone for concrete aggregate, roadstone, and paving was produced at Geneva by General Crushed Stone Co.

Orange.—Output of sand and gravel reported by 12 operators totaled 642,000 tons valued at $952,000. The principal uses were for building and paving, but quantities also were used for fill and highway ice control. Among the leading producers were The Windsor Building Supplies Co., Inc., New Windsor; Delaware Valley Sand & Gravel Co., Inc., Port Jervis; and A. W. Hollenbeck, Inc., Central Valley. The Jova Brick Works at Newburgh produced miscellaneous clay and shale for the manufacture of building brick. Dutchess Quarry & Supply Co., Inc., quarried and crushed limestone at Goshen for use in construction. Humus peat was recovered from bogs near Middletown and sold in bulk by Mt. Bethel Humus Co., Inc. Reed-sedge peat produced near Tuxedo by Sterling Forest Peat Co., Inc., was sold in bulk and packaged form.

Orleans.—Sand and gravel for building construction, paving, and fill was produced from pits operated by B. R. DeWitt, Inc., at Shelby, Barre, and Ridgeway; Oak Orchard Sand & Gravel Co. at Medina; and Arnold H. Picketts Sand & Gravel Pit at Albion.

Oswego.—Sand and gravel was produced mainly for building, paving, and fill at Lacona by the General Crushed Stone Co.; at Hastings by Zupan Stone, Sand & Gravel, Inc.; and at Oswego by Sea Way Sand & Gravel, Inc., and Davies Sand & Gravel Co., Inc. Molding sand was produced by the Whitehead Bros. Co. from a pit near Pulaski.

Otsego.—Barrett Division of Allied Chemical Corp., Springfield Center, produced crushed limestone for use in construction. Oneonta Blue Stone Co., Inc., produced bluestone (sandstone) as cut stone for architectural work and irregularly shaped stone and rubble for rough construction at Oneonta. Sand and gravel was produced by Seward Gravel Co. at Milford and by Unadilla Concrete Products Co. at Unadilla.

Putnam.—Leemac Sand & Stone Corp., Cold Spring, produced sand and gravel for building, paving, and miscellaneous uses. Gravel for paving was produced from a pit at Patterson by Harlem Valley Crusher Co.

Rensselaer.—Production of 637,000 tons of sand and gravel, valued at $731,000, was reported by nine commercial producers. Most of the output was used for building, paving, and fill; other uses included highway ice control and filtration. The principal producing centers were at Albany, Troy, and West Sand Lake. Fitzgerald Bros. Construction Co., Inc., produced crushed graywacke at the Campbell Mountain Quarry, Brunswick. The material was used principally for road construction.

Richmond.—U.S. Gypsum Co. calcined crude gypsum for use in manufacturing plaster building products at its New Brighton plant.

Rockland.—Rock Industries, Inc., successor to New York Trap Rock Corp., quarried and crushed limestone at Tomkins Cove and basalt at West Nyack and Haverstraw. The crushed stone was used principally for concrete aggregate and roadstone, but a quantity was sold for riprap. Rockland Materials Corp., which had purchased Suffern Stone Co. in 1964, recessed operations during construction of a new auto-

mated stone plant. Construction was scheduled to be completed in early 1966. Sand and gravel was produced by Ward Pavements, Inc., at Thiells; Mt. Ivy Sand & Gravel Co., Inc., at Congers; and by Graney Building Material Corp., at Sparkill. The output, 600,000 tons valued at $1 million, was used principally for building, paving, and fill. U.S. Gypsum Co. produced calcined gypsum at its Stony Point plant.

St. Lawrence.—St. Joseph Lead Co. produced zinc ore from the Edwards mine and zinc-lead-silver ore from the Balmat mine, both near Gouverneur. Use of newly installed, expanded facilities at the Edwards mine were principally responsible for a 40-percent increase in output compared with that of 1964. After beneficiation, zinc concentrate was shipped to the company smelter at Josephtown, Pa., for the recovery of zinc. Lead concentrate from the Balmat mine and lead residue from the Josephtown smelter were shipped to the company's smelter at Herculaneum, Mo., for the recovery of lead and silver. Room and pillar stopes were employed at both mines to recover the sulfide ores. Jones & Laughlin Steel Corp., the largest iron ore producer in the State, mined magnetite ore at the Benson open-pit mine near Star Lake. Most of the concentrate from the company's nearby mill was agglomerated by sintering before shipment. Both concentrate and sinter were used in making pig iron and steel.

Gouverneur Talc Co., Inc., recovered talc from the Balmat (talc) mine. International Talc Co., Inc., operated the Arnold open pit and the Wight and No. 3 underground talc mines near Balmat and Edwards. Most of the ore mined underground was from open stopes. Both companies operated grinding mills and produced talc for use in ceramics, paint, rubber, and floor and wall covering. Limestone quarries were operated at Norfolk by Barrett Division of Allied Chemical Corp. and at Ogdensburg by McConville, Inc. The limestone was crushed for use principally as concrete aggregate and roadstone, but quantities were also used for agstone, cement manufacture, and riprap. Crushed marble for roadstone and agstone was produced at Gouverneur by Balducci Crushed Stone Co. Commercial production of sand and gravel was reported by eight operators from pits at Brier Hill, Colton, Gouverneur, Nicholville, Norfolk, Potsdam (two pits), and Sprague ville. The material was used mainly for building, paving, and fill and was transported by truck.

Saratoga.—Glens Falls Portland Cement Co., Division of The Flintkote Co., produced limestone for its cement plant at Glens Falls (Warren County). Limestone was quarried and crushed by Pallette Stone Corp. at Saratoga Springs for use as concrete aggregate, roadstone, and agstone. Commercial sand and gravel production totaling 224,000 tons was used for building, paving, fill, and as industrial sand. Industrial sand was recovered by six operations in Clifton Park (2), Half Moon (3), and Milton Townships. Most of the sand was for molding, but one operator sold a quantity for engine sand. Saratoga National Historical Park crews produced crushed limestone to surface roads, trails, and parking areas.

Schenectady.—Commercial sand and gravel was produced from six pits located at Rotterdam (3), Schenectady, and Scotia (2). Capitol Concrete Products produced lightweight aggregate from shale mined near Scotia.

Schoharie.—Penn-Dixie Cement Corp. produced portland and masonry cement at its Howes Cave plant. The company produced limestone and shale, the principal raw materials, from nearby mines and purchased gypsum and iron ore. Crushed limestone for construction was produced by Schoharie Stone Corp., Schoharie, and Cobleskill Stone Products Division of Allied Materials Corp., Cobleskill. The latter company and Masick Soil Conservation Co. also produced 20-mesh limestone for agricultural purposes. Bank-run gravel used for fill was produced from a pit near Jefferson.

Schuyler.—Salt was produced from brine pumped from wells near Watkins Glen by International Salt Co., and Watkins Salt Co. The evaporated salt was used principally by manufacturers of chemicals, food processors, and in a variety of other industrial applications. Principal markets were in New York, Pennsylvania, and the North and Central Atlantic States. Sand and gravel was recovered by Watkins Transit Mix, Inc., from a pit near Watkins Glen.

Seneca.—Warren Brothers Roads Co. produced crushed limestone for use as con-

crete aggregate, roadstone, and riprap. Finger Lakes Peat Moss Co. produced reed-sedge peat from a bog near Junius. The peat was sold in bulk for general soil improvement and for packing flowers and plants.

Steuben.—The value of commercial sand and gravel was less than that of 1964. Material for building, paving, and fill was produced by Rhinehart Sand & Gravel, Inc., Corning; Bath Sand & Gravel Mix, Inc., Bath; Dalrymple Gravel & Construction Co., East Corning; and The Buffalo Slag Co., Inc., Cohocton.

Suffolk.—Suffolk continued to rank first among sand-and-gravel-producing counties with 5 million tons recovered at 19 operations. Half of the operations accounted for most of the tonnage; six produced from 100,000 to 500,000 tons, two produced from 500,000 to 1,000,000 tons, and one operation reported production of more than 1,000,000 tons. Most of the sand and gravel was processed before shipment; 67 percent was shipped by waterway, 32 percent by truck, and 1 percent by railroad.

Sullivan.—Sullivan Highway Products Corp., mined and crushed sandstone at Kenoza Lake and Monticello for concrete aggregate, roadstone, and stone sand. The company also produced sand and gravel at Monticello. Sand and gravel was produced by Valley Sand & Gravel Co., at Mongaup Valley and by L. Finkle & Son, Inc., at Summitville.

Tioga.—Combined production of 378,000 tons of sand and gravel was reported by Concrete Materials, Inc., and C. & C. Ready-Mix Corp., both of Owego, Herman E. Bunce Sand & Gravel, Barton, and A. O. Swanson, Waverly. The sand and gravel was used for building, paving, fill, ice control, and other purposes.

Tompkins.—Cayuga Rock Salt Co., Inc., mined rock salt by modified room and pillar and longwall methods at its mine near Myers. More than 80 percent of the output was used for highway ice control, but quantities were also used in manufacturing chemicals, processing foods, and for other industrial processes. The principal States of destination for salt shipments were New York, New Jersey, Massachusetts, Pennsylvania, and Virginia. Limestone mined at South Lansing by Cayuga Crushed Stone, Inc., was used for construction, agriculture, riprap, fluxing stone, and sanding roads. At its University quarry, Dryden, Finger Lakes Stone Co., Inc., produced irregular-shaped sandstone for construction work and sawed stone for architectural purposes. Rumsey-Ithaca Corp. and University Sand & Gravel Co., both of Ithaca, produced sand and gravel for building purposes.

Ulster.—Natural and masonry cement was produced from natural cement rock mined underground at Rosendale by Century Cement Manufacturing Co., Inc. Hudson Cement Division, Colonial Sand & Stone Co., Inc., produced portland cement at its Kingston plant. The company mined limestone from a nearby quarry and purchased gypsum and pyrite cinders for cement raw materials. The Callanan Road Improvement Co. mined limestone at its quarry near Kingston for use as concrete aggregate and roadstone. More than half the output was shipped by waterway; the remainder was shipped by truck.

Hudson Lightweight Stone Division of Colonial Sand & Stone Co., Inc., and Nytralite Aggregate, Inc., Division of Lone Star Cement Corp., both near Kingston, and Hudson Valley Lightweight Aggregate Corp., Mt. Marion, mined shale from the Esopus formation for use in the manufacture of lightweight aggregate. The Nytralite quarry operation was entered in the National Safety Competition and received a citation for having had no disabling work injuries during 1965. The Hutton Co. and Star Brick Corp. mined clay for the manufacture of building brick at pits near Kingston. Hurley Sand & Gravel Co., High Falls; Inter-County Block Corp., Marlboro; and Orange & Ulster County Shale Co., Inc., produced sand and gravel for use in construction.

Warren.—Masonry and portland cement were manufactured at the Glens Falls plant of the Glens Falls Portland Cement Co., Division of The Flintkote Co. Limestone (cement rock) quarried in Saratoga County was the principal cement raw material; sand, gypsum, and iron ore also were used. Garnet was recovered from an open pit mine and processed for use as coated abrasive, grinding and polishing glass, and lapping metal. Rough specimens and polished garnet gem from this deposit were marketed commercially. The mine was visited by many collectors and amateur

lapidarists who collected specimens. Jointa Lime Co. quarried and crushed limestone near Glens Falls. The stone was used as concrete aggregate and roadstone. Warren Aggregates, Inc., produced granite and sand and gravel at localities near Chestertown. The granite was used for concrete aggregate, roadstone, stone sand, and riprap. The sand and gravel was used for paving.

Washington.—The Tri-County Stone Co., Inc., Hudson, mined and crushed limestone for use as concrete aggregate, roadstone, and riprap. Inkatron Paving Corp. planned to produce commercial crushed stone with a portable crushing plant from a deposit near Whitehall. The plant had been moved in and the deposit opened to supply stone for a highway construction project in the area. Dimension slate was produced from quarries near Granville (5), Middle Granville (3), Hampton (2), and one quarry near East Whitehall. The slate was sawed and split for use as roofing slate, flagging, architectural facing stone, and tile. Demand for slate, though somewhat less than in 1964, continued to be good. Sand and gravel was produced for use mainly for highway ice control and repairs.

Wayne.—Dolomite Products Co., Walworth, and The General Crushed Stone Co., Sodus, quarried and crushed limestone. Most of the output was used for construction, but the latter company produced agstone. Sand and gravel produced from pits near Clyde, Red Creek, and Palmyra was used for building, paving, fill, and ice control.

Westchester.—Baratta & D'Amato and Di Rienzo Brothers, both near Yonkers, quarried granite and produced rough and dressed dimension stone for construction work and curbing. Lake Street Granite Quarry, Inc., White Plains, quarried granite and produced rough blocks for architectural work, curbing, rubble, and irregular-shaped facing stone. Marble was mined and crushed near Thornwood by Universal Marble Products Corp. The crushed marble was used for cast stone, stucco, garden nuggets, and other uses. Sand and gravel produced near Carmel by Camarco Materials & Supply Co. and near Peekskill by Peekskill Masons Supply Co. was used principally for building, paving, and fill.

DeLuca Emery Mine, DiRubbo American Emery Ore and Peekskill Emery Co. produced emery from three mines at Peekskill. The output was used for abrasive purposes and as an aggregate in heavy-duty, nonslip floors and pavements. The DeLuca No. 1 mine was closed because the lease on the mine property was not renewed. Stone Age Humus Corp. produced humus peat from a bog near Armonk.

Wyoming.—At Silver Springs, Morton Salt Co. produced evaporated salt from brine, using vacuum pans. Sales were chiefly for food processing, chemical, and industrial purposes. American Blue Stone Co., Portageville, produced rough dimension sandstone (bluestone) for use as rubble and irregular-shaped facing stone, and sawed and cut dimension sandstone for architectural work.

The Mineral Industry of North Carolina

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U. S. Department of the Interior, and the Geological Survey of North Carolina for collecting information on all minerals except fuels.

By John W. Sweeney [1] and Stephen G. Conrad [2]

Mineral production in North Carolina set a record of more than $60 million, about $5 million above that of the previous record year of 1964. Principal minerals mined were stone, sand and gravel, feldspar, mica, clays, and lithium minerals. Leading companies were Superior Stone Co., Ideal Cement Co., Nello L. Teer Co., and W. E. Graham & Sons.

North Carolina was the leading producer of sheet mica with more than 99 percent of the production, and ranked first among the States in the production of lithium minerals, producing 98 percent of the national total; feldspar, 45 percent; and scrap mica, 60 percent; second in the production of olivine, 32 percent; crushed granite, 23 percent; and third in talc, with 13 percent of the national total.

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[2] State geologist, North Carolina Department of Conservation and Development, Division of Mineral Resources, Raleigh, N. C.

Table 1.—Mineral production in North Carolina [1]

Mineral		1964		1965	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Clays [2]	thousand short tons	3,199	$2,064	3,383	$2,162
Feldspar	thousand long tons	r 281	r 2,342	279	3,153
Gem stones		NA	15	NA	15
Mica:					
Scrap	thousand short tons	64	2,027	72	1,987
Sheet	pounds	242,662	58	713,293	185
Phosphate rock	thousand long tons	6	41		
Sand and gravel	thousand short tons	11,150	10,404	10,499	10,076
Stone [3]	do	17,943	30,378	18,835	30,920
Talc and pyrophyllite	do	106	495	109	556
Value of items that cannot be disclosed: Asbestos, cement, kaolin, lithium minerals, olivine, stone (marble and slate) and tungsten concentrate 1964		XX	7,903	XX	11,329
Total		XX	r 55,727	XX	60,383

r Revised. NA Not available. XX Not applicable.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Excludes kaolin; included with "Value of items that cannot be disclosed."
[3] Excludes certain stone; included with "Value of items that cannot be disclosed."

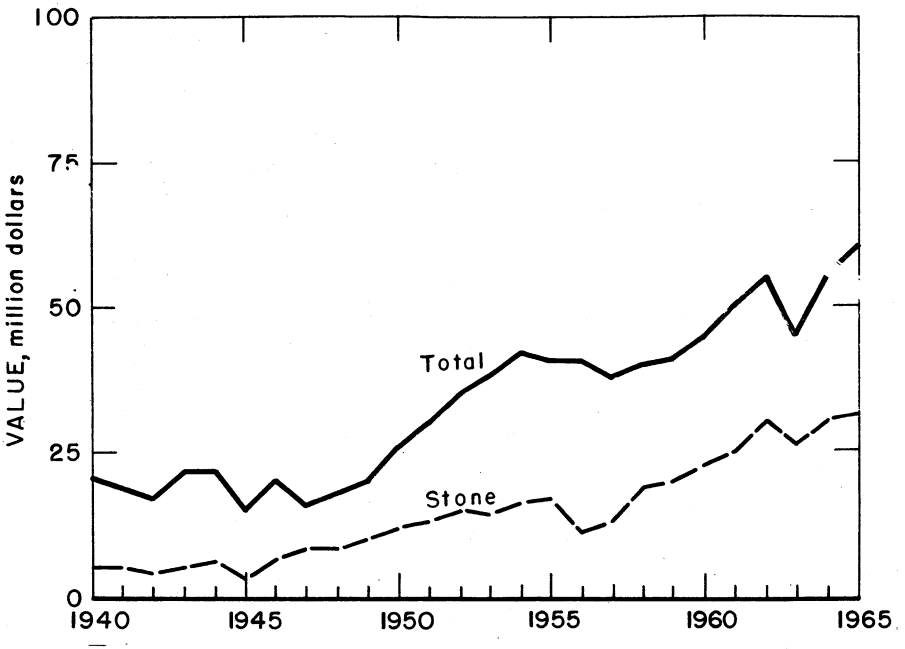

Figure 1.—Value of stone and total value of mineral production in North Carolina.

Table 2.—Value of mineral production in constant 1957–59 dollars

(Thousands)

Year	Value
1956	$41,641
1957	38,066
1958	41,521
1959	40,365
1960	44,196
1961	50,004
1962	54,352
1963	45,131
1964	r 56,096
1965	p 60,260

r Revised.
p Preliminary.

The most significant development in the mineral industry of North Carolina during the year was the continued expansion of Texas Gulf Sulphur's large phosphate complex near Aurora.

Mobil Oil Co. drilled three offshore holes along the North Carolina coast. There were no oil shows in any of the holes. Mobil's leases were extended until 1967.

The North Carolina State Ports Authority will construct at Morehead City, Carteret County, and activate by January 1967, a $9.5 million phosphate bulk handling facility with a 2,500-ton-per-hour loading capacity, and a ship berth able to accommodate large deep sea bulk carriers.

At yearend, 395 miles of North Carolina's total State Highway System mileage was open to traffic. Work was in progress on 261 miles of interstate highway designated for the State, and work had not started on the remaining 113 miles.

Table 3.—Employment and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1964:								
Metal and nonmetal	1,679	232	389	3,051	1	80	26.55	4,217
Sand and gravel	1,043	210	219	1,836	---	43	23.42	908
Stone	1,834	228	417	3,376	1	63	18.96	3,967
Total	4,556	225	1,025	8,263	2	186	22.75	3,379
1965: p								
Metal and nonmetal	1,840	253	465	3,649	3	91	25.76	6,232
Sand and gravel	895	231	206	1,731	---	34	19.64	412
Stone	1,865	236	440	3,562	---	52	14.60	1,001
Total	4,600	241	1,111	8,942	3	177	20.13	3,021

p Preliminary.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Nonmetals accounted for the entire mineral production of the State. No metals nor fuels were produced.

Asbestos.—Powhatan Mining Co. mined amphibole asbestos near Burnsville in Yancey County. Production remained about the same but value decreased 3 percent.

Cement.—Ideal Cement Co. operated the plant at Castle Hayne, Hanover County. Shipments of portland and masonry cement increased substantially during this plant's second year of production.

Raw materials used in manufacturing were limestone, clays, gypsum, and pyrite cinders. Two 11- by 450-foot rotary kilns were operated. A wet production process was used in the cement manufacture. A total of 79 million kilowatt-hours of electricity was consumed; all was purchased. Annual capacity of this plant was 3.5 million barrels.

Types I and II, general-use and moderate-heat cements, and Type III, high-early-strength cement were produced. Consumption of portland cement in North Carolina was 53 percent of shipments. Other shipments were made to Florida (31 percent), South Carolina (7 percent), Washington (5 percent), and other States (4 percent). Consumption of masonry cement in North Carolina was 83 percent of the total shipments. Other shipments were made to Florida (7 percent), South Carolina (7 percent), and other States (3 percent). The cement was shipped by truck (55 percent), railroad (44 percent), and boat (1 percent), chiefly in bulk. Sales of portland cement were to ready-mixed concrete companies (67 percent) concrete product manufacturers (13 percent), highway contractors (7 percent), building material dealers (5 percent), and the remaining 8 percent was sold to others.

Clays.—Miscellaneous clay production increased 6 percent in tonnage and 5 percent in value. Kaolin production decreased 6 percent in tonnage, but increased 18 percent in value. Harris Clay Co., Avery County, and Roy Grindstaff, Mitchell County, were the only kaolin producers. Miscellaneous clay was mined by 25 companies from 33 pits in 21 counties for manufacturing brick, lightweight aggregate, vitrified sewer pipe, and other clay products. Principal producers were Sanford Brick Corp., Boren Clay Products Co., Carolina Solite Corp., Pine Hall Brick & Pipe Co., and Pomona Pipe Products Co.

Feldspar.—Production of crude feldspar decreased 1 percent, but value increased. Mixed and soda feldspar made up the bulk of feldspar production with some potash type produced. Flotation concentrate constituted 92 percent of the total crude production. International Minerals & Chemical Corp. (Hawkins mine), The Feldspar Corp. (Poteat and Wiseman mines), and Lawson-United Feldspar and Minerals Co. (Minpro mine) mined alaskite and recovered feldspar concentrate in Mitchell County. Foote Mineral Co. recovered by-

product feldspar at its lithium plant in Cleveland County. Crude lump feldspar from Mitchell, Yancey, and other counties comprised the balance of the production. Sales of ground feldspar totaled 303,000 tons valued at $3,408,000. The ground feldspar was used mainly for glass and pottery, with a small amount for enamel.

Gem Stones.—Among the gem minerals collected were sapphire, beryl, ruby, emerald, smoky quartz, corundum, rhodolite, garnet, and amethyst.

Lithium.—Foote Mineral Co. mined and milled spodumene at Kings Mountain, Cleveland County. Production and value each increased about 10 percent.

Mica.—Production of scrap mica in North Carolina was 72,000 tons valued at $2 million, an increase of 12 percent in tonnage, but a decrease of 2 percent in value. Production and value of sheet mica increased substantially; over 713,000 pounds was sold or used by producers in North Carolina. Mica production was reported from 15 mines in 5 counties, compared with 17 mines in 4 counties in 1964 and 78 mines in 10 counties in 1962. Cleveland County with four mines accounted for 30 percent of the total value of mica production; Mitchell County with seven mines accounted for 24 percent; Avery, Macon, and Yancey accounted for 36 percent; counties of origin could not be identified for the remaining 10 percent. Principal scrap mica producers were Harris Clay Co., Southern Mica Co. of North Carolina, Kings Mountain Mica Co., Inc., Western Mica of North Carolina, and Deneen Mica Co. Output of ground mica increased 6 percent and the value increased 12 percent. Nine mica grinders were active; both wet and dry processes were used.

Olivine.—Production of olivine increased 31 percent in tonnage and 34 percent in value. Mines were operated in Jackson County by Harbison-Walker Refractories Co. and Balsam Gap Co. and in Yancey County by Northwest Carolina Olivine, Inc. (formerly Wiseman Mining Co., Inc.). The material was used for refractories, molding sand, and slag conditioner.

Phosphate Rock.—Texas Gulf Sulphur continued development at its Lee Creek mine near Aurora, Beaufort County. Over 1 million tons of overburden was removed by dredging in development. A substantial amount of crude ore was mined and stockpiled.

Texas Gulf Sulphur Co. let contracts with Wellman-Lord, Inc., at Lakeland, Fla., for a phosphoric acid plant; a diammonium phosphate plant, with a capacity of 720 tons per day or 220,000 tons per year; and a granular triple superphosphate plant having a capacity of 800 tons per day or 255,000 tons per year. In addition, a contract was signed with Chemical Construction Corp. of New York for a sulfuric acid plant. Initial mine shipments of phosphate were scheduled for April 1966.

Perlite.—Carolina Perlite Co. Inc. expanded perlite at Gold Hill, Rowan County, using crude material from Colorado. Quantity and value increased 39 percent and 14 percent, respectively.

Sand and Gravel.—Sand and gravel continued to be the second leading mineral

Table 4.—Ground mica sold or used by producers, by uses

Use	1964			1965		
	Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per ton
Roofing	24,942	$793,600	$31.82	24,139	$809,981	$33.55
Paint	6,695	969,569	144.82	7,896	1,189,430	150.64
Rubber	3,967	603,342	152.09	4,548	644,592	141.73
Wallpaper	432	55,793	129.15	W	W	W
Plastic	W	W	W	474	61,677	130.12
Other uses [1]	19,469	912,418	46.87	21,988	1,039,431	47.27
Total	55,505	3,334,722	60.08	59,045	3,745,111	63.43

W Withheld to avoid disclosing individual company confidential data.
[1] Includes pipeline enamel (1964), welding rods (1964), well drilling, other uses, and uses indicated by symbol W.

commodity produced in the State. Production and total value of sand and gravel decreased 6 percent and 3 percent, respectively. Commercial sand accounted for 59 percent of the tonnage and 71 percent of the value. Government-and-contractor sand and gravel production decreased 13 percent in tonnage and 21 percent in value. Overall average unit values increased slightly. Commercial building sand and gravel production accounted for 35 percent of the total tonnage and value; commercial paving sand and gravel production accounted for 26 percent of the total tonnage and 29 percent of the total value, and industrial sand production (unground) accounted for less than 1 percent of the total tonnage and value. Sand and gravel was produced in 78 counties; commercial sand and gravel in 12 counties; sand only in 14 counties; and gravel only in 11 counties. Forty-six companies operated 51 pits in 30 counties compared with 46 pits in 29 counties in 1964. Government-and-contractor output of sand occurred in 64 counties, gravel only in 1 county, and sand and gravel in 7 counties. Three percent of the commercial sand and gravel production was sold as unprocessed material. Leading producers were the North Carolina State Highway and Public Works Commission, Becker County Sand & Gravel Co., W. R. Bonsal Co., Inc., and the lessees of B. V. Hedrick Gravel & Sand Co.

Stone.—Stone continued to be the principal mineral commodity of the State. Crushed stone made up over 99 percent of the total production.

Crushed traprock production increased 16 percent in tonnage and 11 percent in value. Crushed granite production decreased 1 percent in tonnage but increased 1 percent in value. Crushed limestone production increased 21 percent in tonnage and 14 percent in value. Production of crushed sandstone decreased 37 percent in tonnage; however, it increased substantially in value, and crushed marble production increased in both tonnage and value. Dimension granite production decreased 24 percent in tonnage and 34 percent in value; Dimension marble production increased in tonnage and value, and dimension slate production decreased in tonnage and value. Byproduct quartz was recovered from feldspar flotation plants in Mitchell County. Stone was quarried in 40 counties. Granite in 30, traprock in 8, limestone in 7, slate in Davidson and Montgomery, and marble in Cherokee. Commercial stone, excluding quartz, was produced by 28 operators from 74 quarries: 54 granite, 8 traprock, 9 limestone, 2 slate, and 1 marble. The State highway department crushed stone from seven granite and three traprock quarries.

Leading producers of crushed granite were Superior Stone Co. (Alamance, Catawba, Gaston, Guilford, Iredell, Mecklenburg, Randolph, Rockingham, Rowan, Wake, and Wilson Counties), W. E. Graham & Sons (Buncombe, Caswell, Forsyth, Guilford, Surry, Vance, Wilkes, and Yadkin Counties), and Nello L. Teer Co. (Nash and Wake Counties).

Leading producers of dimension granite were North Carolina Granite Corp. (Surry County), Harris Granite Quarries, and Crystal Pink Granite Co. (Rowan County).

Leading producers of crushed limestone were Superior Stone Co. (Cleveland, Craven, and Onslow Counties), Ideal Cement Co. (New Hanover County), and Fletcher Limestone Co., Inc. (Henderson County).

Leading producers of crushed traprock were Nello L. Teer Co. (Durham and Johnston Counties), Superior Stone Co. (Davidson, Guilford, and Union Counties), and Ararat Rock Products Co. (Surry County).

Columbia Marble Co. quarried dimension marble. Jacob's Creek Stone Co. quarried dimension slate.

Talc and Pyrophyllite.—Talc and pyrophyllite production increased 3 percent in tonnage and 12 percent in value. Sawed talc (crayons) production remained the same in tonnage but increased 25 percent in value. Ground talc was sold principally for textile use and toilet preparations. Ground pyrophyllite was used mainly in refractories, ceramics, insecticides, and rubber products. Pyrophllite was mined in Alamance, Moore, and Orange Counties, and talc was mined in Cherokee County. Leading producers were Hitchcock Corp. (Cherokee County), Standard Minerals Co., Inc., (Moore County), and Piedmont Minerals Co., Inc., (Orange County).

Vermiculite.—Zonolite Co. operated an exfoliating plant at High Point, Guilford County, using crude vermiculite shipped into the State. Principal uses for the finished product were as concrete aggregate, loose-fill insulation, and building plaster.

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Table 5.—Sand and gravel sold or used by producers, by counties

(Thousand short tons and thousand dollars)

County	1964		1965	
	Quantity	Value	Quantity	Value
Alexander	43	$17	36	$14
Avery	58	45	W	W
Beaufort	102	42	107	38
Bertie	6	2	7	2
Bladen	68	44	75	48
Brunswick	36	21	40	25
Cabarrus	89	132	W	W
Camden	6	3	14	9
Carteret	8	3	8	3
Caswell	10	10	4	4
Catawba	52	21	43	17
Cherokee	46	37	----	----
Chowan	87	50	4	1
Columbus	71	46	73	48
Currituck	36	22	7	4
Dare	1	1	2	1
Davidson	320	159	350	175
Davie	158	114	36	22
Duplin	17	11	15	9
Edgecombe	133	104	133	109
Forsyth	117	140	122	147
Franklin	8	4	5	2
Gaston	107	43	W	W
Gates	7	4	20	12
Granville	5	2	5	5
Greene	63	26	62	22
Guilford	5	5	3	3
Halifax	59	23	W	W
Hertford	33	8	23	6
Hoke	47	15	20	6
Hyde	5	1	5	1
Iredell	72	29	53	21
Johnston	44	42	40	39
Jones	48	20	45	16
Lee	291	226	293	238
Lincoln	53	22	51	21
Macon	106	76	8	6
Martin	41	24	----	----
McDowell	W	W	219	134
Montgomery	58	23	52	21
Moore	599	385	648	353
New Hanover	10	6	12	8
Onslow	21	12	18	11
Pamlico	1	1	3	1
Pasquotank	32	16	18	11
Pender	32	19	36	23
Perquimans	4	2	6	4
Person	5	2	3	3
Pitt	125	74	140	81
Polk	114	54	34	11
Richmond	25	16	26	14
Robeson	135	84	140	83
Rockingham	5	5	4	4
Rowan	70	35	65	32
Rutherford	120	48	103	41
Sampson	190	168	W	W
Scotland	25	14	42	33
Stanly	73	92	2	4
Stokes	65	39	52	31
Surry	7	11	73	87
Union	33	25	45	34
Vance	3	2	4	2
Wake	6	4	8	6
Washington	2	1	4	1
Wayne	40	28	W	W
Wilkes	111	85	29	21
Wilson	87	63	154	108
Yadkin	3	5	7	11
Yancey	25	36	W	W
Undistributed [1]	6,666	7,455	6,843	7,829
Total	11,150	10,404	10,499	10,076

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] Includes Anson, Ashe, Buncombe, Burke, Caldwell, Cleveland, Craven, Cumberland, Harnett, Haywood, Lenoir, Madison, Mecklenburg (1964), Mitchell, Northamption, and Watauga Counties, and counties indicated by symbol W.

Table 6.—Sand and gravel sold or used by producers, by uses
(Thousand short tons and thousand dollars)

Use	1964			1965		
	Quantity	Value		Quantity	Value	
		Total	Average per ton		Total	Average per ton
Sand:						
Structural	2,311	$1,865	$0.81	2,551	$2,133	$0.84
Paving	3,012	1,884	.63	2,411	1,626	.67
Fill	453	293	.65	618	360	.58
Blast	W	W	W	11	11	1.00
Other sands [1]	701	326	.47	758	332	.44
Total	6,477	4,368	.67	6,349	4,462	.70
Gravel:						
Paving	2,918	3,135	1.07	2,422	2,619	1.08
Structural	1,038	1,661	1.60	1,169	1,888	1.62
Railroad ballast	63	54	.86	24	21	.88
Fill	51	43	.84	12	11	.92
Other gravel	603	1,143	1.90	523	1,075	2.06
Total	4,673	6,036	1.29	4,150	5,614	1.35
Total sand and gravel	11,150	10,404	.93	10,499	10,076	.96

W Withheld to avoid disclosing individual company confidential data; included with "Other sands."
[1] Includes railroad ballast, filtration, and other sands, and uses indicated by symbol W.

Table 7.—Crushed granite sold or used by producers, by counties

County	1964		1965	
	Short tons	Value	Short tons	Value
Cabarrus	86,155	$129,232	80,530	$120,794
Caldwell	82,000	95,000	W	W
Cherokee	57,485	86,349		
Macon	126,000	126,000	82,557	82,557
Moore			18,265	22,000
Orange	33,620	50,430	24,480	36,720
Undistributed [1]	12,290,275	18,732,504	12,424,990	19,047,152
Total	12,675,535	19,219,515	12,630,822	19,309,223

W Withheld to avoid disclosing individual company confidential data: included with "Undistributed."
[1] Includes Alamance, Buncombe, Burke (1965), Caswell, Catawba, Forsyth, Gaston, Guilford, Henderson, Iredell, Jackson, McDowell (1965), Mecklenburg, Nash, Pitt (1964), Polk, Randolph, Rockingham, Rowan, Surry, Swain (1964), Vance, Wake, Wilkes, Wilson, and Yadkin Counties, and counties indicated by symbol W.

REVIEW BY COUNTIES

Ninety-three of the 100 counties reported mineral production; New Hanover, Cleveland, Mitchell, Guilford, and Anson were the leading counties. The North Carolina State Highway and Public Works Commission produced sand and gravel, crushed granite, and crushed traprock in 77 counties for paving, concrete, and roadstone use. In addition to the detailed production listed in table 7, substantial quantities of mica, crude feldspar, and gem stones of undetermined county origin were produced. Counties with sand and gravel production by the State highway department only are not discussed; see table 5 for additional details.

Alamance.—Superior Stone Co., a division of Martin Marietta Corp. (Burlington quarry), and the State highway department crushed granite for concrete and roads. Hanford Brick Co., Inc., mined miscellaneous clay for heavy clay products from its Hanford mine near Burlington.

Table 8.—Value of mineral production in North Carolina, by counties [1]

County	1964	1965	Minerals produced in 1965 in order of value
Alamance	W	W	Granite, miscellaneous clay, pyrophyllite.
Alexander	$17,000	$14,000	Sand and gravel.
Anson	W	W	Do.
Ashe	W	W	Do.
Avery	W	W	Mica, kaolin, sand and gravel.
Beaufort	83,000	38,000	Sand and gravel.
Bertie	2,000	2,000	Do.
Bladen	44,000	48,000	Do.
Brunswick	21,000	25,000	Do.
Buncombe	W	W	Sand and gravel, granite.
Burke	W	W	Granite, sand and gravel.
Cabarrus	W	W	Granite, traprock, sand and gravel.
Caldwell	W	W	Granite, sand and gravel.
Camden	3,000	9,000	Sand and gravel.
Carteret	3,000	3,000	Do.
Caswell	W	W	Granite, sand and gravel.
Catawba	W	W	Granite, miscellaneous clay, sand and gravel.
Chatham	496,624	396,946	Miscellaneous clay, traprock.
Cherokee	W	W	Marble, talc.
Chowan	50,000	1,000	Sand and gravel.
Cleveland	W	W	Limestone, lithium minerals, mica, sand and gravel, feldspar, sandstone.
Columbus	46,000	48,000	Sand and gravel.
Craven	W	W	Limestone, sand and gravel.
Cumberland	W	W	Sand and gravel, miscellaneous clay.
Currituck	22,000	4,000	Sand and gravel.
Dare	1,000	1,000	Do.
Davidson	W	W	Sand and gravel, traprock, slate, miscellaneous clay.
Davie	114,000	22,000	Sand and gravel.
Duplin	11,000	9,000	Do.
Durham	W	W	Traprock, miscellaneous clay.
Edgecombe	104,000	109,000	Sand and gravel.
Forsyth	W	W	Granite, sand and gravel.
Franklin	4,000	2,000	Sand and gravel.
Gaston	W	W	Granite, sand and gravel.
Gates	4,000	12,000	Sand and gravel.
Granville	2,000	5,000	Do.
Greene	26,000	22,000	Do.
Guilford	W	W	Granite, traprock, miscellaneous clay, sand and gravel.
Halifax	W	W	Sand and gravel, miscellaneous clay.
Harnett	W	W	Do.
Haywood	W	W	Sand and gravel.
Henderson	645,588	464,557	Limestone, granite, miscellaneous clay.
Hertford	8,000	6,000	Sand and gravel.
Hoke	15,000	6,000	Do.
Hyde	1,000	1,000	Do.
Iredell	W	W	Granite, sand and gravel.
Jackson	W	W	Granite, olivine.
Johnston	W	W	Traprock, sand and gravel, miscellaneous clay.
Jones	20,000	16,000	Sand and gravel.
Lee	W	602,500	Miscellaneous clay, sand and gravel.
Lenoir	W	W	Sand and gravel.
Lincoln	22,000	21,000	Do.
Macon	202,000	130,782	Granite, limestone, mica, sand and gravel.
Madison	W	W	Sand and gravel, feldspar.
Martin	24,000	----------	
McDowell	W	W	Sand and gravel, granite.
Mecklenburg	W	W	Granite.
Mitchell	r 2,663,078	3,749,172	Feldspar, mica, sand and gravel, sandstone, kaolin.
Montgomery	W	W	Sandstone, sand and gravel, slate, miscellaneous clay.
Moore	W	W	Sand and gravel, pyrophyllite, granite, miscellaneous clay.
Nash	W	W	Granite.
New Hanover	W	W	Cement, limestone, miscellaneous clay, sand and gravel.
Northampton	W	W	Sand and gravel.
Onslow	W	W	Limestone, sand and gravel.
Orange	233,030	268,220	Pyrophyllite, granite.
Pamlico	1,000	1,000	Sand and gravel.
Pasquotank	16,000	11,000	Do.
Pender	19,000	23,000	Do.
Perquimans	2,000	4,000	Do.
Person	2,000	3,000	Do.
Pitt	W	81,000	Do.
Polk	W	W	Granite, sand and gravel.
Randolph	W	W	Granite.
Richmond	16,000	14,000	Sand and gravel.
Robeson	84,000	83,000	Do.

See footnotes at end of table.

Table 8.—Value of mineral production in North Carolina, by counties [1]—Continued

County	1964	1965	Minerals produced in 1965 in order of value
Rockingham	W	W	Granite, miscellaneous clay, sand and gravel, traprock.
Rowan	W	W	Granite, miscellaneous clay, sand and gravel.
Rutherford	$48,000	$41,000	Sand and gravel.
Sampson	209,880	W	Miscellaneous clay, sand and gravel.
Scotland	14,000	33,000	Sand and gravel.
Stanly	457,111	W	Miscellaneous clay, traprock, sand and gravel.
Stokes	W	W	Miscellaneous clay, sand and gravel.
Surry	W	W	Granite, traprock, sand and gravel.
Swain	W	152,634	Limestone.
Union	W	W	Traprock, miscellaneous clay, sand and gravel.
Vance	W	W	Granite, sand and gravel.
Wake	W	W	Do.
Washington	1,000	1,000	Sand and gravel.
Watauga	W	W	Do.
Wayne	28,000	W	Do.
Wilkes	W	W	Granite, sand and gravel.
Wilson	W	W	Do.
Yadkin	W	W	Do.
Yancey	W	W	Mica, olivine, feldspar, sand and gravel, asbestos.
Undistributed	49,941,689	53,899,189	
Total	r 55,727,000	60,383,000	

r Revised.
W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] The following counties are not listed because no production was reported: Alleghany, Clay, Graham, Transylvania, Tyrrell, and Warren.

Boren & Harvey, Inc., mined pyrophllite at its Snow Camp mine for refractory and ceramic uses.

Anson.—W. R. Bonsal Co., Inc. (Bonsal mine), the lessees of B. V. Hedrick Gravel and Sand Co. (Lilesville mine), and the State highway department mined building, paving, railroad ballast, blasting, filtration, and other sand, and building, paving, and railroad ballast gravel.

Ashe.—Sand and gravel was mined by Lyalls Construction Co. from its Jefferson mine near Jefferson. The entire production was used for paving.

Avery.—Harris Clay Co. (Gusher Knob mine) mined mica. English Mica Co. and Harris Clay Co. ground mica for roofing, paint, rubber, wallpaper, plastics, and other uses. Harris Clay Co. (Gusher Knob mine) and Roy Grindstaff (Fluking Ridge mine) mined kaolin for whiteware and refractory uses. Clark, Anderson & Guy (Frank mine) and Harris Clay Co. mined sand and gravel for paving use.

Beaufort.—Texas Gulf Sulphur Co. continued development at the Lee Creek mine. Overburden was removed and crude ore stockpiled. No marketable phosphate was produced. Construction of plant facilities was in progress.

Buncombe.—Four companies mined building, paving, railroad ballast, and fill sand and gravel. Leading producers were Grove Stone & Sand Branch (Grove mine) and Asheville Sand Co. (Asheville mine). W. E. Graham & Sons, a division of Vulcan Materials Co. (Enka quarry), J. L. Colville Construction Co., Inc. (Buncombe County quarry), and Carolina Portable Aggregates, Inc. (Portable plant), crushed granite for concrete, roads, and riprap. Asheville Mica Co. ground mica for rubber and other uses.

Burke.—Great Lakes Carbon Corp. manufactured carbon and graphite products at the Morgantown plant. A. P. Causby Stone Co. (Causby quarry) crushed granite for concrete and road use. A. P. Causby Sand Co., A. R. Thompson, Contractor, Inc., and the State highway department mined sand and gravel for building and paving use.

Cabarrus.—The State highway department crushed granite from three quarries for concrete and road use. Young Stone Co. mined and crushed traprock from their Gold Hill quarry for concrete and road use. Morrison & White and the State highway department mined sand and gravel for paving use.

Caldwell.—Carl W. Clement Co. crushed granite at the Lenoir quarry for concrete and road uses. Miller Brothers Co. and the State highway department mined paving and other sand, and paving gravel.

Caswell.—W. E. Graham & Sons (Shelton quarry) and the State highway department crushed granite for concrete, roads,

riprap, and railroad ballast. The State highway department mined sand for paving.

Catawba.—Superior Stone Co. (Hickory quarry) crushed granite for concrete and road use. Statesville Brick Co. (Statesville mine) mined miscellaneous clay for heavy clay products. The State highway department mined paving sand.

Chatham.—Pomona Terra Cotta Co. (Gulf mine), Sanford Corp., and Boren Clay Products Co. (Gulf mine) mined miscellaneous clay for heavy clay products. The State highway department crushed traprock from the Goldston quarry for concrete and roads.

Cherokee.—Columbia Marble Co. (Pleasant Valley quarry) crushed marble for terazzo and other uses and quarried dimension marble for rough interior, sawed and cut interior building stone, and cut and dressed monumental stone. Hitchcock Corp. (Nancy Jordan mine) mined talc for crayons, toilet preparations, textiles, and other uses.

Cleveland.—Superior Stone Co. crushed limestone at Kings Mountain quarries Nos. I and 2 for concrete, roads, and railroad ballast. Foote Mineral Co. at Kings Mountain mined and milled lithium minerals and also produced a quantity of by-product feldspar for glass. Kings Mountain Mica Co., Inc. (Moss and Patterson mines), Western Mica of North Carolina (Industrial mine), and Foote Mineral Co. (Kings Mountain mine) produced scrap mica. Shelby Sand & Stone, Inc. (First Broad River mine), and the State highway department mined sand for building, paving, and fill. Kings Mountain Silica, Inc., shipped quartz from Kings Mountain.

Columbus.—Riegel Carolina Corp. recovered quicklime at the Acme Paper Mill. The State highway department mined paving and fill sand.

Craven.—Superior Stone Co. (New Bern quarry) crushed limestone for concrete and roads. Southern Sand Co., Inc. (New Bern mine), and the State highway department mined sand for building and stabilization uses.

Cumberland.—Becker County Sand & Gravel Co. (Fayetteville mine) and the State highway department mined building, paving and fill sand, and building gravel. Ideal Brick Co., Inc. (Linden mine), mined miscellaneous clay near Fayetteville for heavy clay products.

Davidson.—Superior Stone Co. (Lexington quarry) crushed traprock for concrete and roads. Jacob's Creek Stone Co., Inc. (Flagstone quarry), quarried dimension slate for structural mill stock and flagging. Cunningham Brick Co. (Thomasville mine) mined miscellaneous clay for heavy clay products. The State highway department mined paving sand and gravel.

Durham.—Nello L. Teer Co. (Durham County quarry) crushed traprock for concrete and roads. Tri-Angle Brick Co. (Durham mine) and Borden Brick & Tile Co. (Durham mine), mined miscellaneous clay for heavy clay products.

Edgecombe.—Quality Sand & Gravel Co. (Rocky Mount mine), Tar River Sand & Gravel (Whitehurst mine), and the State highway department mined building, paving, fill, and other sand, and fill gravel.

Forsyth.—W. E. Graham & Sons (North, Piedmont, and 421 quarries) crushed granite for riprap, concrete, roads, and railroad ballast. Ira Pope & Sons, Inc. (Yadkin River mine), and the State highway department mined sand for building and paving uses.

Gaston.—Superior Stone Co. (Gaston quarry) crushed granite for concrete and roads. H. D. Bartlett Sand Co. (Charlotte mine) and the State highway department mined sand for building and paving uses.

Guilford.—Superior Stone Co. (Jamestown, Pomona, and Buchanan quarries) and W. E. Graham & Sons (Stokesdale quarry) crushed granite for concrete, roads, and railroad ballast. Superior Stone Co. (Hicone quarry) crushed traprock for concrete and roads. Boren Clay Products Co. (Pleasant Garden mine) mined miscellaneous clay for heavy clay products. Zonolite Co. exfoliated vermiculite at the High Point plant. The State highway department mined paving sand.

Halifax.—Superior Stone Co. (Weldon mine) and the State highway department mined sand and gravel for paving. Nash Brick Co., Inc. (Ita and Page mines), mined miscellaneous clay for heavy clay products. Albemarle Paper Manufacturing Co. recovered quicklime at the Roanoke Rapids mill.

Harnett.—Becker County Sand & Gravel Co. (Senter mine), Nello L. Teer Co. (Erwin mine), and the State highway department mined sand and gravel for build-

ing, paving, fill, and other uses. Norwood Brick Co. (Lillington mine) mined miscellaneous clay for heavy clay products.

Haywood.—A. M. Sale, Inc. (Waynesville mine), mined sand and gravel for paving. Champion Papers, Inc., recovered quicklime at the Canton mill.

Henderson.—Fletcher Limestone Co., Inc. (Fletcher quarry) and Cogdill Limestone Co. (Cogdill quarry) crushed limestone for concrete and roads. Rock Products, Inc. (Corn quarry), crushed granite for concrete and roads. Moland-Drysdale Corp. (Fletcher mine) mined miscellaneous clay for heavy clay products.

Iredell.—Gilbert Engineering Co. (Mooresville quarry), and Superior Stone Co. (Statesville quarry), crushed granite for concrete and roads. The State highway department mined paving sand.

Jackson.—Rock Products, Inc. (Dillsboro quarry), crushed traprock for concrete and roads. Harbison Walker Refractories Co. (Addie quarry), and Balsam Gap Co. (Balsam Gap mine), mined olivine for refractories, molding sand, and slag conditioners.

Johnston.—Nello L. Teer Co. (Princeton quarry), crushed traprock for concrete and roads. Crumpler Brick & Tile Co. mined miscellaneous clay for heavy clay products. The State highway department mined paving sand.

Lee.—Sanford Brick & Tile Co., Inc. (Colon mine), Borden Brick & Tile Co. (Sanford mine), and Lee Brick & Tile Co. (Sanford mine), mined miscellaneous clay for heavy clay products. The State highway department mined paving sand and gravel.

Lenoir.—Barrus Construction Co. (Kinston mine) and the State highway department mined sand and gravel for building, paving, fill and other uses.

Macon.—Franklin Construction Co. (Tubb Mill quarry) crushed granite for concrete and roads. Nantahala Talc & Limestone Co. (Wayah quarry) produced crushed limestone. Eugene Owenby (Sheppard Knob mine) mined scrap mica. Franklin Mineral Products Co. ground mica for paint, rubber, wallpaper, plastic, pipeline enamel, and other uses. Rock Products, Inc. (Dills mine), mined paving gravel.

Madison.—Western Stone Co., Inc., mined paving gravel from their Madison mine. Watson Boone (Boone mine) mined a small quantity of crude feldspar.

McDowell.—Becker County Sand & Gravel Co. (Marion mine) McCreary Construction Service, Inc. (Woodlawn mine), E. P. Boyd (Marion mine), and the State highway department mined sand and gravel for building and paving. Pendley & Duncan (Pendley quarry), crushed granite for concrete and roads.

Mecklenburg.—Superior Stone Co. (Charlotte and Davidson quarries) crushed granite for concrete and roads.

Mitchell.—Crude feldspar was produced by 17 operators from 18 mines; the leading producers were International Minerals & Chemical Corp. (Hawkins mine), The Feldspar Corp. (Poteat and Wiseman mines), and Lawson-United Feldspar & Minerals Co. (Minpro mine). Ground feldspar for glass, pottery, enamel, filler, and tile uses was produced by International Minerals & Chemical Corp. (Kona and Spruce Pine plants), Lawson-United Feldspar & Minerals Co., and The Feldspar Corp. Quartz was recovered from these feldspar milling operations and was used for concrete, roads, and glass. Six operators mined mica from seven mines; the leading producers of scrap mica were Southern Mica Co. of North Carolina (Bailey mine), The Feldspar Corp. (Poteat and Wiseman mines), and International Minerals & Chemical Corp. (Hawkins mine). Three companies ground mica for paint, rubber, wallpaper, plastics, roofing, and well drilling. Pitman Stone Co., Inc. (Bakersville mine), and Crabtree Stone & Gravel Co. (Crabtree mine) mined paving gravel.

Montgomery.—Southern Aggregates, Inc., produced quartz from its new Montgomery quarry. Jacobs Creek Stone Co., Inc. (Edenboro quarry), quarried dimension slate for structural millstock and flagging. Mt. Gilead Brick Co. (Mt. Gilead mine) mined miscellaneous clay for heavy clay products. The State highway department mined paving sand.

Moore.—Five companies and the State highway department mined sand and gravel for building, paving, and fill. The leading producers were Pleasants Sand & Supply Co. (Pleasants mine) and Aberdeen Sand & Gravel Co. (Aberdeen mine). Standard Mineral Co., Inc., and General Minerals Co. (Glendon mine) mined pyro-

phyllite for ceramics, insecticides, paint, rubber, plaster products, and refractory uses. Blythe Brothers (Robbins quarry) crushed granite for concrete and roads. Borden Brick & Tile Co. mined miscellaneous clay for heavy clay products.

Nash.—Nello L. Teer Co. (Rocky Mount quarry) crushed granite for concrete and roads.

New Hanover.—Ideal Cement Co. manufactured portland and masonry cement at their plant near Castle Hayne. Limestone and clay were mined from their Wilmington quarry for use in cement manufacture. The State highway department mined paving sand.

Northampton.—Superior Stone Co. (Garysburg mine), and the State highway department mined sand and gravel for paving, stabilization, and ice control.

Onslow.—Superior Stone Co. (Belgrade quarry) crushed limestone for roadstone. The State highway department mined paving sand.

Orange.—Piedmont Minerals Co., Inc. (Hillsboro mine), mined pyrophyllite for ceramic and refractory uses. Duke University quarried dimension granite for building stone and rubble. The State highway department crushed granite for roadstone.

Pitt.—White Concrete Co., Inc. (Munford mine), Hurst Concrete Products Co., Inc. (Greenville mine), and the State highway department mined sand for building and other uses.

Polk.—A. R. Thompson Contractor, Inc. (Mill Spring quarry), crushed granite for roadstone. The State highway department mined paving sand.

Randolph.—Superior Stone Co. (Ashboro quarry) and the State highway department crushed granite for roadstone.

Rockingham.—Superior Stone Co. (Reidsville quarry), crushed granite for roadstone. Virginia Solite Corp. (Leakesville mine), mined miscellaneous clay for use in the manufacture of lightweight aggregates. Webster Brick Co., Inc. (Draper mine), mined miscellaneous clay for heavy clay products. M. Lester Hall (King's quarry), crushed traprock for roadstone. The State highway department mined paving sand.

Rowan.—Four companies quarried dimension granite from six quarries for use as rough architectural stone, rough and dressed monumental stone, curbing and flagging, paving blocks, and rubble. The leading producer was Harris Granite Quarries Co. (Collins, Balfour, and Shuping quarries). Superior Stone Co. (Woodleaf and Kannapolis quarries), and Harris Granite Quarries Co. (Collins quarry), crushed granite for roadstone, railroad ballast, and riprap. Isenhour Brick & Tile Co. (East Spencer and Clearwater mines) and Carolina Tuff-Lite Corp. mined miscellaneous clay for use in heavy clay products and lightweight aggregate, respectively. Carolina Perlite Co., Inc., expanded crude perlite shipped from Colorado at the Gold Hill plant for use as building plaster, concrete aggregate, and soil conditioner. The State highway department mined paving sand.

Sampson.—Boren Clay Products Co. (Roseboro mine) and Patterson Brick Co. (Roseboro mine) mined miscellaneous clay for heavy clay products. Williams Sand & Gravel Co. and the State highway department mined paving sand and gravel.

Stanly.—Carolina Solite Corp. (Aquadale mine), Stanly Shale Products, Inc. (Norwood mine), and Yadkin Brick Yards, Inc. (Yadkin mine), mined miscellaneous clay for lightweight aggregate and heavy clay products. The State highway department crushed traprock and mined sand for concrete and roadstone.

Stokes.—Pine Hall Brick & Pipe Co. (No. 1 mine), mined miscellaneous clay for heavy clay products. The State highway department mined paving sand.

Surry.—W. E. Graham & Sons (Elkins, Pilot Mountain, and Mt. Airy quarries) and North Carolina Granite Corp. crushed granite for concrete, roads, riprap, railroad ballast, and poultry grit. North Carolina Granite Corp. (Mt. Airy quarry), quarried dimension granite for rough and dressed monumental stone, paving blocks, curbing, flagging, rough and dressed architectural stone, and rubble. Ararat Products Co. crushed traprock for roadstone. Mt. Airy Sand Co. and the State highway department mined sand for paving and fill.

Swain.—Nantahala Talc & Limestone Co. crushed limestone at its Hewitt quarry near Andrews. The material was used for roadstone, railroad ballast, and agricultural stone.

Union.—Superior Stone Co. (Bakers quarry) and the State highway department crushed traprock for roadstone and rail-

road ballast. Kendrick Brick & Tile Co. (Monroe mine), mined miscellaneous clay for heavy clay products. The State highway department mined paving sand.

Vance.—W. E. Graham & Sons (Greystone quarry), crushed granite for riprap, roadstone, and railroad ballast. The State highway department mined sand for snow and ice control.

Wake.—Nello L. Teer Co. (Raleigh and Crabtree quarries) and Superior Stone Co. (Garner, Knightdale, and Rolesville quarries), crushed granite for roadstone and railroad ballast. The State highway department mined sand for ice and snow removal and for patching.

Washington.—Weyerhaeuser Co. recovered quicklime at the Plymouth mill. The State highway department mined sand for stabilization and ice control.

Watauga.—Maymead Lime Co., Inc. (Maymead mine) and Clark, Anderson & Guy (Boone mine) mined paving gravel.

Wayne.—Builders Supply Co. (Goldsboro mine) and the State highway department mined sand for building and paving purposes.

Wilkes.—W. E. Graham & Sons (115 quarry) and Carolina Portable Aggregates, Inc. (Portable plant), crushed granite for roadstone. The State highway department mined paving sand.

Wilson.—Superior Stone Co. crushed granite for roadstone and railroad ballast at Neverson. Gray Concrete Pipe Co., Inc. (Stantonsburg mine), Allied Sand & Gravel Co., Inc. (Wilson mine), Deans Sand Co. (Wilson mine), and the State highway department mined sand and gravel for building, paving, fill, and stabilization uses.

Yadkin.—W. E. Graham & Sons (Cycle quarry), crushed granite for roadstone and riprap. The State highway department mined paving sand.

Yancey.—Deneen Mica Co. (International mine) and Hassett Mining Co. (Simpson mine) produced scrap mica. Deneen Mica Co. and Hassett Mining Co. ground mica for roofing, well drilling, and other uses. Northwest Carolina Olivine, Inc. (Wray mine), mined olivine for refractory uses. Crude feldspar was mined by 11 operators at 11 mines. The Feldspar Corp. ground feldspar at the Burnsville plant for use in pottery and glass. Deneen Mica Co. and Yancey Sand & Gravel Co., Inc., mined building, paving, and fill sand and gravel. Powhatan Mining Co. mined a small quantity of amphibole asbestos at Burnsville.

The Mineral Industry of North Dakota

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the State Geological Survey of North Dakota for collecting information on all minerals except fuels.

By R. G. Raabe [1] and William C. Henkes [2]

North Dakota mineral production was valued at $92.9 million, approximately the same as in 1964. Mineral fuels—coal (lignite), natural gas, natural gas liquids, peat, and crude petroleum—comprised the major portion of the total value of mineral production. The quantity and value of stone increased tenfold, and production and value of uranium ore rose considerably over that of 1964.

Employment and Injuries.—Final statis-

[1] Geologist, Bureau of Mines, Denver, Colo.
[2] Petroleum engineer, Bureau of Mines, Denver, Colo.

Table 1.—Mineral production in North Dakota [1]

Mineral	1964		1965	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays—thousand short tons	85	$119	81	$114
Coal (lignite)—do	2,637	5,659	2,732	5,848
Gem stones	NA	1	NA	1
Natural gas—million cubic feet	r34,512	7,634	35,652	5,704
Natural gas liquids:				
LP gases—thousand gallons	84,338	2,960	85,174	3,066
Natural gasoline and cycle products—do	21,368	1,338	21,059	1,263
Petroleum (crude)—thousand 42-gallon barrels	25,731	63,813	26,350	65,875
Sand and gravel—thousand short tons	10,520	10,142	7,574	7,895
Stone—do	31	56	356	624
Uranium ore—short tons	W	W	44,558	1,359
Value of items that cannot be disclosed: Lime (1965), molybdenum, peat, salt, vanadium (1965), and values indicated by symbol W	XX	1,144	XX	1,129
Total	XX	92,866	XX	92,878

NA Not available. r Revised. W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed." XX Not applicable.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Value of mineral production in constant 1957–59 dollars
(Thousands)

Year	Value	Year	Value
1956	$57,215	1961	$84,485
1957	56,098	1962	89,128
1958	59,456	1963	r 93,129
1959	68,099	1964	r 91,804
1960	78,641	1965	p 91,257

r Revised. p Preliminary.

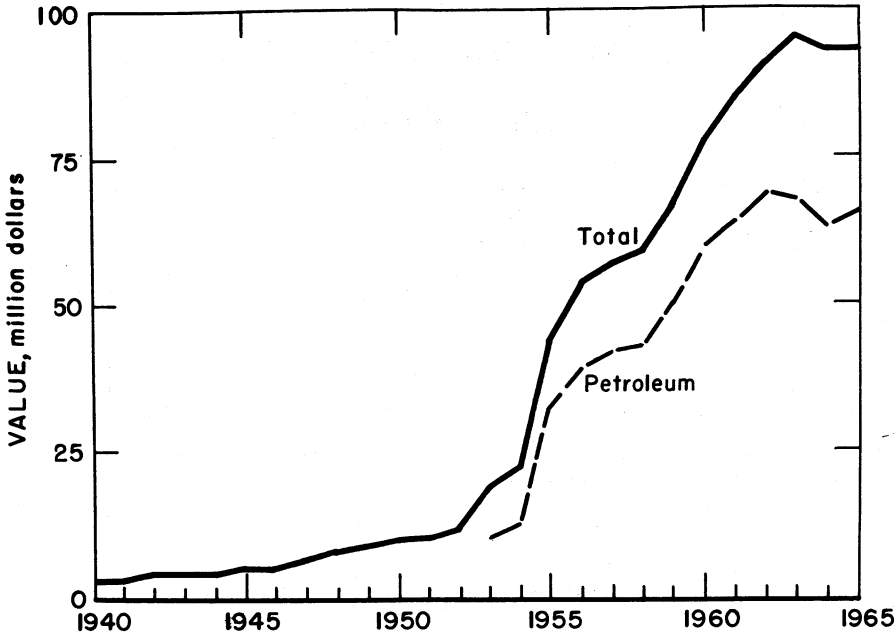

Figure 1.—Value of petroleum and total value of mineral production in North Dakota.

tics on employment and injuries in the mineral industries for 1964 and preliminary data for 1965, compiled by the Federal Bureau of Mines, are given in table 3.

Table 3.—Employment and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1964:								
Coal and peat	279	211	59	457	1	12	28.43	14,416
Metal	69	174	12	99	-------	3	30.35	830
Nonmetal	38	263	10	79	-------	1	12.69	1,218
Sand and gravel	617	188	116	963	-------	19	19.73	646
Stone	20	70	1	11	-------	-------	-------	-------
Total	1,023	194	198	1,609	1	35	22.37	4,594
1965: p								
Coal and peat	268	232	62	481	1	13	29.11	13,786
Metal	70	214	15	122	-------	2	16.39	311
Nonmetal	40	225	9	73	-------	-------	-------	-------
Sand and gravel	625	188	118	978	-------	19	19.43	330
Stone	20	100	2	12	-------	-------	-------	-------
Total	1,023	201	206	1,666	1	34	21.01	4,197

p Preliminary.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Coal (Lignite.—The multimillion-dollar bucket-wheel excavator at the Glenharold lignite strip mine of Truax-Traer Coal Co. Division, Consolidation Coal Co., was modified for 24-hour use. More than 80 railroad cars were required to transport this largest wheel-type excavator in the United States to North Dakota where assembly began at the mine site in 1964. The excavator can handle 3.5 million tons of overburden per year; a 14-yard shovel was used to load the uncovered lignite. The raw crushed lignite was shipped 1 mile to the $36.6 million Leland Olds electric generating plant of Basin Electric Power Cooperative at Stanton, the largest (200 megawatts) lignite-fueled electric powerplant in the Western Hemisphere. Truax-Traer Coal Co. which also operated the Dakota Star, Kincaid, and Velva strip mines at Hazen, Columbus, and Voltaire, respectively, was the largest producer of lignite in North Dakota. Directors of Continental Oil Co. and Consolidation Coal Co. approved in principle the combination of Truax-Traer Coal Co. coal activities with Continental Oil Co. oil and gas operations.

Table 4.—Coal (lignite) production, by counties

(Excludes mines producing less than 1,000 short tons)

County	1964	1965
	Short tons	Short tons
Adams	15,637	17,388
Bowman	139,867	83,369
Burke	515,916	510,946
Burleigh	7,988	7,327
Dunn	2,809	1,058
Grant	19,930	19,515
Hettinger	2,919	2,500
McLean	47,842	46,038
Mercer	1,237,512	1,538,032
Morton	12,216	19,029
Oliver	7,055	3,323
Stark	88,848	77,769
Ward	536,345	400,429
Williams	1,867	5,212
Total	2,636,751	2,731,935

Knife River Coal Mining Co. used a 750-ton, 17-cubic-yard bucket, electric dragline excavator at its lignite strip mine near Beulah.

The North American Coal Corp. ordered equipment for its Indian Head mine at Zap, where expanded mining operations were scheduled to begin late in 1966. North American planned to ship about 1 million tons of lignite per year to the United Power Association's new 162-megawatt powerplant at Stanton.

Great Northern Railway Co. authorized $175,000 to finance a liquid-fuel-from-lignite research project to be conducted by the University of North Dakota. The U.S. Office of Coal Research and several chemical companies stimulated the project designed to develop a fuel for railway locomotives and a crude oil which could be refined by oil companies. With nearly 350 billion tons, North Dakota has three-fourths of the Nation's lignite coal reserves.

Natural Gas.—The quantity of marketed natural gas increased 3 percent to 35.7 billion cubic feet, valued at $5.7 million. Most of this output was casing head gas, processed at three gas plants where the associated liquids were removed. Montana-Dakota Utilities Co. continued as the purchaser and marketer of the dry and residual gas.

Natural Gas Liquids.—Operation of the three natural gas liquids plants was continued at approximately the same level as during 1964. The largest, Signal Oil and Gas Co. plant at Tioga, Williams County, had a daily throughput capacity of 105 million cubic feet of gas. The Texaco Inc. plant at Lignite, Burke County, was ranked second with a daily capacity of 23 million cubic feet. The Hunt Industries plant at North Tioga, Burke County, had a daily capacity of 12 million cubic feet of gas.

Petroleum.—Petroleum production increased 2 percent over that of 1964 to 26,350,096 barrels. At yearend, 1,983 wells were producing oil in 96 fields from 114 reservoirs. Estimated known primary and secondary recoverable reserves of oil were 630.8 million barrels; nearly 33 percent of the known reserves were in Williams County, and 20 percent in McKenzie County. Eighty-one percent of the reserves were in rocks of Mississippian age.[3]

The North Dakota Geological Survey reported that during 1965, 231 wells were completed; 74 wells, 32 percent, were ex-

[3] Folsom, Clarence B., Jr. North Dakota Crude Oil Inventory as of Jan. 1, 1966. Miscellaneous Series No. 27. North Dakota Geological Survey. Table II, Crude Oil Inventory in North Dakota.

Table 5.—Drilling for petroleum in 1965, by counties

County	Oil	Dry	Total	Footage
Exploratory completions:				
Billings	----	2	2	21,481
Bottineau	----	32	32	125,885
Bowman	----	1	1	8,883
Burke	----	10	10	60,182
Dickey	----	3	3	4,000
Divide	----	2	2	13,502
Dunn	----	1	1	9,271
La Moure	----	1	1	2,509
McHenry	----	4	4	14,408
McKenzie	----	3	3	30,587
Morton	----	2	2	15,843
Pierce	----	4	4	15,816
Renville	1	23	24	117,141
Stark	----	1	1	8,219
Towner	----	1	1	4,585
Ward	----	10	10	60,173
Wells	----	2	2	7,205
Williams	----	2	2	11,526
Total	1	104	105	531,216
Development completions:				
Billings	15	3	18	171,284
Bottineau	27	13	40	162,015
Bowman	4	----	4	33,686
Burke	16	7	23	145,329
Divide	1	----	1	6,429
McKenzie	3	5	8	72,127
Renville	18	16	[1] 36	163,912
Stark	2	----	2	15,950
Williams	4	----	4	44,164
Total	90	44	[1] 136	814,896
Total all drilling	91	148	[1] 241	1,346,112

[1] Includes 2 service wells.

Source: Oil and Gas Journal.

ploratory wells. Only one wildcat, the Scotia field discovery in Bottineau County, was successful. The well, Plaza Oil and Gas Co., No. 1 Sivertson, sec 8, T 163 N, R 79 K, was completed and pumping 83 barrels of oil per day from the Madison formation at a depth of 3,226 to 3,244 feet. The single discovery of 1964, the Medora field, had 17 new producing wells in 1965.

In Bottineau County, the Federal Bureau of Land Management offered, at a sealed-bid sale, oil and gas leases in the Lower Souris National Wildlife Refuge. The acreage offered was on the known geologic structure of four nearby fields. Land leased totaled 1,533 acres, for which a bonus of $93,956 was paid; high bid was $229 per acre for Tract 1. Leases stipulated adequate protection for the wildlife in the refuge.

Early in 1965, the State enacted a law of great significance to the petroleum industry. This law provided for compulsory unitization of oilfields and gasfields, when a minimum of 80 percent of the gross working interests and 80 percent of the gross mineral and royalty interests involved approved the unitization.[4] Voluntary unitization required 100-percent approval of such interests, often difficult to attain.

In November, the North Dakota Industrial Commission issued an order allowing all wells in the State, except in Marketing District II-A, to produce at an unrestricted rate. Oil wells in District II-A were limited to a production of 200,000 cubic feet of associated gas per day.[5]

Refinery activity was continued at the same level as in 1964. Total throughput

[4] Rocky Mountain Oil Reporter. V. 22, No. 5, May 1965, p. 23.

[5] Petroleum Information. V. 38, No. 230, Nov. 26, 1965.

Table 6.—Crude petroleum production, by counties

(Thousand 42-gallon barrels)

County	1964	1965	Principal fields in 1965, in order of production
Billings	747	1,252	Fryburg, Medora, Rocky Ridge.
Bottineau	2,581	2,685	Newburg, South Westhope, Wiley, Haas.
Bowman	790	706	Cedar Creek.
Burke	3,450	3,392	North Tioga, Black Slough, Rival, Foothills.
Divide	318	293	North Tioga, Stoneview.
Dunn	28	24	Lost Bridge.
McHenry	56	54	Pratt.
McKenzie	7,061	7,538	Antelope, Blue Buttes, Charlson.
Mountrail	1,418	1,129	Tioga, White Earth, East Tioga.
Renville	2,061	2,525	Sherwood, Glenburn, Mouse River Park.
Stark	52	104	Dickinson.
Ward	26	7	Southwest Aurelia.
Williams	7,143	6,641	Beaver Lodge, Tioga, Capa, Grenora.
Total	25,731	26,350	

Source: North Dakota Geological Survey.

was 16.4 million barrels of crude oil—15.6 million barrels through the American Oil Co. refinery at Mandan, the remainder through the Westland Oil Co. refinery at Williston. Most of the petroleum refined was North Dakota crude oil, but a small part, 145,000 barrels, was from Montana. Slightly over 10 million barrels of crude oil was shipped out of the State, virtually all to Minnesota.

At yearend, Westland Oil Co. announced plans to more than double the capacity of its Williston refinery. Refinery improvements were scheduled for completion in the spring of 1966, when throughput capacity was to be 5,000 barrels per day of crude oil. Plans included construction of a new distillation unit, a 2,200-barrel-per-day platforming unit, a larger thermal cracking unit, a desulfurization unit, and increased storage and loading facilities.[6]

NONMETALS

The value of nonmetal commodities decreased 13 percent in 1965.

Based on gamma ray logs, the North Dakota Geological Survey has reported potash deposits up to 20 feet thick in the Devonian Prairie formation in northwestern North Dakota at depths ranging from 5,800 to 12,500 feet. This depth makes exploitation contingent on solution mining.

Clays.—Clay production continued to decrease in 1965. Fire clay, produced in one county, was used in manufacturing sewer tile. Miscellaneous clay, including shale, was used in manufacturing lightweight aggregate, building brick, and other heavy clay products. A small quantity of bentonite was produced for manufacturing prepared mortar.

Gem Stones.—Agate, chalcedony, jasper, petrified wood, and other gem stones and mineral specimens, valued at $1,000, were collected.

Lime.—Lime production was reported for the first time in 1965. American Crystal Sugar Co. produced lime for manufacturing sugar at its new $22.7 million processing plant at Drayton.

Salt.—Salt production, by solution mining from the Charles formation, decreased 23 percent. The salt was used principally for stock and other feeds, oil well drilling, and water softening. Shipments were made to neighboring States, to the upper Midwest, and to Canada.

Sand and Gravel.—Sand and gravel, mostly used in constructing Federal-aid highways, comprised 8 percent of the State total value of mineral production. Output and value, however, decreased 28 and 22 percent, respectively.

The State planned to award $27.5 million in highway-construction contracts in 1966, 3 percent more than in 1965.[7] At yearend, of a total 570.6 miles designated Interstate and Defense Highway System, 326.4 miles (27th in the Nation) was open to traffic, 165.4 miles was underway, and 78.8 miles was not yet in progress.[8]

Seven leading commercial producers accounted for 22 percent of the total production and 26 percent of the total value of sand and gravel.

Production by Government crews and contractors, 25 percent and 75 percent, respectively, was used almost entirely for road construction. Production was at 282 operations, 34 percent less than in 1964. There were 69 commercial operations and 213 Government-and-contractor operations.

Prices ranged from $1.47 per ton for building gravel to $0.50 per ton for gravel used for miscellaneous uses. The average value of all sand and gravel produced was $1.04 per ton, an increase of $0.08 per ton over that produced in 1964.

Stone.—Output of stone, used for riprap, concrete, and roadstone, increased sharply. Most of the production was used by contractors for the North Dakota State Highway Department for construction of Federal-aid and State highways.

Sulfur.—Elemental sulfur was recovered as a byproduct at the natural gas processing plants at Lignite in Burke County and at the plant at Tioga in Williams County. The quantity recovered was 28,804 tons. Shipments from production and stockpiles were 31,677 tons, a 24-percent increase over 1964.

METALS

Molybdenum.—Two companies reported recovery of molybdenum from uraniferous-lignite ores. Mines Development, Inc.,

[6] Minot Daily News. Minot, N. Dak., Sept. 10, 1965, p. 2.

[7] Engineering News-Record. State Highway Contracting Plans: 1966 Will Be a Record Breaker. V. 176, No. 14, Apr. 7, 1966, pp. 74–76.

[8] Bureau of Public Roads. Quarterly Report on The Federal-Aid Highway Program, Dec. 31, 1965. Press Release BPR 66–5, Feb. 9, 1966, Table 1.

Table 7.—Sand and gravel sold or used by producers, by classes of operations and uses
(Thousand short tons and thousand dollars)

Class of operation and use	1964		1965	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Construction:				
Building	375	$507	325	$392
Paving	225	260	202	224
Fill	52	52	186	194
Total	652	819	713	810
Gravel:				
Construction:				
Building	490	735	363	538
Paving	972	1,237	1,193	1,606
Railroad ballast	468	288	321	201
Fill	244	194	397	390
Other	--	--	2	1
Miscellaneous	14	7	--	--
Total	2,188	2,461	2,276	2,736
Total sand and gravel	2,840	3,280	2,989	3,546
Government-and-contractor operations:				
Sand:				
Paving	3,074	2,503	1,702	1,462
Gravel:				
Building	1	1	8	8
Paving	4,605	4,358	2,875	2,879
Total	4,606	4,359	2,883	2,887
Total sand and gravel	7,680	6,862	4,585	4,349
All operations:				
Sand	3,726	3,322	2,415	2,272
Gravel	6,794	6,820	5,159	5,623
Total	10,520	10,142	7,574	7,895

from ores mined in Billings County, and Union Carbide Corp., from ores mined in Billings and Stark Counties. Quantity and value increased nearly threefold in 1965.

Uranium Ore.—The quantity and value of uranium oxide, contained in ash derived from uraniferous lignite, increased substantially. Three firms — Union Carbide Corp.; Susquehanna-Western, Inc., a subsidiary of Susquehanna Corp.; and Geo Resources Exploration, Inc.—mined uranium-bearing lignite in Billings, Slope, and Stark Counties. The uranium ore was recovered by strip mining lignite, which was concentrated into ash by burning. The ash was shipped to mills in Colorado and South Dakota for further processing. A total of 44,558 short tons of ash concentrate was produced, valued at $30 per ton.

Union Carbide Corp. burned uraniferous-lignite, 24 hours per day, 7 days per week, at its Belfield plant and shipped the uranium ash by rail to Rifle, Colo. Susquehanna-Western, Inc., burned its ore at mine sites and shipped the ash to its mill operated by Mines Development, Inc., a subsidiary of Suequehanna Corp., at Edgemont, S. Dak. Geo Resources Exploration, Inc., burned most of its ore in place at its strip mine, 15 miles south of Belfield, and shipped the ash to the Union Carbide Corp. mill at Rifle, Colo; a small amount of crude material from the mine was shipped to the Union Carbide Corp. burning plant at Belfield. Kerr-McGee Corp. operated its new $500,000 burning plant at Bowman. The ash was shipped to its uranium mill at Grants, N. Max.

Vanadium.—At its plant at Rifle, Colo., Union Carbide Corp. recovered vanadium from uraniferous-lignite ores, mined in Billings and Stark Counties.

REVIEW BY COUNTIES

Billings.—The county was ranked sixth in the State in petroleum production, which increased 68 percent. The new Medora field, yielding 433,334 barrels of oil, accounted for this great increase. Among the various oilfields, the Fryburg field, with its three producing zones, again had the greatest production in the county.

Uranium output, produced by burning uraniferous lignites, increased 84 percent in tonnage and 109 percent in value; by-product molybdenum and vanadium also were recovered.

Bottineau.—The county again was the fourth largest oil-producing county; output was slightly higher than in 1964. From among the 28 distinct pools, in 27 fields, the Newburg field had the largest production.

Production of sand and gravel, used mostly by the State and county highway departments, increased 53 percent.

The production of peat, mined and dried for use as a soil conditioner, from bog deposits in the Turtle Mountains, increased.

Bowman.—Output of coal (lignite) declined 40 percent.

The county was ranked second, 33 percent of the State total, in the production of stone.

Oil production from the two fields decreased 11 percent; drilling activity remained at a low level. One wildcat and four development wells were drilled.

Burke.—Although petroleum production declined slightly, the county again was the third largest oil producer in the State; 20 fields were all productive from the Madison formation. North Tioga, Black Slough, and Rival were the three fields with the largest production.

The county was ranked second in the State in output of coal (lignite). Strip mines yielded 510,946 tons of lignite coal.

Burleigh.—With 12 percent of the State total output of sand and gravel, the county was ranked first. Building and fill sand and gravel and paving gravel were produced by Dakota Sand & Gravel Co., and Northern Improvement Co. produced building, paving, and fill sand and gravel. Contractors for the city of Bismarck produced paving sand and gravel, and crews produced paving gravel; contractors produced paving sand and gravel for the Burleigh County Highway Department and paving sand for the North Dakota State Highway Department. Much of this production was used in the construction of Interstate Highway 94.

Ecklund-Taplin Coal Co. was again the only coal operator in the county.

Divide.—The county was ranked third in production of clays. Baukol-Noonan, Inc., produced and used clay in manufacturing lightweight aggregate at its plant at Noonan.

Petroleum output from the six fields in the county was 8 percent below that of 1964.

Dunn.—The Lost Bridge oilfield continued to decline in production, down 14 percent from its 1964 output.

Along with Grand Forks County, Dunn was ranked fourth in the State in the production of sand and gravel. All sand and gravel was produced by contractors for the North Dakota State Highway Department.

Eddy.—Ranked second in the State, the county produced 6 percent of North Dakota's sand and gravel. Building sand and gravel, and paving, railroad-ballast, and fill gravel produced by Sheyene Sand & Gravel, Inc., and railroad-ballast gravel produced by Northern Pacific Railway Co. comprised the major portion of the county total. Contractors for the Federal Bureau of Public Roads produced paving gravel; contractors for the North Dakota State Highway Department produced paving sand and gravel.

Grand Forks.—The county, along with Dunn County, was ranked fourth in the State in sand and gravel production. Ninety-six percent of all sand and gravel produced was used for paving. Paving sand and gravel, produced by the North Dakota State Highway Department crews and contractors, comprised 64 percent of the county total. Davidson Gravel Supply produced building sand and gravel, paving gravel, and fill sand. Contractors for the city of Grand Forks and the U.S. Army Corps of Engineers produced paving sand and gravel, and crews and contractors for the Grand Forks County Highway Department and crews for the University of North Dakota produced paving gravel.

McKenzie.—Petroleum production in McKenzie County—largest in the State—

Table 8.—Value of mineral production in North Dakota, by counties

County	1964	1965	Minerals produced in 1965 in order of value
Adams	$52,187	$98,158	Coal, sand and gravel, clays.
Barnes	248,900	W	Sand and gravel.
Benson	233,000	101,000	Do.
Billings	2,276,075	3,690,684	Petroleum, uranium ore, sand and gravel, natural gas, stone, molybdenum, vanadium.
Bottineau	6,595,750	7,017,700	Petroleum, sand and gravel, natural gas, peat.
Bowman	2,426,349	2,243,018	Petroleum, stone, coal, natural gas, sand and gravel.
Burke	r 13,411,758	12,071,775	Petroleum, natural gas, coal, LP gases, natural gasoline, sand and gravel.
Burleigh	619,660	932,752	Sand and gravel, coal.
Cass	38,000	68,000	Sand and gravel.
Cavalier	60,000	255,000	Do.
Dickey	354,000	93,000	Do.
Divide	1,031,647	940,160	Petroleum, sand and gravel, natural gas, LP gases, clays, natural gasoline.
Dunn	107,427	361,400	Sand and gravel, petroleum, coal, natural gas, stone.
Eddy	292,000	367,000	Sand and gravel.
Emmons	94,000	3,000	Do.
Foster	41,000	114,000	Do.
Golden Valley	18,000	12,000	Do.
Grand Forks	692,500	326,000	Do.
Grant	199,969	169,507	Sand and gravel, coal.
Hettinger	82,217	7,000	Coal.
Kidder	40,000	58,000	Sand and gravel.
La Moure	10,000	94,000	Do.
Logan	198,700	----------	
McHenry	286,000	W	Sand and gravel, petroleum, natural gas.
McIntosh	90,000	203,000	Sand and gravel.
McKenzie	r 20,680,000	21,622,750	Petroleum, natural gas, LP gases, natural gasoline, stone.
McLean	512,580	590,456	Stone, coal, sand and gravel.
Mercer	W	3,131,411	Coal, sand and gravel.
Morton	797,872	203,769	Sand and gravel, clays, coal, stone.
Mountrail	4,214,000	3,367,000	Petroleum, natural gas, sand and gravel.
Nelson	60,000	169,000	Sand and gravel.
Oliver	W	124,038	Sand and gravel, coal.
Pembina	65,000	W	Lime, sand and gravel.
Pierce	75,000	107,000	Sand and gravel.
Ramsey	231,000	270,000	Do.
Ransom	48,000	112,000	Do.
Renville	5,396,000	6,543,000	Petroleum, sand and gravel, natural gas.
Richland	38,000	223,000	Sand and gravel.
Rolette	313,000	249,000	Do.
Sargent	136,000	W	Do.
Sheridan	8,000	17,000	Do.
Sioux	204,000	46,000	Do.
Slope	172,000	W	Uranium ore.
Stark	1,098,038	1,896,222	Uranium ore, sand and gravel, petroleum, coal, molybdenum, vanadium, clays, natural gas, stone.
Steele	W	W	Sand and gravel.
Stutsman	337,000	273,860	Sand and gravel, stone.
Towner	W	W	Sand and gravel.
Traill	305,000	309,000	Do.
Walsh	436,000	152,000	Do.
Ward	2,163,971	1,411,361	Coal, sand and gravel, petroleum, stone.
Wells	121,000	90,000	Sand and gravel.
Williams	r 22,990,971	21,415,531	Petroleum, natural gas, LP gases, salt, natural gasoline, sand and gravel, coal.
Undistributed [1]	r 2,964,853	1,328,567	
Total	92,866,000	92,878,000	

r Revised. W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] Includes gem stones and some sand and gravel (1965) that cannot be assigned to specific counties, and values indicated by symbol W.

increased 7 percent to 7.5 million barrels. The 14 fields had 22 producing horizons. Antelope, Blue Buttes, and Charlson were the largest fields in terms of production.

The county was ranked third in the State in the output of stone, all produced by the McKenzie County Highway Department.

McLean.—The county, ranked first in stone production, increased its output 323 times over that of 1964. The material was produced for the U.S. Army Corps of Engineers.

Mercer.—Continuing to lead the State in coal (lignite) output, the county had a 24-percent increase and accounted for 56

percent of all coal produced within the State.

Morton.—The county was ranked first in production of North Dakota clay. Hebron Brick Co. produced miscellaneous clay for manufacturing brick and bentonite for use in prepared mortar. Baukol-Noonan, Inc., produced shale for manufacturing lightweight aggregates.

In output of sand and gravel, the county dropped from 2d in 1964 to 32d in 1965, 90 percent less.

Renville.—Petroleum output, from six fields being produced from the Madison formation, increased 23 percent to 2.5 million barrels. The county had more drilling than any other except Bottineau. The Vaughn Petroleum, Inc., No. 1 Palmer well sec 11 T 158 N, R 82 W, Glenburn field was completed in February, pumping 150 barrels of oil per day from the interval 4550–4554 in the Mission Canyon (Madison) formation.

Stark.—The county was ranked first in the State in the production of uranium ore, and first in the production of byproduct molybdenum and vanadium from lignite ash. Union Carbide Corp. concentrated uranium-bearing lignite at its $300,000 burning plant at Belfield.

The county was ranked fifth in coal (lignite) production. Coal (lignite) was produced at strip mines by Dickinson Coal Mining Co., Schultz & Lindsay Construction Co., and Walter's Coal Mine.

Fisher Sand & Gravel Co. produced building, paving, and fill sand and gravel. Contractors produced paving sand and gravel for the North Dakota State Highway Department; Stark County Highway Department crews produced paving gravel. The county was ranked sixth in the State in output of sand and gravel, mostly used in constructing highways, and second in clay production. Bison Clay Products Co., Inc., produced fire clay for manufacturing heavy clay products.

Ward.—The county was ranked third in the State in sand and gravel production and in coal (lignite) output. Production in these commodities decreased 55 and 25 percent, respectively. Atlas Sand & Gravel, Inc., produced building, paving, and fill sand and gravel. Minot Sand & Gravel Co. produced building, paving, and fill sand and gravel, and railroad-ballast gravel. Everetts & Associates, Oberg Construction Co., and Ward County crews and North Dakota State Highway Department crews and contractors produced paving gravel. Soo Line Railroad Co. produced railroad-ballast gravel.

Coal (lignite) was produced from the Velva strip mine, Truax-Traer Coal Co.; the Miller strip mine, Sawyer Fuels, Inc.; and the Valley strip mine, Valley Coal Co.

Petroleum production from the Southwest Aurelia field declined 73 percent.

Williams.—Petroleum production declined 7 percent, to 6.6 million barrels. The county was ranked second in the State, after McKenzie County, in oil production; 10 fields produced oil from 15 pools.

Dakota Salt and Chemical Co. produced salt by solution mining of beds through 8,500-foot wells in the Charles formation.

The Mineral Industry of Ohio

By Joseph Krickich [1]

Mineral production in Ohio in 1965 established a record high of $464.3 million, exceeding the previous high year, 1964, by $9.3 million. Record production of salt and sand and gravel and substantial increases in output of bituminous coal and stone were largely responsible for the overall gain. Significant increases were also recorded for abrasive stone and gypsum. Cement production and shipments were down because of fewer operating plants. Clay production and value remained relatively stable.

Legislation and Government Programs.—A new law affecting Ohio strip mines became effective November 12. Main features of the law were its requirement that strip mine operators submit a reclamation plan to the Division of Forestry and Reclamation for approval prior to issuance of a license, and its authorization of the Division Chief to refuse a license in areas that cannot be adequately reclaimed. The amount of bond to guarantee reclamation was raised from $220 to $300 per acre. License fees were increased from $50.00 to $75.00 and acreage fees raised $5.00 to $15.00. Other provisions of the law included: Authority of the Chief of the Division of Forestry and Reclamation to require the operator to perform reclamation work at any time it was judged necessary, operators were required to cover exposed coal seams at the bottom of high walls with either overburden or impounded water, and authority of the State's Attorney General to take legal action to require compliance with reclamation orders.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Abrasive Stones.—Abrasive stones (grindstones) were produced in Lorain and Washington Counties. Output and value were above that of 1964.

Cement.—Production, shipments, and value of portland and masonry cement decreased compared with that of 1964. The decline was attributed chiefly to lower productive capacity as the number of active plants dropped from 10 in 1964 to 9 in 1965. Total plant capacity was 19.7 million barrels compared with 22.4 million barrels in 1964. The Painesville, Lake County, plant of Standard Portland Cement Division, Diamond Alkali Co., discontinued operations at the end of 1964. Additionally, lower unit prices were recorded; portland cement dropped from $3.26 per barrel to $3.21, and masonry cement was down to $2.86 per barrel compared with $2.93 the previous year. Greene, Muskingum, and Lawrence Counties were the leading cement-producing areas. Plants also were active in Lucas, Paulding, Stark, and Summit Counties.

Portland cement was shipped primarily to consumers in Ohio, Michigan, West Virginia, and Indiana. Masonry cement shipments were chiefly to Ohio and Indiana. Of the total portland cement shipments, 65 percent went to ready-mixed concrete companies and 16 percent to concrete product manufacturers. The remainder in decreasing order went to highway and other contractors, building materials dealers, miscellaneous customers, and Federal, State, and local governmental agencies. Over 12.9 million barrels were shipped by truck and 1.9 million barrels by rail. Bulk shipments predominated; only 7 percent was shipped in containers.

[1] Mineral specialist, Bureau of Mines, Pittsburgh, Pa.

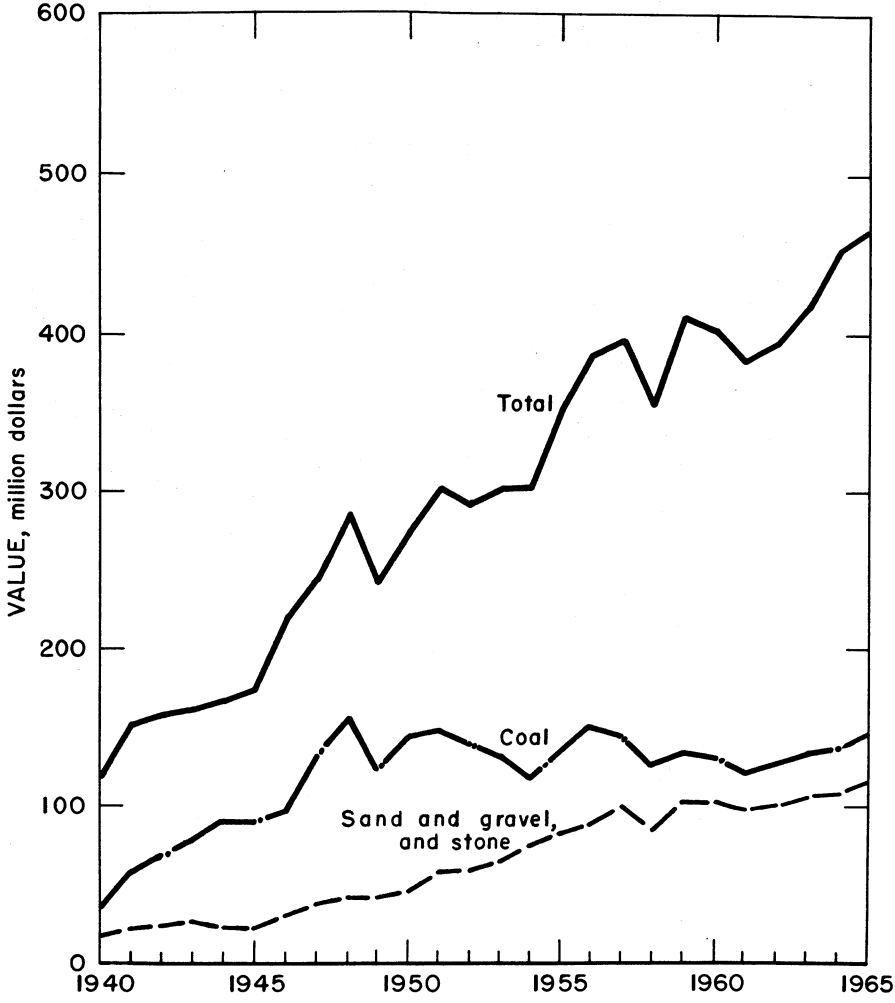

Figure 1.—Value of coal, sand and gravel, and stone, and total value of mineral production in Ohio.

In National Safety Competition, two companies had outstanding safety records for the year. The Ironton mine of Alpha Portland Cement Co. and the Jonathan mine of Columbia Cement Corp. were awarded Certificates of Achievement in Safety for working without any disabling injuries.

Clays.—Production of clays (fire clay and miscellaneous clay and shale) continued to increase. The 1-percent increase was due primarily to greater demand for refractory clay used by the iron and steel industry. Fire clay production more than offset decreased output of miscellaneous clay and shale. Production of refractory clays increased 9 percent and totaled 1.1 million tons. Output of clay used for heavy clay products (mainly building brick) increased by 35,000 tons to 2.9 million tons. Cement companies produced less clay for manufacturing cement, 604,000 tons compared with

Table 1.—Mineral production in Ohio [1]

Mineral	1964 Quantity	1964 Value (thousands)	1965 Quantity	1965 Value (thousands)
Cement:				
Portland ---376-pound barrels	15,552,652	$50,647	14,786,190	$47,499
Masonry ---280-pound barrels	1,067,720	3,127	1,050,064	3,004
Clays---thousand short tons	5,005	14,426	5,070	14,816
Coal (bituminous) ---do---	37,310	137,776	39,390	146,028
Gem stones	NA	3	NA	3
Lime---thousand short tons	3,664	53,308	3,831	53,208
Natural gas---million cubic feet	37,106	8,880	35,684	8,421
Peat ---short tons	6,363	83	5,352	80
Petroleum (crude) thousand 42-gallon barrels	15,859	46,420	12,908	37,940
Salt---thousand short tons	4,537	31,092	5,026	34,816
Sand and gravel---do---	37,771	45,567	40,852	49,305
Stone ---do---	37,715	61,814	42,263	66,969
Value of items that cannot be disclosed:				
Abrasive stones and gypsum	XX	1,794	XX	2,163
Total	XX	454,937	XX	464,252

NA Not available. XX Not applicable.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Value of mineral production in constant 1957–59 dollars

(Millions)

Year	Value
1956	$381
1957	381
1958	347
1959	398
1960	397
1961	391
1962	409
1963	439
1964	r 472
1965	483

r Revised.

728,000 tons in 1964. Output of clay by the State's only producer of lightweight aggregate in Cuyahoga County was virtually the same as the previous year. Fifty-one percent of the total clay production was miscellaneous clay or shale and the remainder was fire clay. Miscellaneous clay was produced in 37 counties; Cuyahoga, Tuscarawas, and Stark Counties led in tonnage produced. Tuscarawas, Stark, and Columbiana Counties led in output among the State's 16 fire-clay producing areas.

Table 3.—Employment and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries: Fatal	Number of injuries: Non-fatal	Injury rates per million man-hours: Frequency	Injury rates per million man-hours: Severity
1964:								
Coal	7,733	228	1,763	14,205	6	291	20.91	4,013
Peat	19	105	2	14	--	1	69.85	4,889
Metal and nonmetal	2,633	252	664	5,318	--	113	21.25	736
Sand and gravel	2,328	221	515	4,240	2	70	16.98	4,973
Stone	5,514	278	1,531	12,429	6	169	14.08	3,658
Total	18,227	246	4,475	36,206	14	644	18.17	3,523
1965: p								
Coal	7,900	223	1,758	13,470	8	300	22.87	5,167
Peat	18	111	2	14	--	--	--	--
Metal and nonmetal	2,620	265	695	5,560	2	137	25.00	3,352
Sand and gravel	2,310	244	563	4,634	4	59	13.60	5,701
Stone	5,725	274	1,567	12,723	4	141	11.40	2,235
Total	18,573	247	4,585	36,401	18	637	17.99	3,931

p Preliminary.

Table 4.—Finished portland cement produced, shipped, and in stock

(Thousand barrels and thousand dollars)

Year	Number of active plants	Production	Shipments from mills		Stocks at mills, Dec. 31
			Quantity	Value	
1956–60 (average)	10	16,417	16,092	$52,916	1,856
1961	10	15,059	15,303	53,251	1,695
1962	10	15,465	15,353	51,006	1,857
1963	10	16,300	16,218	53,244	2,064
1964	10	15,606	15,553	50,647	2,079
1965	9	14,599	14,786	47,499	1,600

Gem Stones.—Mines and quarries throughout the State continued to attract gem and mineral specimen collectors. Value remained the same as that of 1964. Specimens collected included calcite, celestite, and flint.

Gypsum.—Output and value of crude gypsum continued to increase. Production was from two underground mines in Ottawa County, the only source of gypsum in the State. Crude gypsum was calcined at nearby plants as well as in Lorain County. The Gypsum, Ottawa County, mine of United States Gypsum Co. was awarded a Certificate of Achievement in Safety in 1965 National Safety Competition for working 65,693 man-hours without any disabling injuries.

Iron Oxide Pigments.—Minnesota Mining & Manufacturing Co. produced red iron oxide pigments at Copley, Summit County. The company used mainly pyrite cinder shipped from Delaware as its primary raw material.

Lime.—Production of lime reached a record high, increasing 5 percent above that of the high year, 1964. The increase was attributed primarily to a greater demand for chemical and industrial lime, which offsets a decline in construction and refractory lime. Output of agricultural lime (aglime) increased and reversed a 10-year downward trend. Total value of lime was below that of 1964 owing to lower value per ton for each type of lime. The greatest change was in chemical and industrial lime, which dropped from $12.20 to $11.69. Nationally, Ohio accounted for 23 percent of the output and was the leading lime-producing State.

Regenerated lime was produced in Montgomery and Ross Counties and was not included in the data reported in table 5. Primary lime production was predominantly quick-lime used mainly for chemical and other industrial uses. Hydrated lime was used mostly in construction. Primary lime was produced in 14 counties; Sandusky County continued as the leading area.

Over 2.2 million tons of the total lime production was captive tonnage or was marketed in Ohio. Pennsylvania and Michigan continued as leading marketing areas for Ohio lime, accounting for 11 percent and 7 percent, respectively. Significant shipments were also made to Indiana and Illinois. Exports were made to Canada, Chile, United Kingdom, and Venezuela. At active plants, shaft-type kilns predominated, and hydrated lime producers used both batch and continuous-type hydrators. Anthracite and bituminous coal, coke, natural gas, producer gas, and carbon monoxide were used as fuels at plants.

Table 5.—Lime sold or used by producers, by uses

(Thousand short tons and thousand dollars)

Year	Agricultural		Building		Chemical and other industrial		Refractory		Total	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1956–60 (average)	33	$476	496	$8,740	1,212	$12,600	1,154	$18,420	2,895	$40,236
1961	27	381	399	7,400	1,615	17,864	1,007	15,621	3,048	41,266
1962	26	396	383	7,257	1,743	20,734	950	15,405	3,102	43,792
1963	24	393	369	7,003	1,820	22,187	994	16,374	3,207	45,957
1964	23	352	374	7,561	2,147	26,209	1,120	19,186	3,664	53,308
1965	27	410	327	6,425	2,387	27,905	1,090	18,468	3,831	53,208

Perlite (Expanded).—Crude perlite shipped from western States was processed by The Cleveland Gypum Co., Division of Cleveland Builders Supply Co., Cleveland; National Gypsum Co., Lorain; and The Philip Carey Manufacturing Co., Lockland. Expanded perlite was used mainly in plaster and concrete aggregate and for insulation.

Salt.—Total output of salt in Ohio reached a record high as production exceeded 5 million tons for the first time. Output rose 11 percent above that of the previous high year, 1964, and value was $3.7 million greater. Rock and evaporated salt output was greater, but brine production declined. Rock salt recovered from underground mines was sold mainly for controlling icy highways. Evaporated salt was marketed for a wide variety of uses. Most of the brine output was used by producers for manufacturing chlorine and soda ash. Lake County ranked first in output, followed by, in decreasing order, Summit, Cuyahoga, Wayne, and Meigs Counties.

Sand and Gravel.—Production of sand and gravel increased 8 percent above that of 1964; output was 2.2 million tons above the previous record high year, 1959. The record output reflected increased construction activity throughout the State. Building and highway construction sand and gravel totaled 33.9 million tons, an increase of 1.8 million tons above that of the previous year. Demand for other construction sand and gravel as well as for industrial sand was higher also. Industrial sand production was 1.4 million tons valued at $5.4 million, 12 and 9 percent, respectively, greater than that of 1964.

Commercial producers were active in 68 counties; Franklin and Hamilton Counties were the leading areas. Butler, Montgomery, and Portage Counties were also important sand and gravel-producing areas. Commercial producers processed nearly 36 million tons of sand and gravel. Shipment to consumers was by truck, 94 percent; rail, 4 percent; and the remainder by water.

Operations throughout the State ranged from the small independent bank-run pit to large volume, automated washing and screening plants. Output exceeding 1 million tons was produced at three operations, and five operations had tonnages in the 500,000 to 1,000,000 ton range. Over 30 percent of the active operations produced less than 25,000 tons and accounted for only 3 percent of the total commercial tonnage.

Stone.—The continuing high level of activity in all phases of highway and building construction resulted in greater production of stone (limestone and sandstone). Total stone output increased 12 percent above that of 1964, and the value was $5.2 million higher. Output of crushed limestone, which accounted for over 98 percent of the total stone tonnage, was 4.4 million tons above the previous year. The increase was attributed mainly to higher aggregate and fluxing stone production. In addition, greater production for all other major uses of limestone was recorded. Limestone was quarried in 54 counties; Sandusky, Erie, Wyandot, and Seneca Counties were the leading areas for production.

Dimension sandstone production declined, but value was above that of 1964. Most of the material was fabricated for use in architectural applications and as firestone in lining furnaces. Output of crushed sandstone, used chiefly for refractory (ganister), increased 13 percent over that of the previous year. Other uses of crushed sandstone included aggregate, riprap, glass and cement manufacture, and abrasive uses. Of the 14 sandstone-producing counties, Lorain County ranked first in quantity and value. No production of calcareous marl was reported as in previous years.

The Barberton, Summit County, limestone mine of Pittsburgh Plate Glass Co., Chemical Division, won the 1965 underground nonmetal category of National Safety Competition sponsored jointly by the Bureau of Mines and the American Mining Congress. The mine was awarded the Sentinel of Safety trophy for working 342,510 man-hours without any disabling injuries. The mine has been a participant in the competitions for the past 5 years.

Sulfur (Recovered Elemental).—Production, shipments, and value of elemental sulfur recovered at the Toledo refinery of Sun Oil Co. were greater than that of 1964. The company recovered sulfur by the catalytic oxidation of hydrogen sulfide.

Vermiculite (Exfoliated).—Crude vermiculite shipped from out of the State was exfoliated at the Cleveland plant of The Cleveland Gypsum Co., Division of Cleve-

Table 6.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1964		1965	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	6,419	$6,915	6,407	$6,974
Paving	7,651	7,774	7,917	8,347
Fill	752	563	1,556	937
Molding	507	2,052	525	2,198
Filtration	14	47	W	W
Other [1]	865	2,975	1,081	3,416
Total	16,208	20,326	17,486	21,872
Gravel:				
Building	5,745	7,009	6,219	7,502
Paving	12,208	14,688	13,312	16,117
Railroad ballast	21	16	3	2
Fill	1,809	1,023	2,054	1,184
Other	1,530	2,413	1,650	2,541
Total	21,313	25,149	23,238	27,346
Total sand and gravel	37,521	45,475	40,724	49,218
Government-and-contractor operations:				
Sand:				
Fill	-----	-----	16	21
Gravel:				
Paving	250	92	102	59
Fill	-----	-----	10	7
Total	250	92	112	66
Total sand and gravel	250	92	128	87
All operations:				
Sand	16,208	20,326	17,502	21,893
Gravel	21,563	25,241	23,350	27,412
Grand total	37,771	45,567	40,852	49,305

W Withheld to avoid disclosing individual company confidential data; included with "Other."

[1] Includes the following sands: Glass, grinding and polishing, blast, fire or furnace, engine, ground, other, and data indicated by symbol W.

land Builders Supply Co. The processed material was used in plaster and concrete aggregate, horticultural, and other industrial applications.

MINERAL FUELS

Coal (Bituminous).—For the fourth consecutive year, production of bituminous coal increased and reached the highest level since 1923. Output was over 2 million tons greater than that of 1964; the average value per ton increased from $3.69 to $3.71. Strip mines supplied 67 percent of the output; the remainder came from underground (29 percent) and auger (4 percent) mines. A total of 417 mines producing 1,000 tons or more were active, 3 less than the total in 1964. The number of active strip and auger mines increased, but active underground mines dropped from 111 in 1964 to 93.

Strip mine production was 26.4 million tons, over 1.5 million tons greater than that of 1964. Harrison, Jefferson, Belmont, and Noble Counties, in decreasing order of tonnage, were the leading strip mine areas. Average value per ton was $3.49 compared with $3.48 in 1964. Nearly 11.3 million tons of coal was produced at underground mines, 5 percent above that of 1964. Underground mines were active in 18 counties; over half of the underground tonnage was produced in Harrison and Belmont Counties. Average value per ton increased from $4.26 to $4.31. The number of continuous mining machines used at underground mines increased from 45 to 52. Auger-mined output remained at 1.8 million tons, but the average value was below

Table 7.—Crushed and broken limestone sold or used by producers, by uses [1]

(Thousand short tons and thousand dollars)

Use	1964		1965	
	Quantity	Value	Quantity	Value
Riprap	192	$235	218	$314
Concrete aggregate and roadstone	18,993	24,941	22,465	29,747
Fluxing stone	4,952	7,668	5,811	8,876
Agriculture	2,176	3,842	2,031	3,626
Railroad ballast	942	1,162	1,103	1,359
Cement	3,981	5,563	4,001	5,260
Lime	5,055	9,084	5,088	8,398
Miscellaneous uses	802	2,298	815	2,338
Total	37,093	54,794	41,533	59,917

[1] Data may not add to totals shown because of rounding.

that of 1964. Auger mines were operated in 15 counties, but over 50 percent of the tonnage was produced in Belmont, Perry, Noble, and Jefferson Counties.

The number of coal preparation plants remained at 22. Of the 14.3 million tons of coal cleaned at preparation plants, only 6 percent was by pneumatic methods and the remainder was by washing. Nearly 20.3 million tons of coal was crushed and 4.9 million tons was treated with antifreezing and dust-allaying materials. Production at captive mines totaled 5.8 million tons. Producers shipped 23.5 million tons of coal by rail or water, and the remainder was shipped by truck or consumed locally.

In National Safety Competition, four strip mines were given Certificate of Achievement in Safety awards for their safety records in 1965. They were the Mapleton mine of Magnolia Mining Co. and the Georgetown No. 12, Bradford No. 16, and West Farm No. 22 mines of Hanna Coal Co., Division of Consolidation Coal Co. Preliminary employment data indicated that an average of 7,800 men worked 13.5 million man-hours. Eight fatalities and 300 nonfatal injuries occurred at Ohio coal mines. Of the eight fatalities, five were at underground mines and three at strip mines. The State's fatality rate of 0.20 per million man-hours was the lowest in the Nation and well below the national average of 0.49.

Table 8.—Bituminous coal production

(Thousand short tons and thousand dollars)

Year	Quantity	Value
1956–60 (average)	35,378	$137,526
1961	32,226	121,343
1962	34,125	127,051
1963	36,790	136,113
1964	37,310	137,776
1965	39,390	146,028

Packaged Fuel.—Ralph Coal & Supply Co., Toledo, produced packaged fuel from low-volatile bituminous coal. Production and value were below that of 1964.

Peat.—Shipments and value of peat were below that of 1964, but the average value per ton increased from $12.98 to $14.99. Output was from five counties; Stark County with three operations ranked first in tonnage. Most of the peat was marketed in bulk form and consisted chiefly of the moss variety. Peat reserves at active operations were 513,300 tons.

Petroleum and Natural Gas.—Production of petroleum declined, but natural gas output increased above that of 1964. Total well completions decreased from 2,489 in 1964 to 1,896 and total footage drilled dropped from 6,815,000 to 5,609,000. A total of 1,584 development completions were made; Morrow County led with 617 wells. Other leading areas were Perry (112), Knox (99), Coshocton (88), and Licking (87). Wildcat completions dropped from 610 in 1964 to 312 (22 oil, 26 gas, and 264 dry). Exploratory wells were drilled in 53 counties, and most of them were drilled to depths of less than 5,000 feet. Morrow and Delaware Counties with 55 and 39 wildcat completions, respectively, were the areas with the greatest wildcat activity [2].

Crude reserves on December 31, 1964 were 754,837 million cubic feet of natural gas (14.73 pounds per square inch absolute, at 60° F) and 100.9 million barrels of

[2] Oil and Gas Journal. V. 64, No. 5, Jan. 31, 1966.

Table 9.—Coal (bituminous) production, by counties

(Thousand short tons and thousand dollars)

County	1964					1965				
	Number of mines			Total production		Number of mines			Total production	
	Underground	Strip	Auger	Quantity	Value	Underground	Strip	Auger	Quantity	Value
Athens	11	2	1	147	$577	9	3	---	142	$487
Belmont	11	20	6	7,835	31,688	9	21	12	7,698	31,235
Carroll	3	9	1	272	915	1	7	---	268	925
Columbiana	3	37	10	1,528	4,849	3	38	8	1,428	4,476
Coshocton	6	8	2	2,302	9,481	5	11	1	2,606	10,781
Gallia	15	7	3	615	1,855	12	7	3	494	1,413
Guernsey	1	6	3	308	1,033	1	6	1	365	1,144
Harrison	8	11	5	7,663	31,273	6	13	3	8,585	34,414
Hocking	2	5	1	79	260	1	6	1	103	339
Holmes	1	3	---	205	623	1	1	---	188	631
Jackson	6	12	---	563	1,946	6	12	---	609	2,316
Jefferson	7	31	9	4,308	15,571	8	34	10	4,970	17,802
Lawrence	1	3	---	W	W	---	3	---	W	W
Mahoning	---	14	---	789	2,894	---	16	1	689	2,582
Meigs	8	4	2	406	1,145	8	5	3	257	885
Morgan	1	4	---	1,870	5,589	1	3	---	1,800	5,844
Muskingum	7	4	1	116	496	5	7	---	132	575
Noble	---	11	4	2,722	8,148	---	9	4	2,985	8,534
Perry	7	9	2	W	W	5	9	1	W	W
Portage	---	1	---	W	W	---	1	---	7	27
Stark	---	12	1	407	1,297	---	14	1	435	1,401
Tuscarawas	9	36	3	2,469	8,298	9	29	10	2,936	10,175
Vinton	4	3	---	160	605	3	5	---	141	558
Washington	---	---	---	------	-------	---	1	1	W	W
Wayne	---	3	---	52	144	---	3	---	45	136
Undistributed	---	---	---	2,494	9,089	---	---	---	2,507	9,348
Total	111	255	54	37,310	137,776	93	264	60	39,390	146,028

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

petroleum, according to the American Gas Association and American Petroleum Institute. Natural gas in underground storage in the State on December 31, 1964, was 428,234 million cubic feet, an increase of 36,909 million cubic feet above that of 1964.

Eleven petroleum refineries were active; total crude oil capacity as of January 1, 1965, was 465,000 barrels per day, 2,600 barrels greater than that of 1964. Active refineries were at Canton, Cincinnati, Cleveland, Cleves, Findlay, Lima, Heath (Newark), and four at Toledo.

METALS

Aluminum.—Production of primary aluminum continued to increase; average value per ton also was greater than that of 1964. Aluminum was produced at the Hannibal reduction plant of Ormet Corp., jointly owned by Olin-Mathieson Chemical Corp. and Revere Copper & Brass, Inc. Olin-Mathieson operated a casting and rolling mill adjacent to the reduction plant.

Beryllium.—Beryllium metal, alloys, and compounds were produced by Brush Beryllium Corp. at Elmore.

Ferroalloys.—Shipments of ferroalloys totaled 755,000 tons valued at $149.4 million as the State continued to be the Nation's leading producer. Ferroalloys were produced by five companies operating plants at Ashtabula, Beverly, Brilliant, Cambridge, Jackson, Marietta, Philo, Powhatan Point, and Vancoram.

Iron and Steel.—According to the American Iron and Steel Institute, steel production was only 13,000 tons greater than that of 1964, totaling 22.2 million tons. Of the total, nearly 17 million tons were produced in open hearth furnace and bessemer converters; 2.7 million tons in basic oxygen furnaces; and the remainder was electric steel. Pig iron production totaled 15.3 million tons; shipments were 15,251,000 tons valued at $905.5 million. Shipments declined by 104,000 tons and value decreased by 2 percent. Seventeen plants and 39 blast furnaces were active. Over 12.9 million tons of basic pig iron were produced compared

with 13.1 million tons in 1964. Steel plants received 12.7 million tons of iron ore; 8.1 million tons was of domestic origin, and the remainder was imported mainly from Labrador and other parts of Canada.

Titanium.—Reactive Metals, Inc., jointly owned by United States Steel Corp. and National Distillers & Chemical Corp., produced titanium sponge metal at Ashtabula. The sponge was shipped to the company's Niles plant for melting and processing. Primary titanium metal shipped from Henderson, Nev. was rolled and fabricated at the Toronto plant of Titanium Metals Corp. of America (TMCA). Titania Corp., jointly owned by Cabot Corp. and Ruberoid Co., at Ashtabula produced titanium dioxide used in manufacturing paint.

Zirconium.—Zirconium chunklets were produced at the Ashtabula plant of Reactive Metals, Inc. The chunklets were shipped to Niles for ingot production. The Chas. Taylor Sons Co., Cincinnati, produced zircon- and zirconia-based refractories. Zirconium Corp. of America, Solon, produced zirconium oxide. Zirconium alloys were produced at the Cambridge plant of Vanadium Corp. of America.

REVIEW BY COUNTIES

Harrison County replaced Belmont County as the State's leading mineral-producing area. Values in excess of $10 million were reported in 12 other counties. No mineral production was reported in Clermont and Fulton Counties. County data on petroleum and natural gas operations were not available. Data on gem stones and some sand and gravel were not specified by county.

Adams.—Limestone used mostly for aggregate and blast-furnace flux was quarried by Davon, Inc., Peebles. Limestone for road construction and maintenance was produced by the Adams County Highway Department.

Allen.—Limestone production increased from 684,000 tons to 929,000 tons. Producers were National Lime & Stone Co. and Western Ohio Stone Co., both near Lima; Suever Stone Co., Delphos; and The Bluffton Stone Co., Bluffton. Wapak Sand & Gravel Co. produced construction sand and gravel at Westminster.

Ashland.—Commercial sand and gravel was produced by Bolin & Son, Ashland; Charles Bucklew, West Salem; and Young's Sand & Gravel Co., Loudonville. Output was greater that that of 1964 and consisted chiefly of processed construction material. Production by Government-and-contractor operations was the same as that of 1964. Shale for drain tile was produced by The E. Biglow Co., New London.

Ashtabula.—Quicklime for metallurgical and chemical uses was produced at Ashtabula. Sand and gravel production was below that of 1964. Construction sand and gravel was produced chiefly by Gleason Sand-Gravel, Inc., Conneaut, and Northeast Materials, Inc., Kingsville. Molding sand

Table 10.—Value of mineral production in Ohio, by counties [1,2]

County	1964	1965	Minerals produced in 1965 in order of value
Adams	$964,186	$1,266,766	Stone.
Allen	1,096,512	1,461,380	Stone, sand and gravel.
Ashland	W	W	Sand and gravel, clays.
Ashtabula	W	W	Lime, sand and gravel.
Athens	1,297,164	1,365,302	Coal, stone, clays, sand and gravel.
Auglaize	W	W	Sand and gravel, stone, clays.
Belmont	31,854,079	31,405,605	Coal, stone.
Brown	58,979	102,900	Stone, sand and gravel.
Butler	2,613,000	2,512,000	Sand and gravel.
Carroll	1,088,968	1,063,779	Coal, clays, sand and gravel, stone.
Champaign	305,000	W	Sand and gravel.
Clark	W	W	Sand and gravel, lime, stone.
Clinton	W	W	Stone, sand and gravel.
Columbiana	7,855,946	7,565,711	Coal, clays, sand and gravel.
Coshocton	11,019,155	12,164,347	Coal, sand and gravel, stone.
Crawford	W	W	Stone, sand and gravel.
Cuyahoga	6,929,470	W	Salt, lime, sand and gravel, clays.

See footnotes at end of table.

Table 10.—Value of mineral production in Ohio, by counties [1,2]—Continued

County	1964	1965	Minerals produced in 1965 in order of value
Darke	W	W	Sand and gravel, clays.
Defiance	W	W	Sand and gravel.
Delaware	$1,462,919	$1,600,139	Stone, lime, clays.
Erie	3,168,304	3,395,304	Stone, sand and gravel.
Fairfield	W	W	Sand and gravel.
Fayette	777,686	631,295	Stone.
Franklin	9,453,564	9,914,192	Sand and gravel, stone, lime, clays.
Gallia	2,504,351	2,233,239	Coal, stone, sand and gravel, clays.
Geauga	W	1,461,019	Sand and gravel, stone.
Greene	W	W	Cement, stone, sand and gravel, clays.
Guernsey	1,143,230	1,144,195	Coal.
Hamilton	5,663,249	W	Sand and gravel, stone.
Hancock	W	W	Stone, lime, clays, sand and gravel.
Hardin	W	W	Stone.
Harrison	31,490,175	34,709,562	Coal, stone, clays.
Henry	W	W	Sand and gravel, clays.
Highland	W	W	Stone, sand and gravel, clays.
Hocking	W	469,605	Coal, clays.
Holmes	1,104,996	1,439,756	Coal, stone, clays, sand and gravel.
Huron	29,000	37,000	Sand and gravel.
Jackson	2,950,796	3,673,708	Coal, clays, stone, sand and gravel.
Jefferson	W	W	Coal, clays.
Knox	W	W	Sand and gravel, stone.
Lake	W	W	Salt, lime, sand and gravel.
Lawrence	9,746,642	10,850,028	Cement, stone, coal, clays, sand and gravel.
Licking	W	W	Sand and gravel, clays.
Logan	399,505	543,588	Stone, sand and gravel.
Lorain	W	W	Stone, sand and gravel, abrasives.
Lucas	W	W	Cement, stone, sand and gravel, clays.
Madison	W	W	Stone, sand and gravel.
Mahoning	W	W	Stone, coal, clays, sand and gravel, peat.
Marion	1,407,782	1,693,910	Stone, clays, sand and gravel.
Medina	W	W	Sand and gravel, clays.
Meigs	W	W	Sand and gravel, coal, salt, stone.
Mercer	W	W	Stone.
Miami	W	W	Stone, sand and gravel.
Monroe	W	W	Sand and gravel, stone.
Montgomery	4,152,187	4,858,983	Do.
Morgan	W	W	Coal, sand and gravel, stone.
Morrow	53,000	52,000	Sand and gravel.
Muskingum	W	W	Cement, stone, sand and gravel, coal, clays.
Noble	W	W	Coal, stone, clays.
Ottawa	7,059,299	7,841,931	Lime, stone, gypsum.
Paulding	W	W	Cement, stone, clays.
Perry	W	W	Coal, sand and gravel, clays, stone.
Pickaway	W	W	Sand and gravel, stone.
Pike	W	W	Do.
Portage	4,026,550	3,899,097	Sand and gravel, stone, clays, coal, peat.
Preble	W	W	Lime, sand and gravel, stone.
Putnam	467,599	598,227	Stone, lime, clays.
Richland	W	W	Sand and gravel, clays, peat.
Ross	W	W	Sand and gravel, stone.
Sandusky	24,729,735	23,945,906	Lime, stone, sand and gravel.
Scioto	W	W	Stone, sand and gravel, clays.
Seneca	W	W	Lime, stone, clays.
Shelby	W	376,202	Sand and gravel, stone.
Stark	11,768,666	12,986,528	Cement, sand and gravel, stone, clays, coal, peat.
Summit	W	W	Salt, lime, cement, stone, sand and gravel, clays.
Trumbull	197,000	242,000	Sand and gravel.
Tuscarawas	12,441,466	14,252,457	Coal, clays, sand and gravel, stone.
Union	W	W	Stone, sand and gravel.
Van Wert	634,029	829,421	Stone, clays.
Vinton	682,145	637,915	Coal, stone.
Warren	1,604,000	1,291,000	Sand and gravel.
Washington	W	W	Sand and gravel, coal, abrasives.
Wayne	W	W	Salt, sand and gravel, stone, clays, coal.
Williams	153,000	W	Sand and gravel.
Wood	1,143,647	1,435,315	Stone.
Wyandot	W	W	Stone, lime, sand and gravel, peat, clays.
Undistributed [3]	249,439,735	258,300,766	
Total	454,937,000	464,252,000	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] Fulton and Clermont Counties not listed, as no production was reported.

[2] Natural gas and petroleum values are not listed by counties, as data are not available; included with "Undistributed."

[3] Includes natural gas, petroleum, and gem stones that cannot be assigned to specific counties, and values indicated by symbol W.

was produced by Peerless Mineral Products Co., Conneaut.

Athens.—Coal production continued to decline and was 3 percent below that of 1964. Most of the output was from underground mines; Karns Coal Co. at mine No. 60 was the leading producer. Of the three active strip mines, Elmer Maiden was the leading producer. Limestone used for aggregate and riprap was quarried from two quarries near Albany by Diamond Stone Quarries, Inc. Plastic fire clay for building brick was mined near Nelsonville for Natco Corp. Construction sand and gravel was produced by Athens Sand & Gravel Co., Nelsonville; The F. H. Brewer Co., Chauncey; and Slater Sand & Gravel Co., The Plains.

Auglaize.—Sand and gravel production totaled 303,000 tons, 9 percent above that of 1964. Producers of processed material were Wapak Sand & Gravel Co., Western Ohio Stone Co., and Quality Sand & Gravel & Ready Mix Co., all near Wapakoneta. Hardin-Coates, Inc., Wapakoneta, produced bank-run material. National Lime & Stone Co. quarried limestone for aggregate and agricultural stone (agstone) at Buckland. Sandkuhl Tile Co. mined clay near Spencerville.

Belmont.—Total output of coal decreased 2 percent below that of 1964; underground and strip mine production declined, but auger output increased substantially. The North American Coal Corp. and Oglebay-Norton Co., with two mines each, were the leading producers at underground mines. Hanna Coal Co., Division of Consolidation Coal Co., was the principal strip mine operator. Coal was cleaned at five plants, all from underground mines. The county was replaced by Harrison County as the leading coal-producing area. Limestone was quarried near Barnesville, Martins Ferry, and Somerton.

Brown.—Limestone for aggregate and agstone was produced by crews of the Brown County Highway Department. Ruggles Stone Co., Aberdeen, produced crushed gravel. Paving gravel was also produced at Georgetown.

Butler.—The county continued to rank fourth among the sand and gravel-producing areas. Production totaled 2.3 million tons valued at $2.5 million. Output increased 2 percent and was reported from 12 operations. Leading producers were American Materials Corp. (two plants), Ohio Gravel Co., Division of Dravo Corp. (two plants), The Middletown Sand & Gravel Co., The Hamilton Gravel Co., and The Moorman Sand & Gravel Co.

Carroll.—Most of the coal output was from seven strip mines; only 1 percent came from one underground mine. James Bros. Coal Co. was the leading strip mine operator. Clay was recovered from five pits compared with seven in 1964. Output was below that of the previous year, and consisted chiefly of fire clay used for manufacturing heavy clay products. Molding and loam sand was produced by Mineral City Sand Co., Mineral City. Rainbow Stone Co., Sherrodsville, produced dimension sandstone.

Champaign.—Construction sand and gravel was produced by American Aggregates Corp. and Miller's Excavating, Inc., both near Urbana, and Walter Dorsey, Springhill.

Clark.—Moores Lime Co., Springfield, produced limestone for manufacturing lime and for commercial sales. Lime production was mostly quicklime used in metallurgical applications. Sand and gravel output was below that of 1964, and totaled 1,023,000 tons. Production was from 10 operations, chiefly near Springfield and Fairborn. Most of the production was processed construction material, but some molding sand was produced.

Clinton.—Limestone used mostly for aggregate and agstone was produced by Melvin Stone Co., Melvin. Sand and gravel was produced by Clinton Gravel, Inc., and Muchmore & Riesenberg, both near Wilmington.

Columbiana.—Output of coal decreased 7 percent and the number of active mines dropped from 50 to 49. Over 88 percent of the output was from strip mines; Buckeye Coal Co., Ferris Coal Co., and Industrial Mining & Engineering Co. were the leading producers. Moore Coal Corp. was the leading auger mine operator. Total output of clay was above that of 1964; fire clay production predominated. Production was centered mainly near Negley, East Liverpool, and Wellsville. Construction sand and gravel was produced by Gurlea Sand &

Gravel, Salem; Neiheisel Sand & Gravel, Leetonia; and Furey Sand & Gravel Co., Hanoverton. Furnace sand was produced by Cherry Valley Sand Co., Leetonia.

Coshocton.—Coal production continued to increase and was 13 percent above that of 1964. Most of the output came from 11 strip mines; Simco-Peabody Coal Co. and Peabody Coal Co. were the leading operators. Commercial sand and gravel increased 8 percent above that of 1964 and totaled 569,000 tons. Seven operations were active mainly near Canal Lewisville, Newcomerstown, Coshocton, and Walhonding. Dimension sandstone was recovered from six quarries operated by The Briar Hill Stone Co. Output was sawed and fabricated for architectural applications. Sandstone also was quarried in Clark Township.

Crawford.—National Lime & Stone Co. operated its Spore quarry near Bucyrus for production of limestone used primarily for flux and aggregate. The Crawford County Highway Department reported production of limestone by contract operation. Galion Gravel Co. produced building and paving sand and gravel at Galion.

Cuyahoga.—Rock salt was recovered from the Cleveland underground mine of International Salt Co. Over half of the output was sold to governmental agencies for use in controlling icy highways. Metallurgical quicklime and limited quantities of construction quicklime were produced by Cuyahoga Lime Co., Cleveland. The company utilized limestone shipped from Michigan. Output of sand and gravel continued to decline. Production was 837,000 tons compared with 927,000 tons in 1964. Leading producers among the nine active operations were Terra Vista Sand & Gravel, Pettibone Sand and Gravel Co., and Testa Brothers, Inc. Output of clay totaled 351,000 tons, 10 percent below that of 1964. Hydraulic Press Brick Co., Independence, was the leading producer and continued as the State's only producer of expanded shale lightweight aggregate. Other pits were operated near Cleveland, Garfield Heights, and Independence.

Darke.—Sand and gravel production was about the same as that of 1964. Operations were centered mainly near Greenville; American Aggregates Corp. was the leading producer. Clay was recovered from pits near Greenville and Versailles. Lakeland Valley Organic Products, New Madison, producers of calcareous marl, did not operate. Louis Meyer did not produce peat at Woodington as in previous years.

Defiance.—Bank-run paving gravel was produced at Bryan by Northwest Materials, Inc. Building sand and paving gravel was produced at Ney.

Delaware.—Limestone was recovered from four quarries, one each near Radnor, Ostrander, Powell, and Delaware. Output was below that of 1964 and totaled 776,000 tons. Scioto Lime & Stone Co., Inc., produced quicklime and hydrated lime at Delaware. Most of the material was used for water purification and softening and in metallurgical applications. The Galena Shale Tile & Brick Co., Galena, and The Delaware Clay Co., Westerville, produced shale used mostly for manufacturing building brick.

Erie.—Limestone quarries were operated by Sandusky Crushed Stone Co., Inc., Parkertown; Wagner Quarries Co., Sandusky; and Castalia Quarries Co., Castalia. Sand and gravel output was virtually the same as that of 1964. Molding sand was produced at Huron by Ohio Foundry Sand Co. and The Keener Sand & Clay Co.

Fairfield.—Sand and gravel production increased substantially over that of 1964. Leading producers were The F. H. Brewer Co. and Febus Gravel Co., both near Lancaster.

Fayette.—Limestone used chiefly for aggregate and agstone was quarried by Blue Rock, Inc., Greenfield, and Sugar Creek Stone Quarry, Inc., and Fayette Limestone Co., both near Washington Court House. County output was below that of 1964 and totaled 414,000 tons.

Franklin.—Commercial production of sand and gravel was 4.8 million tons, 7 percent below that of 1964. Output by Government-and-contractor operations also decreased. The county, however, continued as the State's leading sand and gravel-producing area. Twelve operations were active compared with 14 in 1964. Leading producers were American Aggregates Corp. (three plants), Miller Sand and Gravel, The Olen Corp., and The Jackson Pike Sand and Gravel Co. Most operations were centered near Columbus. Quicklime and hydrated lime was produced near Colum-

bus from limestone quarried nearby. Substantial quantities of limestone for metallurgical and construction uses also were produced. Shale was produced by The Claycraft Co., Gahanna, and The Columbus Clay Manufacturing Co., Blacklick.

Gallia.—Coal production continued to decline and was 20 percent below that of 1964. Most of the output was from seven strip mines. Orchard Coal Corp. was the leading producer. Limestone mostly for aggregate and agstone was quarried near Bidwell by James Merry Stone Co. M. T. Epling Co., Gallipolis, produced processed construction sand and gravel as well as limited quantities of blast sand. The Keener Sand & Clay Co., Kerr, produced molding sand. Jess Brammer mined clay for floor and wall tile near Waterloo, but the mine was closed in August.

Geauga.—Sand and gravel production was greater than that of 1964. Leading producers were R. W. Sidley, Inc., Thompson; Northern Ohio Materials, Inc., Newbury; Chester Sand & Gravel, Inc., Auburn; Haueter Sand & Gravel Co., Newbury; and Cepelli Sand & Gravel, Wickliffe. Quartzite for refractory brick was produced at Thompson by Harbison-Walker Refractories Co.

Greene.—Portland and masonry cements were produced by Southwestern Portland Cement Co. and Universal Atlas Cement Division of United States Steel Corp., both near Fairborn. Southwestern used limestone and clay mined nearby for their primary cement raw materials; Universal Atlas mined limestone and purchased clay for their cement mill requirements. Cedarville Limestone Co., Cedarville, quarried stone for aggregate and agstone. Sand and gravel output increased slightly above that of 1964. Hilltop Concrete Corp., Fairborn, and Phillips Sand & Gravel, Alpha, were the principal producers.

Guernsey.—Most of the county coal production was from six strip mines; output was greater than that of 1964. The New Concord limestone quarry of John Gress & Sons, Inc., was abandoned.

Hamilton.—Production of sand and gravel was 6 percent greater than that of 1964 and totaled 4.6 million tons. The county continued as the second ranking sand and gravel-producing area. Ohio Gravel Division of Dravo Corp. continued as the foremost producer with plants at Camp Dennison, Cleves, Miamitown, and Newton. Other operations were located mainly near Cincinnati. Ohio Gravel Division of Dravo Corp. recovered limestone used for agstone as a byproduct of sand and gravel production at the Newton and Camp Dennison plants.

Hancock.—Limestone was produced at two quarries near Findlay and one quarry near Williamstown. Northern Ohio Sugar Co., a subsidiary of the Great Western Sugar Co., used limestone quarried in Michigan for the production of quicklime used for sugar refining at Findlay. Hancock Brick & Tile Co., Findlay, mined clay for manufacturing drain tile. H. & M. Sand & Gravel Co., Findlay, produced mostly processed sand and gravel for building, paving, and filtration.

Hardin.—The Hardin Quarry Co., Dunkirk, and The Herzog Lime & Stone Co., Forest, produced limestone.

Harrison.—The county ranked first among the 25 coal-producing areas. Output from both underground and strip mines increased but auger mine production was below that of 1964. Underground mining predominated; The Youghiogheny & Ohio Coal Co., with two mines, and Hanna Coal Co., Division of Consolidation Coal Co., were the leading producers. Hanna Coal Co. with three mines was the primary operator at strip mines. Coal preparation plants were operated by Hanna Coal Co., Tappan Lake Coal Co., and Youghiogheny & Ohio Coal Co. Hanna Coal Co. also produced limestone for aggregate and agstone at Cadiz. Shale used for farm drain tile was mined by The Bowerston Shale Co., Bowerston.

Henry.—Sand and gravel output was greater than that of 1964. Producers were Napoleon Sand & Gravel Co. and Turkey Foot Sand & Gravel, both near Napoleon. Clay used for manufacturing drain tile was produced by August Honeck & Son, Malinta, and Napoleon Brick & Tile Works, Napoleon.

Highland.—Limestone used primarily for aggregate and agstone was quarried by Ohio Asphaltic Limestone Co., New Vienna, and Highland Stone Division, Davon, Inc., and Marshall Quarry, both near Hills-

boro. Sand and gravel production was slightly below that of 1964. Greenfield Sand & Gravel Co., Greenfield, was the principal producer. Other production was from Hillsboro and Leesburg. Clay and shale was produced near Mowrystown by The Mowrystown Brick & Tile Co.

Hocking.—General-Hocking Brick Co. mined plastic fire clay and shale near Logan. Most of the coal output was from six strip-mine operations; production increased 30 percent above that of 1964.

Holmes.—Coal production decreased primarily because of a decline in the number of active operations. The only producers were Hardy Coal Co. (strip mine) and Union Coal Co. (underground mine). The Briar Hill Stone Co. quarried sandstone at two quarries near Glenmont and one near Killbuck. Output was fabricated for architectural applications. Holmes Clay Division of The Holmes Limestone Co., Berlin, produced limestone and plastic fire clay. Output of clay was greater than that of 1964; fire clay production predominated. Production was centered from pits near Baltic, Berlin, and Millersburg. Construction sand and gravel was produced by Close Sand & Gravel and Feikert Sand & Gravel, both near Millersburg, and Gallo & Sons, Inc., Holmesville.

Huron.—Sand and gravel was produced by Huron Sand & Gravel Co., Inc., New London, and Costein's Gravel Co., Willard.

Jackson.—Output of coal continued to increase and was 8 percent greater than that of 1964. Over 92 percent of the total output was strip-mined coal; Waterloo Coal Co., Inc., was the leading producer. The company also operated a coal preparation plant. Fire clay production increased substantially over that of 1964. Production was centered near Oak Hill. Cedar Heights Clay Co. and Ohio Fire Brick Co. were the leading producers. Waterloo Coal Co. produced limestone and clay at Oak Hill. Cedar Heights Clay Co. produced limited quantities of blast sand near Oak Hill.

Jefferson.—The county continued to rank third among the coal-producing areas with a 15-percent production increase above that of 1964. Of the total output, 79 percent was strip-mined coal, 17 percent was from underground mines and the remainder came from auger operations. Coal preparation plants were operated by Hanna Coal Co., Division of Consolidation Coal Co., and The North American Coal Corp., the area's leading producers. Clay production was greater than that of 1964; output was mostly fire clay used in refractories. Producers were McLain Works Refractories Division, H. K. Porter Co., Inc., and Frederick J. Dando Co., both near Irondale, and Kaul Clay Co., Toronto.

Knox.—Sand and gravel production totaled 1.1 million tons, an increase of 49 percent above that of 1964. Most of the output was construction material recovered from operations near Brinkhaven, Gambier, Fredericktown, and Mount Vernon. Fredericktown Sand & Gravel Co., Fredericktown, was the principal producer. The Millwood Sand Co., Howard, produced glass, molding, and ground sand. Dimension sandstone was recovered from four quarries by The Briar Hill Stone Co.

Lake.—Morton Salt Co. recovered rock salt from the Fairport underground mine. Diamond Alkali Co. at Painesville produced quicklime and salt brine from nearby wells. The brine and quicklime were used for manufacturing chlorines and alkalies. Grand River Lime Co., Grand River, produced quicklime from limestone quarried in Michigan. Output was used for metallurgical purposes and water purification. Production of sand and gravel totaled 259,000 tons compared with 223,000 tons in 1964. Active operations were centered mainly near Mentor and Willoughby. The Painesville cement plant of Standard Portland Cement Division, Diamond Alkali Co., was sold and will be dismantled. However, the company will continue to use the storage bins as a distribution center.

Lawrence.—Portland and masonry cements were produced by Alpha Portland Cement Co., Ironton, and Marquette Cement Manufacturing Co., Superior. Alpha mined limestone (cement rock) and sandstone, and Marquette mined limestone and shale for use as primary cement raw materials. Limestone also was produced by Engle Stone Co., Division of Benedict, Inc., at Pedro and by the Lawrence County Highway Department at its Buck Creek quarry. Output of clay totaled 135,000 tons, 18 percent below that of 1964. Most of the output was fire clay used for refractories. Production was centered mainly near

Blackfork, Ironton, Pedro, and South Webster. Construction sand and gravel was produced by Wilson Sand & Gravel Co., Chesapeake, and Jerry Sand & Gravel, Inc., South Point. Coal production was greater than that of 1964. Collins Mining Co. operated a preparation plant and was the leading producer.

Licking.—Output of sand and gravel increased 8 percent above that of 1964 and totaled 800,000 tons. Twelve operations were active mainly near Newark, Granville, and Kirkersville. The Bowerston Shale Co. mined shale near Hanover.

Logan.—Limestone production was 342,000 tons, compared with 214,000 tons in 1964. Quarries were operated by Connolly Construction Co., East Liberty; C. E. Duff & Son, Inc., Huntsville; and Northwood Stone & Asphalt Co., Belle Center. Sand and gravel production was slightly below that of 1964 and totaled 106,000 tons. Neer's Engineering Labs, Bellefontaine, was the principal producer.

Lorain.—Sandstone quarries were operated by Cleveland Quarries Co. at Amherst and Kipton. Of the two, the Amherst quarry was the more important, producing substantial quantities of dimension stone for architectural work and for lining steel furnaces. Quantities of crushed and broken stone as well as byproduct abrasive grindstone were also produced. Sand and gravel production totaled 419,000 tons and was greater than that of 1964. Lorain Elyria Sand Co., Lorain, was the principal producer. National Gypsum Co. produced calcined gypsum from crude material shipped from out of State.

Lucas.—Medusa Portland Cement Co., Toledo, produced portland cement from limestone, shale, and sand mined nearby. Limestone for commercial sales was produced by The France Stone Co., Waterville; Maumee Stone Co., Maumee; and Toledo Stone & Glass Sand Co., Sylvania. In addition, prisoners at the Toledo House of Correction, Whitehouse, produced limestone used as rubble. Total limestone production in the county was 2.2 million tons, compared with 1.7 million tons in 1964. Sand and gravel production increased from 617,000 tons in 1964 to 878,000 tons. Output consisted exclusively of sand used for construction. Bellevue Trucking Corp., Holland, was the principal producer.

Madison.—American Aggregates Corp., Plain City, and Madison Stone Co., Inc., Galloway, produced limestone used mostly for aggregate. Sand and gravel was produced by The West Jefferson Sand & Gravel Co., West Jefferson, and Varga Sand & Gravel Co., Inc. (formerly McMullen Sand & Gravel Co., Inc.), Mt. Sterling. No production of sand and gravel by Government-and-contractor operations was reported.

Mahoning.—Limestone was produced by Carbon Limestone Co., Lowellville, and Alliance Stone Co., Alliance. Output of clay was greater than that of 1964. Producers were Alliance Brick Corp., with pits near Alliance and Beloit, American Fire Clay Co., Canfield, and Natco Corp., Petersburg. R. A. Fortune Sand & Gravel Co. produced building sand and gravel at Salem. Humus peat was produced at Damascus by Beaver Peat Products Co. Although the number of active mines was greater than that of 1964, coal production decreased 13 percent. The East Fairfield Coal Co. with two strip mines and Keller Mines, Inc., were the leading operators.

Marion.—Limestone production increased from 711,000 tons in 1964 to 944,000 tons in 1965. Producers were Tri County Limestone Co., LaRue, and National Lime & Stone Co. and J. M. Hamilton & Sons Co., both near Marion. Shale used for brick was mined near Iberia by Marion Brick Corp. Sand and gravel production increased and it was recovered from operations near Radnor, Prospect, Green Camp, and Marysville.

Medina.—Sand and gravel was produced by Seville Sand & Gravel, Inc., Seville; Ray H. Taylor Trucking & Supply, Medina; and Quillin Bros. Construction Co., and Lodi Sand & Gravel Co., both near Lodi. Output was 8 percent greater than that of 1964. Wadsworth Brick & Tile Co., Wadsworth, mined clay for manufacturing brick.

Meigs.—Production of coal was substantially below that of 1964; the greatest decline was from strip-mine operations. Fifty-one percent of the output was strip-mined coal compared with 69 percent in 1964. Sand and gravel was produced by Tri-State Materials Corp. and Richards & Son, Inc., both near Apple Grove. Evaporated salt was produced in open pans by Excelsior

Salt Works, Inc., Pomeroy. Alan Stone Co., Inc., produced riprap sandstone near Reedsville for use by the U.S. Army Corps of Engineers.

Mercer.—Limestone used primarily for aggregate and agstone was produced by The John W. Karch Stone Co., Celina, and Rockford Stone Co., Rockford.

Miami.—Armco Steel Corp. at Piqua produced limestone used mainly for flux, aggregate, and agstone. Gregory Stone Co., Inc., produced dimension limestone used for construction at West Milton. Output of sand and gravel totaled 503,000 tons compared with 610,000 tons in 1964. Troy Gravel Co., Troy, and Steiner's Sand and Gravel Co., Ludlow Falls, were the principal producers.

Monroe.—Blaney Sand & Gravel Co., Inc., Clarington, produced processed building and paving sand and gravel. Watson Piatt produced bank-run paving gravel from the Witten gravel pit near Fly. Christman Quarry Co. produced limestone for aggregate at Summerfield.

Montgomery.—Sand and gravel production continued to increase and was 18 percent above that of 1964. Output was 3.6 million tons valued at $3.8 million. Twenty-four operations were active and the county continued to rank third among the producing areas. Production was mainly from pits near Dayton. Limestone was produced at three quarries, two near Dayton, and one near Phillipsburg. The City of Dayton Water Department recovered lime from waste sludge and from the recarbonation of water in a purification and softening process. The quicklime was used by the department for water treatment.

Morgan.—Production of coal was below that of 1964; most of the output was from the Muskingum No. 4 strip mine of Central Ohio Coal Co. Output from this mine was cleaned at the company preparation plant. Stockport Sand & Gravel Co., Stockport, produced building and paving sand and gravel. Limestone was produced by D. & K. Construction, Inc., Reinersville, and Ball & Ball, Amesville.

Morrow.—Building sand and paving gravel was produced by Chesterville Sand & Gravel, Chesterville.

Muskingum.—Columbia Cement Corp. produced portland and masonry cement at its East Fultonham plant. The company used limestone and shale recovered from its underground Jonathan mine near Zanesville as their main cement raw materials. Limestone for commercial sales was produced by Sidwell Brothers, Zanesville; Chesterhill Stone Co., East Fultonham; and D. & K. Construction, Inc., Cumberland. Production of sand and gravel increased substantially over that of 1964 and totaled 653,000 tons. Principal producers were Muskingum River Gravel Co., Zanesville, and The Zanesville Gravel Co. and Cox Gravel Co., Inc., both near Dresden. The Bowerston Shale Co. reactivated its Frazeysburg shale pit for production of shale used in manufacturing brick. Stoneware clay was recovered from a pit near East Fultonham. Coal production was 16,000 tons above that of 1964. Nearly 68,000 tons was recovered from five underground mines and the remainder from seven strip mines.

Noble.—Coal production increased 10 percent above that of 1964; most of the output was from strip-mine operations. Output from auger mines decreased by nearly a fourth. Central Ohio Coal Co. was the foremost producer. The company's Cumberland cleaning plant did not operate in 1965. Limestone output increased from 168,000 tons in 1964 to 211,000 tons. Quarries were active near Cumberland, Summerfield, Woodsfield, and Caldwell. Shale was recovered near Ava by The Ava Brick Corp.

Ottawa.—The United States Gypsum Co. produced quicklime and hydrated lime at its Genoa plant. Limestone quarried nearby was utilized by the company for lime manufacturing; some stone was used for commercial sales. Limestone also was probuced by Marblehead Stone Division, Standard Slag Co., Marblehead, and Basic, Inc., Clay Center. The Celotex Corp., Port Clinton, and United States Gypsum Co., Gypsum, mined crude gypsum. Both companies calcined the crude material at nearby plants for use in manufacturing finished building products.

Paulding.—Peninsular Portland Cement Division, General Portland Cement Co., Paulding, produced portland and masonry cements. The company used limestone and clay mined nearby and purchased sand and gypsum as its principal cement raw materials. Most of the limestone from the Penin-

sular quarry was utilized by the company, but some was sold locally to The France Co. for further processing and resale. Limestone also was produced at Oakwood by Auglaize Stone Co. Clay for drain tile was produced by Baughman Tile Co., Paulding, and The Haviland Clay Works Co., Haviland. The Paulding clay pit of Dangler Drain Tile Co. was permanently abandoned.

Perry.—Coal production decreased 5 percent below that of 1964. Output from strip and auger mines declined, but production from underground mines was above that of the previous year. An increase in the average unit price for bituminous coal was recorded. Peabody Coal Co. operating the Sunnyhill No. 9 mine was the leading producer. Most of the output from this mine as well as Sunnyhill No. 1 mine was prepared at the company preparation plant. Coal also was processed by Sandra Coal Mining, Inc., and Sidwell Bros. Industrial sands were produced by The Central Silica Co., Glenford, and The Keener Sand & Clay Co., New Lexington. Output of clay totaled 232,000 tons, 6 percent below that of 1964. Output was mainly miscellaneous clay and shale used for manufacturing heavy clay products. Production was from 10 operations; The Belden Brick Co., Somerset; The Claycraft Co., Shawnee; Logan Clay Products Co., Logan; and Ludowici-Celadon Co., New Lexington, were the leading producers. Maxville Stone Co., Logan, produced limestone for aggregate, riprap, and agstone.

Pickaway.—The Sturm & Dillard Co., Circleville, produced processed sand and gravel. Bank-run gravel was produced at Circleville by McFarland Co. Har-Mar Stone Co., Circleville, produced limestone for aggregate, railroad ballast, riprap, and agstone.

Pike.—Output of sand and gravel was above that of 1964. Industrial sand and gravel was produced by Sharon Silica Co. at its Hay Hollow plant near Waverly. The Standard Slag Co., Sargents, Seal Builders Supply Corp., Waverly, and Leo Vulgarmore, Lucasville, produced construction sand and gravel. Durex Division, A. P. Green Refractories Co., and Cambria Clay Products Co. produced quartzite used mostly for refractory (ganister) at quarries near Beaver.

Portage.—Sand and gravel production was slightly below that of 1964, and totaled 2.1 million tons valued at $3.1 million. Most of the material was processed sand and gravel recovered from operations near Kent, Mantua, Ravenna, Streetsboro, and Shalersville. Industrial Silica Division Pennsylvania Glass Sand Corp., produced industrial sands at Aurora and Garrettsville. Quartzite for refractory (ganister) was produced by Harbison-Walker Refractories Co. and General Refractories Co., both near Garrettsville. Shale used for manufacturing vitrified sewer pipe was produced near Diamond by United States Concrete Pipe Co. Green Oaks Peat Moss Co. produced moss peat at Ravenna. Coal production was below that of 1964. Peterson Coal Co., operator of the Atwater strip mine and preparation plant was the only producer.

Preble.—Construction sand and gravel was produced by White Gravel Co., Camden, and Blue Bank Gravel Co. and Steiner's Sand & Gravel Co., both near West Alexandria. Limestone and lime were produced near Lewisburg.

Putnam.—Limestone was produced by Putnam Stone Co., Ottawa; National Lime & Stone Co., Columbus Grove; and Ottawa Stone Co., Inc., Gilboa. Output totaled 399,000 tons, compared with 305,000 tons in 1964. Limestone shipped from Michigan was used by Buckeye Sugars, Inc., Ottawa, for manufacturing quicklime used for sugar refining. Glandorf Tile Co., Glandorf; Etter Tile & Coal Co., Dupont; and Miller Bros. Clay Works, Inc., Ottoville, mined clay for drain tile.

Richland.—Production of sand and gravel was more than double that of 1964 and totaled 614,000 tons. Output was from operations near Bellville, Lexington, and Perrysville. Shale was mined near Mansfield by The Richland Shale Brick Co. and Ohio Brick & Supply Co. Reynolds Farms, Inc., recovered moss peat from a bog near Shelby.

Ross.—Output of sand and gravel was 675,000 tons compared with 657,000 tons in 1964. Central Materials Co., Chillicothe, was the leading producer. Other operations were located near Chillicothe, Bainbridge, and Richmond Dale. Southern Silica, Inc., Richmond Dale, produced quartzite mainly for manufacturing glass and for foundry

use. Limestone for aggregate was produced by Ohio Asphaltic Limestone Co., Inc., Bainbridge. The Mead Corp., Chillicothe, produced and regenerated quicklime for use in manufacturing paper.

Sandusky.—The county continued to lead in production and value of limestone and lime. Output of lime, including dead-burned dolomite, remained about the same as that of 1964, totaling 1.1 million tons valued at $17.7 million. Value was below that of the previous year because of lower average unit prices. Most of the lime was dead-burned dolomite used as refractory material by the steel industry. The remainder consisted chiefly of quicklime used by the chemical industry and hydrated lime used in construction. The number of active lime plants remained at eight. Limestone production decreased from 4.1 million tons in 1964 to 4.0 million tons. Most of the limestone was used for manufacturing lime, but substantial quantities were used for metallurgical flux and aggregate. Output was from nine quarries; three each near Gibsonburg and Woodville and one each near Bellevue, Fremont, and Millersville. The Home Supply Center, Inc., Fremont, recovered structural sand by dredging.

Scioto.—The Taylor Stone Co. and Waller Bros. Stone Co., both near McDermott, produced dimension sandstone for furnace brick and architectural uses. General Refractories Co. produced quartzite for silica brick at Minford. Sand and gravel production was greater than that of 1964. Leading producers were Ohio River Dredging Co., Inc., and the Standard Slag Co. Production also was reported from operations near Lucasville, Franklin Furnace, and Wheelersburg. Fire clay for refractories was mined by Industrial Minerals Division, International Minerals & Chemical Corp., Portsmouth, and William and James Belcher, Scioto Furnace.

Seneca.—Basic, Inc., mined dolomite and produced dead-burned dolomite at its Maple Grove plant near Narlo. Most of the dead-burned dolomite was sold to steel producers in Ohio and Pennsylvania; commercial sales of dolomite were mainly for metallurgical flux, aggregate, and agstone. Limestone was produced by The France Co., Bloomville; Northern Ohio Stone Co., Flat Rock; and Webster Coal Co. (formerly Webster Stone Co.), Bloomville. The latter two companies produced quantities of dimension stone used for construction. Miscellaneous clay for drain tile was mined near Bascom and St. Stephen.

Shelby.—Sand and gravel was produced by The Sidney Sand & Gravel Co., Sidney; The Ernst Gravel Co., Houston, and Spring Creek Gravel Co., Fort Laramie. Output was greater than that of 1964. Limestone for aggregate was quarried at Sidney by Miami River Quarries, Inc.

Stark.—Diamond Portland Cement Co., Division of The Flintkote Co., produced portland and masonry cements at Middle Branch from limestone, shale, and clay mined nearby. Limestone also was produced by East Ohio Limestone Co., Hartville. Eighteen sand and gravel producers were active compared with 20 in 1964. Production decreased 5 percent and totaled 1.8 million tons. Principal producers were Canton Aggregate Co. with four plants near Canton; Massillon Washed Gravel Co., Navarre; Ray C. Oster Sand & Gravel, Canton; and Uniontown Sand & Gravel Supply Inc., Uniontown.

Output of clay increased 6 percent above that of 1964 and totaled 686,000 tons. Nineteen operations were active compared with 17 the previous year. Sixty-two percent of the output was fire clay used chiefly for manufacturing heavy clay products. Lantz Peat Moss, Inc., and Sanders Peat Moss produced peat from bogs near Canton. Raymond Sheets acquired the Canton peat bog formerly operated by Gerald R. Hetrick and produced quantities of moss and reed-sedge peat. Output of coal increased 7 percent and was mostly from strip mines. Magnolia Mining Co. and Mullet Coal Co. were the leading producers.

Summit.—Pittsburgh Plate Glass Co., Chemical Division, Barberton, continued to dominate the county's mineral industry. The company produced portland cement, quicklime, evaporated salt and mined brine, limestone, and sandstone. The brine was processed to produce chlorine and caustic soda as well as combined with quicklime to produce soda ash. Some brine was evaporated and marketed for a variety of chemical uses. Calcium chloride was recovered as a byproduct of the soda-ash

process. Limestone from the company's nearby underground mine provided the raw material for the lime plant and the cement plant. Some commercial sales of limestone were made. The Barberton mine won the 1965 National Safety Competition in the Underground Nonmetal Mine group and was awarded a "Sentinels of Safety" trophy. The mine operated 342,510 manhours without any disabling injuries. The company's sandstone quarry provided material used for manufacturing glass, and some was marketed as concrete aggregate.

Salt brine was produced at Akron by Diamond Crystal Salt Co. Most of the brine was evaporated in both open and vacuum pans and sold for a variety of uses. Some brine was marketed as pressed blocks. Sand and gravel production totaled 924,000 tons compared with 817,000 tons in 1964. Output was from 14 operations; Rubber City Sand & Gravel Co., Akron, was the leading producer. Shale was recovered from two pits near Mogadore.

Trumbull.—The Kinsman Sand & Gravel Co., Kinsman, produced building, paving, and fill sand and gravel.

Tuscarawas.—Coal production increased 19 percent above that of 1964; the number of active mines remained unchanged at 48. Coal preparation plants were operated by Cross Creek Coal Co., Crossroads Coal Co., and Midvale Coal Co., Inc. The county continued as the State's foremost clay-producing area with 24 active mines, 2 less than that of 1964. Clay production totaled 931,000 tons; 7 percent above that of 1964. Of the total, 618,000 tons was fire clay used chiefly for refractories and heavy clay products.

Output of sand and gravel increased 17 percent above that of 1964 and totaled 791,000 tons. Industrial Silica Division, Pennsylvania Glass Sand Corp. produced industrial sands at the Coxey Works near Dundee. Construction sand and gravel was produced primarily by Stocker Sand & Gravel Co., Gnadenhutten; Spring Brothers, New Philadelphia; and Edgar Spring, Inc., Sandyville. Limestone was recovered from operations near Dover, Strasburg, and Sugarcreek. The Briar Hill Stone Co. recovered dimension sandstone used for architectural applications. Dundee Stone Co., Inc., Dundee, discontinued its sandstone quarrying operations.

Union.—Construction sand and gravel was produced by Connolly Construction Co. and Marysville Concrete & Materials, Inc., both near Marysville. Limestone used mainly for aggregate and agstone was produced by Union Limestone, Inc., Ostrander, and L. G. Rockhold & Sons, York Center.

Van Wert.—Limestone was produced by The Union Quarries Co. and Ridge Township Stone Quarry, both near Van Wert, and Delphos Quarries Co., Delphos. Output was greater than that of 1964. Weck Tile Plant, Van Wert, mined clay for drain tile.

Vinton.—Output of coal decreased 12 percent below that of 1964. Strip mining predominated; Benedict, Inc., was the leading operator. McArthur Stone and Coal Co., McArthur, produced limestone for aggregate and agstone.

Warren.—Production of sand and gravel was 1.1 million tons, 23 percent below that of 1964. Output was from 9 operations compared with 10 the previous year. Ohio Gravel Division of Dravo Corp. with plants at Morrow and Waynesville and Morrow Gravel Co., Morrow, were the leading producers.

Washington.—Sand and gravel production was substantially above that of 1964. Producers were Muskingum River Gravel Co., New Matamoras; Fred Price Contracting Co., Waterford;Briggs Gravel Co., Marietta; and Newberry Bottom Sand & Gravel, Little Hocking. The Hall Grindstone Co. produced abrasive stone (grindstones) at Constitution. Coal producers resumed operations in the county after being idle for a year. Peaker Run Coal Co. operated a strip mine and C. & C. Coal Co. recovered coal by auger methods.

Wayne.—Morton Salt Co. produced evaporated salt in open and vacuum pans at Rittman. Some of the evaporated salt was marketed in pressed blocks. Sand and gravel production increased and totaled 458,000 tons. The Rupp Construction, Inc., Marshallville, and Prairie Lane Gravel Co., Wooster, were the principal producers. Mullet Coal Co. mined limestone and plastic fire clay at Mount Eaton. Holmes Clay Division of the Holmes Limestone Co. pro-

duced limestone for aggregate and agstone at Holmesville. Medal Brick, Inc. (formerly Medal Brick & Tile Co.) mined shale at Wooster and Orrville Tile Co. mined clay at Orrville. Coal strip mines were operated by Holmes Limestone Co., M. & M. Coal Co., and Mullet Coal Co.

Williams.—Sand and gravel production increased above that of 1964. Tri-State Gravel Co., Montpelier, was the principal producer. Production also was reported from operations near Blakeslee and Edgerton.

Wood.—Limestone production increased from 854,000 tons in 1964 to 1.1 million tons. Producers were The Brough Stone Co., West Millgrove; The France Stone Co., North Baltimore and Luckey; Maumee Stone Co., Perrysburg and Portage; and The Pugh Quarry Co., Custar.

Wyandot.—National Lime & Stone Co. quarried limestone and produced lime at Carey. Limestone was used at the lime plant but most of the material was sold for a variety of uses. Limestone also was produced by Kuenzli Quarries Co., Inc., and J. L. Foucht Quarry, both near Upper Sandusky, and Wyandot Dolomite, Inc., Carey. Sand and gravel was produced by Wilson Sand Co., Kuenzli Quarries Co., Inc., and Corfman Gravel Co., all near Upper Sandusky. Humus peat was recovered from a bog near Carey by The Humus Co. Output was sold for seed inoculant and for soil improvement purposes. The Claycraft Co. mined shale for building brick at Upper Sandusky.

The Mineral Industry of Oklahoma

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the Oklahoma Geological Survey for collecting information on all minerals except fuels.

By Robert B. McDougal [1] and William E. Ham [2]

Value of mineral production in Oklahoma rose to a new record of $908 million in 1965, nearly $26 million more than that of 1964. The gain resulted from increased output and value of all mineral products except clays, sand and gravel, tripoli, and volcanic ash. The mineral fuels and related products, dominant in the State's mineral industry, accounted for 94 percent of the total mineral value in 1965, nonmetals over 5 percent, and metals the remainder.

Petroleum and natural gas were produced in 69 counties, comprising a wide belt from the northeastern to the western and southwestern sections of the State. Helium was recovered in Cimarron County. Nonmetals were produced in a large area covering 61 counties, primarily in the northeast, north-central, and central areas and in the Arbuckle and Wichita Mountain regions of the southern area. Metal production occurred in opposite corners of the State—Ottawa and Jackson Counties.

Table 1. Mineral production in Oklahoma[1]

Mineral	1964 Quantity	1964 Value (thousands)	1965 Quantity	1965 Value (thousands)
Clays [2] thousand short tons	835	$854	794	$806
Coal (bituminous) do.	1,028	5,474	974	5,520
Gypsum do.	694	1,899	761	2,343
Helium thousand cubic feet	r 298,803	r 8,591	300,992	9,532
Lead (recoverable content of ores, etc.) short tons	2,781	729	2,813	878
Natural gas million cubic feet	r 1,316,201	166,747	1,320,995	182,297
Natural gas liquids:				
Natural gasoline and cycle products thousand gallons	554,053	34,011	570,129	34,561
LP gases do.	880,804	28,055	894,665	32,208
Petroleum (crude) thousand 42-gallon barrels	202,524	587,320	203,441	587,944
Salt thousand short tons	6	41	9	65
Sand and gravel do.	6,680	7,003	5,218	6,023
Stone do.	13,987	15,087	16,417	18,071
Zinc (recoverable content of ores, etc.) short tons	12,159	3,307	12,715	3,713
Value of items that cannot be disclosed:				
Bentonite, cement, copper, lime, silver, tripoli, and pumice (volcanic ash)	XX	22,670	XX	23,953
Total	XX	r 881,788	XX	907,914

r Revised. XX Not applicable.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Excludes bentonite; included with "Value of items that cannot be disclosed."

Table 2.—Value of mineral production in constant 1957–59 dollars
(Millions)

Year	Value
1956	816
1957	803
1958	762
1959	777
1960	783
1961	783
1962	822
1963	r 854
1964	r 864
1965	885

r Revised.

[1] Geologist, Bureau of Mines, Mineral Resource Office, Bartlesville, Okla.
[2] Geologist, Oklahoma Geological Survey, Norman, Okla.

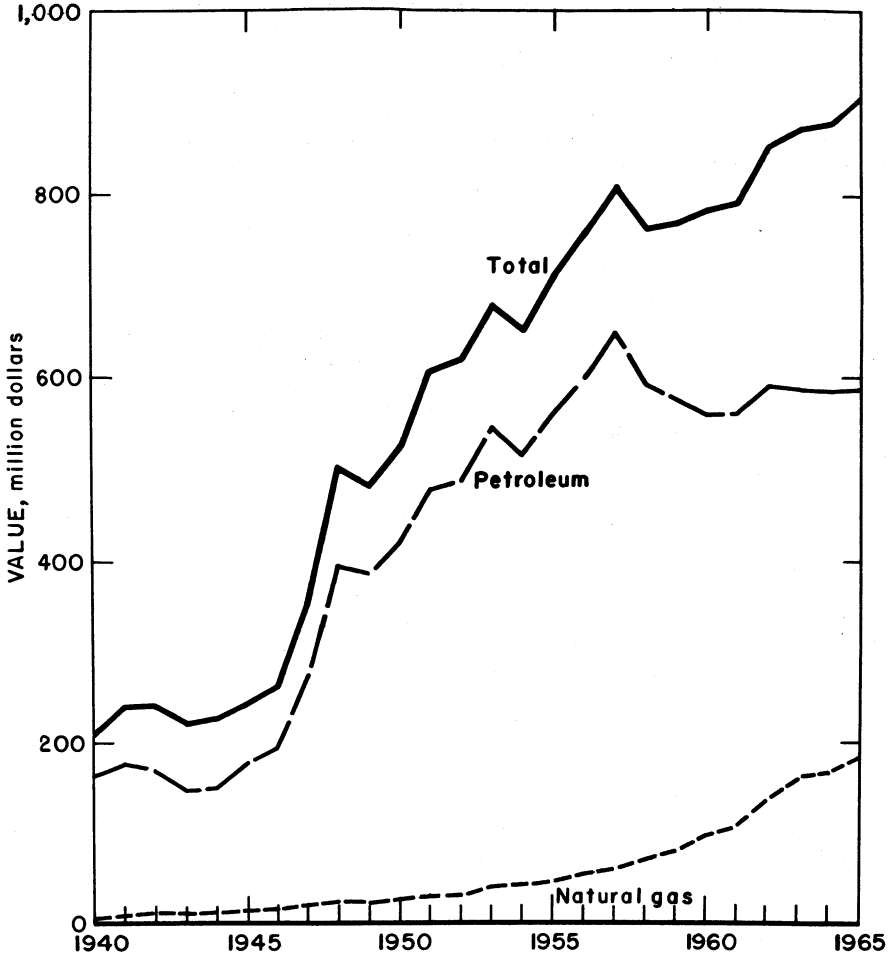

Figure 1.—Value of natural gas, petroleum, and total value of mineral production in Oklahoma.

Strip mining for copper ore began late in the year from red beds in Jackson County in southwestern Oklahoma. Silver was recovered as a byproduct from milling and processing of the copper ore.

Employment and Wages.—The Oklahoma Employment Security Commission reported that the mineral industries employed 42,400 persons, of which 40,500 were engaged in oil and gas drilling and production in 1965. In 1964, 40,300 persons of a total mineral industries employment of 42,200 persons were engaged in oil and gas drilling and production. Under the Oklahoma Employment Security Act, which covers establishments that employ four or more persons, the mineral industries in 1965 paid $289 million in wages to 40,827 persons compared with $276 million in wages paid to 40,600 persons in 1964.

Table 3.—Employment and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1964:								
Coal	278	209	58	457	---	11	24.09	655
Metal	149	235	35	283	---	7	24.71	3,721
Nonmetal	353	229	80	643	---	14	21.78	252
Sand and gravel	407	253	103	878	---	18	20.50	846
Stone	952	264	250	2,056	---	34	16.54	304
Total	2,139	247	526	4,317	---	84	19.46	668
1965: p								
Coal	265	219	58	463	---	12	25.92	700
Metal	155	226	35	276	1	3	14.49	22,703
Nonmetal	375	235	88	710	1	12	18.31	9,325
Sand and gravel	350	254	89	755	1	15	21.19	8,364
Stone	955	264	252	2,072	---	72	34.75	1,870
Total	2,100	249	522	4,276	3	114	27.36	5,473

p Preliminary.

Trends and Developments.—Proved reserves of recoverable petroleum declined for the 10th consecutive year. No significant petroleum reserves were located during the year to offset depletion. Reserves of natural gas liquids increased in 1965 as did the natural gas reserves, though the gain was less than in 1964.

Exploration and development well drilling was widespread in 1965, but the greatest concentration of exploration activity was on the Anadarko basin's northern flank, according to the American Association of Petroleum Geologists' annual report. Rocks of the Pennsylvanian, Mississippian, and Siluro-Devonian systems were the primary objectives in the area. In terms of discovery wells, the most productive rock units in descending order were Meramec-Osage groups (Mississippian), Des Moines and Morrow (Pennsylvania), Simpson (Ordovician), Hunton (Siluro-Devonion), and Chester (Mississippian). Sandstone and limestone were the most important lithologic types in these units.

In April, the Oklahoma Nomenclature Committee of the Kansas-Oklahoma Division, Mid-Continent Oil and Gas Association, combined 21 oil and gas reservoirs in Garfield, Kingfisher, and Logan Counties to form the huge Sooner Trend, heart of which is the Dover-Hennessey field.

According to the annual review published in the Oil and Gas Journal, Oklahoma ranked fourth in the Nation in exploratory drilling with 418 wells. Test well drilling totaled 2.5 million feet, averaging 5,911 feet per well compared with 5,967 feet per well in 1964. The 4,072 field development wells drilled, totaled 17.5 million feet, averaging 4,292 feet per well compared with 3,863 feet per well in 1964.

On June 11, a well fire that had burned out of control for almost 10 months, 4 miles south of Canton, Blaine County, was extinguished. The No. 1 Frank Paulsen, being drilled for Goff Oil Co., blew out under high pressure at 8,810 feet in the Morrow Pay and burst into flame on August 14, 1964. A directional relief well, the No. 1-A Paulsen, drilled in an effort to quench the fire was unsuccessful; however, it was listed as the official discovery well though the burning well opened the South Canton Pool.

In July, APCO Oil Corp. completed its previously announced purchase of oil and gas production properties of Schermerhorn Oil Corp. in Kansas, New Mexico, Oklahoma, and Texas.

On June 1, Nipak, Inc., a subsidiary of Lone Star Gas Co., Dallas, Tex., completed purchase of the John Deere Chemical Co.'s physical properties and assets. Involved in the transaction were a nitrogen fertilizer materials plant at Pryor and an ammonium nitrate plant at Tulsa.

The Nation's first low-level, continuous casting unit for steel billets was put into operation early in the year by the Sheffield Division of Armco Steel Corp. at its Sand Springs plant.

Kerr-McGee Corp. (formerly Kerr McGee Oil Industries, Inc.) announced plans for developing a new multimillion-dollar coal mining operation in Haskell County. Factors which favored the venture, according to the company, were confidence in the coal reserves, particularly in view of the Arkansas River navigation project, and a 15-percent depletion allowance passed during the last session of the State Legislature. The company completed its $1.5 million nuclear fuel materials processing plant on the Cimarron River in Lincoln County north of Oklahoma City. Kerr-McGee Corp. began constructing a multimillion-dollar 4,200 barrel-per-day hydrocracking unit at its Wynnewood refinery. When completed in July 1966, the hydrocracker will permit conversion of light oil into high-quality gasoline.

Other refinery developments during the year included equipment changes by APCO Oil Corp. at its Cyril refinery that reduced the crude-charge capacity from 12,000 to 10,250 barrels per calendar-day. In February, the catalytic-reforming capacity was increased from 11,000 to 16,000 barrels per day at Continental Oil Co.'s Ponca City refinery. In March, Sunray DX Oil Co. doubled asphalt capacity at its Tulsa refinery to 3,000 barrels per day.

On June 30, the General Services Administration sold the former Callery Chemical Co.'s high-energy boron hydride fuels plant at Muskogee to Clinton-Dickson Corp., Philadelphia, Pa.

On May 22, the U.S. Army Corps of Engineers, Tulsa District, officially dedicated the $127 million Keystone Dam on the Arkansas River. Construction of the powerhouse continued. Two other Corps of Engineers projects on the Arkansas River that continued throughout the year were the Webber Falls Lock and Dam, upstream from Webber Falls, and the Robert S. Kerr Lock and Dam (formerly the Short Mountain Lock and Dam), upstream from Sallisaw. The agency also was constructing the Broken Bow Dam on the Mountain Fork River in McCurtain County. Construction of Pine Creek Dam on Little River, near Valliant in McCurtain County, resumed after work was halted for more than 1 year, pending completion of studies to determine whether power facilities should be included at the dam.

The Bureau of Reclamation, U.S. Department of the Interior, continued construction of the Arbuckle Dam and Reservoir on Rock Creek, southwest of Sulphur in Murray County. The agency's Norman Dam, a multipurpose project on Little River east of Norman completed and dedicated early in the year, will supply water to Del City, Midwest City, and Norman.

REVIEW BY COMMODITIES

MINERAL FUELS

Oklahoma continued to be an important source of natural gas and crude petroleum and furnished a major supply of refined products. Low-ash bituminous coal was produced though output was below that of 1964.

Carbon Black.—Output of carbon black increased 15 percent in quantity and 13 percent in value in 1965 and was produced from petroleum distillate at Continental Oil Co.'s Ponca City refinery.

Coal (Bituminous).—Less than 1 million tons, valued at more than $5.5 million, was produced by 13 operators at 15 operations (3 underground, 11 strip, and 1 auger) in 6 counties. Haskell, Craig, and Rogers Counties led in quantity and value of output. Eleven other producers, who mined less than 1,000 tons each, were active in Craig, Haskell, Latimer, Le Flore, Muskogee, and McIntosh Counties. Four companies supplied nearly 82 percent of the total output.

Table 4.—Coal (bituminous) production
(Thousand short tons and thousand dollars)

Year	Quantity	Value
1956–60 (average)	1,740	$11,350
1961	1,032	6,784
1962	1,048	6,978
1963	1,008	5,667
1964	1,028	5,474
1965	974	5,520

Strip mines supplied 99 percent of the total production; the remainder was from an auger and underground mines. Output from the underground mines decreased 18 percent from that of 1964, and strip mine production was down 5 percent for the same period. Ninety-eight percent of the

coal was shipped by railroad and 2 percent was shipped by truck.

Equipment used at 11 strip mines by 10 producers included 10 power shovels, 12 draglines, 1 carryall scraper, 14 bulldozers, 11 power drills, and 48 trucks. An estimated 18.3 million cubic yards of overburden was excavated.

Equipment used at three underground mines included three cutting machines, two power drills, and eight rail mine cars.

Helium.—The Federal Bureau of Mines helium plant at Keyes, Cimarron County, produced 300.9 million cubic feet of helium extracted from natural gas from the Keyes field. Helium sales from the Keyes plant totaled 256.7 million cubic feet, valued at $9.0 million, and the remainder of the production was placed in underground storage as part of the national helium conservation program. The Keyes plant, largest of five helium plants owned by the Federal Government, produces grade-A helium (purity 99.995 percent). More than three-fourths of the sales from the Keyes plant were to other Federal agencies, principally the Department of Defense, the National Aeronautics and Space Administration, and the Atomic Energy Commission.

Natural Gas.—Oklahoma was again the third largest gas producing State as 65 counties, led by Texas, Beaver, Garvin, Harper, and Stephens Counties, in descending order, reported natural gas output. At yearend, the proved recoverable reserve of natural gas in Oklahoma was approximately 14.7 cubic feet of gas reserve for each cubic foot produced. New discoveries found through exploratory drilling added 359 billion cubic feet to the gas reserves. According to the American Gas Association, extensions and revisions added another 1,540 billion cubic feet to the gas reserves.

Nine gas storage fields in nine counties were in use by the natural gas industry. Cities Service Gas Co. completed the Webb underground natural gas storage field in Grant County. The Federal Power Commission authorized Natural Gas Pipeline Company of America to lease from Oklahoma Natural Gas Storage Co., subsidiary of Oklahoma Natural Gas Co., and operate the Sayre underground natural gas storage field in Beckham County. Underground storage facilities had a total capacity of 157.5 billion cubic feet of working gas volume (above minimum working pressure) and 125.1 billion cubic feet of cushion gas volume (below minimum working pressure).

Maximum storage capacity is presently 304.6 billion cubic feet. Available storage capacity permitted continuous production and conservation of casing-head gas from oil wells during periods of low demand.

Table 5.—Marketed production of natural gas [1]

Year	Million cubic feet	Value (thousands)
1956–60 (average)	746,135	$72,723
1961	892,697	108,016
1962	1,060,717	135,772
1963	1,233,883	160,405
1964	1,316,201	166,747
1965	1,320,995	182,297

[1] Comprises gas either sold or consumed by producers, including losses in transmission, amounts added to storage, and increases in gas pipelines.

Table 6.—Estimated proved recoverable reserves of crude oil, natural gas liquids, and natural gas

	Proved reserves, Dec. 31, 1964	Changes in proved reserves, due to extensions and new discoveries in 1965	Proved reserves, Dec. 31, 1965 (production was deducted)	Changes from 1964, percent
Crude oil—thousand 42-gallon barrels	1,585,885	137,888	1,517,490	−4.3
Natural gas liquids [1]—do	342,902	47,432	358,297	+4.5
Natural gas—million cubic feet	19,757,235	1,899,009	20,357,414	+3.0

[1] Includes condensate, natural gasoline, and LP gases.

Source: American Gas Association, American Petroleum Institute, and Canadian Petroleum Association, Proved Reserves of Crude Oil, Natural Gas Liquids, and Natural Gas. V. 20, Dec. 31, 1965, pp. 12–13, 24.

Natural Gas Liquids.—Recovery of natural gas liquids by 73 natural gasoline plants and 4 cycling plants totaled about 1.5 billion gallons in 1965 and represented a 2 per cent increase compared with the quantity recovered in 1964. Natural gasoline and cycle products accounted for 39 percent of the quantity and 52 percent of the value in 1965; LP gases comprised the remainder. Union Texas Petroleum, division of Allied Chemical Corp., was building a 90-million-cubic-foot-per-day refrigerated absorption plant in Major County to produce 225,000 gallons of liquids daily. Anadarko Production Co. completed a depropanizer unit capable of producing 22,000 gallons of propane daily at its North Richland Center plant in Texas County. Continental Oil Co. completed facilities that increased daily propane-butane production by 30,000 gallons at its Medford, Grant County, plant. Pan American Petroleum Corp. completed its 20-million-cubic-foot-per-day refrigerated absorption Star-Lacey plant in Blaine County and doubled the capacity of its Mooreland plant in Woodward County to 100 million cubic feet per day. Skelly Oil Co. bought Cyprus Mines Corp. natural gas liquids plant at Marlow, Stephens County. Mid-America Pipeline Co., through a subsidiary, purchased Hugoton Plains Oil & Gas Co. Hugoton plant in Texas County.

Table 7.—Natural gas liquids production
(Thousand gallons and thousand dollars)

Year	Natural gasoline and cycle products		LP gases		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
1956–60 (average)	474,351	$28,084	652,296	$26,110	1,126,647	$54,194
1961	521,237	33,358	817,082	30,141	1,338,319	63,499
1962	552,795	35,764	838,903	25,223	1,391,698	60,987
1963	555,467	35,131	810,894	28,981	1,366,361	64,112
1964	554,053	34,011	880,804	28,055	1,434,857	62,066
1965	570,129	34,561	894,665	32,208	1,464,794	66,769

The Grimes Gasoline Co. Weleetka plant in Okfuskee County and the Highway Gasoline Co. Stroud plant in Lincoln County were shut down during the year. Greenville Gasoline Co. discontinued operations at its Greenville field plant in Love County.

At yearend the American Gas Association reported proved recoverable reserves of natural gas liquids in Oklahoma were estimated at 358.3 million 42-gallon barrels, about 4.5 percent of the U.S. total. Exploratory drilling added over 5 million barrels to the recoverable reserve; development drilling added more than 42 million barrels through extensions and revisions.

The Oil and Gas Journal reported that yearend underground storage capacity for natural gas liquids amounted to 1,295,000 barrels at eight sites. Service Pipe Line Co. began using its new 200,000-barrel butane storage facilities in mined shale in Creek County. When completed by Continental Oil Co. in 1966, six new sites drilled in salt layers in Grant County will add 1,550,000 barrels to the present capacity.

Petroleum.—Crude petroleum output totaled 203.4 million barrels from 80,947 oil wells, compared with nearly 203 million barrels from 80,511 oil wells in 1964. Daily average production of crude oil was 557,373 barrels, or 6.9 barrels per well. Average indicated daily demand for crude oil was 562,055 barrels, less than 1 percent greater than in 1964.

Table 8.—Crude petroleum production
(Thousand 42-gallon barrels and thousand dollars)

Year	Quantity	Value
1956–60 (average)	204,445	$597,263
1961	193,081	561,866
1962	202,732	591,977
1963	201,962	587,709
1964	202,524	587,320
1965	203,441	587,944

Petroleum output was prorated by the Oklahoma Corporation Commission under the Interstate Oil Compact to maintain a balance between production and indicated demand. The Commission cut the crude oil production allowable for March to 26 percent of the basic depth-acreage formula from 30 percent, which had been in effect

since November 1964. The crude oil production allowable was again raised to 30 percent for November and December 1965.

Estimated proved recoverable reserves of crude oil amounted to over 1,517.5 million barrels as of December 31, 1965, equivalent to 7.5 barrels of recoverable crude oil underground for each barrel of oil produced in 1965. Extensions and revisions added 131.5 million barrels to the proved reserves, and new discoveries added 6.4 million barrels. Oklahoma had 4.8 percent of the total U.S. oil reserve and over 4.7 percent of total liquid fuel reserves, including natural gas liquids.

Petroleum production was reported from 65 counties of which Stephens, Osage, Carter, Garvin, and Creek Counties led in the order named. Unallocated fields, including secondary recovery projects and stripper wells, accounted for 53.9 percent of the total output.

Table 9.—Crude petroleum production, indicated demand, and stocks, in 1965, by months
(Thousand 42-gallon barrels)

Month	Production	Indicated demand	Stocks originating in Oklahoma
January	17,011	16,321	17,506
February	15,553	15,596	17,463
March	17,588	18,732	16,319
April	17,464	16,320	17,463
May	17,368	16,790	18,041
June	16,466	15,828	18,679
July	16,031	16,898	17,812
August	17,322	18,266	16,868
September	17,183	17,804	16,247
October	16,530	17,640	15,137
November	16,667	16,377	15,427
December	18,258	18,578	15,107
Total:			
1965	203,441	205,150	XX
1964	202,524	204,230	XX

XX Not applicable.

Table 10.—Oil and gas wells drilled in 1965, by counties

County	Proved field wells				Exploratory wells			Total
	Oil [1]	Gas	Service	Dry	Oil [1]	Gas	Dry	
Alfalfa	159	30	1	4	3	---	8	205
Atoka	---	---	---	---	---	---	3	3
Beaver	46	39	---	37	---	3	2	127
Beckham	3	4	---	5	---	---	2	14
Blaine	5	17	---	11	3	4	7	47
Bryan	---	---	---	---	---	1	4	5
Caddo	15	---	2	6	---	1	9	33
Canadian	---	4	---	1	1	---	5	11
Carter	122	11	26	35	1	---	4	199
Cimarron	11	2	---	7	---	---	2	22
Cleveland	13	1	---	6	1	---	5	26
Coal	6	1	---	5	---	---	1	13
Comanche	30	1	1	24	---	---	3	59
Cotton	12	---	3	3	---	---	4	22
Craig	---	---	---	2	---	---	---	2
Creek	96	---	55	27	---	---	1	179
Custer	7	4	---	1	---	---	3	15
Dewey	16	8	---	8	2	2	6	42
Ellis	9	29	---	8	---	1	3	50
Garfield	106	26	4	9	8	3	4	160
Garvin	59	5	4	47	1	---	18	134
Grady	6	7	2	5	1	1	7	29
Grant	30	3	1	4	1	---	6	45
Greer	2	---	---	3	---	---	2	7
Harper	5	34	---	19	1	---	4	63
Haskell	---	45	---	21	---	---	1	67
Hughes	10	20	---	28	1	3	9	71
Jackson	---	---	1	---	---	---	6	7
Jefferson	3	---	---	6	---	---	18	27
Kay	25	2	---	24	---	---	12	63
Kingfisher	182	6	---	10	5	---	1	204
Kiowa	8	---	---	16	---	---	8	32

See footnote at end of table.

Table 10.—Oil and gas wells drilled in 1965, by counties—Continued

County	Proved field wells				Exploratory wells			Total
	Oil [1]	Gas	Service	Dry	Oil [1]	Gas	Dry	
Latimer	---	27	---	6	---	---	3	36
Le Flore	---	13	---	10	---	---	7	30
Lincoln	27	2	1	16	---	---	6	52
Logan	66	5	---	10	3	1	6	91
Love	5	---	---	12	1	---	8	26
Major	137	22	3	15	2	4	5	188
Marshall	3	---	1	4	---	1	3	12
McClain	20	2	2	10	3	---	11	48
McCurtain	---	---	4	3	---	---	---	7
McIntosh	---	1	---	1	---	1	4	7
Murray	3	---	---	7	---	---	10	20
Muskogee	27	1	39	13	---	---	3	83
Noble	20	3	3	17	2	---	5	50
Nowata	46	1	29	23	---	---	---	99
Okfuskee	48	7	5	33	2	1	2	98
Oklahoma	4	6	---	6	---	1	2	19
Okmulgee	46	10	14	26	---	1	---	97
Osage	186	3	105	61	4	---	8	367
Pawnee	13	2	3	15	---	1	4	38
Payne	36	1	3	34	2	---	5	81
Pittsburg	---	12	---	9	---	3	7	31
Pontotoc	94	2	5	21	---	---	6	128
Pottawatomie	30	2	2	22	3	---	8	67
Roger Mills	2	3	---	---	---	1	1	7
Rogers	29	1	34	16	---	---	---	80
Seminole	77	1	31	32	---	---	2	143
Sequoyah	---	---	---	---	---	---	2	2
Stephens	60	8	20	39	1	1	4	133
Texas	42	33	3	35	1	3	6	123
Tillman	11	---	1	4	---	---	1	17
Tulsa	29	---	18	5	---	---	---	52
Wagoner	6	2	7	14	---	---	---	29
Washington	64	2	48	13	---	---	---	127
Washita	---	---	---	1	---	---	2	3
Woods	8	16	---	17	3	4	8	56
Woodward	2	19	---	26	---	1	12	60
Total:								
1965	2,127	506	481	958	56	43	319	4,490
1964	2,148	412	510	962	108	52	324	4,516

[1] Includes distillate wells.

Source: Oil and Gas Journal. V. 64, No. 5, Jan. 31 ,1966, pp. 198–200.

The Interstate Oil Compact Commission, in cooperation with the National Stripper Well Association, reported that on January 1, Oklahoma had 67,539 stripper wells which produced 118.8 million barrels of oil in 1964. Oil reserves of stripper wells totaled 1,049 million barrels, or 66 percent of the overall proved oil reserves in Oklahoma on January 1, 1965.

Average price per barrel of crude petroleum at the wellhead was $2.89—down 1 cent from that of 1964.

Thirteen Oklahoma refineries had a total daily operating capacity of 416,430 barrels of crude oil and 154,657 barrels of cracked gasoline on January 1, 1965. The refineries processed 68.8 percent of the State production in 1965. Crude oil runs to stills, total receipts, intrastate receipts, and yearend stocks at Oklahoma refineries for 1964 and 1965, in thousand barrels, were as follows:

Year	Run to stills	Total receipts	Intrastate receipts	Stocks Dec. 31
1964	136,659	136,018	106,058	1,592
1965	139,965	139,960	102,977	1,584

Table 11.—Production of crude petroleum, by fields
(Thousand 42-gallon barrels)

Field [1]	1961	1962	1963	1964	1965
Allen	1,403	1,390	1,445	2,150	2,192
Atlantic	1,171	1,462	1,450	1,363	1,190
Bowlegs	1,125	1,240	1,110	1,208	1,048
Burbank	15,275	14,290	13,685	13,417	12,017
Camrick	1,947	2,175	2,322	2,225	2,166
Cement	4,038	3,533	3,340	3,040	2,831
Cumberland	1,213	1,142	1,133	1,141	1,039
Cushing	2,537	2,629	2,828	3,075	3,110
Dover-Hennessey	4,841	8,945	9,010	8,667	(2)
Edmond, West	1,212	1,179	1,150	1,052	1,605
Enid, Northeast	64	157	1,460	2,148	2,143
Eola-Robberson	3,624	3,444	3,384	3,433	3,473
Garber	595	657	751	730	1,096
Glenn Pool	3,868	3,490	3,303	3,851	4,092
Golden Trend	10,202	10,730	13,427	14,292	13,544
Healdton	2,353	2,513	2,506	2,600	2,677
Hewitt	2,989	2,550	2,461	2,895	2,974
Knox	2,039	1,390	1,838	1,887	1,687
Loco	1,517	1,738	1,848	1,734	1,788
Moore, West	1,294	1,066	685	1,129	1,014
Muskogee	488	702	1,101	1,047	1,089
Naval Reserve	2,456	2,367	2,170	1,702	1,686
Oklahoma City	2,617	2,381	2,300	2,112	1,978
Payne	1,392	2,350	2,274	1,969	1,722
Postle	217	391	470	1,752	2,105
Putnam	449	900	912	2,076	3,081
Ringwood	247	268	1,340	1,314	1,074
Seminole	666	726	785	968	1,122
Sho-Vel-Tum	24,510	24,350	24,995	26,660	28,769
Slick	747	797	1,129	1,114	1,180
Sooner Trend	-----	-----	-----	-----	9,680
St. Louis	1,449	1,440	1,535	1,470	1,454
Stroud	624	682	702	1,161	1,151
Other fields	94,412	99,658	93,113	87,142	85,664
Total	193,081	202,732	201,962	202,524	203,441

[1] Based on Oil & Gas Journal data adjusted to Bureau of Mines total.
[2] Consolidated into Sooner Trend.

The Bell Oil and Gas Co. refinery at Grandfield, Tillman County, was shut down. Units of its Wynnewood and Cushing refineries were updated by Kerr-McGee Corp. from a crude unit acquired some time ago from the former Tidewater Oil Co. refinery near Drumright. Most of the equipment, including two fractionating towers and two heaters, was moved to Wynnewood; a heater and fractionating tower went to Cushing. The company said utilization of the components will provide modernization resulting in increased operation efficiency of the crude units at both refineries.

Pipelines.—The Federal Bureau of Mines in a triennial report stated there were 21,534 miles of petroleum pipeline in place on January 1, 1965.[3] Some 3,305 miles of pipe was laid during the 3-year period and 1,054 miles of pipe was taken up for a net increase of 2,251 miles. Gathering lines for crude oil and natural gasoline totaled 13,029 miles on January 1, 1962, and totaled 13,956 miles on January 1, 1965. Product pipelines also showed an increase in the same period from a total of 2,767 miles to 3,427 miles. Mileage of crude trunklines increased from 5,738 miles on January 1, 1962, to 6,402 miles on January 1, 1965.

Arbuckle Pipe Line Co., jointly owned by Continental Oil Co., Skelly Oil Co., and Sunray DX Oil Co., built a $5 million 180-mile, 8-inch gas liquids line to transport propane, butane, and natural gasoline from southern and central Oklahoma to Medford. The new line, with a capacity of 40,000 barrels daily, serves markets in the Midwest and North-Central United States through connections at Medford with other pipeline systems. Continental Pipe Line Co. operates the line.

Shell Pipe Line Corp. increased capacity of its 10-inch crude oil pipeline from Elk City to Cushing to handle additional oil gathered by Panotex Pipe Line Co.'s new system in the Oklahoma and Texas Panhandles. The increase was accomplished by

[3] Foley, James M. Crude Oil and Refined-Products Pipeline Mileage in the United States, January 1, 1965. BuMines Mineral Industry Survey, Dec. 9, 1965, 7 pp.

installing new pumps at Elk City and Weatherford. Panotex installed booster pumps at its Elk City terminal to transfer crude to the Shell line. From Cushing, the crude can be moved to refining centers in Illinois and eastward.

The Federal Power Commission denied an application of Oklahoma-Illinois Pipeline Co. to build a $62 million 700-mile pipeline system from the Anadarko basin in northwestern Oklahoma and the Arkoma basin in southeastern Oklahoma to St. Louis.

NONMETALS

Output of nine nonmetals was valued at over $51 million, over 5 percent of the State's mineral production value in 1965 and an overall gain of 7 percent in value over that of 1964. In the 10-year period 1956-65, the total value of nonmetallic minerals and commodities increased 67 percent.

Cement.—Output of cement at three plants was 10 percent greater and the value of shipments increased 5 percent. Plants operated by Ideal Cement Co. at Ada, Oklahoma Cement Co. southeast of Pryor, and Dewey Portland Cement Co., division of Martin Marietta Corp., east of Tulsa, were active. The latter firm's plant at Dewey reopened in September to ship clinkers that were trucked from the Tulsa plant.

Table 12.—Shipments of portland cement to Oklahoma consumers

Year	Thousand barrels
1956-60 (average)	4,975
1961	5,573
1962	5,941
1963	7,105
1964	6,163
1965	6,884

Clays.—Fourteen producers mined clay and shale from 19 pits in 13 counties. Clay was used primarily in brick and tile and, to a lesser extent, in portland cement and expanded clay products. Brick and structural clay tile were produced in 11 counties; expanded clay aggregate was produced in Oklahoma and Rogers Counties; and pottery was produced in Creek County. Bentonite was produced in Dewey County for filtering and absorbent uses.

Gypsum.—Eight producers reported production from open pit mines in the following six counties: Blaine, Caddo, Canadian, Comanche, Jackson, and Washita. Most of the gypsum was used to manufacture wallboard, plaster, and other building materials; the remainder was used as a soil conditioner and as a retarder in portland cement.

Table 13.—Clays sold or used by producers[1]
(Thousand short tons and thousand dollars)

Year	Quantity	Value
1956-60 (average)	725	$726
1961	792	801
1962	737	756
1963	898	911
1964	835	854
1965	794	806

[1] Excludes bentonite.

Lime.—Production of lime was 10 percent greater in value than in 1964. Output was used mostly by chemical plants in the Pryor area and by municipal water plants; other uses included steel manufacture, oil refining, waste disposal, building material, and paper manufacture.

Pumice (Volcanic Ash).—Output of volcanic ash, which decreased 1 percent in quantity and 3 percent in value, was used primarily for abrasive-type cleaners.

Salt.—Salt, derived from solar evaporation of brine from springs in Harmon County and from surface encrustations on the Big Salt Plain of the Cimarron River in Woods County, increased over 50 percent in quantity and 59 percent in value. Principal uses were in stockfeed and water softening; other uses included herbicides and salinity control of oil well drilling fluid.

Sand and Gravel.—Johnston, McClain, Oklahoma, Pushmataha, and Tulsa Counties supplied more than 50 percent of the quantity and value of the sand and gravel produced in 37 counties in 1965. Commercial sand and gravel producers shipped 84 percent of their output by truck and the remaining 16 percent by rail. Sand was used mainly in building, paving, fill, and high-purity glass sand. Gravel was used for paving and building.

Stone.—Stone was produced in 40 counties of which Comanche, McIntosh, Murray, Pontotoc, and Tulsa Counties supplied more than 50 percent of the quantity and value in 1965. Limestone was responsible for 80 percent of the stone production, sandstone 12 percent, and the remaining 8 percent was comprised of granite and chat.

Table 14.—Sand and gravel sold or used by producers
(Thousand short tons and thousand dollars)

Year	Commercial		Government-and-contractor		Total sand and gravel	
	Quantity	Value	Quantity	Value	Quantity	Value
1956–60 (average)	4,032	$4,689	2,081	$1,032	6,113	$5,721
1961	4,029	4,515	1,281	998	5,310	5,513
1962	3,802	4,355	634	381	4,436	4,736
1963	4,644	5,756	776	360	5,420	6,116
1964	5,032	6,031	1,648	972	6,680	7,003
1965	4,570	5,614	648	409	5,218	6,023

Table 15.—Sand and gravel sold or used by producers, by classes of operations and uses
(Thousand short tons and thousand dollars)

Class of operation and use	1964		1965	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	2,418	$2,185	1,758	$1,628
Paving	843	777	812	785
Fill	368	211	525	209
Other [1]	549	2,017	1,119	2,534
Total	4,178	5,190	4,214	5,156
Gravel:				
Building	164	165	101	174
Paving	650	618	154	128
Other [2]	40	58	101	156
Total	854	841	356	458
Total sand and gravel	5,032	6,031	4,570	5,614
Government-and-contractor operations:				
Sand:				
Paving	171	218	263	119
Fill	91	32	61	45
Total	262	250	324	164
Gravel:				
Paving	502	394	310	214
Fill	884	328	14	31
Total	1,386	722	324	245
Total sand and gravel	1,648	972	648	409
Grand total	6,680	7,003	5,218	6,023

[1] Includes other construction sand and industrial sand (unground and ground).
[2] Includes miscellaneous gravel, railroad ballast, and fill.

Crushed stone accounted for 99 percent of the total stone production and crushed limestone was responsible for 80 percent of the total. Open pit methods accounted for all stone produced except the output from two underground mines in eastern Oklahoma. Principal uses for crushed stone were for roadstone, concrete aggregate, cement, and lime. Ninety-four percent of the crushed limestone produced commercially was shipped by truck and 6 percent by railroad.

Tripoli.—Tripoli output was 23 percent lower in quantity and 4 percent lower in value. The crude material, mined in eastern Ottawa County, was processed at Seneca, Mo., by American Tripoli Division of The Carborundum Co. and sold primarily for buffing compounds and in minor quantities for foundry use.

Vermiculite.—Vermiculite, exfoliated from crude material, mined in several Western States by Texas Vermiculite Co. at its Oklahoma City plant, decreased 24 percent. Principal uses of the exfoliated material were for loose fill insulation and as lightweight aggregate in plaster and concrete.

Water.—Keystone Dam, last of the high-rise dams to be constructed on the north

Table 16.—Sand and gravel production in 1965, by counties

(Thousand short tons and thousand dollars)

County	Quantity	Value
Bryan	51	$52
Cimarron	4	6
Comanche	5	2
Cotton	39	36
Delaware	5	2
Garfield	73	29
Harmon	4	2
Kay	166	132
Kiowa	94	76
Le Flore	70	71
Mayes	12	4
Nowata	15	6
Oklahoma	233	324
Osage	3	1
Ottawa	85	34
Pittsburg	56	23
Texas	6	6
Tulsa	1,290	806
Woodward	33	26
Other counties [1]	2,974	4,385
Total	5,218	6,023

[1] Includes Alfalfa, Caddo, Canadian, Grady, Greer, Jackson, Johnston, Kingfisher, Logan, McClain, Major, Murray, Muskogee, Pawnee, Pontotoc, Pushmataha, Tillman, and Wagoner Counties, combined to avoid disclosing individual company confidential data. Undistributed amounts from various counties are also included.

end of the Arkansas River navigation project, was dedicated on May 22. The $127 million structure built by the U.S. Army Corps of Engineers, Tulsa District, began to impound water in September 1964. The powerhouse, under construction at yearend, will generate 70,000 kilowatts when completed in 1967.

Four other structures were under construction in eastern Oklahoma by the Tulsa District. On the Arkansas River, upstream from Webber Falls, the Webber Falls Lock and Dam was under construction. Farther downstream near Sallisaw, the Robert S. Kerr Lock and Dam (formerly Short Mountain Lock and Dam) was being erected. Construction was well along on the Broken Bow Dam on Mountain Fork River in McCurtain County; also in McCurtain County, construction was resumed on the Pine Creek Dam on Little River after a delay of more than 1 year to determine the practicality of developing hydroelectric power at the site.

The Bureau of Reclamation, U.S. Department of the Interior, completed the Norman Dam east of Norman on Little River in Cleveland County. Work continued at the agency's Arbuckle Dam on Rock Creek in Murray County.

The Grand River Dam Authority, a State agency, began the third phase of a long-range coordinated and integrated program of hydroelectric and flood control development of the Grand River Watershed. In February, the agency granted a contract for $8.5 million for the initial stages of $70 million Salina Pumped-Storage Project at Lake Hudson (Markham Ferry).

METALS

Copper.—Copper was strip mined by The Eagle-Picher Co. southeast of Creta in southwestern Jackson County from a deposit in the Flowerpot Shale in the Permian red beds. The company erected a small mill to concentrate the ore—a combination of carbonates and sulfides of copper—for smelting at El Paso, Tex.

Occurrences of copper exist in many areas of Oklahoma; however, the earliest mention of copper in Oklahoma is to be found in the report of Capt. Randolph B. Marcy, entitled "Exploration of the Red River of Louisiana in the Year 1852", published by U.S. Senate, 33d Congress, 1st session, 1854.[4] In traversing the divide between the Red River and Cache Creek in the area now known as Jefferson County,

[4] Ham, William E., and Kenneth S. Johnson. Copper in the Flowerpot Shale (Permian) of the Creta Area, Jackson County, Oklahoma. Oklahoma Geol. Survey Circ. 64, 2 pts., 1964, 32 pp.

Merritt, C. A. Copper in the "Red Beds" of Oklahoma. Okla. Geol. Survey, Miner. Rept. No. 8, 1940.

Table 17.—Stone sold or used by producers, by kinds

(Thousand short tons and thousand dollars)

Year	Granite		Limestone		Sandstone		Miscellaneous stone		Total	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1961	22	$681	12,531	$13,712	1,133	$1,529	1,295	$639	14,981	$16,561
1962	15	1,043	12,579	15,793	1,040	1,351	1,032	632	14,666	18,819
1963	7	832	12,437	14,537	135	214	1,238	577	13,817	16,160
1964	3	219	11,375	12,669	1,271	1,552	1,338	647	13,987	15,087
1965	6	503	13,121	14,771	2,057	2,092	1,233	705	16,417	18,071

Okla., the Marcy party found numerous small detached fragments of copper ore.

Shipments of copper ore from a deposit 4 miles west of Byars were reported in 1897 and 1898. In 1913, a shipment of 29 tons of copper ore was made from a deposit, 5 miles west of Byars. In southwestern Okfuskee County, 25 tons was shipped in 1920 and 30 tons was shipped during the period 1931–34 to El Paso, Tex. Attempts were made to develop copper prospects in the western part of Pawnee County, but none demonstrated the presence of a commercial deposit. Efforts have been unsuccessful elsewhere in the red beds, since Oklahoma was first opened to settlers.

Germanium.—Reclaimed as an accumulation of residue in zinc smelting, germanium was recovered from domestic and foreign ore concentrates by The Eagle-Picher Co. at Henryetta, Okmulgee County, and by National Zinc Co. at Bartlesville, Washington County. The residue was shipped to The Eagle-Picher Co. germanium processing plant north of Quapaw, Ottawa County.

Lead.—Thirty-two producers reported output of lead ore from 61 operations, compared with 31 producers at 57 operations in 1964. Output of recoverable lead in Ottawa County increased 1 percent and value rose 20 percent. The price of lead at New York remained unchanged at 16 cents per pound throughout 1965.

Silver.—A small amount of silver in association with the copper being mined near Creta was recovered from the copper concentrate.

Table 18.—Mine production of lead and zinc, in terms of concentrate and recoverable metals [1]

Year	Lead concentrate (galena)		Zinc concentrate (sphalerite)		Recoverable metal content [2]			
					Lead		Zinc	
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)
1956–60 (average)	7,195	$1,217	19,458	$1,569	4,952	$1,431	10,223	$2,585
1961	1,333	130	5,936	405	980	202	3,148	724
1962	3,600	343	18,327	1,278	2,710	499	10,013	2,303
1963	4,317	432	24,329	1,757	3,192	689	13,245	3,046
1964	3,730	505	22,592	1,963	2,781	729	12,159	3,307
1965	3,896	651	23,668	2,277	2,813	878	12,715	3,713
Total 1891–1965	1,692,274	164,895	9,833,217	490,290	1,297,164	197,408	5,185,776	785,675

[1] Based on Oklahoma ore (dirt) and old tailing treated at mills during calendar year indicated.
[2] In calculating metal content of the ores from assays, allowance made for smelting losses of both lead and zinc. In comparing values of concentrate (ore) and metal, it should be noted that value given for concentrate is that actually received by producer, whereas value of lead and zinc is calculated from average price for all grades.

Table 19.—Tenor of lead-zinc ore milled and concentrates produced

	1964	1965
Total material milled—short tons	486,545	595,205
Recovery of concentrate and metal from quantity milled:		
Galena—short tons	3,730	3,896
Sphalerite—do	22,592	23,668
Galena—percent	.77	.65
Sphalerite—do	4.64	3.98
Lead [1]—do	.57	.47
Zinc [1]—do	2.50	2.14
Average lead content of galena concentrate—do	75.95	73.54
Average zinc content of sphalerite concentrate—do	59.80	59.74
Average value per ton:		
Galena concentrate	$135.50	$167.15
Sphalerite concentrate	$86.90	$96.22

[1] Figures represent metal content of crude ore (dirt) as recovered in concentrate. Data on tailing losses not available.

Table 20.—Mine production of lead and zinc in 1965, by months, in terms of recoverable metals

(Short tons)

Month	Lead	Zinc
January	245	1,118
February	275	1,132
March	372	1,238
April	251	1,200
May	161	1,179
June	195	1,019
July	230	1,142
August	153	892
September	226	997
October	181	945
November	226	907
December	298	946
Total	2,813	12,715

Zinc.—Recoverable zinc output in Ottawa County increased nearly 5 percent in tonnage and over 12 percent in value over that of 1964. Thirty-six producers reported zinc ore output from 64 operations compared with 34 producers at 61 operations the previous year. The price of zinc at East St. Louis was unchanged throughout 1965 at 14.5 cents per pound.

Custom Mills and Smelters.—Three horizontal retort zinc plants were operated in 1965: American Metal Climax, Inc., at Blackwell, Kay County; The Eagle-Picher Co. at Henryetta, Okmulgee County; and National Zinc Co. at Bartlesville, Washington County. Ores and concentrates of domestic and foreign origin were treated at these smelters. Federated Metals Division of the American Smelting & Refining Co. operated a secondary zinc plant in Sand Springs, Tulsa County.

TRI-STATE DISTRICT

Tri-State mining activity was confined to the Kansas and Oklahoma sections as mines in the District's southwest Missouri segment were inactive for the eighth consecutive year. Lead and zinc production increased 12 and 14 percent, respectively, in quantity and 34 and 23 percent, respectively, in value. Lead concentrates were up 16 percent from 1964; zinc concentrates rose 14 percent in the same period. Value of the concentrates increased 41 and 26 percent, respectively. Sixty-three percent of the District's lead concentrate and 66 percent of the zinc concentrate were produced from crude ore mined in Oklahoma and the remainder was credited to mines in Kansas. Although the Lead-Zinc Mining Stabilization Program continued in effect throughout the year, no payments were made to miners in the District as the lead and zinc prices remained above the level at which payment is made under the program.

According to the E&MJ Metal & Mineral Markets, quoted prices on 60-percent zinc concentrates at Joplin, Mo., were unchanged at $92 per ton throughout 1965.

Table 21.—Mine production of lead and zinc concentrates in Tri-State District, in terms of concentrate and recoverable metals

Year	Lead concentrate (galena)		Zinc concentrate (sphalerite)		Recoverable metal content			
					Lead		Zinc	
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)
1956-60 (average)	11,255	$1,927	39,198	$3,194	7,925	$2,299	20,862	$5,289
1961	3,243	352	10,666	716	2,429	500	5,594	1,287
1962	4,890	481	25,564	1,771	3,680	677	13,956	3,210
1963	5,719	604	30,762	2,271	4,219	911	16,753	3,853
1964	5,333	733	31,228	2,732	3,966	1,039	16,824	4,576
1965:								
Kansas	2,304	380	12,003	1,157	1,644	513	6,508	1,900
Oklahoma	3,896	651	23,668	2,277	2,813	878	12,715	3,713
Total 1965	6,200	1,031	35,671	3,434	4,457	1,391	19,223	5,613

Table 22.—Tenor of lead and zinc ore milled and concentrates produced in the Tri-State District

	1961 [1]	1962	1963	1964	1965
Total material milled:					
Crude ore, short tons	180,331	474,219	612,862	691,798	905,973
Recovery of concentrate and metal from material milled:					
Galena, percent	1.67	1.03	0.93	0.77	0.68
Sphalerite, do	5.64	5.39	5.02	4.51	3.94
Lead [2], do	1.28	.78	.69	.57	.49
Zinc [2], do	2.98	2.94	2.73	2.43	2.12
Average lead content of galena concentrate, do	78.43	76.75	75.21	75.77	73.27
Average zinc content of sphalerite concentrate, do	58.65	60.64	60.52	59.86	59.91
Average value per ton:					
Galena concentrate	$111.82	$98.24	$105.68	$137.52	$166.32
Sphalerite concentrate	$67.56	$69.30	$73.82	$87.48	$96.28

[1] Lead-zinc concentrates from accumulated slimes excluded.
[2] Metal content of the crude ore (dirt) as recovered in concentrate.

REVIEW BY COUNTIES

Seventy-six of the State's 77 counties reported mineral production; however, 53 percent of Oklahoma's total mineral production value was supplied by Garvin, Stephens, Osage, Carter, Texas, Beaver, Kingfisher, Creek, Seminole, and McClain Counties in descending order of value. Crude oil was reported from 65 counties, natural gas from 65 counties, and natural gas liquids from 29 counties. Nonmetals were produced in 61 counties and metals in 2 counties.

Beaver.—Mineral output value climbed about 7 percent as increased sales of natural gas, petroleum, and natural gas liquids accounted for the gain that offset a decrease in volcanic ash production value. The Camrick field in Beaver and Texas Counties yielded nearly 2.2 million barrels of crude oil. Natural gas liquids were recovered by Cabot Corp. Beaver plant; El Paso Natural Gas Co. Cabot-Highland plant; Texaco Inc. Camrick plant; and Warren Petroleum Corp. Mocane plant. Volcanic ash was mined north of Gate by LaRue-Axtell Co. Texaco Inc. operated a 40,000-barrel propane storage reservoir in a salt layer near its processing plant; Warren Petroleum Corp. maintained a 140,000-barrel LP gas storage reservoir in a salt layer near its gas liquids plant.

Beckham.—Total mineral production value declined 6 percent as decreased sales were noted in petroleum and natural gas. Natural gas and petroleum were produced mainly from the Elk City field. Natural gas liquids were extracted from natural gas at the Elk City cycling plant of Shell Oil Co. Near Sayre, Oklahoma Natural Gas Co. maintained an underground natural gas storage reservoir, part of which was leased to the Natural Gas Pipeline Company of America under authorization from the Federal Power Commission. Shell Oil Co. maintained a 17,000-barrel propane storage reservoir in a salt layer near Sayre.

Blaine.—Mineral production value increased 48 percent owing to gains in sales of natural gas, petroleum, natural gas liquids, and gypsum. Universal Atlas Cement Co. quarried gypsum, northeast of Watonga, for use as portland cement retarder, and Walton Gypsum Co. quarried gypsum, west of Okeene, for agricultural uses. United States Gypsum Co. quarried and crushed gypsum and operated a large calcining, sheetrock, and plaster products plant at Southard. Natural gas from fields in Blaine and Major Counties was processed at Pan American Petroleum Corp. Okeene plant and natural gas from Blaine and Kingfisher Counties fields was processed at the company's new Star-Lacey plant.

Caddo.—Gains in petroleum and stone accounted for a 16 percent rise in total mineral output, though the value of natural gas and gypsum output declined. Petroleum and natural gas were produced from several fields; the largest field, Cement, produced over 2.8 million barrels of petroleum. Crude oil was processed at the Cyril refinery of APCO Oil Corp. Equipment changes in the refinery reduced crude-charge capacity from 12,000 to 10,250 barrels per calendar-day. Harrison Gypsum

Table 23.—Value of minerals produced in Oklahoma, by counties [1]

County	1964 r	1965	Minerals produced in 1965 in order of value
Alfalfa	$3,570,789	$6,348,631	Petroleum, natural gas, sand and gravel.
Atoka	311,325	W	Stone, petroleum.
Beaver	42,150,534	45,081,361	Natural gas, petroleum, natural gas liquids, volcanic ash.
Beckham	17,554,786	16,531,428	Natural gas, natural gas liquids, petroleum.
Blaine	4,132,396	6,132,567	Natural gas, gypsum, petroleum, natural gas liquids.
Bryan	2,425,735	2,291,519	Petroleum, natural gas, sand and gravel, stone.
Caddo	11,117,315	12,846,922	Petroleum, natural gas, stone, gypsum, sand and gravel.
Canadian	861,165	1,275,916	Natural gas, petroleum, clays, sand and gravel, gypsum.
Carter	51,837,967	53,150,080	Petroleum, natural gas liquids, natural gas, stone.
Cherokee	W	1,264,650	Stone.
Choctaw	189,725	185,109	Do.
Cimarron	11,653,897	13,088,929	Helium, natural gas, petroleum, natural gas liquids, sand and gravel.
Cleveland	14,537,871	12,915,330	Petroleum, natural gas, natural gas liquids.
Coal	2,628,766	2,650,143	Petroleum, natural gas, stone.
Comanche	3,165,922	3,234,044	Stone, natural gas, petroleum, gypsum, sand and gravel.
Cotton	6,146,912	5,752,493	Petroleum, sand and gravel, natural gas.
Craig	1,110,405	998,481	Coal, petroleum, natural gas.
Creek	33,530,488	31,817,109	Petroleum, natural gas liquids, natural gas, stone, clays.
Custer	2,961,142	3,251,797	Natural gas, petroleum, clays, stone.
Delaware	16,000	2,000	Sand and gravel.
Dewey	11,935,247	15,999,908	Petroleum, natural gas, natural gas liquids, clays.
Ellis	1,088,631	3,053,349	Natural gas, petroleum.
Garfield	19,834,402	21,907,542	Petroleum, natural gas, natural gas liquids, sand and gravel, clays.
Garvin	70,743,053	73,677,170	Petroleum, natural gas, natural gas liquids, stone.
Grady	22,826,876	24,221,131	Petroleum, natural gas, natural gas liquids, sand and gravel.
Grant	7,034,820	6,991,496	Petroleum, natural gas, natural gas liquids.
Greer	310,660	260,817	Stone, petroleum, sand and gravel, natural gas, clays.
Harmon	31,000	56,600	Salt, sand and gravel.
Harper	20,802,526	21,492,949	Natural gas, natural gas liquids, petroleum, stone.
Haskell	4,952,440	7,970,372	Natural gas, coal, stone.
Hughes	5,799,066	5,183,587	Petroleum, natural gas.
Jackson	902,739	1,059,325	Petroleum, gypsum, copper, sand and gravel, stone, silver, natural gas.
Jefferson	3,516,804	2,856,986	Petroleum, natural gas.
Johnston	W	W	Sand and gravel, stone.
Kay	12,515,143	12,852,299	Petroleum, natural gas liquids, natural gas, sand and gravel, stone.
Kingfisher	35,351,236	38,456,041	Petroleum, natural gas, natural gas liquids, sand and gravel.
Kiowa	910,091	1,139,340	Stone, petroleum, sand and gravel, natural gas.
Latimer	4,166,011	5,239,199	Natural gas, stone.
Le Flore	1,369,536	1,462,135	Natural gas, sand and gravel, coal, stone.
Lincoln	22,938,275	17,710,086	Petroleum, natural gas, natural gas liquids.
Logan	7,047,837	8,897,308	Petroleum, natural gas, natural gas liquids, sand and gravel.
Love	9,362,645	10,746,178	Petroleum, natural gas, natural gas liquids.
Major	14,953,477	17,881,017	Petroleum, natural gas, natural gas liquids, sand and gravel.
Marshall	5,195,243	4,965,961	Petroleum, natural gas liquids, natural gas.
Mayes	6,809,460	6,040,111	Cement, stone, clays, sand and gravel, petroleum.
McClain	26,136,107	25,273,299	Petroleum, natural gas, natural gas liquids, sand and gravel.
McCurtain	582,915	134,236	Stone, natural gas, petroleum.
McIntosh	1,036,774	2,804,704	Do.
Murray	3,112,302	3,198,166	Stone, petroleum, sand and gravel, natural gas.
Muskogee	4,397,154	4,633,746	Petroleum, sand and gravel, coal, stone.
Noble	7,191,355	7,048,256	Petroleum, natural gas, natural gas liquids.
Nowata	4,739,438	3,167,786	Petroleum, stone, natural gas, sand and gravel.
Okfuskee	7,516,956	6,933,778	Petroleum, natural gas, natural gas liquids.
Oklahoma	20,380,288	18,049,700	Petroleum, natural gas liquids, natural gas, sand and gravel, clays.
Okmulgee	5,243,770	4,639,407	Petroleum, natural gas, coal.
Osage	68,670,146	67,012,515	Petroleum, stone, natural gas, sand and gravel.
Ottawa	4,826,190	5,429,885	Zinc, lead, stone, tripoli, sand and gravel.
Pawnee	4,749,904	4,270,391	Petroleum, sand and gravel, natural gas, stone.
Payne	7,429,338	7,324,074	Petroleum, natural gas, stone.
Pittsburg	401,002	695,374	Natural gas, stone, sand and gravel, clays, petroleum.

See footnote at end of table.

Table 23.—Value of minerals produced in Oklahoma, by counties[1]—Continued

County	1964 r	1965	Minerals produced in 1965 in order of value
Pontotoc	$19,850,308	$20,207,677	Petroleum, cement, stone, sand and gravel, natural gas liquids, clays, natural gas.
Pottawatomie	10,727,497	9,857,358	Petroleum, natural gas, stone.
Pushmataha	W	W	Sand and gravel, stone.
Roger Mills	13,824	38,107	Petroleum, natural gas.
Rogers	10,219,890	12,656,108	Cement, petroleum, coal, stone, clays, natural gas.
Seminole	26,462,716	25,644,574	Petroleum, natural gas liquids, natural gas, stone, clays.
Sequoyah	1,948,361	W	Lime, stone, natural gas.
Stephens	69,323,407	69,879,363	Petroleum, natural gas, natural gas liquids.
Texas	45,631,115	47,212,433	Natural gas, petroleum, natural gas liquids, sand and gravel.
Tillman	939,384	917,439	Petroleum, sand and gravel.
Tulsa	8,864,707	8,953,422	Petroleum, stone, sand and gravel, clays, natural gas.
Wagoner	505,935	440,239	Petroleum, sand and gravel, natural gas.
Washington	10,771,613	8,069,140	Petroleum, stone, natural gas.
Washita	1,231,999	1,089,245	Natural gas, petroleum, gypsum, stone.
Woods	2,769,399	4,269,675	Natural gas, petroleum, salt.
Woodward	2,755,081	4,127,458	Natural gas, natural gas liquids, petroleum, sand and gravel.
Undistributed	3,058,767	4,997,029	
Total	881,788,000	907,914,000	

r Revised.
W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] Adair County is not listed because no production was reported.

Co., Inc., strip mined gypsum near Cement for use in agriculture and as a retarder in portland cement. Dimension and crushed limestone were produced by J. W. McPhearson and Bernard Thiessen, southeast of Hydro. Roosevelt Materials Co., Inc., quarried and crushed limestone near Carnegie for concrete aggregate. Sand for building purposes was produced by Karlin Sand & Gravel Co. from the Canadian River.

Canadian.—The value of mineral production was 48 percent greater as the result of increased sales in natural gas, petroleum, clays, sand and gravel, and gypsum. Oklahoma Brick Co. mined clay south of El Reno for making brick and tile. Gypsum for agricultural purposes was strip mined near Okarche by Raymond Schweitzer. Sand and gravel for construction was produced by Tindel Materials Co. from the Canadian River in the extreme western section of the county and by The Dolese Co. near Banner.

Carter.—The county ranked fourth in total mineral production value, fourth in value of petroleum, and sixth in natural gas liquids. Petroleum and natural gas were produced from many fields: Fox-Graham, Healdton, Hewitt, and Sho-Vel-Tum fields were the largest. Sho-Vel-Tum was the Nation's third largest field, producing more than 28.7 million barrels of petroleum. The Hewitt and Healdton fields produced over 2.9 million barrels and 2.6 million barrels of petroleum, respectively. Natural gas liquids were extracted from natural gas at plants operated by Apache Gasoline Co. near Ardmore; Harry Ells, Inc., at Healdton; Mack Oil Co. near Wilson; Mobil Oil Co. near Healdton; Shell Oil Co. near Wilson; Signal Oil & Gas Co. near Fox; Sinclair Oil & Gas Co. at Healdton; and Union Oil Company of California (formerly Pure Oil Co.) near Springer. Limestone was quarried and crushed by Sooner Crushed Stone Co.

Cimarron.—Total mineral production value was 18 percent greater than in 1964 owing to improved sales of helium, natural gas, natural gas liquids, and petroleum. At the Federal Bureau of Mines Keyes plant, helium was removed from natural gas supplied by Colorado Interstate Gas Co. Several fields in the Keyes area produced natural gas and petroleum. Colorado Interstate Gas Co. recovered natural gas liquids from natural gas at its Keyes plant. Gravel was produced for paving use by several producers.

Cleveland.—A drop of 11 percent in total mineral value was due to decreased output of mineral fuels. Natural gas liquids were recovered by Continental Oil Co. at its Short Junction plant and Sunray DX Oil Co. at its Moore plant. On Little River

east of Norman, the Bureau of Reclamation, U.S. Department of the Interior, completed the multipurpose Norman Dam. Water impounded by the structure will be supplied to Del City, Midwest City, and Norman.

Comanche.—Total mineral output value rose 2 percent as a result of production gains in stone and gypsum that compensated for reduced output of natural gas and petroleum. Limestone was quarried and crushed by Dolese Bros. Co. at its Richards Spur quarry north of Lawton. Gypsum was mined near Fletcher by Castile Mining Co., the mining affiliate of Texas Gypsum Co., Inc., for wallboard manufacture at the latter's Irving, Tex., plant.[5] Sand for paving use was produced by the Oklahoma State Highway Department. Natural gas and petroleum were produced from a group of small fields (comprising three districts) and the Fort Sill Reservation field.

Craig.—Total mineral value decreased over 10 percent owing to lower coal and natural gas output. Craig County ranked second among the coal producing counties. Coal was strip mined by six operators at six pits. Another operator producing less than 1,000 tons was active at one additional pit.

Creek.—Production losses in petroleum, natural gas, stone, and clays were responsible for a 5-percent decrease in total mineral value. The prolific Cushing and Glenn Pool fields produced 3.1 million and 4.1 million barrels of petroleum, respectively. Natural gas liquids were recovered by Kerr-McGee Corp. plant near Milfay and Sinclair Oil & Gas Co. Drumright plant. Near Depew, Oklahoma Natural Gas Co. maintained an underground natural gas storage reservoir. Service Pipe Line Co. completed a cavern in shale capable of storing 200,000 barrels of butane. Clay for manufacturing brick and tile was produced at Sapulpa by Sapulpa Brick & Tile Co. and for pottery by Frankoma Pottery Co.

Dewey.—Mineral production value increased 34 percent. The substantial rise resulted from large gains in production of petroleum, natural gas, and natural gas liquids; output of bentonite decreased and output of sand and gravel ceased. Putnam field produced over 3 million barrels of petroleum. Natural gas liquids were recovered from natural gas by Humble Oil & Refining Co. Camargo plant and Mobil Oil Co. Thomas plant. South of Vici, the Filtrol Corp. produced bentonite for filtering and absorbent uses.

Garfield.—A 10-percent increase in total mineral value resulted from increased production of petroleum, natural gas, and natural gas liquids. The Northeast Enid field produced over 2.1 million barrels of petroleum. Natural gas liquids were stripped from natural gas by Champlin Petroleum Co. Enid plant, Livingston Oil Co. Northeast Enid field plant, and Sinclair Oil & Gas Co. Covington plant. Sand for paving was produced by the Oklahoma State Highway Department. Clay was mined for brick and tile manufacturing by Enid Brick & Tile Manufacturing Co.

Garvin.—Garvin County ranked first in the total value of minerals produced owing to a gain of about 10 percent in natural gas. The county ranked third in petroleum and fourth in natural gas production value and first in natural gas liquids. The Eola-Robberson field yielded over 3.4 million barrels of petroleum and the huge Golden Trend field over 13.5 million barrels of crude oil—the second largest yield in the State. Natural gas liquids were recovered at the O. H. Grimes Pauls Valley field plant, Lone Star Gas Co. plant near Katie, Phillips Petroleum Co. plant near Lindsay, Service Gas Products Co. Hoover field plant, Sohio Petroleum Co. plant southwest of Elmore City, and Warren Petroleum Corp. plant west of Maysville. Crude oil was processed at the Wynnewood refinery of Kerr-McGee Corp.

Grady.—Production loss in natural gas was offset by increased petroleum, natural gas liquids, and sand and gravel production for a 6-percent increase in total mineral value. Natural gas liquids were recovered by British-American Oil Producing Co. at its cycling plant in the Knox-Bromide field and by the Mobil Oil Co. cycling plant in the Chitwood field. Sand for building and paving was obtained from pits near Tuttle by The Dolese Co.

Grant.—Total mineral value fell slightly as increased output of petroleum and natural gas liquids were offset by a decline in natural gas. Natural gas liquids were removed from natural gas in the Continental Oil Co. Medford plant and CRA, Inc., La-

[5] Johnson, Kenneth S. Gypsum Quarry Operating near Fletcher, Comanche County, Oklahoma. Oklahoma Geol. Survey, Oklahoma Geol. Notes, v. 25, No. 3, March 1965, pp. 78–81.

mont field plant. Continental Oil Co. completed facilities at its Medford plant that increased propane and butane production by 30,000 gallons per day. Cities Service Gas Co. completed an underground reservoir in the Webb field to store natural gas for peak demand. The reservoir will have a maximum capacity of 54.7 billion cubic feet. Near Medford, Continental Oil Co. maintained a 150,000-barrel butane storage reservoir in a salt layer and a 300,000-barrel propane storage reservoir.

Haskell.—The county again led in coal output. Increased output of natural gas and coal raised the total mineral value 61 percent over that of 1964. Garland Coal & Mining Co. and Evans Coal Co., the county's largest producers, produced coal from open pits. Two other producers, each mined less than 1,000 short tons, were active at an open pit operation and an auger mine.

Jackson.—Increased output of gypsum and stone resulted in a slight gain in total mineral value and offset losses in petroleum, sand and gravel, and natural gas. Gypsum was strip mined south of Duke for manufacturing wallboard and other gypsum products by Republic Gypsum Co.'s Duke plant. Late in the year, The Eagle-Picher Co. began strip mining copper ore from the Permian red beds southeast of Creta. Sand and gravel for construction uses was produced by Pitts Sand & Gravel Co.

Johnston.—Total mineral value declined 8 percent owing to reduced output of sand and gravel and stone. Pennsylvania Glass Sand Corp. of Oklahoma produced sand for glass and ground silica from pits north of Mill Creek. Dimension limestone for building was produced near Pontotoc by A-D-A Stone Co., and E&E Stone Co. quarried and crushed limestone for concrete aggregate. Rock Products Manufacturing Corp. quarried and crushed dolomite near Troy for use in agriculture. Dimension granite was produced by The Century Granite Co., Inc.

Kay.—Total value of mineral production was 3 percent above that of 1964 as gains were noted in natural gas liquids, petroleum, stone, and sand and gravel. Petroleum and natural gas were produced from numerous fields; natural gas liquids were recovered from Cities Service Oil Co. Ambrose plant and Wunderlich Development Co. Newkirk plant. A 300,000-barrel propane storage cavern in mined limestone was maintained near Ponca City by Continental Oil Co. Crude petroleum was processed at refineries operated by Cities Service Oil Co. and Continental Oil Co. at Ponca City. Continental Oil Co. increased the catalytic reforming capacity from 11,000 to 16,000 barrels per day at its refinery. Petrochemical units of the Continental Oil Co. refinery produced benzene, toluene, propylene hydrocarbons, and carbon black. Limestone was quarried and crushed by Standard Industries, Inc., at its Uncas quarry northeast of Ponca City. Sand for building, paving, and fill was produced by Sober Brothers Sand & Gravel Co. and for paving use by the Oklahoma State Highway Department. Blackwell Zinc Co., Inc., a division of American Metal Climax, Inc., operated its zinc smelter.

Kingfisher.—A gain of 9 percent in total mineral value was noted due to increased petroleum, natural gas, and natural gas liquids output. Value of petroleum produced was almost 8 percent greater than in 1964. The new Sooner Trend of Kingfisher and adjoining counties, into which the Dover-Hennessey field was consolidated with 20 smaller fields in April, yielded over 9.6 million barrels of oil. Natural gas liquids were recovered at the Continental Oil Co. Hennessey plant, Humble Oil & Refining Co. Dover-Hennessey plant, Pan American Petroleum Corp. North Okarche plant, and Sohio Petroleum Co. Trindle plant. Oklahoma Natural Gas Co. maintained an underground natural gas storage reservoir in the West Edmond field of Kingfisher and Logan Counties. The Dolese Co. produced sand for building and paving from pits near Dover.

Kiowa.—Output of stone was responsible for a 25 percent increase in mineral value as petroleum, natural gas, and sand and gravel declined. Dimension granite was quarried near Snyder by Roosevelt Granite Co., Inc. and Wichita Granite Co. Southwest Sand Co. processed sand and gravel from the North Fork Red River west of Snyder for paving purposes and gravel was processed by other commercial producers for paving use.

Latimer.—Output of natural gas from the Red Oak—Norris field increased over that of the previous year and accounted for the substantial rise in mineral value

though output and value of stone dropped. H. D. Youngman Co. quarried and crushed sandstone for use as concrete aggregate and roadstone by the Oklahoma State Highway Department. Development well drilling continued as 27 gas wells were completed in the Arkoma basin by the industry. In the Wilburton Pool, Shell Oil Co. had an interesting discovery at its No. 1-4 Williams-Mabry, sec. 4, T4N, R18E, that struck gas on the upthrown block of the Choctaw fault, flowing 2 million cubic feet per day from the Spiro (Atokan) sand at 2,947 feet. The well is a 640-acre offset to 11,000-foot Spiro production to the north.

Le Flore.—Increased production of natural gas accounted for a 7 percent rise in mineral value despite a decline in mineral production values for coal, stone, and sand and gravel. Coal was produced from underground mines by three operators. Two other operators, who produced less than 1,000 tons annually, were active at two underground mines. Sandstone was quarried and crushed by contractors for use by Oklahoma State Highway Department as roadstone and as riprap by U.S. Army Corps of Engineers, Tulsa District. Limestone was quarried and crushed by Poteau Crushed Rock Co. for riprap. Oklahoma State Highway Department used sand and gravel for paving highways.

Lincoln.—Mineral value decreased 23 percent from the previous year as production losses were registered in the mineral fuels and clays. Petroleum and natural gas were produced from numerous fields; Stroud field, a portion of which extends into Creek County, yielded nearly 1.2 million barrels of oil. Natural gas liquids were stripped from natural gas at plants operated by Apache Gas Products Corp. northwest of Kendrick, Sunray DX Oil Co. west of Carney, and Texaco Inc. east of Davenport. The Highway Gasoline Co. south of Stroud was shut down. Crude oil was processed at the Stroud refinery of Allied Materials Corp.

Logan.—Increased output of petroleum, natural gas, natural gas liquids, and sand and gravel raised total mineral production value 26 percent. Petroleum and natural gas were produced from numerous fields. Natural gas liquids were stripped from natural gas at Eason Oil Co. No. 3 plant, south of Crescent. Sand for building and paving was produced by The Dolese Co. near Guthrie and for paving by Oklahoma State Highway Department.

Love.—An increase in total mineral production value resulted from gains in the mineral fuels. Natural gas liquids were recovered by the Chevron Oil Co. (formerly California Oil Co.) cycling plant in Southeast Marietta field and by Texaco Inc. at its Enville plant. The Greenville Gasoline Co., Inc., plant north of Marietta was closed.

Major.—Total mineral production value showed an increase of 20 percent though value of natural gas liquids and sand and gravel was lower than in the previous year. More than 1 million barrels of petroleum was produced by the Ringwood field. Natural gas liquids were stripped from natural gas by National Fuels, Inc., at its Ringwood plant. Union Texas Petroleum, a division of Allied Chemical Corp., is building a 90-million-cubic-foot-per-day refrigerated absorption plant to produce 225,000 gallons of liquids daily.

Mayes.—Total mineral production value was 11 percent lower due largely to decreased output of cement and petroleum. Limestone and clay were produced for cement by Oklahoma Cement Co. at its plant southeast of Pryor. Northeast of Pryor, Standard Industries, Inc., quarried and crushed limestone for roadstone, concrete aggregate, and agricultural uses. Sand and gravel for paving use was produced by Oklahoma State Highway Department.

McClain.—Value of minerals produced declined 3 percent owing to a production loss in petroleum that was sufficient to offset gains in natural gas, natural gas liquids, and sand and gravel. Natural gas liquids were recovered by Sohio Petroleum Co. Norman plant; Sunray DX Oil Co. Criner plant; and Universoil, Inc., Dibble field plant near Blanchard. The Dolese Co. and Lamar Lawson produced sand and gravel for building, and The Dolese Co. produced sand for paving.

McIntosh.—A substantial increase in the output of stone that offset a decline in sand and gravel, petroleum, and natural gas production was responsible for a 171 percent rise in total mineral value. Limestone and sandstone were quarried and crushed for concrete aggregate and roadstone by H. D. Youngman for use by Oklahoma State Highway Department. Natural gas and petroleum were produced, mostly

from Coalton and Stidham fields. One operator strip mined a small quantity of coal.

Murray.—Mineral production value increased slightly owing to gains in petroleum, natural gas, and sand and gravel. Limestone was quarried and crushed at Rayford and Big Canyon quarries by Dolese Bros. Co. and by Sooner Rock & Sand Co. Sand and gravel for paving and building was produced by Joe Brown Sand & Gravel Co. and by the Bureau of Reclamation, U.S. Department of the Interior, for fill purposes at the Arbuckle Reservoir project. Two fields produced petroleum and natural gas. The Arbuckle Reservoir was under construction by the Bureau of Reclamation on Rock Creek southwest of Sulphur.

Muskogee.—Value of minerals produced was 5 percent above that of 1964; production of petroleum was responsible. Petroleum was produced from several fields; Muskogee field, the largest, yielded over 1 million barrels of petroleum. Mustang Fuel Corp. maintained an underground natural gas storage reservoir in Butler Creek field and Oklahoma Natural Gas Co. maintained an underground natural gas storage reservoir near Haskell. Three operators strip mined coal, each producing less than 1,000 tons. Sand for building, paving, and fill was dredged from the Arkansas River by Yahola Sand Co. Fansteel Metallurgical Corp. operated its columbium-tantalum plant at Muskogee. The former Callery Chemical Co. high-energy fuels plant at Muskogee was sold by the General Services Administration to Clinton-Dickson Corp., Philadelphia, Pa.

Oklahoma.—The 11 percent decline in total mineral value resulted from lower production in all segments of the mineral industry. Largest of many fields, Oklahoma City field yielded nearly 2 million barrels of petroleum. Natural gas liquids were extracted from natural gas at Champlin Petroleum Co. Witcher field plant, Cities Service Oil Co. Bodine plant in Oklahoma City field, and Phillips Petroleum Co. Edmond field plant and Oklahoma City field plant; the Patton & Swab, Inc., Edmond field plant was shut down. Sand for building and paving was produced by The Dolese Co., Sizemore Sand & Gravel, and Sand Products, Inc. Clay for brick and tile products was obtained from pits in the western part of Olahoma County by Acme Brick Co. Near Choctaw, Chandler Materials Co. mined and expanded clay for lightweight aggregate.

Okmulgee.—The total mineral value was 11 percent below that of 1964 as a result of reduced crude oil, natural gas, and coal output. Petroleum and natural gas were produced from numerous fields; Bald Hill, the largest, produced 404,000 barrels of petroleum. Crude oil was processed at Phillips Petroleum Co. refinery in Okmulgee. Carbon Hill Coal Co. strip mined coal near Henryetta. The Eagle-Picher Co. operated its horizontal retort zinc plant at Henryetta.

Osage.—Osage County ranked third in total mineral production value and first in petroleum. Mineral value declined 2 percent owing to production losses in petroleum. Numerous fields produced petroleum and natural gas. Burbank field, under extensive waterflooding, yielded 12 million barrels of crude oil to remain the State's third largest field. Naval Reserve field produced 1.7 million barrels of crude oil. Limestone was quarried and prepared by Sedan Limestone Co., Standard Industries, Inc., and others for concrete aggregate and roadstone. Contractors also quarried and prepared limestone for the U.S. Army Corps of Engineers, Tulsa District.

Ottawa.—Oklahoma's entire lead and zinc production, a major part of the Tri-State District, was supplied from mines in Ottawa County. In terms of recoverable content of ores, output increased 1 percent and 5 percent, respectively, but value rose 20 percent for lead and over 12 percent for zinc. The Eagle-Picher Co.'s Rare Metals plant was operated north of Miami. Chat, a waste product of lead and zinc milling, was supplied by five producers from five locations. Tripoli was quarried in east-central Ottawa County by American Tripoli Division, The Carborundum Co. and processed at its plant in Seneca, Mo.

Pawnee.—Petroleum and natural gas were produced from numerous fields. W. O. Cox, Standard Industries, Inc., and others crushed limestone for concrete aggregate and roadstone. Limestone, used by the Oklahoma State Highway Department for riprap, concrete aggregate, and roadstone, was supplied by one contractor. Construction, paving, and fill sand were

produced by Tulsa Sand Co., Inc., from the Arkansas River near Ralston.

Payne.—Numerous fields produced petroleum and natural gas. Yale-Quay, the largest field, which extends northward into Pawnee County, produced 603,000 barrels of petroleum. Crude oil was processed into gasoline, asphalt, and lubricating greases at the Cushing refinery of Kerr-McGee Corp. and into gasoline at Midland Cooperative, Inc., Cushing refinery. Limestone was quarried and crushed by two commercial producers and one Government-and-contractor operation for concrete aggregate and roadstone. Unprocessed gravel was used by Payne County Highway Department.

Pontotoc.—Mineral production value was 2 percent greater due to gains in petroleum, stone, and cement. The Allen field, portions of which are in Hughes and Seminole Counties, yielded 2.2 million barrels of oil; Fitts field yielded almost 800,000 barrels of oil. Natural gas liquids were removed from natural gas at Humble Oil & Refining Co.'s Fitts field plant. An underground natural gas storage reservoir in the North Ada field was operated by Arkansas-Louisiana Gas Co. Clay, limestone, and shale, quarried near Lawrence, were used in cement by Ideal Cement Co. at its Ada plant. Dimension limestone was quarried near Fittstown by Townsend Brothers Quarry. Mid-Continent Glass Sand Co. produced sand for glass and molding purposes from its quarry near Roff.

Rogers.—Increased production of cement and stone offset losses in clays, coal, petroleum, and natural gas. Petroleum and natural gas were produced from three fields; Chelsea District produced most of the crude petroleum. Quantity of coal, strip mined by Sinclair Coal Co., placed the county third among the State's coal producing counties. Dewey Portland Cement Co., Division of Martin-Marietta Corp., quarried limestone and shale for cement at its plant northeast of Tulsa.

Seminole.—A 3-percent decrease in total mineral value was noted as losses registered in petroleum, natural gas, and sand and gravel compensated for gains in natural gas liquids, stone, and clays. Petroleum and natural gas were produced from many fields; most notable was Seminole field which produced over 1.1 million barrels of petroleum. Natural gas liquids were extracted from natural gas by Redco Corp. at its Seminole plant and Sinclair Oil & Gas Co. Seminole plant. Limestone was quarried and crushed by Standard Industries, Inc., and Quality Materials Co. for concrete aggregate and roadstone and by one Government-and-contractor operator for use by Oklahoma State Highway Department. Shale for brick and tile was quarried west of Wewoka for Wewoka Brick & Tile Co.

Sequoyah.—Limestone was mined and crushed at underground mines north of Marble City by St. Clair Lime Co. Part of the crushed limestone was burned to make lime in the company kilns at Sallisaw and at Marble City. The remainder was used for agricultural purposes, glass manufacturing, paper mills, fertilizers, and coal mine dust. The lime was used in steel manufacturing, carbide manufacturing, oil refining, water purification, waste disposal, building materials, and paper manufacturing.

Stephens.—Production value of petroleum, natural gas, and natural gas liquids combined, placed the county second in the State for 1965 and was slightly above the value in 1964. The county was second in petroleum, sixth in natural gas, and seventh in natural gas liquids values. The county shared in production of crude oil from the giant Sho-Vel-Tum field, as did Carter and Garvin Counties, which produced more than 28.7 million barrels of oil. Loco field produced over 1.7 million barrels of crude oil; Knox field, in part in Grady County, yielded nearly 1.7 million barrels of oil under a pressure maintenance and cycling program. Natural gas liquids were stripped from natural gas at Mobil Oil Co. plant in the Sholem-Alechem field, Service Gas Products Co. Doyle field plant, Skelly Oil Co. Marlow (purchased from Cyprus Mines Corp.) and Velma plants, and Warren Petroleum Corp. Duncan plant. Sunray DX Oil Co. processed crude oil at its Duncan refinery.

Texas.—The county ranked fifth in total mineral value, first in natural gas, and fifth in natural gas liquids as all minerals except sand and gravel made significant gains to raise the value 1 percent over that of 1964. Natural gas liquids were recovered by Anadarko Production Co. North Richland Center plant, Cities Service Oil Co. Guymon and Murdock plants, Dorchester Gas Producing Co. Hooker plant, Excelsior

Oil Corp. Tyrone plant, Mapco Production Co. Tyrone plant (formerly Hugoton Plains Oil & Gas Co. Hugoton plant), and Mobil Oil Co. Postle-Hough plant. Anadarko Production Co. completed the addition of a depropanizer unit capable of producing 22,000 gallons per day to its North Richland Center plant. Stewart Brothers Sand & Gravel Co. and two other producers processed sand for building and fill.

Tulsa.—A 1 percent rise in total mineral value was due to increased output of stone which offset losses in the output of natural gas, petroleum, sand and gravel, and clays. Crude oil was processed at Sunray DX Oil Co. and The Texas Co. refineries in west Tulsa. In March, Sunray DX Oil Co. doubled asphalt capacity to 3,000 barrels per day at its Tulsa refinery. Limestone was quarried and crushed by plants operated by Anchor Stone Co., Standard Industries, Inc., at two locations, and Tulsa Rock Co. for concrete aggregate, roadstone, agriculture, and other uses. Sand for building, paving, fill, and other uses and gravel for fill were processed by 10 producers and the Oklahoma State Highway Department; the largest were Bagby-Harris Sand Co., Chandler Materials Co., McMichael Sand Co., Mohawk Rock and Sand Co., and Standard Industries, Inc. Brick and tile products were made in Tulsa by Acme Brick Co. U.S. Army Corps of Engineers, Tulsa District, completed the Keystone Dam on the Arkansas River, and on May 22, the $127 million structure was dedicated; at year-end, the powerhouse was under construction.

Woods.—Mineral output was 50 percent greater in value as natural gas, petroleum, and salt output increased. Natural gas and petroleum were produced from several small fields. Ezra S. Blackmon recovered salt by solar evaporation from water basins adjacent to the Cimarron River west of Freedom.

Woodward.—Increased production in all segments of the mineral industry resulted in a 47 percent increase in total mineral value. Natural gas liquids were stripped from natural gas at Pan American Petroleum Corp. Mooreland plant. The firm completed an expansion of the plant which doubled capacity to 100 million cubic feet per day. Sand for building and fill was produced northeast of Woodward by Klines Sand Pit.

The Mineral Industry of Oregon

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the Oregon Department of Geology and Mineral Industries for collecting information on all minerals except fuels.

By Ronald P. Collins [1], Jerry J. Gray [2], and Gary A. Kingston [2]

The value of the mineral production in Oregon increased $19 million to a record-setting $83 million, 29 percent greater than the value of the mineral production of 1964. Increased sand, gravel, and stone production represented 84 percent of the $19 million increase. Road-building programs and heavy engineering construction projects required larger quantities of sand and gravel and crushed stone. Of the 16 mineral commodities produced in Oregon 10 increased in value, and 6 of these were nonmetallic commodities. Substantial nickel and mercury production gains were recorded. Output of mercury was the most active component of the State's mineral industry. In response to continued high prices, production increased elevenfold from that of 1964, but the value of mercury production increased nineteenfold, as shown in table 1.

The following capital investment decisions exemplified efforts by numerous

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Table 1.—Mineral production in Oregon [1]

Mineral		1964		1965	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Clays	thousand short tons	r 290	r $356	291	$359
Copper (recoverable content of ores, etc.)	short tons	15	10	W	W
Gold (recoverable content of ores, etc.)	troy ounces	661	23	499	17
Lime	thousand short tons	95	1,918	98	1,853
Mercury	76-pound flasks	126	40	1,364	779
Nickel (content of ore and concentrate)	short tons	15,420	W	16,188	W
Perlite	do	5	(2)	----	----
Pumice and volcanic cinder	thousand short tons	566	909	657	1,181
Sand and gravel	do	18,253	25,158	21,800	32,849
Silver (recoverable content of ores, etc.)	troy ounces	14,372	19	8,801	11
Stone	thousand short tons	16,120	19,296	21,212	27,301
Tungsten concentrate (60 percent WO_3 basis)	short tons	1	1	----	----
Uranium ore	do	27	2	----	----
Value of items that cannot be disclosed: Cement, diatomite, gem stones, iron ore (1965), lead, vanadium (1964), zinc, and values indicated by symbol W		XX	16,631	XX	18,617
Total		XX	r 64,363	XX	82,967

r Revised. W Withheld to avoid disclosing individual company confidential data. XX Not applicable.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Less than ½ unit.

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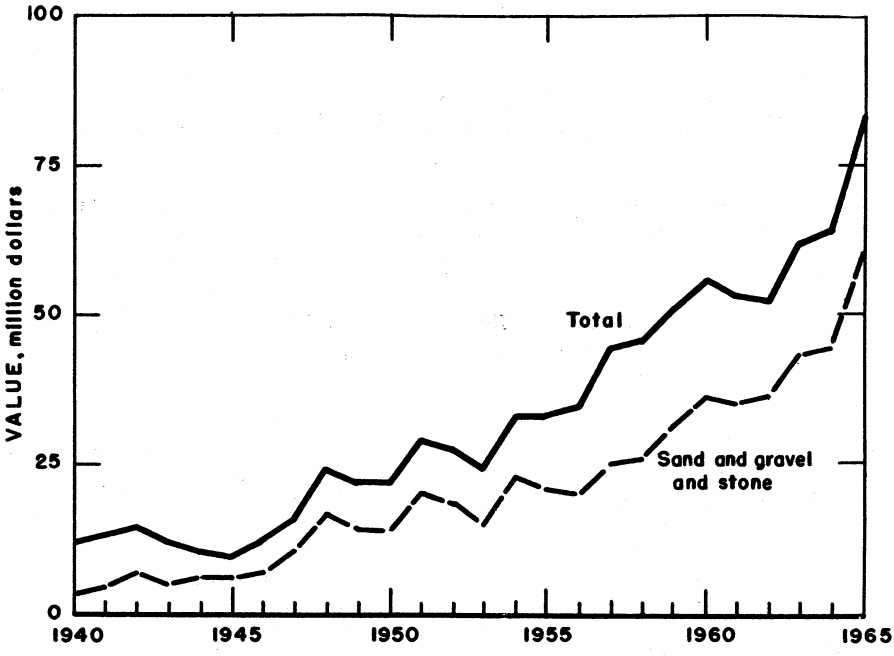

Figure 1.—Value of sand and gravel and stone, and total value of mineral production in Oregon.

firms to augment mineral production and development conducive to continued economic growth in Oregon. Five deep-test wells were drilled by two oil company groups in a multimillion-dollar exploration project on offshore property leased in 1964. Extensive improvements completed at the Riddle plant of Hanna Nickel Smelting Co. prompted a recordbreaking nickel output. Oregon Metallurgical Corp., Albany, was building a plant at its present complex to produce titanium sponge. An addition to the Troutdale aluminum plant of Reynolds Metals Co. doubled the casting capacity, and the firm also registered a 52-percent increase in delivered energy by Bonneville Power Administration (BPA). The Union Pacific Railroad entered directly into the Oregon mineral industry when it purchased a gold-silver mine in Grant County and began intensive development.

As a result of interest generated by the International Lunar Geological Field Conference held in Bend, volcanic rock from Deschutes County lava beds was sent to agencies throughout the nation interested in lunar surface research. The University of Oregon established a Center of Volcanology, and the State [3] published an illustrated booklet describing volcanic features in the High Cascades and Bend region.

Table 2.—Value of mineral production in constant 1957–59 dollars

(Thousands)

Year	Value
1956	$34,865
1957	44,078
1958	46,987
1959	50,044
1960	55,483
1961	53,277
1962	52,828
1963	r 63,333
1964	r 64,405
1965	83,092

r Revised.

[3] Peterson, N. V., and E. A. Groh. Lunar Geological Field Conference Guide Book. Oregon Dept. of Geology and Mineral Industries, Bull. 57, 1965, 56 pp.

Table 3.—Indicators of Oregon business activity

		1964	1965 p	Change, percent
Personal income:				
Total	millions	$4,915.0	$5,309.0	+8.0
Per capita		$2,613.0	$2,794.0	+6.9
Construction activity:				
Building permits	millions	$252.5	$242.8	−3.8
Heavy engineering awards	do	$140.0	$273.5	+95.4
Value of highway contracts awarded	do	$70.6	$79.6	+12.7
Expenditures on highway contract work	do	$90.2	$89.1	−1.2
Cement shipments to and within Oregon	thousand 376-pound barrels	3,024.0	4,309.4	+42.5
Cash receipts from farm marketings	millions	$423.9	$454.4	+7.2
Factory payrolls	do	$933.6	$1,013.0	+8.5
Annual average labor force and employment:				
Total labor force	thousands	765.6	790.8	+3.3
Unemployment	do	35.4	32.4	−8.5
Employment:				
Construction	do	31.1	32.3	+3.9
Lumber and wood products	do	72.2	72.5	+0.4
Food products	do	20.3	21.1	+3.9
All manufacturing	do	149.5	154.9	+3.6
All industries	do	730.0	757.9	+3.8

p Preliminary.

Sources: Survey of Current Business, Construction Review, Pacific Builder & Engineer, State Highway Commission, State Employment Department, and Federal Bureau of Mines.

Table 4.—Employment and payrolls in mineral-industry establishments subject to Oregon unemployment-compensation law, by industries

Industry	1964		1965	
	Employment	Payrolls (thousand)	Employment	Payrolls (thousand)
Mining	1,478	$10,226	1,670	$12,129
Stone, clay, and glass products:				
Glass products	376	2,565	364	2,661
Hydraulic cement	401	2,902	412	3,104
Structural clay products	141	726	146	750
Concrete, gypsum, and plaster products	2,024	13,957	2,090	14,969
Cut-stone, stone, and pottery products	72	342	72	386
Miscellaneous	62	364	71	402
Total	3,076	20,856	3,155	22,272
Primary metals:				
Blast furnaces, steelworks, rolling and finishing mills	1,505	12,201	954	8,661
Primary smelting and refining of nonferrous metals	1,674	12,212	2,357	17,672
Iron and steel foundries	1,910	13,221	2,031	14,661
Nonferrous foundries	409	2,580	558	3,740
Secondary smelting and refining of nonferrous metals and miscellaneous industries	172	1,192	208	1,458
Total	5,670	41,406	6,108	46,192
Industrial chemicals	445	3,332	506	3,671
Petroleum refining and related products	372	2,308	382	2,486
Grand total	11,041	78,128	11,821	86,750

Source: Oregon Employment Department. Industries may vary from those in the Federal Bureau of Mines canvass.

Table 5.—Employment and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1964:								
Metal	160	175	28	220	----------	11	49.93	980
Nonmetal and coal	145	193	28	224	----------	7	31.14	734
Sand and gravel	1,929	221	427	3,418	----------	61	17.84	529
Stone	1,610	183	295	2,367	----------	73	30.84	585
Total or average	3,844	202	778	6,229	----------	152	24.40	574
1965: p								
Metal	160	206	33	266	1	12	48.87	24,632
Nonmetal and coal	140	207	29	223	----------	15	67.26	1,422
Sand and gravel	2,060	221	455	3,647	----------	66	18.10	362
Stone	1,665	193	322	2,583	----------	53	20.52	506
Total or average	4,025	208	839	6,719	1	146	21.88	1,413

p Preliminary.

Consumption, Trade, and Markets.—The key indicators of Oregon business activity summarized in table 3 reflect a vigorous economic growth during 1965. Peak employment exceeded 800,000 for the first time in Oregon's history. Employment of 700,000 was first attained 10 years ago, but if current trends continue, the next 100,000 increment should require about half as many years. A strong upward employment trend forced the unemployment ratio downward to 4.1 percent, the lowest annual adjusted rate for any year since 1947.

The upsurge of construction activity compared with 1964 was marked by increases in awarded heavy-engineering and highway contracts and in the growth in cement shipments. The U.S. Department of the Interior's BPA awarded Oregon's largest single construction contract for $52 million to Allmanno Svenka Elektriska Aktiebolaget — General Electric Company (ASEA-GE), Schenectady, N.Y., to build facilities that will transmit energy between the northern terminal at The Dalles and the southern terminal at Sylmar, Calif. for the Pacific Northwest-Pacific Southwest power intertie.

Legislation and Government Programs.—A bill to establish a National Wild Rivers System was introduced into the U.S. Senate. Oregon's Rogue River from Grants Pass to the Pacific Ocean was designated a "wild river area." The bill provided, among other things, that mining operations would be subject to waste disposal criteria regulated by the Secretary of Interior or the Secretary of Agriculture in the case of national forest land.

An important development affecting the industrial base of the Oregon economy was approval by the Federal Power Commission of a 3-percent BPA power-rate increase effective December 20, 1965. It was authorized to allow repayment of the Federal investment in presently authorized power facilities within the period expected by Congress. The rate increase was the first in BPA's 28-year history as the marketing agent for power, generated at Pacific Northwest Federal dams.

There were important government actions related to water resources which are discussed in the commodity review section on Water in this chapter.

There were no new contracts negotiated during the year by the Office of Minerals Exploration. An existing contract with the Oregon King gold-silver mine in Jefferson County continued during the year.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Abrasives and Roofing Granules.—Mining-Mineral Manufacturing Co. increased shipments of dried-and-screened granulated slag, a waste product from the Hanna Nickel Smelting Co. operation at Riddle, 56 percent over the 1964 total. The material was principally used as a sandblast-

ing abrasive at shipyards. Flintkote Co., Pioneer Division, Portland, increased production of naturally and artificially colored roofing granules 10 and 16 percent, respectively, over the 1964 totals.

The Pacific Northwest artificial-abrasives industry was the subject of a report.[4]

Cement.—Production and shipment of cement were 11 percent greater than in 1964. Output was from the plants of the Oregon Portland Cement Co. at Oswego (Clackamas County) and at Lime (Baker County), and from the Ideal Cement Co. plant at Gold Hill (Jackson County). Destinations of shipments were chiefly within the State; out-of-State shipments were made to Washington, Idaho, and northern California. Shipments of portland cement were distributed to ready-mixed concrete companies, 67 percent; to general contractors, 17 percent; to concrete-product manufacturers, 11 percent; to building-material dealers, 4 percent; and to highway contractors and to Federal, State, and local government agencies, 1 percent. Trucking, the principal method of transportation, accounted for 88 percent of the portland cement shipped; 11 percent went by rail and 1 percent by boat. The ratio of bulk to paper-bag shipments was about 9:1.

A new method of preparing and merchandising ready-mixed concrete to reach the small-project "do-it-yourself" market was developed by U-Pour Concrete Co., Inc., a new Portland firm. The firm developed an additive to slow the setting action of concrete, engineered a compact new plant for mixing the concrete at retail outlets, and designed a special U-Pour safety-dump trailer for the "do-it-yourselfer" to transport small amounts of the concrete mix. Several U-Pour plants were opened in Portland, Eugene, and Spokane, Wash.

Cement data for Oregon have been combined with Washington figures in the past to avoid disclosing information concerning Oregon producers. Oregon production was combined with that of Nevada instead of Washington in 1965 because Nevada production also must be concealed. Washington production from four firms was published. Production in Nevada was initiated during 1964. Four cement plants in Oregon and Nevada produced 3.5 million barrels (376 pounds each) of finished portland cement. The average value of portland cement shipped from these producing plants was $3.57 per barrel, f.o.b. plant.

A historical review of Oregon Portland Cement Co. was published by the Oregon Department of Geology and Mineral Industries.[5]

Clays and Shale.—The quantity of clays and shale, sold or used, increased slightly from a revised 1964 total of 290,000 tons. The increase was due almost wholly to greater demand at cement plants, because production of miscellaneous clay (used for making heavy-clay products) and shale (used for making expanded aggregate) declined 11 and 29 percent, respectively. A small tonnage increase for Crook County bentonitic clay was reported. Material for two cement firms came from two shale quarries (Baker and Jackson Counties) and from one clay pit (Baker County). Miscellaneous clay was produced by 12 companies in Benton, Clackamas, Klamath, Multnomah, Polk, Tillamook, Union, Washington, and Yamhill Counties. Keasey shale, bloated and used as lightweight-concrete aggregate, was produced at two quarries in Washington County. Empire Lite-Rock, Inc., completed a $250,000 equipment and plant expansion at Banks, providing 150 tons of aggregate and pozzolan capacity per day. Pozzolan, a finely ground cementitious material, was used as a partial replacement of portland cement in concrete.

Diatomite.—A. M. Matlock mined, processed, and shipped less diatomite than in 1964. The crude diatomaceous earth was taken from a deposit near Silver Lake, Lake County, and trucked to Eugene for processing into pet litter.

Gem and Gem Materials. — Oregon's recreation mining industry continued to attract rock collectors to the State. The Prineville annual All Rockhound Pow Wow, a gem and mineral show combined with field trips to collecting sites, was reported to have had 16,000 persons in attendance. The Bureau of Mines estimated that 1,500 tons of cryptocrystalline vari-

[4] Petersen, N. S., and W. N. Hale. Trends and Outlook for Manufacture of Artificial Abrasives in the Pacific Northwest (Report for the Bonneville Power Administration, Portland, Oreg.). BuMines Mineral Resource Office, Area VII, Albany, Oreg., 1965, 37 pp.

[5] McCaslin, F. E. A Brief History of the Oregon Portland Cement Co. Ore Bin, v. 27, No. 2, February 1965, pp. 25–34.

eties of quartz and other gem materials was produced valued at $750,000. This figure was based on the Prineville Chamber of Commerce's 100,000-visitor-day estimate of rockbounding in central Oregon, on a 30-pound limit set at fee collecting sites, and on the lowest retail price of agate ($0.25 per pound) given in the "Catalog of Gem Material Values–1965."[6]

Obsidian and cryptocrystalline varieties of quartz—thunder egg, moss agate, plume agate, jasper, silicified rhyolite, and petrified wood—were the most popular materials collected. One quartz variety, designated "Thunderegg" became Oregon's official State rock by an act of the 1965 Legislative Assembly. Articles reviewing the legislative act and the origin and history of the thunder egg were published by the Oregon Department of Geology and Mineral Industries.[7]

Lime.—Four companies produced quick- and hydrated-lime. Calcium carbide, sugar, pulp and paper, and metallurgical industries were the major markets for quicklime. Hydrated lime was supplied for plywood manufacture and water purification. Chemical Lime Co., Baker, and Ash Grove Lime & Portland Cement Co., Portland, produced lime for commercial markets. The Amalgamated Sugar Co., Nyssa, and Pacific Carbide & Alloys Co., Portland, produced and used lime for sugar refining and calcium-carbide manufacturing, respectively. Limestone barged from Texada Island, British Columbia, Canada, was burned to lime by the Ash Grove and the Pacific Carbide companies; the other two firms were supplied from local limestone quarries. Lime regenerated (136,800 tons) from recycled calcium-carbonate sludge at four pulp mills was not included in the State total as primary production.

Perlite.—Supreme Perlite Co., Portland, expanded crude perlite shipped from Idaho and Nevada. The expanded product was used chiefly as a building-plaster aggregate and as a wallboard filler; small quantities were sold for soil conditioning, filler, loose-fill insulation, and concrete aggregate.

Pumice and Pumiceous Materials.—The quantity of pumice and pumiceous materials (volcanic cinder and scoria) sold or used by Oregon producers was 16 percent higher than in 1964. Output, usually unprocessed, was used for road construction; smaller amounts were processed and used for lightweight-concrete aggregate, concrete admixture (pozzolan), and as an abrasive. Central Oregon Pumice Co. and Graystone Corp., Cascade Pumice Division, produced pumice and volcanic cinder at quarries near Bend. Processed material was sold to concrete-products plants throughout the northwestern States, California, and Canada. Kaiser Cement & Gypsum Corp. mined and processed volcanic ash for its pozzolanic properties from a deposit near Shutler, Gilliam County. The finished material was shipped by truck and rail to the John Day and Green Peter dam projects.

Sand and Gravel.—Output of sand and gravel reached a record of 21.8 million tons, an increase of 19 percent over the 1964 total. The principal cause of the increase was highway construction for the U.S. Army Corps of Engineers (relocating of highways due to the John Day and Green Peter dam projects), and State highway department projects in Baker, Benton, and Clackamas Counties. The sand and gravel requirements for road repairs after the December 1964 flood also contributed to the increased tonnage output. All categories of production had gains; commercial output totaled 0.9 million tons more than in 1964. Government-and-contractor production (largely contractor production for Federal, State, county, and municipal agencies) rose 2.6 million tons. Under the Government-and-contractor classification, output for Federal agencies increased from 2.1 million tons (1964) to 4.0 million tons (1965), output for State agencies increased from 5.8 million tons to 6.5 million tons, and output for the counties increased from 0.9 million tons to 1.0 million tons. Production was reported from all 36 counties.

Output exceeding 3 million tons was reported from Lane County, over 2 million tons each was reported from Multnomah and Sherman Counties, and over 1 million tons each was reported from Clackamas, Douglas, Josephine, and Linn Counties.

Stone.—Output of stone reached a record of 21.2 million tons, an increase of 32 per-

[6] Gems & Minerals. Catalog of Gem Material Values—1965. October 1965, pp. 21–27.

[7] Ore Bin. Thunderegg: Oregon's State Rock. V. 27, No. 10, 1965, pp. 189–194.
Staples, Lloyd W. Origin and History of the Thunder Egg. Ore Bin, v. 27, No. 10, 1965, pp. 195–204.

Table 6.—Sand and gravel sold or used by producers, by class of operations and uses
(Thousand short tons and thousand dollars)

	1964		1965	
	Quantity	Value	Quantity	Value
Commercial operations:				
Building	3,285	$4,333	3,618	$4,733
Railroad ballast	117	94	80	74
Road material	4,874	6,070	5,629	7,113
Other [1]	1,079	1,163	926	897
Total	9,355	11,660	10,253	12,817
Government-contractor operations:				
Building	193	287	143	226
Road material	8,628	13,166	10,489	18,649
Other [1]	77	45	915	1,157
Total	8,898	13,498	11,547	20,032
All operations:				
Building	3,478	4,620	3,761	4,959
Railroad ballast	117	94	80	74
Road material	13,502	19,236	16,118	25,762
Other [1]	1,156	1,208	1,841	2,054
Grand total	18,253	25,158	21,800	32,849

[1] Includes fill material, special sands, and sand and gravel used for miscellaneous purposes.

cent over that of 1964. The rise resulted from the repairs required after the December 1964 flood and from increased requirements at U.S. Army Corps of Engineers dam projects. Stone output for the Government-and-contractor market increased 51 percent from 11.7 million tons (1964) to 17.7 million tons (1965); however, this caused a diversion of output from the commercial market which declined 22 percent from 4.5 million tons (1964) to 3.5 million tons (1965). Basalt, used for roadstone, ballast, riprap, concrete and asphalt aggregate, and fill, continued to be the principal stone quarried. The downward trend of limestone production appeared to bottom following the instigation (1961) of barge shipments from Texada Island, British Columbia, Canada. The 1960 limestone production totaled 1.2 million tons; 952,000 tons (1961); 901,000 tons (1962); 824,000 tons (1963); 623,000 tons (1964); and 626,000 tons (1965). The largest limestone market was the cement industry, followed by the sugar, lime, paper, metallurgical, and agricultural industries. Limestone was quarried in Baker, Josephine, and Polk Counties. Quartz (silica) was produced by Bristol Silica Co., Jackson County, and by G. D. Rannels, Douglas County. The silica was marketed for use in making silicon metal, silicon carbide, roofing granules, and cement. Stone was produced from operations in 34 of the 36

Table 7.—Stone sold or used by producers by uses
(Thousand short tons and thousand dollars)

Use	1964		1965	
	Quantity	Value	Quantity	Value
Building (dimension stone)	1	$12	W	W
Concrete and roadstone	11,822	14,052	13,293	$19,886
Railroad ballast	220	307	263	366
Riprap	2,550	2,552	2,364	3,321
Other [1]	1,527	2,373	5,292	3,728
Total	16,120	19,296	21,212	27,301

W Withheld to avoid disclosing individual company confidential data.
[1] Used at cement, paper, and chemical plants; sugar refineries; and for miscellaneous unspecified purposes, and items indicated by symbol W.

counties; output exceeded 6 million tons in Lane County and 1 million tons in Jackson County.

Sulfur.—A report prepared by the Bureau of Mines Albany Office of Mineral Resources giving sulfur and sulfuric acid consumption in the Pacific Northwest with projections through 1985 was released by the BPA.[8]

Talc and Soapstone.—Soapstone mined in Skagit County, Wash., was ground and prepared at plants of Miller Products Co. and Stauffer Chemical Co., Portland. Ground soapstone output, for use as a carrier in insecticides, increased 23 percent compared with that of 1964.

Vermiculite (Exfoliated). — Crude vermiculite was expanded at Portland plants of Supreme Perlite Co. and Vermiculite-Northwest, Inc., at about the same rate as during 1964. The exfoliated product was marketed as loose-fill insulation, as lightweight aggregate for plaster and concrete, and as soil conditioner.

Water.—A $2.5 million water-quality research laboratory, which is to serve eight Western States, was being built by the U.S. Department of Health, Education, and Welfare on the Oregon State University campus at Corvallis. The laboratory, to be finished by April 1966, is to be used for basic research of Northwest water-quality problems, to provide technical water services, and to conduct graduate research programs. The facility was to be staffed by 150 persons.

Governor Mark Hatfield requested that a $25,000 water-quality study of the Rogue River be made by six State agencies concerned with the river. Cost of the study, to determine conditions adversely affecting the stream, was to be shared equally by the U.S. Department of the Interior and by the State. One of the agencies, the State Sanitary Authority, was to conduct a separate study of Rogue River sand and gravel operations to determine if any State laws on river pollution were being violated.

Two reports describing the importance of water in Oregon were published.[9]

METALS

Aluminum. — Harvey Aluminum, Inc., The Dalles, and Reynolds Metals Co., Troutdale, produced a record output of ingot, exceeding that of 1964 by 18 percent. The Harvey plant was operated at capacity the entire year, and the Reynolds plant was brought to full production in February. Published combined capacity of the two plants was 178,500 annual tons.

A study of regional aluminum mill-product trends in which the 1985 Western States market was projected to be 1.1 million tons was released.[10]

Gold, Silver, Copper, Lead, and Zinc.—Gold output was the lowest of record in this century, but developments at the Buffalo mine offered hope for improved future production.

Virtually all the gold and silver mined came from the Buffalo (Grant County) and the Oregon King (Jefferson County) lode mines and the Davis (Josephine County) and Mormon Basin (Malheur County) placer mines.

Negligible quantities of copper, lead, and zinc were recovered as byproducts of gold and silver ore mining. Some copper ore was taken from a Grant County property.

Magnesium.—The BPA published a survey of the Pacific Northwest States magnesium production potential.[11] The report pointed up factors that could lead to production by 1970 and projected 1985 output at 100,000 tons, about 30 percent of the projected 1985 United States consumption. Some portion of the anticipated production capacity was expected to locate in the State.

Mercury.—An alltime high average mercury price ($570.75 per flask containing 76 pounds) brought forth 1,364 flasks, a significant increase over that of 1964, but small compared with the 1957 production when nearly 4,000 flasks were produced at a $247 average price. The fluctuating mercury market has instilled the producer

[8] Hale, William N., and Norman S. Petersen. Sulfur Consumption in the Pacific Northwest (Report for Bonneville Power Administration, Portland, Oreg.). BuMines Mineral Resource Office, Area VII, Albany, Oreg., 1965, 51 pp.

[9] Bodhaine, G. L., and Others. The Role of Water in Shaping the Economy of the Pacific Northwest (Report for the Bonneville Power Administration, Portland, Oreg.). Geol. Survey, Tacoma, Wash., 1965, 218 pp.

Phillips, K. N., and Others. Water for Oregon. U.S. Geol. Survey Water-Supply Paper 1649, 1965, 150 pp.

[10] Fulkerson, Frank B., and Jerry J. Gray. Economic Trends in the Pacific Northwest Aluminum Mill Products Industry. BuMines Inf. Circ. 8267, 1965, 36 pp.

[11] Fulkerson, Frank B., and Jerry J. Gray. The Magnesium Industry and Its Relation to the Pacific Northwest (Report for the Bonneville Power Administration, Portland, Oreg.). BuMines Mineral Resource Office, Area VII, Albany, Oreg., 1965, 59 pp.

with justified reluctance to make long-term capital expenditures for mercury ore development. Should the mercury price remain favorable to production for a number of years, it is possible that exploration and development investments would be made to bring about additional ore and increased output.

Mercury production was reviewed in a State report.[12] The Bretz mine (Malheur County) and Black Butte mine (Lane County) accounted for all of the production excepting a few flasks derived from five other properties.

Oregon mercury properties and resources were reported.[13]

Nickel.—The only nickel ore producer in the United States, Hanna Nickel Smelting Co., Riddle, thrived in a strong market that drew mine and smelter outputs to record totals. Average grade of nickel ore mined was dropped to 1.42 percent contained nickel, the lowest annual average since mining was begun in 1954. The company maintained interest in low-grade Curry County nickel occurrences.

Zircon.—A fair zircon-production potential was reported for Oregon coastal blacksand deposits, assuming marketability of coproduct chromite.[14]

Metallurgical Plants.—Oregon Metallurgical Corp. (Linn County) was constructing a titanium-sponge plant, thereby integrating the Albany operation from rutile ore (purchased) to marketable ingot and castings. Self-sufficiency in titanium metal was to supplant purchased sponge from Japan, England, and the U.S.S.R. The move to integrate was inspired, in part, by rising costs of purchased metal (scrap and sponge) resulting from increased demands on available metal supplies.

The Albany Division, Wah Chang Corp., produced zirconium and its sister ore constituent, hafnium, at capacity from Australian zircon. Also produced from imported foreign ores was columbium and tantalum metal. Wah Chang alloyed and fabricated these four metals as well as other purchased metals, including titanium, molybdenum, and tungsten.

Pacific Northwest steel ingot production, approximately 25 to 30 percent of which was produced at Oregon Steel Mills, Portland, was projected to double by 1985 according to a BPA report.[15]

Metallurgical Research.—To develop fundamental behavioral knowledge and extractive methods the Bureau of Mines Albany Metallurgy Research Center (Linn County) conducted 40 diverse investigations of the elements and their compounds. The scope of work ranged from steelmaking investigations of automobile scrap to basic research in metal-alloy superconductivity.

MINERAL FUELS

Carbon.—Koppers Tars & Chemical Division, Koppers Co., Pittsburgh, Pa., announced that a $1 million plant would be built in Portland to produce carbon pitch and creosote from coal tar. The pitch would be used by the aluminum industry for manufacturing carbon anodes, and the creosote would be used for preserving wood products. The raw material feed was to come primarily from coking operations of steel manufacturers.

Coal.—Madrones Mining Co., Inc., Molalla, Clackamas County, mined a carbonaceous shale for use as soil conditioner. Material from an 8-foot bed of shale and clay containing a small seam of subbituminous coal was mined, dried, ground, processed, and packaged. The coal was handpicked to fire the drier.

Natural Gas.—An agreement on a plan to divest the $243 million Pacific Northwest Pipeline Co. from El Paso Natural Gas Co. was reached with the U.S. Department of Justice in May. The U.S. Supreme Court had ruled previously that El Paso had violated antitrust laws and ordered the company to establish an independent competitive gas pipeline company. The 2,633-mile pipeline involved in the legal battle, twists from New Mexico through Colorado, Wyoming, Utah, Idaho, Oregon, and Washington.

Northwest Natural Gas Co., under a 1961 Utility Area Act, was granted an exclusive service area that includes nearly all of the Willamette Valley and the great-

[12] Brooks, Howard C. Quicksilver in Oregon in 1965. Ore Bin, v. 28, No. 1, 1966, pp. 8–19.

[13] Bureau of Mines Staff. Mercury Potential of the United States. BuMines Inf. Circ. 8252, 1965, pp. 301–336.

[14] Kauffman, A. J. Jr., and Dean C. Holt. Zircon: A Review, With Emphasis on West Coast Resources and Markets. BuMines Inf. Circ. 8268, 1965, 69 pp.

[15] Kingston, Gary A. The Steel Industry of the Columbia Basin (Report for the Bonneville Power Administration, Portland, Oreg.). BuMines Mineral Resource Office, Area VII, Albany, Oreg., 1965, 58 pp.

pose of the act was to control costs to consumers by eliminating expensive duplication of utility facilities. The company, which serves most of the Willamette Valley, was investing $10 million to extend its distribution system to the Astoria area on the north coast and to the midcoast Newport-Toledo area. Willamette Tug & Barge Co., Portland, at a point near Kalama, Wash., dredged a trench across the Columbia River for the El Paso Natural Gas Co. to lay a connecting line to the Northwest Natural Gas Co. coastal system.

A report concerning the Pacific Northwest natural gas and petroleum products pipelines industry was published by the Oregon Department of Geology and Mineral Industries.[16]

Petroleum[17]. — Onshore petroleum exploration was at a standstill; the Oregon Department of Geology and Mineral Industries issued no new drilling permits nor was any drilling done on the three permits in force, two of which were officially abandoned during 1965. Offshore footage drilled on Federal leases, obtained during 1964, totaled 35,485 feet. Four holes were finished during the year with drilling continuing on one other.

A partnership of Union Oil Co. and Standard Oil Co. of California drilled two exploratory wells off the Oregon coast. The drilling, which could be performed at maximum water depth of 600 feet, was done from the Wodeco III, which was built like the hull of a ship, 365 feet long and 75 feet wide. No data were released except the location of the holes and their depths; one hole, 11 miles offshore from Lincoln Beach, was drilled to a depth of 12,628 feet, and the other, 16 miles offshore from Seal Rock, was bottomed at 5,603 feet.

Shell Oil Co. drilled offshore sites with the Blue Water II. This drilling rig was a floating semisubmersible platform with the main deck 188 feet by 188 feet; a floating steel island nearly an acre in size. The first hole, 17 miles off Newport, bottomed at 3,348 feet, and the second attempt, located 1,000 feet south of the first, was drilled to a depth of 8,306 feet. At yearend the company was at the depth of 5,600 feet on a third attempt, 25 miles offshore from Seaside. By October the Olympic Pipeline Co. was operating an 8- to 16-inch, 267-mile pipeline extending from refineries in the Ferndale-Anacortes, Wash., area to Portland. Pipeline construction began in September 1964.

REVIEW BY COUNTIES

Mineral production was reported from all 36 counties in 1965. With certain important exceptions, output was principally from nonmetallic deposits. Only selected counties with significant metal and nonmetal developments are discussed in the following review.

Baker.—Increased demand for sand and gravel and stone was the major cause of the mineral production value rising 30 percent over that of 1964. Cement production, which continued to be the principal mineral industry activity in terms of value, recorded an 18-percent gain. Oregon Portland Cement Co., at its Lime plant, utilized limestone from the Limerock quarry and shale from a new quarry located near the mined-out Durkee limestone quarry. Both quarries were company-owned. Compared with 1964, lime output value decreased 54 percent. Chemical Lime Co. produced quicklime and hydrated lime at a plant north of Baker. Limestone for the plant was produced from a quarry on Baboon Creek.

An attempt to reopen the Gray Eagle antimony property resulted in shaft and drift cleanup and in intersection of a low-grade mineralized zone on the 165 level.

Clackamas. — Greater mineral requirements for the construction industry caused the yield of sand and gravel and stone to double and Oregon Portland Cement Co. to raise cement output 8 percent over that of 1964. Limestone for the cement operation was transported by barge from Texada Island, British Columbia, Canada.

Crook.—Central Oregon Bentonite Co. increased production from its Silver Wells pit because of a greater demand for bentonite, used in forest-fire retardant mix-

[16] Newton, Vernon C., Jr. Natural Gas and Petroleum Products Pipelines in the Northwest. Ore Bin, v. 27, No. 8, August 1965, pp. 149–166.

[17] Oil-well drilling data were obtained from the Ore Bin, a monthly publication of the Oregon Department of Geology and Mineral Industries.

Table 8.—Value of mineral production in Oregon, by counties

(Thousand dollars)

County	1964	1965	Minerals produced in 1965 in order of value
Baker	r $4,174	$5,429	Cement, stone, sand and gravel, lime, clays, gold, silver.
Benton	543	1,323	Sand and gravel, stone, clays.
Clackamas	6,406	9,024	Cement, sand and gravel, stone, clays.
Clatsop	323	203	Stone, sand and gravel.
Columbia	341	266	Sand and gravel, stone, iron ore.
Coos	341	652	Stone, sand and gravel.
Crook	104	331	Stone, sand and gravel, clays, mercury.
Curry	210	351	Sand and gravel, stone.
Deschutes	653	888	Pumice, stone, sand and gravel.
Douglas	9,804	11,483	Nickel, sand and gravel, stone, mercury.
Gilliam	4,295	1,930	Stone, pumice, sand and gravel.
Grant	358	142	Sand and gravel, stone, silver, gold, copper, mercury, lead, zinc.
Harney	112	261	Sand and gravel.
Hood River	236	1,168	Sand and gravel, stone.
Jackson	4,049	6,772	Cement, stone, sand and gravel, clays, gold, pumice, silver.
Jefferson	1,253	269	Sand and gravel, pumice, stone, silver, lead, gold, copper, zinc.
Josephine	1,217	2,034	Sand and gravel, stone, gold, silver.
Klamath	1,245	911	Sand and gravel, stone, pumice, clays.
Lake	210	1,167	Sand and gravel, stone, pumice, diatomite, mercury.
Lane	5,696	10,046	Stone, sand and gravel, mercury.
Lincoln	878	1,050	Stone, sand and gravel.
Linn	1,182	3,250	Sand and gravel, stone, gold, silver.
Malheur	1,091	1,690	Sand and gravel, lime, mercury, stone, gold, silver.
Marion	1,181	1,537	Sand and gravel, stone.
Morrow	1,821	556	Do.
Multnomah	5,998	5,198	Sand and gravel, lime, stone, clays.
Polk	231	879	Sand and gravel, stone, clays.
Sherman	3,102	3,527	Sand and gravel, stone.
Tillamook	227	511	Stone, sand and gravel, clays.
Umatilla	516	665	Stone, sand and gravel.
Union	360	632	Stone, sand and gravel, clays.
Wallowa	W	138	Stone, sand and gravel.
Wasco	560	1,947	Do.
Washington	1,477	1,309	Stone, sand and gravel, clays.
Wheeler	59	120	Sand and gravel.
Yamhill	429	144	Sand and gravel, stone, clays.
Undistributed [1]	3,681	5,164	
Total	r 64,363	82,967	

r Revised. W Withheld to avoid disclosing individual company confidential data.

[1] Includes value of mineral production that cannot be assigned to specific counties and values indicated by symbol W.

tures, as a binder in making stock-feed pellets, as a sealer for irrigation canals, and as a carrier in insecticides.

Curry.—The Hanna Mining Co. mapped and sampled the Red Flats nickel prospect near Gold Beach under a lease option with Red Flats Nickel Corp.

Deschutes.—More than a carload of volcanic materials from Oregon's "moon country" was shipped to various space research agencies throughout the nation by the Oregon Department of Geology and Mineral Industries. Interest in this type of material was generated by the International Lunar Geological Field Conference which was held in Bend during August.

Douglas.—Morrison Sand & Gravel Co. and G. D. Rannels Construction Co. produced 2,060 tons of crushed silica from the Big Quartz mine, previously leased by M & B Logging Co. Early in the year, the firms constructed a 500-ton-per-day crushing plant near the mouth of Quartz Creek above Tiller. Ore from the mine, located near the top of Quartz Mountain, was trucked to the crushing plant, crushed, and then trucked to the Riddle nickel smelter for ferrosilicon production.

The mining and smelting operations of Hanna Mining Co. and Hanna Nickel Smelting Co. Riddle, shipped 12,681 tons of nickel (in ferronickel); 1,139,995 tons of ore was mined. Smelter improvements begun in 1964 were completed. They included a new dryer, an air classifier, and two gas-fired roasters. The air classifier was used to beneficiate fines which in turn were fed to the new multiple-hearth roasters. Electric-energy purchases from the BPA were 712.2 million kilowatt-hours, 4.9 percent more than in 1964.

Gilliam.—Reduced stone requirements at the John Day Dam highway relocation

project caused a 55-percent drop in the mineral-production-value total compared with that of 1964.

Grant.—Four flasks of mercury were recovered at the Canyon Creek (Williams ranch) mine by Canyon Creek Mercury Mines. Cordero Mining Co., Palo Alto, Calif., dropped an exploration sublease on the property, obtained in 1964, after completing planned tunneling and long-hole drilling.

After a geologic examination and exploration drilling the Buffalo gold-silver mine was purchased in September by Union Pacific Railroad Co. The property sold for $100,000 and a 5-percent royalty on smelter receipts. The previous owner, James P. Jackson, Jr., was to continue operating the mine.

Jim Kinsella ceased mining copper ore at the Standard mine.

Jackson. — Higher yields of sand and gravel and stone were the major causes of a 67-percent rise in mineral production value from that of 1964. The Gold Hill cement plant of Ideal Cement Co. continued to be the principal mineral-industry activity in terms of value. Cement production increased 9 percent over that of 1964. Limestone used at the plant was obtained from the company-owned Marble Mountain quarry in Josephine County, and shale was supplied from the company's Gold Hill quarry.

Bristol Silica Co. mined silica (quartz) from a quarry near Rogue River. The material was transported about 4 miles by truck to a screening plant at Gold Hill. The sized material was sold for industrial uses.

Jefferson.—A small tonnage of gold-silver concentrate was shipped to a Tooele, Utah, smelter from the Oregon King mine near Madras. An Office of Minerals Exploration contract was in effect at the mine throughout the year.

Josephine.—The December 1964 flood indirectly caused mineral output value to increase 67 percent because of the need for road-repair materials.

Lane.—The county ranked first in production of sand and gravel (3.2 million tons) and stone (6.7 million tons). A large share of the output was utilized by the U.S. Army Corps of Engineers.

Federal Resources Corp. completed an exploration program in the Bohemia district. Results of the work were not revealed.

Consistent output was attained at American Mercury Corp.'s Black Butte mercury mine, and ore reserves were extended beyond monthly mill requirements. Nearly 21,000 tons of ore and 4,000 tons of waste rock were mined on the 900 and 1100 levels. Production was sold to National Lead Co., Chicago, Ill.

Linn. — The construction-material requirements at the U.S. Army Corps of Engineers Green Peter and Foster dam projects caused the value of mineral production to jump 175 percent over that of 1964. The lack of a suitable sand and gravel source for concrete aggregate at the Foster dam site forced the use of river cobblestone (plus 3 inch). The cobblestone was crushed and screened into five particle sizes. A portion of the screened material was further reduced in size in a rotary impact crusher and re-graded to finer sizes in a wet-process sand classifier.

A titanium-sponge production plant with 3.5-million-annual-pound capacity was being built by Oregon Metallurgical Corp. at a cost of approximately $4 million. Company sales of titanium ingot and castings exceeded $6 million.

Malheur.—Exploration drilling to considerable depth was conducted at the Bretz mercury mine, and improvements were made in the milling and furnacing plant, raising daily ore-treating capacity to 200 tons. Production was from stockpiled low-grade ore and newly mined ore taken from the margins of previously mined ore bodies. Underground mining was being considered.

Multnomah.—Mineral production value was 13 percent lower than that of 1964 because of reduced yield of sand and gravel. Mineral commodities produced in the county were sand and gravel, lime, stone, and clay; however, many other mineral commodities were consumed. Chemical, metallurgical, and processing plants furnished calcium carbide, ferrosilicon, ferromanganese, silicomanganese, caustic soda, chlorine, rolled-and cast-steel products, roofing granules, lightweight-plaster aggregate, loose-fill insulation, and an inert carrier for insecticides.

Pacific Carbide & Alloys Co. and Ash Grove Lime & Portland Cement Co. calcined Texada Island (British Columbia) limestone to lime for use by the metallur-

gical, chemical, and construction industries. Salt barged from Baja California, Mexico, was reduced to caustic soda and chlorine by Pennsalt Chemicals Corp. Silica from Jackson County was used for manufacturing roofing granules. Vermiculite from Montana and South Africa was expanded for use in loose-fill insulation, as plaster and concrete aggregate, as fertilizer conditioner, and for soil conditioning. Soapstone for use as a carrier material in insecticides was ground from crude ore obtained from Washington. Crude perlite from Nevada and Idaho was expanded for use mainly as a lightweight-plaster aggregate.

Union Carbide Corp. purchased 178.3 million kilowatt-hours of electric energy from the BPA, 23 percent more than in the previous year to produce alloy metals and calcium carbide. African manganese ore and Montana silica rock were the alloy-metal raw materials.

Reynolds Metals Co. doubled casting capacity through installation of a vertical sheet-ingot casting unit. About 50 percent of the Troutdale plant's output went into sheet ingot, and the remainder went into ingot for extrusions and to foundries.

Sherman.—A 14-percent gain in mineral-production value was recorded because of sand and gravel needs at the John Day dam project.

Wallowa.—A 50- to 70-acre peat deposit located south of Enterprise was being readied for mining by Wes Cruikshank and associates. For peat marketing, they planned to incorporate as Jewell's Sales and Service.

The Mineral Industry of Pennsylvania

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the Pennsylvania Bureau of Topographic and Geologic Survey for collecting information on all minerals except fuels.

By Charles C. Yeloushan [1]

The value of mineral production in Pennsylvania for 1965 totaled $913.8 million, a $11.8 million increase over that of 1964. Production of bituminous coal accounted for 45 percent of the total value, showed the greatest value increase for an individual commodity, $19 million. Cement, sand and gravel, and stone industries, accounting for 28 percent of the total value, increased significantly from the previous year's production owing to the greater demand for raw materials in iron and steel manufacture, roadbuilding, and private and public building construction. The cement industry regained its loss of $3.8 million from 1963 to 1964 with a $3.9 million gain from that of 1964 to 1965. The sand and gravel industry continued to increase steadily at an annual rate of about $3 million in value. The stone industry also continued its strong steady growth with an $8.6 million increase over that of 1964.

Anthracite mining had the greatest decline in recent years with a value loss of $26.6 million from that of 1964. For the first time since accurate records of anthracite production were reported in 1870 annual production fell below 15 million tons. Anthracite output had reached an alltime peak in 1917 with nearly 100 million tons produced, but has fallen steadily since, producing 90 million tons in 1920, 69 million tons in 1930, 51 million tons in 1940, 44 million tons in 1950, 19 million tons in 1960, and 14.9 million tons in 1965. The unusually high exports of 3.4 million tons in 1963 dropped to less than 1 million tons in 1965.

Other individual commodities reporting declines in total production and value from 1964 were natural gasoline, crude petroleum, and zinc.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Coal (Anthracite).—Anthracite production decreased 13 percent in tonnage and 18 percent in value from that of 1964. Strip pits accounted for 40 percent of the production, underground mines 35 percent, culm banks 20 percent, and river dredging 5 percent. Of the underground production, 61 percent was mechanically loaded and 39 percent hand loaded. Of the anthracite loaded mechanically underground, 403 conveyors and pit-car loaders (including duckbills and other self-loading conveyors) accounted for 60 percent of the production, 155 scraper loaders for 28 percent, and 25 mobile loaders for 12 percent.

By regions, Schuylkill accounted for 49 percent of the total production, Wyoming for 31 percent, and Lehigh for 20 percent. All of the dredging came from the Schuylkill region, 88 percent from the Susquehanna River and tributaries, and 12 percent from the Schuylkill River and tributaries

[1] Mining engineer, Bureau of Mines, Pittsburgh, Pa.

Table 1.—Mineral production in Pennsylvania[1]

Mineral	1964 Quantity	1964 Value (thousands)	1965 Quantity	1965 Value (thousands)
Cement:				
Portland ---376-pound barrels--	37,662,763	$113,409	40,153,219	$116,925
Masonry ---280-pound barrels--	2,817,796	7,594	3,005,105	7,991
Clays[2] ---short tons--	3,187,100	15,814	3,394,222	17,697
Coal:				
Anthracite ---short tons--	17,184,251	148,648	14,865,955	122,021
Bituminous ---do--	76,530,758	388,218	80,308,449	407,267
Copper ---do--	3,614	2,356	4,354	3,083
Gem stones	NA	4	NA	4
Lime ---short tons--	1,440,285	20,656	1,568,492	22,496
Natural gas ---million cubic feet--	r 81,720	22,349	84,461	22,551
Natural gas liquids:				
Natural gasoline and cycle products thousand gallons--	1,138	64	1,022	55
LP gases ---do--	1,481	100	1,683	109
Peat ---short tons--	39,500	397	45,600	527
Petroleum (crude) ---thousand 42-gallon barrels--	5,113	22,088	4,922	21,263
Sand and gravel ---short tons--	16,199,000	26,414	18,502,000	29,606
Stone ---do--	52,829,268	91,075	56,806,160	99,627
Zinc[3] (recoverable content of ores, etc.) --do--	30,754	8,345	27,635	8,014
Value of items that cannot be disclosed: Clays (kaolin), cobalt, gold, iron ore, mica, pyrites, sericite-schist, silver, and tripoli	XX	34,519	XX	34,587
Total	XX	902,050	XX	913,823

r Revised. NA Not available. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes kaolin; included with "Value of items that cannot be disclosed."

[3] Recoverable zinc valued at the yearly average price of prime western slab zinc, East St. Louis market. Represents value established after transportation, smelting, and manufacturing charges have been added to the value of ore at the mine.

at an average value for all dredging of $3.34 per ton. Production from the Lehigh region preparation plants averaged $8.80 per ton, Schuylkill region preparation plants $7.75 per ton, and Wyoming region preparation plants $9.24 per ton. Average value for all anthracite production was $8.21 per ton. Of the total production, 51 percent was shipped by truck, 48 percent by rail, and 1 percent was used as colliery fuel.

The leading county in anthracite production was Luzerne with 37 percent of the total tonnage, followed by Schuylkill with 35 percent and Northumberland with 11 percent. There were eight fatal accidents in the anthracite mines in 1965 (16 less than 1964) for a frequency rate of 0.51 per million man-hours of exposure. Nonfatal accidents totaled 1,135 (207 less than 1964) for a frequency rate of 71.65 per million man-hours of exposure. Of the eight fatal accidents, five were due to falls of face, rib or roof, two from an inrush of surface material saturated with water, one from haulage, and all occurred underground. Four of the five face, rib, or roof fatalities were at mines employing 15 or more persons underground, and one was at a mine employing three persons.

Employment at anthracite operations (including operations of strip contractors) totaled 11,132 men, a decrease of 2,012 men from 1964; 4,501 men underground (692 less than 1964), 2,349 men in strip pits (726 less than in 1964), 566 men at culm banks (8 less than 1964), 2,047 men at

Table 2.—Value of mineral production in constant 1957–59 dollars

(Millions)

Year	Value
1956	$1,105
1957	1,058
1958	889
1959	891
1960	862
1961	839
1962	869
1963	r 918
1964	r 956
1965	p 967

p Preliminary.
r Revised.

preparation plants (366 less than 1964), 1,572 men at other surface (209 less than 1964), and 97 men on dredge operations (11 less than 1964). The men worked an average of 204 days throughout the year for a total of 2.3 million man-days. An average of 6.55 tons per man-day was produced compared with 6.11 tons produced in 1964.

Consumption of anthracite by the electric utilities decreased 4 percent from that of 1964 while use of anthracite for carbonizing (coke plants) increased 3 percent. Exports (not including shipments to military forces) totaled only 851,000 tons, a 46-percent decrease from that of 1964. Retail dealer deliveries totaled 3.1 million tons, a 6-percent decrease from that of 1964 while stocks in retail dealer yards decreased 14 percent.

Coal (Bituminous).—Production of bituminous coal increased 5 percent in tonnage and value from 1964. Coal sold in the open

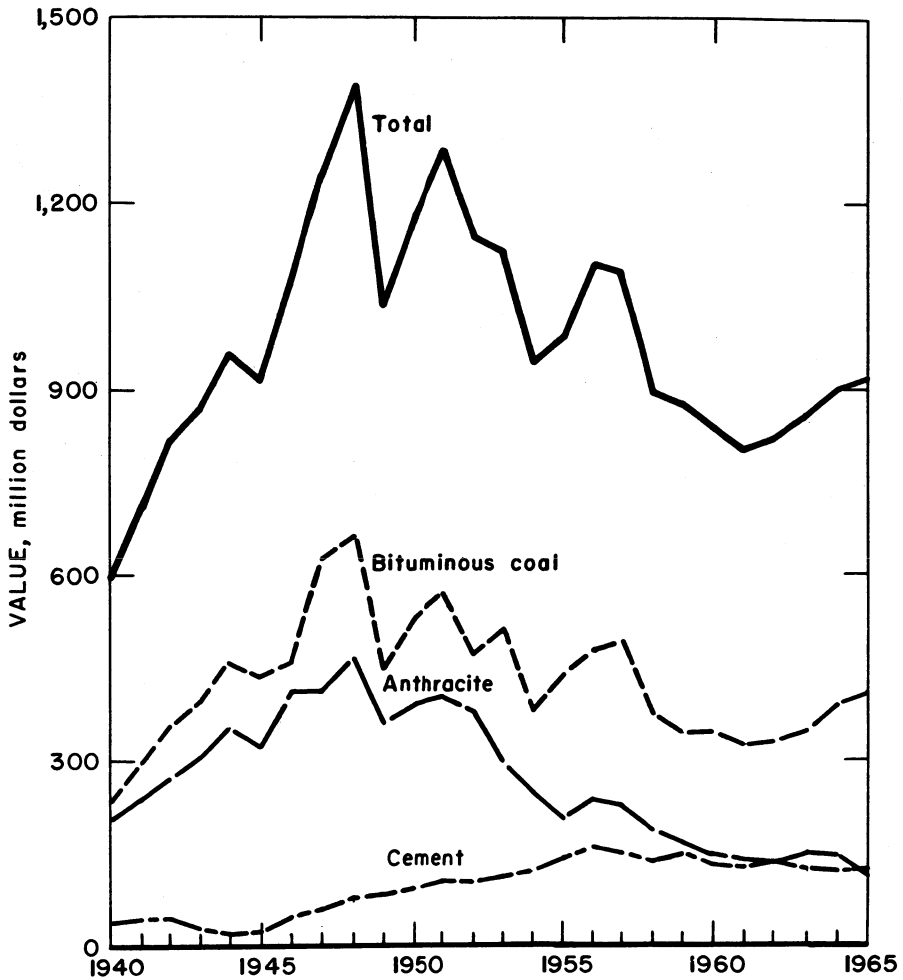

Figure 1.—Value of bituminous coal, anthracite, cement, and total value of mineral production in Pennsylvania.

Table 3.—Employment and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1964:								
Bituminous coal	24,959	222	5,529	44,523	18	896	20.53	4,068
Anthracite	13,144	214	2,812	20,368	24	1,342	67.07	9,650
Peat	52	231	12	95	---	2	21.01	19,431
Metal	1,451	291	422	3,467	1	38	11.25	2,114
Nonmetal	1,780	244	434	3,504	1	125	35.96	3,379
Sand and gravel	1,179	233	273	2,297	---	48	20.90	499
Stone	7,984	271	2,164	17,948	3	303	17.05	1,544
Total	50,549	230	11,646	92,202	47	2,754	30.38	4,637
1965: [p]								
Bituminous coal	24,400	226	5,514	44,630	35	910	21.17	6,377
Anthracite	11,132	204	2,271	16,375	8	1,067	65.65	4,936
Peat	59	186	11	90	---	1	11.05	309
Metal	1,475	285	420	3,467	---	27	7.77	421
Nonmetal	1,735	249	433	3,497	2	137	39.75	4,137
Sand and gravel	1,210	233	282	2,368	---	48	20.27	324
Stone	8,435	269	2,265	18,758	6	303	16.47	2,721
Total	48,446	231	11,196	89,185	51	2,493	28.52	4,857

[p] Preliminary.

market averaged $4.19 per ton (a $0.03 increase from that of 1964) and comprised 61 percent of the total tonnage. Coal not sold in the open market averaged $6.48 per ton (a $0.02 decrease from that of 1964) and accounted for the remaining 39 percent of the total tonnage. Average value for all bituminous coal produced was $5.07 per ton (same as that of 1964).

Underground mining accounted for 69 percent of the total output, strip for 30 percent, and auger for 1 percent. Mine count totaled 1,140 (17 more than 1964); 494 were underground mines (43 less than 1964), 581 were strip (71 more than 1964), and 65 were auger (11 less than 1964). Of the total output, 69 percent was mechanically cleaned: 87 percent of the underground coal, 28 percent of the strip coal, and 29 percent of the auger coal.

Of the coal mechanically cleaned, 65 percent was cleaned by wetwashing other than by jigs, 19 percent by pneumatic methods, and 16 percent by jigs. Coal was cleaned at 102 preparation plants (5 more than 1964), of which 17 plants (2 more than 1964) conducted thermal drying and dried 8.1 million tons of coal (1.2 million tons more than 1964).

Of the total output, 52 percent was crushed at 214 mines or plants and 10 percent was treated with oil, calcium chloride, or other materials at 63 plants; 78 percent was shipped to market by rail or water, 20 percent by truck, and 2 percent by other means.

Of the underground output, 97 percent was loaded mechanically, of which 408 continuous miners (with 97 mobile loaders) accounted for 81 percent of the mechanically loaded tonnage, 189 mobile loading machines for 18 percent of the tonnage, and 146 hand-loaded face conveyors, duckbills, self-loading conveyors and scraper loaders for 1 percent of the tonnage. Mechanical loading was carried out at 241 mines (8 more than 1964). In addition, 504 cutting machines (84 less than 1964) cut 21 percent of the underground tonnage, while less than 1 percent of the tonnage was shot from the solid and cut by hand; 449 hand-held and post-mounted drills (79 less than 1964) drilled 9 percent of the underground tonnage; 44 mobile drills (10 less than 1964) drilled 12 percent of the underground tonnage; 270 rotary and 242 percussion drills were used for roof bolting, and 28 rotary and 105 percussion drills were used for other purposes. Underground haulage was accomplished by 1,321 electric trolley locomotives, 84 electric battery locomotives, and 11 other locomotives; 119 rubber-tired tractors; 22,634 rail mine cars with an average capacity of 5 tons and 192 rubber-tired

mine cars with an average capacity of 3 tons; 618 miles of main line track and 316 miles of secondary track; 979 cable-reel shuttle cars, 14 battery shuttle cars, and 17 shuttle buggies; 557 conveyors with an average length of 1,553 feet.

Strip mining equipment included 2 electric, 11 diesel-electric, 692 diesel, and 61 gasoline power shovels, and 10 electric, 25 diesel-electric, 354 diesel, and 7 gasoline draglines for a grand total of 1,162 power shovels and draglines (79 less than 1964); 697 power shovels had less than a 3 cubic-yard bucket capacity, 62 shovels had from 3 to 5 yards' capacity, 4 shovels had from 6 to 12 yards' capacity, and 3 shovels had over 12 yards' capacity; 94 draglines had less than 3 yards' bucket capacity, 149 draglines from 3 to 5 yards, 140 draglines from 6 to 12 yards, and 13 draglines over 12 yards of bucket capacity; 8 carryall scrapers, 762 bulldozers, 101 horizontal and 139 vertical power drills, and 1,495 trucks with an average hauling capacity of 14 tons and an average one-way hauling distance of 7 miles were in use.

Auger mining equipment included 75 augers, 8 diesel and 1 gasoline power shovels with bucket capacities of less than 3 cubic yards, 38 bulldozers, 6 horizontal and 4 vertical drills, and 83 trucks with an average hauling capacity of 14 tons and hauling an average one-way distance of 6 miles.

Fatal injuries rose from 18 in 1964 to 35 in 1965, while nonfatal injuries fell from 1,035 to 1,015; injury-frequency rates per million man-hours of exposure rose from 0.37 to 0.73 for fatalities and fell from 21.53 to 21.09 for nonfatalities. Of the fatal injuries, 30 occurred underground, 1 at surface facilities associated with underground mines, and 4 at strip mines. Of the underground fatalities, 16 were due to falls of the roof, 8 to haulage, 3 to machinery, 1 to mine fires, and 2 to other causes. The surface fatality was a haulage accident. Strip fatalities were listed under two from machinery accidents and two from other causes.

Washington County continued to be the leading coal producer, followed by Greene, Cambria, Clearfield, and Indiana Counties. Bituminous coal also was mined in 23 other counties.

Plans were announced by Pennsylvania Electric Co. and New York Electric & Gas Co. to build a mine-mouth generating plant near Homer City in Indiana County. The site is 12 miles northwest of the projected Conemaugh mine-mouth plant and 15 miles southeast of the Keystone plant, now well under construction. The new plant is expected to use 3.5 million tons of coal annually, to be similar in design to the Keystone and Conemaugh plants, and to increase to more than 5 million kilowatts the total coal-fired generating capacity in the Indiana-Johnstown area. The Keystone and Conemaugh plants are each expected to consume over 5 million tons of coal annually, which, along with this new plant, will bring the total new coal consumed in the area to about 14 million tons annually by the early 1970's.

Coke and Coal Chemicals.—Oven-coke production totaled 18.9 million tons, a 7-percent increase over that of 1964, and beehive-coke production totaled 879,600 tons, a 57-percent increase over that of 1964 and 129-percent increase over that of 1963. Twelve oven-coke plants were in operation with 3,419 ovens in existence at yearend (243 ovens fewer than in 1964). Of the 3,419 slot ovens, 660 were Koppers, 1,546 were Koppers-Becker, 88 were Semet-Solvay, and 1,125 were Wilputte. Oven-coke operations carbonized 27.0 million tons of coal (with an average value of $8.54 per ton) and had a 70.11-percent yield of coke from coal, with an average value for coke at the ovens listed at $15.45 per ton ($1.57 a ton less than in 1964). Twelve beehive-coke plants were in operation with 2,200 ovens in existence at yearend (1,600 ovens were abandoned during the year) carbonizing 1.4 million tons of coal (with an average value of $5.56 per ton) and had a 61.87-percent yield of coke from coal. Beehive coke had an average value at the ovens of $13.94 per ton ($0.46 per ton more than in 1964).

Of the 27.3 million tons of coal received by oven-coke plants, 74 percent was high-volatile, 20 percent low-volatile, and 6 percent medium-volatile; 54 percent originated in Pennsylvania, 41 percent in West Virginia, 4 percent in Virginia, and 1 percent in Kentucky. Oven-coke producing companies used 17.4 million tons in blast furnaces and 19,000 tons for other purposes and sold 807,000 tons commercially to blast-furnace plants, foundries, other indus-

trial plants, and retail dealers for residential heating. Of the 15.6 million tons of oven and beehive coke distributed in Pennsylvania, 15.3 million went to blast-furnace plants, 144,000 tons to foundries, 123,000 tons to other industrial plants, and 15,000 tons for residential heating.

Production of breeze recovered at coke plants totaled 869,500 tons at an average value of $6.39 per ton. Of the breeze used by producers, 470,000 tons were used in agglomerating plants, 86,300 tons in steam plants, and 60,300 tons in other industrial uses. Breeze sold on the open market totaled 238,800 tons at an average of $6.89 per ton. Stocks of breeze on hand at yearend totaled 259,900 tons.

Coke-oven gas production totaled 290.7 billion cubic feet, a 7-percent increase over 1964. Coke-oven gas producers used 113.5 billion cubic feet in heating ovens, 29.6 billion cubic feet under boilers, and 141.5 billion cubic feet in steel or allied plants and sold 3.5 billion cubic feet for industrial use or distribution through city mains.

Coal chemicals produced at the oven-coke plants included 246,000 tons of ammonium sulfate equivalent; 255 million gallons of tar; and 82 million gallons of crude light-oil, from which were derived 45.4 million gallons of benzene, 11.6 million gallons of toluene, 3.7 million gallons of xylene, and 3.7 million gallons of solvent naphtha.

Koppers Co., Inc., Pittsburgh, Pa., has been awarded a contract by the Alan Wood Steel Co., Conshohocken, Montgomery County, to rebuild a battery of 55 coke ovens. The new ovens will replace Alan Wood's No. 3 battery, originally constructed by Koppers in 1919. The present battery will be taken out of service and the new ovens will be charged in April.

Natural Gas Liquids.—Natural gas liquids production totaled 2.7 million gallons, a 3-percent increase over that of 1964. Liquefied petroleum gases and ethane final (manufactured at natural gasoline plants) accounted for 62 percent of the production while natural gasoline and cycle products accounted for the remaining 38 percent. Liquefied petroleum gases were listed at 6.5 cents per gallon compared with 6.8 cents in 1964, and natural gasoline was listed at 5.4 cents per gallon compared with 5.6 cents in 1964. Proved reserves of natural gas liquids totaled 1.3 million barrels at yearend, a 5-percent decrease from yearend reserves in 1964. Underground-storage capacity for liquid petroleum gas was 1.1 million barrels at four mined granite caverns in Delaware County and one mined shale cavern in Westmoreland County.

Natural gas processing plants in operation included absorption plants in Elk, Venango, and Warren Counties with a total capacity of 16,500 gallons per day. A combination drying and gasoline plant was also operated in Greene County producing about 1,000 gallons of product per day.

Peat.—Peat was produced at 12 operations in 7 counties and totaled 57,400 tons with an average value of $11.86 per ton. Sales totaled 45,600 tons with an average value of $11.56 per ton. Of total sales, 61 percent was reported as humus, 36 percent as reed-sedge, and 3 percent as moss peat; 83 percent was sold in bulk for $10.25 per ton and 17 percent was packaged for $18.21 per ton. Peat operations were conducted in deposits involving a total of 1,110 acres with an average depth of 32 feet. Seventeen shredders shredded 84 percent of the total production. Wayne County was the leading producing area, followed by Luzerne County.

Petroleum and Natural Gas.—Crude oil production totaled 4.9 million barrels, a 4-percent decrease from that of 1964. Wellhead values of Pennsylvania crude from the Bradford district was $4.48 per barrel (same as 1964), from the Allegheny district $4.40 per barrel, from the Middle district $4.20 per barrel, and from the Southern district $3.93 per barrel. Productive oil wells at yearend totaled 52,731. There were 13 petroleum refineries in operation with a crude-oil throughput capacity of 695,100 barrels per day and a cracking and reforming capacity (gasoline output) of 252,795 barrels per day. According to the American Petroleum Institute, proved reserves of crude oil at yearend totaled 76.8 million barrels, a 9.9-million-barrel decrease from yearend 1964.

Natural gas production totaled 84.4 billion cubic feet, was marketed for $22.6 million. Productive gas wells at yearend totaled 17,516. According to the American Gas Association, proved natural gas reserves at yearend totaled 1,257 billion cubic feet, a 13-billion-cubic-foot increase over

yearend 1964. Pennsylvania ranked second in underground gas-storage capacities with a storage capacity of 651 billion cubic feet. Natural gas in underground storage at yearend was 510 billion cubic feet, a 12 billion cubic-foot decrease from yearend 1964.

According to the Oil and Gas Section, Pennsylvania Bureau of Topographic and Geologic Survey, 770 shallow-sand wells were drilled, of which 571 were drilled independently of underground gas-storage and secondary-recovery projects, 198 wells in secondary-recovery projects, and 1 well in gas-storage. Of the 571 wells, 165 were gas, 325 oil, and 81 dry holes. Two important significant discoveries were made in the Onondaga Chert-Oriskany Sandstone interval: One in Jackson Township, Cambria County, on the Laurel Hill Anticline (production depth, 7,696–7,810 feet) and one in Young Township, Jefferson County, on the Sabinsville Anticline (production depth, 7,094–7,193 feet). Of the 122 deep wells drilled, 82 were drilled in Erie and Crawford Counties. Of the 28 exploratory wells, all were deep test of which 5 were successful and 23 were dry. The Youngsville-Sugar Grove field in Warren County continued to have the most activity with 138 new oil completions. The Tionesta-Pleasantville area was the second most active area with 73 oil wells and 5 dry holes drilled. Seismic crews logged 65 crew-weeks, a decrease of 35 percent from that of 1964. Some gravity work was done in Crawford County, and geological field parties were active in several areas.

NONMETALS

Total production of portland cement (376-pound barrels) increased 4 percent and shipments increased 7 percent from that of 1964 while the average price decreased $0.10 per barrel to $2.91. Total production of masonry cement (280-pound barrels) increased 9 percent and shipments increased 7 percent while the average price decreased $0.04 per barrel to $2.66. Pennsylvania ranked second in the shipment of portland cement in the United States and first in the shipment of masonry cement.

Portland cement capacity was 51 million barrels, a decrease of 3 percent from that of 1964. Portland cement was produced at 21 plants during 1965. The leading county was Northampton with eight plants, followed by Lehigh County with four plants, Allegheny, Lawrence and Montgomery with two plants each, and Berks, Butler, and York with one plant each. Of the 5 plants, (11 kilns) in operation in western Pennsylvania, shipments of all types of portland cement totaled 10.4 million barrels at an average price of $3.18 per barrel, of which 89 percent was types I–II (general use and moderate heat) and 3 percent was type III (high-early-strength); 54 percent was consumed in western Pennsylvania, 37 percent in Ohio, 8 percent in West Virginia, and the remaining 1 percent in nine other States. Of 16 plants (72 kilns) in eastern Pennsylvania, shipments of all types of portland cement totaled 29.8 million barrels at an average price of $2.82 per barrel, of which 88 percent was types I–II, 6 percent type III, and 3 percent was white cement; 33 percent was consumed in eastern Pennsylvania, 29 percent in New Jersey, 15 percent in New York, 6 percent in Connecticut, 6 percent in Maryland, and the remaining 11 percent in 39 other States, District of Columbia, and several foreign countries.

Shipments of masonry cement from western Pennsylvania totaled 1.0 million barrels at an average price of $2.79 per barrel, of which 53 percent was consumed in western Pennsylvania, 39 percent in Ohio, and the remaining 8 percent in 6 other States. Shipments of masonry cement from eastern Pennsylvania totaled 2.0 million barrels at an average price of $2.59 per barrel, of which 24 percent was consumed in eastern Pennsylvania, 30 percent in New Jersey, 17 percent in New York, 7 percent in Virginia, 6 percent in Maryland, 5 percent in the District of Columbia, and the remaining 11 percent in 19 other States and several foreign countries.

Electrical energy used by the portland cement industry in western Pennsylvania totaled 251 million kilowatt-hours, all of which was purchased; eastern Pennsylvania used 741.6 million kilowatt-hours, of which 84 percent was purchased with the remaining 16 percent generated. Portland cement stocks at the end of the year totaled 1.5 million barrels in western Pennsylvania and 3.2 million barrels in eastern Pennsylvania.

Of the total portland cement shipments from western Pennsylvania, 62 percent

went to ready-mixed concrete companies, 14 percent to concrete product manufacturers, 13 percent to highway contractors, 7 percent to building material dealers, and the remaining 4 percent to miscellaneous customers and other contractors. Shipments from eastern Pennsylvania went to ready-mixed concrete companies (57 percent), concrete product manufacturers (23 percent), building material dealers (12 percent), highway contractors (7 percent) and the remaining 1 percent to other contractors and miscellaneous customers.

Cement rock and limestone were the chief raw materials consumed for the manufacture of portland cement, totaling 2.4 million tons for 83 percent of the total in western Pennsylvania and 8.5 million tons for 93 percent of the total in eastern Pennsylvania. Other raw materials used included shale, clay, sand, sandstone, slag, bauxite, gypsum, iron ore, slate, flue dust, and miscellaneous mill materials.

Air-entrained portland cement accounted for 59 percent of the production in western Pennsylvania and 19 percent in eastern Pennsylvania. Shipments from western Pennsylvania were by truck (94 percent), rail (5 percent), and boat (1 percent); shipments from eastern Pennsylvania were by truck (59 percent), and rail (41 percent). Bulk shipments accounted for 91 percent of the total in western Pennsylvania and 83 percent of the total in eastern Pennsylvania, with the balance packaged in containers.

Clays.—Total production of clays (excluding kaolin) increased 6 percent in tonnage and 12 percent in value from that of 1964. Fire clay accounted for 50 percent of the total production increasing 8 percent in tonnage and 15 percent in value over that of 1964. Miscellaneous clay and shale accounted for the remaining 50 percent of the total, increasing 5 percent in tonnage and 7 percent in value over that of 1964.

Lawrence County was the leading clay producer, but only 56 percent of the tonnage was fire clay. Clarfield County was the leading fire clay producer and (because of the high-grade plastic and flint clay commanding a premium price) led the State in total clay value. Berks County was the leading miscellaneous clay and shale producer. Of the total fire clay production, 48 percent was used for firebrick and block, 31 percent for building brick, 5 percent for vitrified sewer pipe, and the remaining 16 percent for high alumina brick, mortar, clay crucibles, foundries (bulk), other refractories, other heavy clay products, filler, absorbent uses, floor and wall tile, and other uses. Of the total miscellaneous clay and shale, 75 percent was used for building brick, 13 percent for cement, and the remaining 12 percent for lightweight aggregate, vitrified sewer pipe, foundries (bulk), pottery, floor and wall tile, filler, and other heavy clay products.

Kaolin was produced in Cumberland County for white cement and in Blair County for firebrick and block.

The Pennsylvania Geological Survey's new Bulletin M–51 on "Properties and Uses of Pennsylvania Shales and Clays" should stimulate further development of these resources.

Table 4.—Clays sold or used by producers, by kinds and uses [1]

(Short tons)

Use	Fire clay		Miscellaneous clay	
	1964	1965	1964	1965
Refractories:				
Firebrick and block	735,106	821,411	---	---
Fire clay and mortar	43,306	41,125	---	---
Heavy clay products	605,062	612,191	1,308,816	1,373,089
Portland and other hydraulic cements	---	---	198,358	221,122
Undistributed	[2] 200,639	[2] 232,492	[3] 95,813	[3] 92,792
Total	1,584,113	1,707,219	1,602,987	1,687,003

[1] Excludes kaolin.
[2] Includes exports, floor and wall tile, high-alumina brick, clay crucibles, foundries, steelworks (bulk), other refractories, insecticides and fungicides, other filler, absorbent uses, and other uses.
[3] Includes art pottery, flowerpots, and glaze slip; floor and wall tile (1965); foundries and steelworks (bulk); lightweight aggregate; and linoleum and oilcloth.

Table 5.—Clays sold or used by producers in 1965, by counties

County	Short tons	Value	Types of clay
Adams	80,400	$40,200	Miscellaneous clay.
Armstrong	303,096	1,537,293	Fire clay, miscellaneous clay.
Beaver	115,421	980,802	Fire clay, miscellaneous clay.
Bucks	62,000	62,000	Miscellaneous clay.
Chester	95,915	120,000	Miscellaneous clay.
Clarion	47,360	188,146	Fire clay, miscellaneous clay.
Clearfield	429,790	3,254,446	Do.
Clinton	34,280	98,041	Do.
Columbia	14,962	26,900	Miscellaneous clay.
Lawrence	523,335	656,390	Fire clay, miscellaneous clay.
Montgomery	57,470	97,470	Miscellaneous clay.
Somerset	114,726	870,633	Fire clay.
Undistributed [1]	1,515,467	9,764,572	
Total [2]	3,394,222	17,696,893	

[1] Includes Allegheny, Berks, Blair, Cambria, Centre, Cumberland, Dauphin, Fayette, Greene, Huntingdon, Indiana, Jefferson, Lancaster, Luzerne, McKean, Monroe, Northumberland, Schuylkill, and York Counties.
[2] Incomplete total; excludes kaolin produced in Blair and Cumberland Counties.

Gem Stones.—Mineral specimens were collected chiefly by hobbyists and amateur lapidarists at scattered locations throughout the State but mostly in Berks, Chester, Carbon, Lancaster, Lebanon, and Montgomery Counties.

Graphite.—Manufactured (artificial) graphite was produced in Elk County and further processed at Niagara Falls and sold to steel companies, foundries, and chemical companies in the form of graphite electrodes and anodes.

Gypsum.—A gypsum-calcining plant was operated at Philadelphia using both domestic and imported crude gypsum.

Iodine.—One company in Allegheny County and one company in Lebanon County consumed out-of-State crude iodine in the production of both inorganic and organic compounds.

Iron Oxide Pigments.—Crude iron oxide pigments were mined in the form of sulfur mud in Cambria County and extracted from the alumina processing of bauxite in the form of red iron oxide in Allegheny County. Finished iron oxide pigments were produced and shipped from two plants in Northampton County and one plant in Carbon County. Finished pigments included natural and manufactured black, brown, red, and yellow pigments, and mixtures of natural and manufactured red iron oxides.

Lime.—Production of lime (quicklime and hydrated lime) increased 9 percent in tonnage and value from that of 1964. Of the total lime production, 81 percent was quicklime and 19 percent hydrated. The average price per ton of quicklime increased from $13.73 in 1964 to $13.85 while hydrated lime decreased from $16.89 to $16.46. The chemical and other industrial markets consumed 75 percent of the lime production with the remaining 25 percent being distributed among refractory, agricultural, and construction markets. Eighteen plants were operated in 16 counties with Centre County ranking first in production with three large plants producing quicklime and hydrated lime accounting for 53 percent of the total lime tonnage and 47 percent of the total value. Of the 18 plants, 6 plants sold only quicklime, 4 plants sold only hydrated lime, and 8 plants sold quicklime and hydrated lime. Kilns in use included 17 rotary, 19 pot, and 16 shaft. Both batch and continuous hydrators were used for manufacture of hydrated lime. Regenerated quicklime was consumed at a pulp and paper plant in Blair County. Of the total lime sold, 65 percent was consumed in Pennsylvania, 8 percent in Maryland, 6 percent in New Jersey, 3 percent in Delaware, and the remaining 18 percent in 23 other States, District of Columbia, Canada, Chile, and Venezuela.

Mica.—Crude scrap mica was produced at a mine in York County. The quantity produced decreased slightly from that of 1964 but the value per ton increased. The processed mica was used in paint, rubber

Table 6.—Lime sold by producers, by counties

County	1964		1965	
	Short tons	Value	Short tons	Value
Armstrong	310	$4,371	340	$6,120
Centre	767,948	9,716,998	827,543	10,522,573
Dauphin	7,800	132,600	6,000	90,000
Lancaster	560	5,066	420	4,200
Lebanon	204,000	2,812,000	201,000	2,703,000
Mifflin	4,023	36,705	2,600	25,100
Northumberland	355	3,200	350	3,150
Other counties [1]	455,289	7,945,084	530,239	9,141,705
Total	1,440,285	20,656,024	1,568,492	22,495,848

[1] Includes Bedford, Butler, Chester, Columbia (1965), Juniata, Montgomery, Snyder, Westmoreland, and York Counties.

(mold lubricant), welding rods, and textile coating.

Perlite (Expanded).—Crude perlite from out-of-State sources was expanded at two plants in Allegheny County and one plant each in Delaware, Lehigh, Montgomery, and York Counties. Lehigh County led in expanded perlite production. Production of expanded perlite was 13 percent less than that of 1964. The average price per ton of perlite sold or used increased 5 percent. The building plaster industry consumed the major portion of the expanded perlite production, with the remainder being used for loose fill insulation, concrete aggregate, soil conditioner, filler, filter aid, refractories, charbase, cryogenic applications, and other miscellaneous industrial uses.

Pyrites.—Pyrite concentrate was recovered by flotation in the milling process for magnetite iron ore in Berks and Lebanon Counties. The concentrate was then shipped to Sparrows Point, Md. for further processing.

Sand and Gravel.—Total sand and gravel production increased 14 percent in tonnage and 12 percent in value over that of 1964. Sand and gravel for building and paving purposes accounted for 86 percent of the total tonnage and increased 16 percent over that of 1964. Of total output, 50 percent was sand for construction (building, paving, fill, and other uses), 41 percent was gravel for construction (building, paving, railroad ballast, fill, and other uses), and 9 percent was unground sand for industrial (glass, molding, grinding and polishing, blast, fire or furnace, engine, and other uses). A small amount of ground sand was used for abrasives, chemicals, enamel, filler, glass, pottery, porcelain, tile, foundry and other uses, and a small amount of Government-and-contractor processed gravel was produced for paving purposes. The average price per ton for the total sand and gravel production decreased from $1.63 in 1964 to $1.60 in 1965 because sand and gravel for building and paving purposes, which had the lowest unit value of all types of sand and gravel, showed the greatest increase in output.

The leading producing county was Bucks County followed by Erie, Beaver, Westmoreland, Luzerne, and Mercer Counties. Company reports on 104 commercial operations in 45 counties show that 52 percent of the operations produced less than 100,000 tons each for 11 percent of the total tonnage, 26 percent of the operations produced between 100,000 and 200,000 tons each for 21 percent of the total, 16 percent of the operations produced between 200,000 and 500,000 tons each for 29 percent of the total, 3 percent of the operations produced between 500,000 and 1,000,000 tons each for 10 percent of the total, and 3 percent of the operations produced over 1,000,000 tons each for 29 percent of the total production.

Of total production, 97 percent was processed; 66 percent was trucked to markets, 28 percent by waterways, and 6 percent by railroads.

Sericite-Schist.—Crude sericite-schist was produced from two mines in Adams County. Output decreased from that of 1964. After processing, sericite-schist was used as a carrier in insecticide chemicals, as a filler in asphaltic compounds, and in joint cement.

Table 7.—Sand and gravel sold or used by producers, by classes of operations, and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1964		1965	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Molding	124	$396	234	$581
Building	4,697	6,648	5,566	7,575
Paving	2,859	4,109	3,374	4,902
Fire or furnace	108	326	140	406
Fill	24	25	42	43
Undistributed [1]	1,818	5,382	1,492	5,094
Total	9,630	16,886	10,848	18,601
Gravel:				
Building	3,137	4,550	3,522	4,987
Paving	2,978	4,507	3,418	5,241
Fill	207	138	321	200
Undistributed [2]	217	276	361	511
Total	6,539	9,471	7,622	10,939
Total sand and gravel	16,169	26,357	18,470	29,540
Government-and-contractor operations:				
Sand:				
Other	26	33	---	---
Gravel:				
Paving	---	---	32	66
Other	4	24	---	---
Total sand and gravel	30	57	32	66
All operations:				
Sand	9,656	16,919	10,848	18,601
Gravel	6,543	9,495	7,654	11,005
Grand total	16,199	26,414	18,502	29,606

[1] Includes glass, grinding and polishing, blast, engine, ground, and other sand.
[2] Includes railroad ballast, miscellaneous, and other gravel.

Stone.—Total production of stone increased 8 percent in tonnage and 9 percent in value from that of 1964. Increases in tonnage over those of 1964 were reported for limestone (9 percent), basalt (5 percent), and miscellaneous stone (17 percent). Decreases were reported for sandstone (10 percent), granite (3 percent), and slate (1 percent). Of the total tonnage, limestone accounted for 84 percent, basalt for 7 percent, sandstone for 5 percent, miscellaneous stone for 3 percent, and granite and slate for 1 percent. Almost all of the stone production was crushed and broken of which 55 percent was used for concrete aggregate and roadstone, 19 percent for cement manufacture, 11 percent for furnace flux, 5 percent for lime manufacture, 2 percent for agricultural, 1 percent for riprap, 1 percent for railroad ballast and the remaining 6 percent for other uses including limestone dust for coal mines, roofing granules, glass manufacture, and fillers.

Dimension stone accounted for less than one-half of 1 percent of the total tonnage, but more than 6 percent of the total value owing to the greater value per ton placed on such items as blackboards, structural and sanitary ware, flagstone, roofing slate, and building stone. Slate accounted for 35 percent of the dimension stone and 65 percent of its value with sandstone accounting for 45 percent of the tonnage and only 23 percent of the value. Stone was produced in 53 counties, 40 of which produced limestone. The leading stone producing county was Northampton, followed by Montgomery, Adams, Lancaster, and Berks. Limestones and dolomites, the most widely used mineral resources in Pennsylvania, next to coal, are featured in a new publication, "An Atlas of Pennsylvania's Mineral Resources, Part 1", released through the

Table 8.—Stone sold or used by producers, by uses

Use	1964		1965	
	Short tons	Value	Short tons	Value
Dimension stone:				
Building stone	121,921	$1,340,151	90,378	$1,334,311
Curbing and flagging	43,964	1,163,893	54,623	1,222,054
Other uses [1]	31,086	3,654,579	29,884	3,536,583
Total	196,971	6,158,623	174,885	6,092,948
Crushed and broken stone:				
Riprap	9,463	20,039	535,545	690,514
Concrete and roadstone	28,983,140	42,279,571	31,388,647	46,597,053
Furnace flux (limestone)	5,885,117	10,375,887	6,289,387	11,197,022
Railroad ballast	486,989	742,077	609,816	929,114
Agricultural	1,000,054	3,104,776	1,236,490	3,731,886
Other uses [2]	16,267,534	28,393,707	16,571,390	30,388,830
Total	52,632,297	84,916,057	56,631,275	93,534,419
Grand total	52,829,268	91,074,680	56,806,160	99,627,367

[1] Includes roofing slate and millstock.
[2] Includes refractory.

Pennsylvania Geological Survey in Harrisburg.

Sulfur.—Sulfur was recovered in Delaware County at one refinery using the Claus type process and at another refinery using single stage catalytic oxidation of hydrogen sulfide. Hydrogen sulfide was recovered by the Girdler System using diethanolamine and monethanolamine, and molten sulfur was recovered by the im-

Table 9.—Stone sold or used by producers, by counties

County	1964		1965	
	Short tons	Value	Short tons	Value
Adams, Cumberland	4,137,126	$10,847,874	4,558,149	$11,516,082
Armstrong	185,813	431,532	326,222	688,284
Berks	3,396,066	4,578,911	3,535,373	4,917,995
Blair, Huntingdon	1,489,990	2,567,420	1,751,989	3,864,976
Bucks	3,160,124	4,223,338	3,367,985	4,614,913
Butler	1,289,182	2,467,851	1,479,334	2,836,027
Cambria	W	W	3,000	9,000
Carbon, Monroe, Schuylkill	928,550	2,364,168	846,089	2,222,169
Centre	2,432,183	4,259,858	2,803,809	4,798,857
Chester	2,449,119	5,073,218	2,665,405	5,671,473
Dauphin	988,084	1,616,504	1,094,256	1,736,573
Fayette, Somerset	935,980	1,832,068	1,156,916	2,454,028
Juniata, Mifflin, Snyder	888,606	1,249,631	660,840	936,057
Lancaster	2,948,392	4,181,751	3,599,565	5,273,131
Lawrence	3,199,749	4,345,289	3,322,735	4,653,231
Lebanon	1,698,035	2,867,643	1,778,070	3,051,168
Lehigh	2,533,795	2,624,085	2,640,717	2,810,401
Luzerne	W	W	498,952	832,222
Montgomery	4,679,418	7,671,742	4,844,640	7,899,248
Northampton	5,341,525	8,427,109	5,503,516	8,772,578
Northumberland	55,410	97,810	W	W
Susquehanna	170,896	745,587	267,364	906,985
Wayne	157,408	330,176	163,756	331,085
Westmoreland	667,021	1,167,469	756,458	1,330,625
York	3,074,191	6,617,425	3,442,201	7,130,166
Other counties [1]	6,022,605	10,486,221	5,738,819	10,370,093
Total	52,829,268	91,074,680	56,806,160	99,627,367

W Withheld to avoid disclosing individual company confidential data.
[1] Includes Allegheny, Bedford, Clarion, Clearfield, Clinton, Columbia, Delaware, Elk, Franklin, Fulton, Jefferson, Lycoming, McKean, Mercer, Montour, Perry, Potter, Tioga, Union, Washington, and Wyoming Counties, and counties indicated by symbol W.

proved Claus-type process at a refinery in Philadelphia County. Another refinery in Philadelphia County recovered sulfur by the Claus process. The quantity of sulfur produced was 14 percent less than in 1964.

Tripoli.—Total sales of tripoli (rottenstone) were about the same as in 1964. Two companies in Lycoming County mined and processed the material for use as an abrasive compound and as a filler material.

Vermiculite (Exfoliated).—Shipments of exfoliated vermiculite decreased 1 percent in tonnage but increased 5 percent in value from that of 1964. Two plants were in operation, one in Bucks County and one in Lawrence County. The largest use was for loose fill insulation. Other uses included a lightweight aggregate in concrete and plaster, horticulture, packing, and other miscellaneous uses.

METALS

Beryllium.—Besides beryllium metal, alloys, and compounds being produced by the Beryllium Corporation at Reading, the company announced the manufacture of beryllium sheets rolled directly from cast ingots. Intermediate steps in the powder metallurgy process used to make conventional hot pressed sheets are eliminated. The sheets are reported to have more than average ductility and can be fabricated with the same equipment and at the same temperature (500 to 700° F) as magnesium alloys.

Cadmium.—Shipments of cadmium (primary and secondary metal from processing plants) decreased considerably from 1964. Cadmium was recovered by St. Joseph Lead Co. at its Josephtown plant in Beaver County and by New Jersey Zinc Co. at its Palmerton plant in Carbon County.

Cobalt.—Cobalt content in shipments of pyrite concentrate from magnetite iron ore mines in Berks and Lebanon Counties increased slightly over that of 1964.

Columbium.—Kawecki Chemical Co., Boyertown, Berks County, entered into licensing agreement with Imperial Chemical Industries, Ltd., for exclusive manufacture and marketing in the United States of a high-strength columbium alloy which is expected to have applications in aerospace industries. The metal can stand temperatures up to 2,500° F. It can be easily fabricated into thin sheets and wire and be recrystallized after coldworking without loss of ductility. Welding properties are reported excellent. Composition of the alloy is 11 percent tungsten, 3 percent molybdenum, 2 percent hafnium, 0.08 percent carbon, and the remainder columbium.

Copper, Gold, and Silver.—Copper concentrate was recovered by flotation of magnetite iron ore mined in Lebanon County and shipped to western refineries for processing. The concentrate also contained gold and silver.

Ferroalloys.—Production of ferroalloys increased 19 percent above that of 1964 and totaled 697,000 tons. Shipments also were greater and amounted to 708,000 tons valued at $125.3 million. Of the 12 types of ferroalloys produced in the State, ferromanganese was the most predominant. Other significant ferroalloys produced included ferromolybdenum and spiegeleisen.

Iron Ore.—Production and shipments of iron ore (usable) was slightly lower in quantity but slightly higher in value compared with that of 1964. Shipments were in the form of pellets processed from pulverized magnetite concentrated by magnetitic separation at agglomerating plants at mines in Berks and Lebanon Counties. Crude magnetite was mined underground by block-caving methods. Most of the iron-ore pellet production was shipped to company-owned iron and steel plants in Pennsylvania and Maryland for consumption in blast furnaces.

Iron and Steel.—Pig iron production totaled 21.8 million tons, a 4-percent increase over that of 1964. Of the pig iron output, 91 percent was basic, 6 percent Bessemer, and the remaining 3 percent malleable, low phosphorus, foundry, and direct castings.

Receipts of iron ore totaled 27.8 million tons, 62 percent from foreign countries and 38 percent from domestic production. Consumption of iron ore totaled 27.6 million tons, 49 percent by agglomerating plants, 46 percent by blast furnaces, and 5 percent by steel furnaces. Iron ore stocks at beginning and end of year were 11.3 million tons and 10.6 million tons, respectively. Fluxes consumed by the iron and steel in-

dustry included 3.4 million tons of limestone, 3.1 million tons of dolomite, and 1.1 million tons of other type fluxes. Other materials consumed included 1.3 million tons of mill cinder and roll scale, 1.0 million tons of raw flue dust, 1.6 million tons of steel furnace slag, 14.9 million tons of net coke, 0.35 million tons of coke breeze, and 0.36 million tons of anthracite. Steel furnaces consumed 20.6 million tons of pig iron and hot metal, 11.0 million tons of home and purchased scrap, and 234,000 tons of slag scrap. Blast furnaces consumed 947,000 tons of home and purchased scrap, 193,000 tons of slag scrap, and 60,000 tons of pig iron and hot metal.

Agglomerates consumed in blast furnaces totaled 20.5 million tons, of which 66 percent was United States sinter (regular), 18 percent iron ore pellets (regular), and the remaining 16 percent semi-and-self-fluxing sinter, foreign iron ore, and other agglomerates. Agglomerates consumed in steel furnaces totaled 723,600 tons, of which most were U.S. sinter (regular) and iron ore pellets (regular). Slag produced at blast furnaces totaled 7.2 million tons, scrap produced 165,000 tons, and flue dust recovered 993,000 tons.

Nine companies operated 20 plants, the same number as in 1964. Fifty-four blast furnaces were operated at sometime during the year, compared with 58 blast furnaces in 1964.

According to the American Iron and Steel Institute, steel production (ingots and steel for castings) totaled 32.0 million tons, a 5-percent increase over that of 1964. Of the total steel production, 24.2 million tons were from open hearth and bessemer, 4.7 million tons from basic oxygen process, and 3.1 million tons from electric furnaces. Production of hot-rolled steel products totaled 23.8 million tons; merchant bars and light shapes, 3.0 million tons; concrete reinforcing bars, 853,000 tons; wire rods, 912,000 tons; and blanks, tube rounds, or pierced billets for seamless tubing, 1.8 million tons.

Smelters.—Zinc concentrates were shipped to smelters at Josephtown in Beaver County and at Palmerton in Carbon County. Zinc concentrates shipped to the Josephtown smelter came from New York, Missouri, Alabama, Peru, Argentina, and Canada. Zinc concentrates and crude ore shipped to the Palmerton smelter came from Pennsylvania, New Jersey, Virginia, Tennessee, Indiana, Colorado, and various suppliers of foreign origin zinc ores. Products from the Josephtown smelter included zinc metal, lead-free zinc oxide, cadmium metal, and sulfuric acid, which were used in such consumer items as galvanized ware, die castings and brass in the case of zinc; paint, rubber, ceramics, and pharmaceuticals in the case of zinc oxide; and protective coatings, bearings, and atomic uses in the case of cadmium. Products from the Palmerton smelter include slab zinc, zinc base die casting alloys, zinc oxide, rolled zinc, dry-battery shells, cadmium, and spiegeleisen.

The Josephtown smelter established a new production record for the second consecutive year, producing 202,657 tons of zinc metal equivalent for the year, compared with 193,444 tons in 1964.

Zinc.—Production of zinc ore (based on the recoverable zinc metal tonnage and value as metal established after transportation, smelting, and manufacturing charges have been added to the value of the ore at the mine) decreased 10 percent in tonnage and 4 percent in value from that of 1964. The zinc ore was concentrated at the mine in Lehigh County and the concentrates were shipped to the company's smelter in Carbon County.

REVIEW BY COUNTIES

Adams.—Crushed limestone was produced for blast-and-open heartlh furnace flux, concrete aggregate, roadstone, railroad ballast, and agricultural purposes by Bethlehem Mines Corp. near Hanover. Gettysburg Limestone Products, Inc., near Fairfield, and Teeter Stone, Inc., near Gettysburg, produced limestone for concrete aggregate and roadstone. The Ruberoid Co. produced crushed basalt at its Greenstone quarry and quartzite at its Greystone quarry, principally for roofing granules near Charmain. The Bethlehem Steel Corp. plans to build a second 600-ton-per-day lime plant to serve its oxygen steelmaking furnaces. The new installation will be lo-

cated at the Hanover limestone quarry. Its output will be shipped by rail to steelmaking plants. The new plant will handle approximately 1,200 tons of limestone a day. Alwine Brick Co. mined miscellaneous clay at New Oxford for manufacturing building brick. Sericite schist was produced at two open pit mines near Mt. Hope and Bendersville by Summit Industries, Inc. The crude material was trucked to the company mill at Aspers. After grinding, the material was shipped for consumption as asphalt filler, insecticides, and joint cement.

Alegheny.—Bituminous coal was produced at 35 operations; 14 underground, 19 strip, and 2 auger. Production totaled 5.0 million tons, a 3-percent increase over that of 1964. Underground production totaled 3.9 million tons, 3.3 million tons of which was not sold on the open market. Of the 14 underground operations, 10 loaded coal mechanically; 17 continuous miners with 14 mobile loaders produced 3.2 million tons, 18 mobile loaders produced 0.73 million tons, and 2 duckbills produced 6,000 tons. Fifteen cutting machines cut 0.75 million tons. Strip mines reported 25 power shovels, 9 draglines, 22 bulldozers, 12 power drills, and 32 trucks. Auger mines reported two augers, three power shovels, two bulldozers, two power drills, and three trucks. Five preparation plants prepared 3.8 million tons of clean coal, 3.1 million tons of which was mined underground. Coal crushed totaled 3.6 million tons and coal treated totaled 2.1 million tons.

Portland and masonry cements were produced by Universal Atlas Cement Division, United States Steel Corp., at Universal, and by Green Bag Cement Co., Division of Marquette Cement Manufacturing Co., near Pittsburgh. Most of the portland cement produced was of the general use and moderate heat type, but some high-early-strength type was also produced. Portland cement output was almost evenly divided between air-entrained and non-air-entrained. Some slag was used to produce portland slag. Most of the portland cement was shipped in bulk by truck in western Pennsylvania. Primary customers were ready-mixed concrete companies. A new 12,000-barrel bulk cement distribution station was built at Creighton by the Columbia Cement Corp., a subsidiary of the Pittsburgh Plate Glass Co. The Marquette Cement Co. instituted a rebuilding program at its Neville Island plant near Pittsburgh. Along with an annual clinker production capacity of more than 1.7 million barrels, about twice that of the old plant, the new plant incorporates maximum feasible automation and impressive physical features that far transcend the capabilities of its predecessor in terms of efficiency and output.[2]

Shale was produced by Milliken Brick Co., Inc., near Wilkinsburg for manufacturing Building bricks at its Wilkinsburg and Pitcairn plants. Clay was produced by Glassmre Brick and Tile Co. near Creighton for manufacturing bricks. Sand and gravel for paving purposes and fill and industrial sand for molding uses was produced by McCrady, Inc., near Harmarville. Burrell Construction and Supply Co. produced sand for paving purposes near Natrona Heights. Sidwell Loam Sand Co. produced molding sand near Pittsburgh. Dimension sandstone for construction purposes was produced by Malli Mines in Jefferson Borough. The Allegheny Ludlum Steel Corp. purchased all surface properties of Pennsalt Chemicals Corp. in January, and continued the recovery of crude red iron oxide pigments from the red mud residue resulting from the extraction of alumina from bauxite at Natrona. Expanded perlite, mainly for use in lightweight plaster and concrete, was produced by Panacalite Perlite Co., Pittsburgh; and Perlite Manufacturing Co., Carnegie. Clover Chemical Co. reported an increase in the production of organic and inorganic iodine compounds from out-of-State crude iodine at a plant near Pittsburgh.

Armstrong.—Bituminous coal was produced at 92 operations; 42 underground, 39 strip, and 11 auger. Production totaled 4.8 million tons, an 11-percent increase over that of 1964; 3.3 million tons from underground, 1.4 million tons from strip, and 0.1 million tons from auger. Most of the production, 4.5 million tons, was sold in the open market for an average price of $3.98 per ton. Of the underground production, almost all of the tonnage was loaded mechanically by 16 continuous miners and 37 mobile loaders at 26 operations. Fifty-five cutting machines cut 2.3 million tons. Strip mines had 54 power shovels, 19 draglines,

[2] Pit and Quarry. V. 58, No. 1, July 1965, pp. 168–183.

Table 10.—Value of mineral production in Pennsylvania by counties [1]

County	1964	1965	Minerals produced in 1965 in order of value [2]
Adams	W	W	Stone, sericite schist, clays.
Allegheny [3]	$27,192,462	$28,042,471	Coal, cement, clays, sand and gravel, stone, iron ore (pigment material).
Armstrong	21,465,940	22,687,658	Coal, clays, sand and gravel, lime.
Beaver	3,784,588	4,449,172	Sand and gravel, coal, clays.
Bedford	W	W	Stone, coal, sand and gravel, lime.
Berks	W	W	Iron ore, cement, stone, clays, coal, cobalt, pyrites.
Blair	1,924,474	2,180,478	Stone, clays, coal, sand and gravel.
Bradford	341,185	389,510	Sand and gravel, coal.
Bucks	W	W	Sand and gravel, stone, clays.
Butler [4]	9,445,729	11,218,902	Coal, cement, stone, lime, sand and gravel.
Cambria	48,488,015	51,336,952	Coal, clays, sand and gravel, stone, iron ore (pigment material).
Cameron	W	W	Coal.
Carbon	5,906,595	4,624,670	Coal, stone, sand and gravel.
Centre	W	W	Lime, stone, coal, clays.
Chester [5]	5,194,718	5,791,473	Stone, lime, clays.
Clarion	12,329,169	12,993,341	Coal, stone, sand and gravel, clays.
Clearfield	W	29,679,981	Coal, clays, sand and gravel, stone.
Clinton	W	W	Coal, stone, clays.
Columbia	W	W	Coal, sand and gravel, lime, clays, peat, stone.
Crawford	108,000	308,000	Sand and gravel.
Cumberland	W	W	Stone, sand and gravel, clays.
Dauphin	W	3,591,208	Stone, coal, clays, sand and gravel.
Delaware	W	W	Stone.
Elk	W	W	Coal, stone.
Erie	W	W	Sand and gravel, peat.
Fayette	12,824,818	10,640,146	Coal, clays, stone, sand and gravel.
Forest	W	W	Sand and gravel.
Franklin	1,534,184	1,402,981	Stone, sand and gravel.
Fulton	W	W	Do.
Greene	71,621,786	W	Coal, clays.
Huntingdon	W	5,578,588	Sand and gravel, stone, coal, clays.
Indiana	W	W	Coal, clays.
Jefferson	W	8,400,759	Coal, clays, stone.
Juniata	W	W	Stone, lime.
Lackawanna	W	W	Coal, sand and gravel, peat.
Lancaster	6,856,245	7,926,777	Stone, coal, clays, sand and gravel, lime.
Lawrence	[3] 7,792,359	W	Cement, stone, coal, clays, sand and gravel, peat.
Lebanon	W	22,776,493	Iron ore, copper, stone, lime, cobalt, coal, pyrites, gold and silver.
Lehigh	[6] 26,997,146	[3] 10,824,551	Cement, zinc, stone.
Luzerne	58,439,697	W	Coal, sand and gravel, stone, peat, clays.
Lycoming	W	2,083,702	Stone, sand and gravel, coal, tripoli.
McKean	W	392,657	Clays, stone, coal, sand and gravel.
Mercer	W	W	Coal, sand and gravel, stone.
Mifflin	W	W	Sand and gravel, stone, lime.
Monroe	535,407	655,616	Stone, sand and gravel, clays, peat.
Montgomery	[4] 7,787,028	W	Stone, cement, lime, clays, sand and gravel.
Montour	W	W	Stone, sand and gravel.
Northampton	62,486,684	60,458,181	Cement, stone, sand and gravel.
Northumberland	W	12,458,825	Coal, clays, stone, lime.
Perry	W	W	Stone.
Philadelphia	W	W	Sand and gravel.
Potter	W	W	Stone.
Schuylkill	W	43,796,225	Coal, stone, sand and gravel, clays.
Snyder	431,676	455,499	Stone, sand and gravel, coal, lime.
Somerset	15,682,072	18,054,987	Coal, clays, stone, sand and gravel.
Sullivan	82,377	127,095	Coal.
Susquehanna	745,587	927,083	Stone, coal.
Tioga	1,603,429	1,764,081	Coal, sand and gravel, stone.
Union	W	W	Stone.
Venango	W	W	Coal, sand and gravel.
Warren	412,000	470,000	Sand and gravel.
Washington	W	W	Coal, stone.
Wayne	W	713,085	Stone, sand and gravel, peat.
Westmoreland	W	W	Coal, sand and gravel, stone, lime.

See footnotes at end of table.

Table 10.—Value of mineral production in Pennsylvania by counties [1]—Continued

County	1964	1965	Minerals produced in 1965 in order of value [2]
Wyoming	$593,267	$758,817	Sand and gravel, stone.
York [4]	7,421,637	7,986,401	Cement, stone, lime, clays, sand and gravel, mica.
Undistributed [7]	482,021,681	517,876,635	
Total	902,050,000	913,823,000	

W Withheld to avoid disclosing company confidential data.
[1] Pike County is not listed because no production was reported.
[2] Excludes value of natural gas, natural gasoline, LP gases, petroleum, and gem stones unspecified by counties; included with "Undistributed."
[3] Excludes cement; included with "Undistributed."
[4] Excludes cement and lime; included with "Undistributed."
[5] Excludes lime; included with "Undistributed."
[6] Excludes masonry cement; included with "Undistributed."
[7] Includes values indicated by symbol W.

55 bulldozers, 2 carry-all scrapers, 10 power drills, and 121 trucks. Auger mines reported 12 augers, 6 bulldozers, 1 power drill, and 10 trucks. Seven preparation plants prepared 2.5 million tons of coal, most of which was produced from underground mines. Coal crushed totaled 1.9 million tons, and coal treated totaled 0.12 million tons.

Eight clay companies operated six underground and two opencut mines. Freeport Brick Co., operating an underground mine near Freeport, was the leading producer, followed by Howmet Corp. with an underground mine near Kittanning. Output of clay increased 18 percent over that of 1964, and most of it was used for firebrick and block. Sand and gravel produced at four operations was primarily used for building and paving purposes. Output increased 52 percent over that of 1964. The leading producers were Glacial Sand and Gravel Co. near Tarrtown and Manorville Sand Co. near Manorville. Output of crushed limestone increased considerably from last year and was chiefly used for concrete aggregate and roadstone. Of the five producers, Manor Minerals, Inc., near Kittanning reported the largest output, followed by Black Limestone Co. near West Franklin, and Mowry & Good near McWilliams in West Franklin Township. Black Limestone Co. reported production for the first time. C. D. McCanna reported hydrated agricultural lime production at a plant near Kittanning.

Beaver.—Building activity continued the upward trend as was apparent in the large increase in building sand and gravel, which accounted for almost four-fifths of the sand and gravel output. Most of the balance was consumed as paving aggregate. Of the six sand and gravel operations, Shippingport Sand & Gravel Co. at Georgetown and Shippingport, and Dravo Corp., Keystone Division at Vanport, were the leading producers. Four clay pits and three underground clay mines produced mostly fire clay for building brick manufacture. Leading producers were Standard Clay Manufacturing Co. at New Brighton and Colonial Clay Products Co. at Fallston.

Bituminous coal was produced at 18 operations; 2 underground, 14 strip, and 2 auger. Production totaled 424,000 tons, a 14-percent decrease from that of 1964. Strip mines accounted for 71 percent of the production with 20 power shovels, 10 draglines, 19 bulldozers, 2 power drills, and 23 trucks. Underground operations reported one mobile loader loading into shuttle cars, two hand-loaded face conveyors, and three cutting machines. Auger mines reported the use of two augers, one bulldozer, and five trucks. No preparation plants were reported in operation but 3,300 tons was crushed at loading tipples.

Bedford.—Crushed limestone and sandstone output decreased from that of 1964, but increased 5 percent in value, owing principally to the increase in the average value per ton of crushed sandstone. The Detwilers Industries, Inc., produced crushed sandstone for concrete aggregate and roadstone near New Enterprise. New Enterprise Stone & Lime Co. produced crushed limestone for concrete aggregate, coal mine rock dust, and hydrated lime at

its Ashcom quarry near Everett. Bituminous coal was produced at 12 operations, 9 underground and 3 strip. Production totaled 317,000 tons, 11-percent more than in 1964. All the underground production was shipped by truck and all was sold on the open market for an average value of $3.17 a ton; one continuous miner and three hand-loaded face conveyors loaded coal mechanically, one cutting machine was in operation, and 22,800 tons was shot from the solid or cut by hand. Strip mines reported four power shovels, two draglines, three bulldozers, two power drills, and seven trucks. No preparation plants were reported in operation but some coal was crushed at loading tipples.

Berks.—Bethlehem Mines Corp. mined crude magnetite at its Grace mine near Morgantown. A concentrating plant at the mine processed the iron ore by crushing and grinding and magnetically separating and pelletizing the fine-sized material. Pyrites (containing cobalt and copper) recovered by flotation were shipped to the company's plant at Sparrows Point, Md. for processing. Allentown Portland Cement Co. produced portland and masonry cements, most of which was non-air-entrained, general use and moderate-heat-type portland cement. Stone output increased 4 percent over that of 1964. Crushed limestone was the principal type of stone produced and accounted for more than 70 percent of the total stone output, followed by crushed basalt and sandstone. Allentown Portland Cement Co. with quarries near Evansville and Oley produced crushed limestone and cement rock for cement manufacture. Other large crushed limestone producers included Eastern Industries, Inc., with quarries at Kutztown and Oley; Berks Products Co. at South Temple; and E. J. Breneman, Inc., at Sinking Spring. Crushed basalt was produced by The John T. Dyer Quarry Co. at Birdsboro; Bradford Hills Quarry, Inc., at Morgantown; and Pottstown Trap Rock Quarries at Douglassville, mostly for concrete aggregate, roadstone, and railroad ballast. Glen-Gery Shale Brick Corp. reported a slight increase in their production of shale at opencut mines near Shoemakersville and Wyomissing for the manufacture of building brick. Anthracite production was reported at a lower rate than that of 1964.

Blair.—Stone output increased 17 percent over that of 1964 owing chiefly to the increased demand for crushed limestone, concrete aggregate, and roadstone. Eight companies operated nine limestone quarries near Roaring Spring, Canoe Creek, Tyrone, Hollidaysburg, Altoona, Claysburg, Royer, and Duncansville. Quartzite was crushed for ganister (silica brick) near Hollidaysburg and Sproul, and for railroad ballast near Williamsburg. Plastic fire clay and kaolin were produced at separate operations near Williamsburg for use in making firebrick and block. Sand for building purposes was produced by Frankstown Sand Supply, near Frankstown. West Virginia Pulp & Paper Co. produced regenerated quicklime in secondary recovery operations for use in the manufacture of paper at its Tyrone plant. Bituminous coal was produced at only two small underground operations compared to four underground and one strip operation in 1964. Production totaled 5,500 tons, all shot from the solid or cut by hand.

Bradford.—Sand and gravel was produced at two operations near Towanda; State Aggregates, Inc., and Towanda Sand & Gravel Co., Inc. Most of the output was used for paving purposes, but some was also used for building, fill, ready-mixed concrete, and antiskid highway protection. Bituminous coal was produced at only one strip mine on Sand Run.

Bucks.—The county continued to be the leading sand and gravel producing area with operations near Tullytown, Upper Black Eddy, New Hope, and Levittown. Most of the production was used for building and paving purposes. A. L. Lewis, Inc., is building a new modern sand and gravel preparation plant near Uhlerstown. Limestone was the leading type of stone produced, followed by miscellaneous stone, basalt, and sandstone. Total stone output was slightly higher than that of 1964. Eureka Stone Quarry, Inc., near Eureka, was the leading limestone producer with all of its output used for concrete aggregate and roadstone. Miscellaneous stone (argillite) was quarried by Better Material Corp., near Penns Park and Gill Quarries, Inc., near Trevose, for use in concrete aggregate and roadstone.

Seven basalt quarries were in operation. The largest operations were The General Crushed Stone Co. near Quakertown;

Tohickon Quarry Co. near Weisel; and Bucks County Crushed Stone, Inc., near Ottsville. Virtually all of the output was used for concrete aggregate and roadstone. Crushed bluestone was produced at Wiley's quarry near Point Pleasant and used for concrete aggregate and roadstone. Dimension sandstone was produced at a quarry along the Delaware River near Lumberville. Quakertown Brick & Tile Co., Inc., mined shale near Quakertown for manufacturing building brick. Hyzer & Lewellen produced exfoliated vermiculite at Southampton for use in home insulation, lightweight aggregate, and miscellaneous items.

Butler.—Bituminous coal was produced at 69 operations; 12 underground, 45 strip, and 12 auger. Production totaled 2.2 million tons, a 22-percent increase over that of 1964. Underground production totaled 453,000 tons, and averaged $4.08 per ton in value, cut by 21 cutting machines, and 87 percent mechanically loaded by 5 mobile loaders and 3 hand-loaded face conveyors. Strip mines produced 1.6 million tons with 51 power shovels, 37 draglines, 3 carry-all scrapers, 67 bulldozers, 27 power drills, and 127 trucks, and averaged $3.58 per ton in value. Auger production totaled 177,000 tons with 16 augers, 2 power shovels, 7 bulldozers, and 16 trucks at an average of $3.67 per ton in value. Five preparation plants prepared 441,000 tons of clean coal. Fifteen mine tipples crushed 1.1 million tons, and two plants treated 55,000 tons with calcium chloride and oil.

The Penn-Dixie Cement Corp. utilized limestone, cement rock, and sand produced from their own operations at West Winfield for manufacturing portland and masonry cements. Most of the portland cement was of the general use and moderate-heat-type but some high-early-strength was also produced, both air-entrained and non-air-entrained. Cement was shipped principally in bulk by truck, chiefly in the western Pennsylvania area. Output of limestone increased 15 percent over that of 1964. Most of the production was used for concrete aggregate and roadstone, with a sizable amount also used for cement manufacture. The largest producers were the Penn-Dixie Cement Corp. at West Winfield and Allegheny Mineral Corp. near Harrisville. Dimension sandstone for architectural work was produced near Boyers. Mercer Lime & Stone Co. produced mostly quicklime near Branchton for consumption in steel furnaces. Output of sand and gravel decreased 32 percent from that of 1964. Building and paving sand and gravel was the greatest quantity produced near Slippery Rock, with a small amount of sand produced by Penn-Dixie Cement Corp. for their cement operation at West Winfield.

Cambria.—Bituminous coal was produced at 97 operations; 75 underground, 20 strip, and 2 auger. Production totaled 8.9 million tons, a 2-percent increase over that of 1964. Underground mines produced 7.9 million tons, 7.8 million tons of which was loaded mechanically at 32 mines with 91 continuous miners, 17 mobile loaders (of which 4 were used with continuous miners), and 29 hand-loaded face conveyors. Seventy-four cutting machines cut 1.0 million tons. Strip mines reported 33 power shovels, 15 draglines, 34 bulldozers, 11 power drills, and 59 trucks. Auger mines reported three augers, one bulldozer, and two trucks. Eleven preparation plants prepared 6.8 million tons of clean coal, most of which was mined underground. Twenty-three mine tipples crushed 5.1 million tons, and eight plants treated 319,000 tons.

Plastic fire clay was used to manufacture firebrick and block by Harbison-Walker Refractories Co. near Blandburg. Triangle Clay Products Co. produced miscellaneous clay for building brick near Johnstown. Flint fire clay was mined by the Buck Hill Coal Co. near Patton for the manufacture of vitrified sewer pipe. Sand and stone gravel was crushed from a standstone deposit near Menoker Heights, south of Johnstown, for building and fill purposes. Crushed sandstone was produced by Samuel Nicosia near Johnstown for the manufacture of silica brick and for concrete aggregate and roadstone. Lanzendorfer Minerals Co. produced sulfur mud for yellow iron oxide pigments at an operation near Twin Rocks.

Cameron.—Bituminous coal was produced at one strip mine near Sterling Run having one power shovel, one dragline, one bulldozer, and two trucks.

Carbon.—Anthracite production continued its downward trend as it decreased 17 percent in tonnage and 24 percent in value from that of 1964. North American Refractories Co. produced crushed quartzite at its Little Gap quarry near Palmerton

for silica brick. Fauzio Bros. produced crushed sandstone at its Red Rock quarry near Nesquehoning for concrete aggregate and roadstone. Sand for building and paving purposes and for cement manufacture was produced by the Alliance Sand Co., Division of Martin Marietta Corp. at a stationary plant near Palmerton. Building sand and gravel was produced by Wagner Sand Co. near Weatherly. Production of finished natural black, brown, red, and yellow pigments, and manufactured brown and red pigments was reported by The Prince Manufacturing Co. near Bowmanstown.

Centre.—The county continued as the leading lime-producing area. Most of the production was high-calcium quicklime for chemical and other industrial uses, chiefly for steel furnaces and paper and pulp mills. Producers were Warner Co. and National Gypsum Co. near Bellefonte, and Standard Lime & Refractories Co., Division of Martin Marietta Corp. near Pleasant Gap. Smaller quantities of hydrated lime for construction, agriculture, chemical, and other industrial purposes was also produced. Crushed limestone was produced and used in lime manufacture by the companies already mentioned. A significant amount was also produced and used for concrete aggregate and roadstone by Appalachian Stone Division, Martin Marietta Corp. near Pleasant Gap, Neidigh Bros. Limestone Co., Inc., near State College, Nittany Materials, Inc., in Marion Township, and Black Hawk Quarries near Centre Hall. Harbison-Walker Refractories Co. produced plastic fire clay near Stormstown for manufacturing firebrick and block.

Bituminous coal was produced at 23 operations; 8 underground, 13 strip, and 2 auger. Production totaled 622,000 tons, a 3-percent increase over that of 1964. Strip mines accounted for 84 percent of the total tonnage and reported 20 power shovels, 10 draglines, 16 bulldozers, 10 power drills, and 50 trucks. Three of the eight underground operations loaded coal mechanically with one mobile loader and two hand-loaded face conveyors. Seven cutting machines were also in use. Auger mines reported three augers and four trucks in use. Two preparation plants prepared 274,000 tons of clean coal, most of which came from strip mines. Four mine tipples reported 343,000 tons crushed and one tipple treated a small amount of coal with oil.

Chester.—Most of the stone production was crushed limestone for concrete aggregate and roadstone, but some was also used for blast furnace flux, lime manufacture, and magnesium metal manufacture. Producers included Bradford Hills Quary, Inc., near Downington, and Appalachian Stone Division, Martin Marietta Corp., near Malvern. Crushed basalt, chiefly for concrete aggregate and roadstone, was reported by V. Di Francesco & Sons near Devault and Keystone Trappe Rock Co. near Glen Moore. Dimension basalt, rough and dressed, for building stone and flagging was produced by French Creek Granite Co. near St. Peters. Operations in Avendale, Malvern, and New Garden Township reported production of dimension sandstone for construction, curbing, and flagging purposes. Warner Co. produced high-magnesium lime at its Cedar Hollow plant near Devault, mostly for sewage and tradewastes treatment. McAvoy Vitrified Brick Co. continued to mine miscellaneous clay and shale near Phoenixville for building brick manufacture.

Clarion.—Bituminous coal was produced at 81 operations; 7 underground, 70 strip, and 4 auger. Production totaled 3.2 million tons, a 2-percent increase over that of 1964. Strip mines accounted for 3.1 million tons and reported 61 power shovels, 34 draglines, 53 bulldozers, 14 power drills, and 109 trucks. Four of the seven underground mines loaded coal mechanically with two continuous miners loading onto conveyors and two hand-loaded face conveyors. Five cutting machines cut 13,000 tons. Auger mines reported four augers, three bulldozers, one drill, and four trucks. Six preparation plants prepared 2.4 million tons of clean coal, 2.3 million tons of which was strip coal. Ten mine tipples crushed 2.8 million tons of coal, and three plants treated 135,000 tons with calcium chloride or oil. Production of crushed limestone for concrete aggregate and roadstone near Parker and Turkey City increased considerably from last year. Some crushed limestone for cement manufacture and agricultural purposes was also produced at the Parker operation.

Sand and gravel, mostly for paving purposes, was reported by Glacial Sand & Gravel Co. from a stationary plant near Parker. Plastic and flint fire clay was mined underground by the Climax Division of A. P. Green Fire Brick Co. near Climax for its own use in producing firebrick and block. Plastic fire clay was produced from several strip pits near Corsica by W. P. Stahlman Coal Co., Inc., for the manufacture of clay crucibles. Shale was produced by New Bethlehem Tile Co. near New Bethlehem for the manufacture of building brick and other heavy clay products. Frank P. Pope Co. near New Bethlehem produced plastic fire clay for refractory mortar.

Clearfield.—Bituminous coal was produced at 143 oprations; 51 underground, 83 strip, and 9 auger. Production totaled 7.0 million tons, a 4-percent decrease from that of 1964. Strip mines accounted for 5.8 million tons and reported 149 power shovels, 89 draglines, 143 bulldozers, 59 power drills, and 339 trucks. Of the 51 underground mines, 20 loaded 863,000 tons of coal mechanically with 9 continuous miners, 4 mobile loaders, 1 duckbill, and 31 hand-loaded face conveyors. Sixty-six cutting machines cut 558,000 tons. Auger mines reported 10 augers, 1 power shovel, 3 bulldozers, 5 power drills, and 15 trucks. Ten preparation plants prepared 3.2 million tons of clean coal, 1.9 million tons of which was strip coal and 1.2 million tons was underground coal; thirty-four mine tipples crushed 3.6 million tons and seven plants treated 31,000 tons with oil or calcium chloride.

The Harbison-Walker Refractories Co. consumed both purchased fire clay and fire clay of its own production from their various mines throughout the county mostly for manufacturing firebrick and block. Other major reporting companies were Falls Creek Refractories Co., Blair Clay Products, Inc., and Clearfield Clay Products Co., all near Curwensville; Williamsgrove Clay Products Co. near Bigler; and Bartell Excavating, Inc., and Hiram Swank's Sons, Inc., both near Boardman. Almost all of the clay mined in the county was fire clay, most of which was for firebrick and block. Gravel produced near Curwensville and crushed limestone quarried near Clearfield by Appalachian Stone Division, Martin Marietta Corp., was used as fill for dam construction.

Clinton.—Bituminous coal was produced at nine operations, one underground and eight strip. Production totaled 555,000 tons, a 15-percent increase over that of 1964. Strip mines accounted for most of the tonnage and reported 10 power shovels, 4 draglines, 11 bulldozers, 3 power drills, and 29 trucks. The underground operation reported a small tonnage shot from the solid or cut by hand. One preparation plant using heavy media equipment was in operation. One tipple reported crushed coal tonnage and a small amount of coal treated with oil. Crushed limestone for concrete aggregate and roadstone was reported by Lycoming Silica Sand Co. from their Salona quarry. Flint block and nodular clay was produced by F. E. Fink and R. H. Stackhouse at a strip mine near Farrandsville, trucked to Monument for firing, and then trucked to various customers for use as mortars, castable mixes, and high alumina brick. Shale was produced by Mill Hall Clay Products, Inc., near Castanea for the manufacture of heavy clay products. Flint clay was produced by R. C. Gillen & Son near Lock Haven for high alumina brick and foundries, and by Peter M. Evock near Renovo for firebrick and block.

Columbia.—Anthracite production decreased approximately 26 percent in tonnage and 28 percent in value from that of 1964. Sand and gravel for building purposes was produced by Bloomsburg Sand & Gravel Co., Inc., and was processed at a stationary plant near Bloomsburg. A. Barletta & Sons produced sand and gravel near Mifflinville for paving purposes. Baker Stone Co. produced crushed limestone near Bloomsburg for the manufacture of quicklime and a small amount of hydrated lime for agricultural purposes. Shale was produced for manufacturing building brick by The Alliance Clay Product Co. near Mifflinville. Benton Peat, Inc., produced moss and humus peat for general soil improvement from a bog near Benton.

Crawford.—Increased demand for sand and gravel for paving purposes by local townships and Pennsylvania Department of Highways was atrributed to an output more than double that of 1964. Sand and gravel producers were W. L. Dunn, Cochranton; Conneaut Lake Sand & Gravel,

Inc., Conneaut Lake; and Hasbrouck Sand & Gravel, Titusville.

Cumberland.—Improved construction activity was reflected by an incrase in crushed limestone production, chiefly for concrete aggregate and roadstone. Major producers of limestone were Hempt Brothers, Inc., with quarries near Camp Hill and Harrisburg, and Valley Quarries, Inc., near Shippensburg. Three companies reported sand and gravel production for building and paving purposes, two companies near Mt. Holly Springs, and one near Walnut Bottom. Philadelphia Clay Co., Mt. Holly Springs, reported kaolin production for portland and other hydraulic cement manufacture. Penn Products Corp., Boiling Springs, mined fire clay for use in floor and wall tile.

Dauphin.—Crushed limestone for hearth furnace flux, concrete aggregate, roadstone, and some quicklime was produced by H. E. Millard Lime & Stone Co., near Palmyra. Crushed limestone for concrete aggregate and roadstone was also produced by Hempt Bros., Inc., near Steelton and George E. Ebersole & Sons near Hummelstown. Basalt trap rock was quarried and crushed for concrete aggregate and roadstone by Faylor Lime & Stone Co. near Elizabethville. Anthracite production decreased 25 percent from that of 1964. The Glen Gery Shale Brick Corp., mined shale near Harrisburg and Middletown for manufacturing building brick. Sand and gravel was produced by Pennsy Supply, Inc., near Duncannon for building and paving purposes.

Delaware.—The General Crushed Stone Co. near Glen Mills and V. Di Francesco & Sons near Havertown quarried crushed basalt for concrete aggregate and roadstone. Dimension sandstone for construction work was produced by Media Quarry Co. near Media. Miscellaneous dimension stone was produced near Marple, Broomall, and in Springfield Township. Dimension granite was produced near Swarthmore and Lima. Perlite Products Co. expanded perlite at its Primos plant chiefly for use in building plaster. Sinclair refining Co. and the Sun Oil Co. recovered sulfur in the liquid purification of oil refinery gas at Marcus Hook.

Elk.—Bituminous coal was produced at 24 operations; 12 underground, 8 strip, and 4 auger. Production totaled 516,000 tons, a 17-percent increase over that of 1964. Strip mines accounted for 332,000 tons and reported 16 power shovels, 4 draglines, 16 bulldozers, 3 power drills, and 20 trucks. Of the 12 underground mines, 6 loaded 93,000 tons mechanically with 2 mobile loaders, and 8 hand-loaded face conveyors. Fifteen cutting machines cut 112,000 tons. Auger mines reported four augers, one power shovel, three bulldozers, and seven trucks. No preparation plants were reported in operation, but two mine tipples crushed 177,000 tons of coal. Crushed quartzite for concrete aggregate and roadstone was produced by Clark Construction Co. near Johnsonburg. Artificial graphite was produced by Speer Carbon Co., a division of Air Reduction Co., Inc., at a plant near St. Mary's.

Erie.—Production of sand and gravel increased 17 percent in tonnage over that of 1964. Erie Sand Steamship Co. at Erie produced large tonnages of sand for building purposes. Nickel Plate Sand & Gravel Co. near Fairview produced sand and gravel for building and paving purposes and antiskid uses. Clark Construction Supply Co., Inc., near Erie produced sand and gravel mostly for ready-mixed concrete. A. Duchini, Inc., produced unprocessed gravel for fill near Erie. Peerless Mineral Products Co. produced industrial sand near Springfield for foundry uses. Corry Peat Products Co. produced mostly reed-sedge peat for general soil improvement near Corry.

Fayette.—Bituminous coal was produced at 49 operations; 24 underground, 24 strip, and 1 auger. Production totaled 1.2 million tons, a 34-percent decrease from that of 1964. Five of the 24 underground mines loaded 681,000 tons of coal mechanically with 9 continuous miners and 7 mobile loaders (of which 5 were used with continuous miners). Strip mines accounted for 436,000 tons and reported 23 power shovels, 5 draglines, 17 bulldozers, 9 power drills, and 20 trucks. Auger mines reported one auger, one power shovel, two bulldozers, one power drill, and two trucks. Four preparation plants prepared 5.7 million tons of clean coal, mostly from under ground mines in Greene and Washington

Counties. Four mine tipples crushed 885,000 tons.

Crushed sandstone (bluestone) was produced by the Connellsville Blue Stone Co. near Connellsville for concrete aggregate and roadstone. General Refractories produced crushed quartzite for silica brick near Layton. Crushed limestone was produced by the Appalachian Stone Division of Martin Marietta Corp. for concrete aggregate and roadstone from its Lake Lynn and Uniontown operations. Their Lake Lynn operation was recognized for its outstanding safety record in 1965.

Plastic and flint fire clay was produced by Kaiser Refractories, Division of Kaiser Aluminum & Chemical Corp., Near Ohiopyle and Robert H. Mathews near Uniontown for firebrick and block. Harbison-Walker Refractories Co. produced flint fire clay near Ohiopyle for firebrick and block. Miscellaneous clay was produced by Layton Fire Clay Co. near Layton for building brick. Sand and gravel for building and paving purposes was produced by McClain Sand Co., Inc., near Point Marion.

Forest.—Tionesta Sand and Gravel, Inc., produced processed sand and gravel for building and paving purposes at a stationary plant near Tionesta.

Franklin.—Crushed limestone chiefly for concrete aggregate and roadstone uses was produced by Valley Quarries, Inc., near Chambersburg and Pinola; Appalachian Stone Division, Martin Marietta Corp. near Williamson and Zullinger; and New Enterprise Stone & Lime Co. near Dry Run. Some crushed limestone for agricultural purposes was also produced at Williamson, Pinola, and Dry Run. Dimension sandstone for construction work was produced by J. R. Zeek near Carstown. Processed sand for building purposes was produced by Mt. Cydonia Sand Co., Inc., near Fayetteville. Caledonia Sand Co. produced unprocessed sand for concrete products, blocks, and tanks, near Fayetteville.

Fulton.—Crushed limestone for concrete aggregate, roadstone, and agricultural purposes was produced by H. B. Mellott Estate, Inc., at their Morton quarry near Big Cove Tannery, and Charlton quarry near Warfordsburg. Sand was produced for paving purposes by H. B. Mellott Estate, Inc., at its operation near Warfordsburg.

Greene.—Bituminous coal was produced at 36 operations; 29 underground and 7 strip. Production totaled 12.3 million tons, a 7-percent increase over that of 1964. Most of the tonnage was from underground mines and not sold in the open market. Eighteen of the 29 underground mines loaded 12.2 million tons of coal mechanically with 87 continuous miners and 50 mobile loaders, (of which 42 were used with continuous miners). Fifteen cutting machines cut 156,000 tons. Strip mines reported eight power shovels, seven bulldozers, one power drill, and four trucks. Four preparation plants prepared 6.6 million tons of clean coal, all of which was mined underground. Five plants crushed 5.1 million tons and two plants treated 1.1 million tons with oil. The Robena No. 4 mine of the United States Steel Corp. has been awarded the "Sentinels of Safety" trophy for having attained the best safety record in the Underground Coal Group of the 1965 National Safety Competition.

Miscellaneous clay and shale was mined near Waynesburg for use in manufacturing building brick.

Huntingdon.—Industrial ground and unground sand was produced by Pennsylvania Glass Sand Corp., at its Keystone Works near Mapleton Depot. for a wide range of uses but mostly for glass. Crushed limestone for concret aggregate, roadstone, and agricultural purposes was produced by L. H. Parsons Stone & Lime Co. at its Shade Gap plant near Orbisonia. Crushed limestone was also produced near Union Furnace and McConnellstown. Harbison-Walker Refractories Co. near Mt. Union and the North American Refractories Co. near Three Springs produced crushed quartzite for silica brick.

Bituminous coal was produced at eight operations; five underground, two strip, and one auger. Production totaled 66,000 tons, a 3-percent decrease from that of 1964. Strip mines accounted for 55,000 tons and reported four power shovels, two draglines, three bulldozers, two power drills, and five trucks. Three of the five underground mines loaded 4,700 tons of coal mechanically with three hand-loaded face conveyors. The auger mine reported one auger. No preparation plants were reported in operation, but one mine tipple crushed and treated coal with oil. Plastic fire clay

was produced by Alexandria Fire Clay Co. from its opencut mine near Alexandria for sale to refractory mortar producers.

Indiana.—Bituminous coal was produced at 97 operations; 63 underground, 30 strip, and 4 auger. Production totaled 6.6 million tons, a 20-percent increase over that of 1964. Forty of the 63 underground mines loaded 5.7 million tons of coal mechanically with 67 continuous miners, 32 mobile loaders, (of which 9 were used with continuous miners), and 12 hand-loaded face conveyors. Fifty-five cutting machines cut 647,000 tons. Strip mines accounted for 746,000 tons and reported 36 power shovels, 12 draglines, 2 carryall scrapers, 32 bulldozers, 7 power drills, and 87 trucks. Auger mines reported four augers, three bulldozers, and four trucks. Sixteen preparation plants prepared 5.0 million tons of clean coal, all of which was produced underground. twenty-five mine tipples crushed 3.2 million tons and seven plants treated 689,000 tons with oil and other materials.

Plastic fire clay was produced by Hiram Swank's Sons, Inc., and L. H. Foehrenbach near Clymer for use in manufacturing a variety of clay refractory products.

Jefferson.—Bituminous coal was produced at 63 oprations; 22 underground, 36 strip, and 5 auger. Production totaled 1.8 million tons, a 3-percent decrease from that of 1964. Strip mines accounted for 1.0 million tons and reported 58 power shovels, 18 draglines, 47 bulldozers, 4 power drills, and 127 trucks. Fifteen of the 22 underground mines loaded 712,000 tons of coal mechanically with 9 continuous miners, 1 duckbill, and 18 hand-loaded face conveyors. Thirty-one cutting machines cut 170,000 tons. Auger mines reported six augers, one power shovel, four bulldozers, and seven trucks. Five preparation plants prepared 975,000 tons of clean coal, of which 725,000 tons was mined underground. Fifteen mine tipples crushed 760,000 tons and four plants treated 187,000 tons with calcium chloride.

Miscellaneous clay was produced at an underground and opencut mine near Brockway by the Brockway Clay Co. for the manufacture of vitrified sewer pipe. Plastic fire clay was produced by Hanley Co. at Summerville for the manufacture of building brick. Crushed limestone, chiefly for agricultural purposes, was produced by Sugar Hill Limestone Co. near Brockway.

Juniata.—Crushed limestone for concrete aggregate and roadstone was produced by Juniata Limestone Co. near McAllisterville. Crushed limestone was produced for the manufacture of quicklime used for agricultural purposes by Fulkroad Lime Quarry near McAllisterville.

Lackawanna.—Anthracite production was 705,000 tons, 216,000 tons less than that of 1964. Sand and gravel for building and paving purposes was produced by Contractors Sand & Gravel, Inc., near Moscow. Reed-sedge peat was produced by Lake Linda Peat Co., Inc., from a bog near Dalton.

Lancaster.—The county ranked second in the production of limestone in the State, with 3.6 million tons of crushed limestone, chiefly for concrete aggregate and roadstone. The largest producer was D. M. Stoltzfus & Son, with quarries near Talmage, Quarryville, and Cedar Hill. Other large limestone producers were Ivan M. Martin, Inc., near Blue Ball; Binkley and Ober, Inc.; near East Petersburg; Compass Quarries, Inc., near Gap; and A. G. Kurtz & Sons, Inc., near Denver.

Anthracite dredged from the Susquehanna River increased production slightly over that of 1964. Plastic fire clay was produced by Narvon Mines, Ltd., near Narvon for a variety of uses but mainly for a mineral filler. Miscellaneous clay and shale was produced by Glen Gery Shale Brick Corp. near Ephrata, Lancaster Brick Co., near Lancaster, and Roger Gerhart near Lititz for the manufacture of building brick.

Sand was produced by Milton Grove Sand, Inc., near Milton Grove for building and paving purposes. Sand was also produced near Brownstown and Honey Brook. Amos K. Stoltzfus produced agricultural quicklime near Elverson.

Lawrence.—Portland and masonry cements were produced by the Bessemer Cement Co., Division of Diamond Alkali Co. at Bessemer, and the Medusa Portland Cement Co. at Wampum. Most of the production was general use and moderate heat (air-entrained) portland cement, although both companies also produced high-early-strength cement. Most of the shipments were made in bulk by trucks to ready-

mixed concrete companies. Crushed limestone production totaled 3.3 million tons. The leading producer was United States Steel Corp., with a quarry near Hillsville, producing stone for blast furnace flux and cement manufacture. Besides the limestone produced by the two cement companies, mentioned above, crushed limestone was also produced by New Castle Lime & Stone Co. in Mahoning Township for concrete aggregate, roadstone, agricultural purposes, coal mine dust, and fillers.

Bituminous coal was produced at 24 operations; 1 underground, 21 strip, and 2 auger. Production totaled 906,000 tons, an 8-percent increase over that of 1964. Strip mines accounted for 884,000 tons and reported 21 power shovels, 20 draglines, 34 bulldozers, 10 power drills, and 42 trucks. The underground mine cut a small tonnage of coal with one cutting machine. Auger mines reported three augers and one bulldozer. Coal crushed at five mine tipples totaled 261,000 tons. Reed-sedge peat was recovered by D. M. Boyd Co. and Moore's Humus & Nursery from bogs near Leesburg. The Moore's Humus & Nursery was active until June 1, then sold to Welker Greenhouses of New Castle. Zonolite Div., W. R. Grace & Co., produced exfoliated vermiculite at its Ellwood City plant chiefly for use as loose-fill insulation.

Plastic fire clay was produced by Ralph A. Veon, Inc., and The Negley Fire Clay Co., both of Enon Valley; Jack Craig Coal & Clay Co., near Wampum; and McQuiston Coal Co., near Bessemer, mostly for the manufacture of building brick. Shale was produced by cement companies for use in portland cement and by Fenati Brick Co., Inc., near New Castle for the manufacture of building brick. The McQuiston Coal Co. also produced shale for the manufacture of building brick.

Increase of building in the area and State approval of material for road construction stimulated the sand and gravel industry in the county and accounted for the largest annual sand and gravel output on record. Mahoning Valley Sand Co. produced sand and gravel near West Pittsburg for building and paving purposes, fill, and antiskid uses. Superior Sand & Supply Co. near New Castle produced sand and gravel for building and paving purposes and gravel for fill. Mooney Bros, Supply Co. near New Castle produced sand for fill and gravel for drainage.

Lebanon.—Bethlehem Mines Corp. mined magnetite iron ore at Cornwall and processed the crude ore at its Cornwall concentrator. The magnetite was recovered by crushing, grinding, magnetic separation, and agglomeration. Valuable byproducts, recovered by flotation, included gold, silver, copper, pyrite, and cobalt. The No. 4 Cornwall mine of the company has been awarded the "Sentinels of Safety" trophy for having attained the best safety record in the Underground Metal Mine Group of the 1965 National Safety Competition for operating throughout the year without a disabling work injury. In addition to the trophy, the Bureau of Mines awarded Certificates of Accomplishment in Safety to each official and employee of the operation.

Production of crushed limestone slightly increased in 1965 over that of 1964. H. E. Millard Lime & Stone Co. produced crushed limestone mostly for its own quicklime and hydrated lime production near Annville, in addition to the stone sold for cement manufacture, agricultural purposes, and metallurgical flux for open hearth plants. Calcite Quarry Corp., produced crushed limestone near Lebanon, chiefly for concrete aggregate, roadstone, metallurgical flux, and cement manufacture. Fiala, Inc., near Annville produced crushed limestone for cement manufacture and metallurgical flux. Pennsylvania Aggregates, Inc., near Cornwall and Sheridan Slag Co. near Lebanon produced crushed limestone for concrete aggregate and roadstone. Dimension limestone was produced by Jonas E. Wenger near Myerstown. Anthracite production was slightly lower than that of 1964. The Paul Kerrigan Coal Co. operated two strip mines. The Whitmoyer Laboratories, Inc., consumed crude iodine in manufacturing inorganic and organic compounds at its plant near Myerstown.

Lehigh.—Portland and masonry cements were produced by Lehigh Portland Cement Co. near Fogelsville, and Coplay Cement Manufacturing Co. near Coplay. Portland cement was also produced by the Whitehall Cement Manufacturing Co. near Cementon, and Giant Portland Cement Co. near Egypt. Most of the portland cement was shipped in bulk by truck to ready-mixed concrete companies and concrete

product manufacturers. A major portion of the portland cement production was of the general use and moderate heat type and non-air-entrained. All the cement manufacturing companies produced captive crushed cement rock and limestone near their plants. Zinc sulfide ore mined and concentrated at the Friedensville mine was shipped to a smelter at Palmerton for recovery of zinc metal. Stone production totaled 2.6 million tons, mostly crushed limestone for cement manufacture. Lehigh Stone Co. near Ormrod and Eastern Industries, Inc., near Stiles also produced crushed limestone for concrete aggregate and roadstone. Penn Big Bed Slate Co., Inc., quarried dimension slate near Slatedale, mostly for flagging, structural and sanitary use, blackboards, aquarium bottoms, and cut slate blocks. The Pennsylvania Perlite Corp. expanded perlite at its Allentown plant chiefly for use in the manufacturing of building plaster and cryogenic applications.

Luzerne.—Anthracite production decreased 10 percent in tonnage from 1964. Leading producers were Glen Alden Corp. and Lehigh Valley Anthracite, Inc. Sand and gravel was produced by Airport Sand & Gravel Co., Inc., near Wyoming for building and paving purposes, fill, and roofing. Glendale Sand & Stone Co. near Avoca produced sand for building purposes and gravel for building and paving purposes. No. 1 Contracting Corp. of Delaware near West Pittston produced sand and stone gravel for paving purposes. Sand was produced for building purposes by Mt. Yeager Sand Pit near Drums. Sand and gravel was also produced at operations near Nescopeck and Forty Fort. Crushed sandstone was produced by Coolbaugh Sand & Stone, Inc., near Dupont; by The General Crushed Stone Co. near White Haven; and American Asphalt Paving near Shavertown, mostly for concrete aggregate and roadstone. Four producers mined and sold peat, mostly humus and reed-sedge, in bulk for general soil purposes. Producers were Bald Mountain Peat Corp. near Wilkes-Barre; Blue Ridge Soil Pep Co., Pennsylvania Peat Moss, Inc., and Stillers Blue Ridge Peat Co., all near White Haven, Hazleton Brick Co. mined shale at an opencut mine near Hazleton for manufacturing building brick. Bylite Corp. produced shale from a coal mine refuse bank near Plains for lightweight aggregate used in building block and high-rise buildings.

Lycoming.—Crushed limestone was produced for concrete aggregate and roadstone near Muncy and Jersey Shore by Lycoming Silica Sand Co. Some crushed limestone was also produced for agricultural purposes at the Jersey Shore operation. The company also produced building and paving sand, industrial sand, building gravel, gravel for railroad ballast, and gravel for fill at a stationary plant near Montoursville. Dimension sandstone for flagging and rubble was produced near Slate Run by Rummings Bluestone Co. Tripoli (rottenstone) was produced by Penn Paint & Filler Co. near Antes Fort and Keystone Filler & Manufacturing Co. near Muncy, for sale as a filler and abrasive material. The latter company also produced crushed slate flour. Bituminous coal was produced at three strip operations, which reported three power shovels, three draglines, four bulldozers, two power drills, and five trucks. All the strip tonnage was crushed at two mine tipples, Bucky Run and Cogan Station.

McKean.—Shale, chiefly for building brick, was produced at an opencut mine near Lewis Run by the Hanley Co. Crushed sandstone was produced for concrete aggregate, roadstone, and riprap. Sand was produced at a small pit near Eldred. Bituminous coal was produced at two strip operations. Production totaled 16,000 tons, a 27-percent decrease from that of 1964. Strip mines reported two power shovels, three draglines, three bulldozers, and four trucks. Coal was crushed at one tipple.

Mercer.—Bituminous coal was produced at 10 strip operations. Production totaled 553,000 tons, a 6-percent decrease from that of 1964. Strip mines reported 13 power shovels, 11 draglines, 16 bulldozers, 4 power drills, and 28 trucks. One preparation plant was active and used pneumatic equipment. One strip mine shipped coal to a preparation plant in Butler County for cleaning and crushing. Four mine tipples reported tonnages of crushed coal. Sand and gravel for paving purposes was produced by Seidle Sand & Gravel, Inc., near Mercer; Atlas Sand & Gravel, Inc., near Hadley; Transfer Sand & Gravel Co. in South Pymatuning Township; and Taylor

Sand & Gravel Co. near Big Bend. Crushed sandstone for various uses was reported by the White Rock Silica Sand Co. at its Greenville quarry.

Mifflin.—Industrial unground sand was produced near McVeytown by Pennsylvania Glass Sand Corp. chiefly for glass, grinding and polishing, molding, and engine purposes. George E. Miller Coal Co. produced sand for building purposes and gravel for paving purposes near McVeytown. James R. Kline's Sons produced sand for building purposes near Lewistown. Bethlehem Mines Corp. produced crushed limestone near Naginey for metallurgical flux, construction aggregate, and pulverizing. Derry Limestone Co. near Lewistown, and George E. Miller Coal Co. near McVeytown, produced crushed limestone for concrete aggregate and roadstone. Honey Creek Lime Co. produced crushed limestone for the manufacture of quicklime and hydrated lime at its pot kilns near Reedsville for agricultural and mason's lime. Quartzite was quarried and crushed for silica brick manufacture near Hawstone by Haws Refractories Co.

Monroe.—Crushed limestone was produced by Hamilton Stone Co., Inc., near Bossardsville and was sold for concrete aggregate, roadstone, and cement manufacture. Sand and gravel was produced by Sheesley Minerals, Inc., near Kunkletown, and by Javelyn Mobile Mix, Inc., near Stroudsburg for ready-mixed concrete. Universal Atlas Cement Division, United States Steel Corp., mined miscellaneous clay at an opencut mine near Kunkletown for their own use in making portland cement. Moss and humus peat was recovered by Pocono Peat Co., and World Wide Peat & Humus Corp. from bogs near East Stroudsburg and Blakeslee.

Montgomery.—Crushed limestone for concrete aggregate and roadstone was produced by Bradford Hills Quarry, Inc., near Norristown; G. & W. H. Corson, Inc., near Plymouth Meeting; Bethlehem Mines Corp. near Bridgeport; Glasgow Quarry, Inc., near Conshohocken; and Allentown Portland Cement Co. near West Conshohocken. These operations also produced crushed limestone for the following uses: Corson for metallurgical work, agricultural purposes, lime and cement manufacture and chemical uses; Bethlehem for metallurgical and agricultural purposes; Glasgow for lime manufacture; and Allentown for cement manufacture. Crushed argellite was produced for concrete aggregate and roadstone near Harleysville by M & M Stone Co., and near Fairview Village and Spring House by Gill Quarries, Inc. Rough building stone was produced near Eaglesville by Burdo Brothers. Granite was produced near Bethayres by Mignatti Construction Co., Inc., for concrete aggregate, roadstone, and irregular-shaped dimension stone. Dimension granite for rubble was produced near Laverock by Marcolina Bros., Inc. Crushed basalt for concrete aggregate and roadstone was produced by Montgomery Stone Co., Inc., near Montgomeryville (which also produced rough and dressed building dimension stone); by Kibblehouse Quarries, Inc., near Perkiominville; and Pottstown Trap Rock Quarries, Inc., near Saratoga. Dimension sandstone was produced near Morristown by William Bambi & Sons, Inc. Dimension quartzite for rubble and rough blocks for furnace linings was produced near Glenside by Firestone Products Co., Inc.

Portland and masonry cements were manufactured by Allentown Portland Cement Co. near West Conshohocken, and G. & W. H. Corson, Inc., Plymouth Meeting. Most of the portland cement was general use and moderate heat type, non-air-entrained. Shale was mined by the Philadelphia Brick Co. at an opencut mine near Trappe, for heavy clay products. Miscellaneous clay was mined by The Keller Pottery Co. at an opencut mine near North Wales for flowerpots. Sand and gravel was produced near Norristown for construction uses by William Bambi & Sons, Inc. Expanded perlite was produced by Refractory & Insulation Corp., near Port Kennedy for concrete aggregate and filler.

Montour.—Crushed limestone for roadstone and agricultural purposes was produced by The Lycoming Silica Sand Co. near Milton. Mausdale Quarry Co. near Danville also produced crushed limestone for roadstone. Sand and gravel for building purposes was produced by Thomas Sand & Gravel Co. at a stationary plant near Danville.

Northampton.—The county continued to be first in the production of cement, with nine plants shipping almost 18 million bar-

rels of portland cement. All but one plant also shipped masonry cement. Producers were Keystone Portland Cement Co., Bath; Hercules Cement Co., Division of American Cement Corp., Stockertown; Universal Atlas Cement Division, United States Steel Corp., and Dragon Cement Co., Division of Martin Marietta Corp., both of Northampton; Lone Star Cement Corp., Penn-Dixie Cement Corp., and Nazareth Cement Co., all of Nazareth; and National Portland Cement Co., Bethlehem. Ready-mixed concrete companies purchased most of the cement, with a significant quantity purchased by concrete product manufacturers. Alpha Portland Cement Co. abandoned its plant at Martins Creek, but reported sales from its cement stocks. Thirty-four kilns were used during the year. Most of the Eastern States received cement shipments from the county.

Production of crushed limestone increased 3 percent in tonnage as the county continued to be first in the State. Captive limestone and cement rock produced by cement manufacturers for their own use was the largest portion of the crushed limestone output. Other companies producing crushed limestone were Bethlehem Mines Corp. near Bethlehem and the Trumbower Co., Inc., near Nazareth, mostly for concrete aggregate and roadstone, but Bethlehem also produced some stone for clay filler, stone sand, railroad ballast, agricultural purposes, and riprap.

Dimension slate was produced mostly for flagging, structural and sanitary ware, blackboards, and roofing. Leading dimension slate producers were Capitol Slate Co., Inc., near East Bangor; Albion Vein Slate Co., Anthony Dally & Sons, Inc., and Stephens-Jackson Co., all of Pen Argyl.

Two producers reported crushed slate production, the leading one being Pennsylvania Lightweight Aggregate, Inc., near Bangor, with most of the output used for lightweight aggregate plus a small quantity used for roofing granules.

Production of sand and gravel was slightly less than that of 1964. Output was chiefly for building and paving purposes. Companies active included Houdaille Construction Materials, Inc., Portland; Lehigh Valley Sand & Gravel Co., Inc., Easton; and W. J. Lowe & Sons, Inc., Bangor.

Minerals, Pigments, & Metals Division, Charles Pfizer and Co., Inc., at Easton, and Reichard-Coulston, Inc., at Bethlehem produced finished (natural and manufactured) pigments.

Northumberland.—Anthracite production totaled almost 1.6 million tons, a 26-percent decrease from that of 1964. The Alarcon Coal Co.'s Treverton mine received recognition for its safety record in the Underground Coal Group of the 1965 National Safety Competition for working 31,138 man-hours without a disabling work injury.

Shale was produced for manufacturing building brick by Glen Gery Shale Brick Corp. and Watsontown Brick Co. Watsontown Minerals Products produced shale for linoleum filler. All operations were near Watsontown. Crushed limestone for concrete aggregate, roadstone, and agricultural purposes was produced by Eugene Meckley at a stationary plant near Herndon. Clyde Starook produced a small amount of burnt lime for agricultural use near Northumberland.

Perry.—Crushed limestone for concrete aggregate and roadstone was produced by Bradford Hills Quarry, Inc., at its Newport quarry,

Philadelphia.—The Liberty Corp. Operated a dredge on the Delaware River and a stationary plant near Philadelphia to produce sand and gravel for building purposes. The Atlantic Refining Co. recovered hydrogen sulfide and molten sulfur, and Gulf Oil Co. recovered sulfur, both operations near Philadelphia. Hydrogen sulfide was recovered by the Girdler system using monethanolamine and diethanolamine, and sulfur was recovered by the Claus process. Calcined gypsum (stucco) was produced by United States Gypsum Co. near Philadelphia.

Potter.—Dimension sandstone was reported from quarries near Austin, Bark Shanty, Coudersport, Gold, Roulette, and Wharton, mostly for flagging. Penn Kress Flagstone Co., Inc., was the largest producer. Lloyd A. Tyler, John Majot, and McCloskey's Stone Quarry reported tonnages for the first time.

Schuylkill.—Anthracite production decreased 10 percent from that of 1964. Leading producers were Reading Anthracite

Co., Greenwood Stripping Corp., and Gilberton Coal Co.

Crushed sandstone was produced near Summit Station for concrete aggregate and roadstone by Summit Quarries, Inc. Harbison-Walker Refractories Co. produced crushed sandstone near Andreas for silica brick. Crushed limestone was produced by Huss Contracting Co. near Andreas for concrete aggregate and roadstone. Sand for paving purposes and industrial sand for fire or furnace was produced by Refractory Sand Co., Inc., at a stationary plant near Andreas. Shale was purchased from various producers for the manufacture of lightweight aggregate by Lehigh Materials Co., near Tamaqua. Auburn Brick Co. produced shale for manufacturing building brick near Auburn.

Snyder.—Crushed limestone was produced near Paxtonville by National Limestone Quarry, Inc., for concrete aggregate, roadstone, and agricultural purposes. Carton L. Comfort produced crushed limestone for use in making quicklime of his own manufacture at a quarry near Mt. Pleasant Mills, but terminated operations during the year.

Sand and gravel was produced near Selinsgrove by Central Builders Supply Co. for building and paving purposes, fill, highway maintenance, and manufacturing concrete masonry units. Anthracite production was about the same as that of 1964.

Somerset.—Bituminous coal was produced at 127 operations, 63 underground and 64 strip. Production totaled 3.7 million tons, an 18-percent increase over that of 1964. Strip mines accouned for 2.4 million tons and reported 81 power shovels, 61 draglines, 87 bulldozers, 29 power drills, and 165 trucks. Twenty of the 63 underground mines loaded 982,000 tons of coal mechanically with 15 continuous miners and 21 hand-loaded face conveyors. Fifty-nine cutting machines cut 385,000 tons. Nine preparation plants prepared 1.5 million tons of clean coal, 1.0 million tons of which was strip coal and 0.5 million tons was underground coal. Twenty mine tipples crushed 1.8 million tons, and nine plants treated 152,000 tons with oil.

Flint fire clay was produced by General Refractories Co. near Fort Hill and Rockwood for manufacturing firebrick and block. Plastic fire clay was produced by Otto Brick and Tile Works, Inc., near Springs for manufacturing building brick; by Harbison-Walker Refractories Co. near Somerset for firebrick and block; and by C. Brant Mining Co. near Somerset for firebrick and high alumina brick. Svonavec Coal Co. produced flint fire clay near Shanksville for firebrick and block. Hiram Swank's Sons, Inc., operated an underground mine near Holsopple producing plastic fire clay for manufacturing firebrick and block.

Crushed limestone for concrete aggregate and roadstone was produced by Somerset Limestone Co., Inc., near Bakersville. Keystone Lime Co. produced crushed limestone near Springs for concrete aggregate, roadstone, and agricultural purposes. Crushed sandstone was produced by Detwilers Industries, Inc., near Central City and by Clarence Rodamer near Springs for concrete aggregate and roadstone. Sand and gravel was produced near Berlin and sand was produced near Boswell for construction purposes.

Sullivan.—Anthracite production was 23,000 tons compared with 16,000 tons in 1964, an increase of more than 40 percent. Bliss Coal Co., E. and B. Coal Sales, Meg Coal Co., and James and Albert Oliver operated strip mines.

Susquehanna. — Dimension standstone mostly for flagging purposes was reported by seven companies with quarries near Harford, Kingsley, Montrose, Rush Township, Springville, and Susquehanna. Crushed sandstone for concrete aggregate and roadstone was reported by Keelor Supply Co., Inc., near Clifford and Susquehanna Quarry Co. near Montrose. Anthracite was produced by Matisko Coal Co.

Tioga.—Bituminous coal was produced at three operations, one underground and two strip. Strip mines accounted for most of the production and reported 9 power shovels, 6 draglines, 10 bulldozers, 3 power drills, and 9 trucks. The underground mine shot coal from the solid or cut by hand. One preparation plant cleaned coal with pneumatic equipment and crushed most of the strip production.

Sand and gravel output from Fredric M. Gee Gravel Co.'s portable plant near Middlebury Center almost tripled that of 1964, principally because of the increased use of paving gravel by the Pennsylvania Department of Highways. A small amount

of dimension sandstone chiefly for flagging purposes was quarried in Elk Township.

Union.—Crushed limestone for concrete aggregate, roadstone, and agricultural purposes was produced by Faylor Lime and Stone Co. near Winfield. Crushed limestone for concrete aggregate and roadstone also was produced by John L. Iddings near Mifflinburg. Production was slightly higher than that of 1964.

Venango.—Bituminous coal was produced at 14 operations; 1 underground, 12 strip, and 1 auger. Production totaled 399,000 tons, a 19-percent decrease from that of 1964. Strip mines accounted for most of the tonnage and reported 13 power shovels, 8 draglines, 11 bulldozers, 3 power drills, and 40 trucks. All the coal from the underground mine was cut with one cutting machine. The auger mine reported one auger, one bulldozer, and two trucks. Three mine tipples crushed 69,000 tons of strip and auger coal. Sand and gravel, chiefly for building and paving uses, was produced by Oil City Sand & Gravel Co. near Oil City. Gravel for building and paving purposes, fill, and miscellaneous uses was produced by White City Sand & Gravel near Titusville. Industrial Silica Division, Pennsylvania Glass Sand Corp., produced unground sand for molding and fire or furnace uses near Utica.

Warren.—Sand and gravel was produced by dredging near Warren by Warren Sand and Gravel Co. and General Concrete Products Corp., mostly for building and paving purposes. Bank-run gravel was produced by Nelson & Ellberg near Warren for fill and miscellaneous purposes.

Washington.—Bituminous coal was produced at 37 operations; 19 underground, 16 strip, and 2 auger. Production totaled 14.2 million tons, a 6-percent increase over that of 1964. Fourteen of the 19 underground mines loaded 13.5 tons of coal mechanically with 68 continuous miners and 71 mobile loaders, of which 10 were used with continuous miners. Thirty-eight cutting machines cut 4.0 million tons. Strip mines reported 20 power shovels, 4 draglines, 1 carryall scraper, 23 bulldozers, 8 power drills, and 30 trucks. Auger mines reported two augers, one bulldozer, and two trucks. Eight preparation plants prepared 12.7 million tons of clean coal, 12.4 million tons of which was underground coal. Eight mine tipples crushed 8.0 million tons, and four plants treated 1.2 million tons with oil and other materials. Crushed limestone for concrete aggregate and roadstone was produced by Washington Stone Co., Inc., at a stationary plant near Washington. Crushed sandstone was sold from stocks by the Appalachian Stone Division of Martin Marietta Corp. near Claysville. The Mercer Lime and Stone Co. announced plans to erect a multimillion-dollar complete lime manufacturing plant for the production of quicklime an dhydrated lime products near Burgettstown. This new facility is expected to be completed by the fall of 1966 and, together with the expansion of the company's Branchton operation, will provide the steel industry with approximately 1,500 tons of lime products daily.

Wayne.—Dimension standstone (bluestone), used chiefly for flagging, was reported by W. R. Strong and Son, Paul Tompkins Estate, and Sterling Quarries, Inc. Crushed sandstone for concrete aggregate and roadstone was produced by Wayne Crushed Stone, Inc., near Lake Ariel. Production of sand and gravel was more than double that of 1964, due principally to the great road building activity in the area. Willis Black Sand & Gravel Co. and Keystone Pavement & Construction Co., Inc., both near Lake Ariel, produced sand and gravel for building and paving purposes. Wayne Peat Humus Co., Inc., recovered reed-sedge and humus peat from a bog near Gouldsboro and sold the product both packaged and in bulk for general soil improvement uses.

Westmoreland.—Bituminous coal was produced at 60 operations; 31 underground, 28 strip, and 1 auger. Production totaled 4.1 million tons, a 2-percent increase over that of 1964. Eleven of the 31 underground mines loaded 3.8 million tons of coal mechanically with 17 continuous miners, 27 mobile loaders (13 of which were used with continuous miners), and 3 hand-loaded face conveyors. Thirty-five cutting machines cut 942,000 tons. Strip mines accounted for 263,000 tons and reported 30 power shovels, 7 draglines, 27 bulldozers, 4 power drills, and 9 trucks. Auger mines reported one auger in operation. Six preparation plants prepared 3.4 million tons of clean coal, all of which was mined underground. Eight mine tipples crushed 2.3

million tons, and four plants treated 1.8 million tons with oil, sodium chloride, and other materials.

Davison Sand & Gravel Co. operated a dredge on the Allegheny River and produced large quantities of sand and gravel for building and paving purposes. Crushed sandstone for use as concrete aggregate and roadstone, was produced by J. M. Hall and J. M. Hall, Jr., Inc., Baggaley; Penn Aggregates, Jeannette; Latrobe Construction Co., Ligonier; Eidenmiller Enterprises, Inc., Lycippus; and Clayton H. Remaley, Murrysville. Dimension sandstone for flagging was quarried by Lynns Quarry, Belle Vernon. Crushed limestone, chiefly for use as concrete aggregate and roadstone, was produced near Apollo, Derry, East Huntington Township, Lower Burrell, and Torrance. A small amount of agricultural lime was produced by the Agricultural Lime and Stone Co. near Derry.

Wyoming.—Sand and gravel was produced chiefly for building and paving purposes by Wyoming Sand & Stone Co. near Falls; The East Lemon Sand & Gravel Co. near East Lemon; and East Falls Sand & Gravel near Falls. J. G. Robinson, Inc., near Fort Washington, quarried dimension sandstone (bluestone) for flagging.

York.—Portland and masonry cement was produced by Medusa Portland Cement Co. at York. Most of the portland cement was the general use and moderate heat type, but substantial quantities of white and high-early-strength were also produced. Shipments were mainly in bulk and shipped by railroad. Most of the cement was sold to ready-mixed concrete companies with a large amount also sold to concrete product manufacturers. About one-half of the limestone and clay used as raw materials by Medusa was captive tonnage from nearby sources. Crushed limestone for concrete aggregate and roadstone was produced by York Stone and Supply Co., York; National Gypsum Co., York; Lincoln Stone, Inc., Thomasville; Standard Concrete Products Co., York; and The J. E. Baker Co., York. York Stone and Supply Co. also produced limestone for asphalt filler; National Gypsum Co. also produced limestone for floor covering, metallurgical work, and agricultural purposes; and The J. E. Baker Co. also produced limestone for the manufacture of dead-burned dolomite and for agricultural purposes. Thomasville Stone and Lime Co. produced crushed limestone near Thomasville for metallurgical work, roadstone, agricultural purposes, cement manufacture, chemical uses, miscellaneous filler, dust for coal mines, and mineral food. White Pigment Corp. produced limestone near York for a wide variety of whiting filler markets. Slate was crushed and ground by The Ruberoid Co. at their Delta quarry for natural roofing granules and slate flour.

Shale for manufacturing building brick was produced by Glen Gery Shale Brick Corp., York Colonial Division, from their opencut mine near York. Medusa Portland Cement Co. mined clay from an opencut mine near York for their own use in the production of cement. Sand and gravel was produced by Pennsy Supply, Inc., near York Haven for building and paving purposes. Sand was produced by Neuman Sand & Supply Co. near York for building purposes. General Mining Associates recovered crude flake mica near Glenville, which was ground and sold to paint, rubber (mold lubricant), welding rod, and textile coating manufacturers. Pennsylvania Perlite Corp. expanded perlite at its plant near York chiefly for building plaster.

The Mineral Industry of Puerto Rico, The Panama Canal Zone, The Virgin Islands, Pacific Possessions, and Trust Territory of the Pacific Islands

The Puerto Rico section of this chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the Mineralogy and Geology Section, Industrial Research, Economic Development Administration, Commonwealth of Puerto Rico, for collecting information on all minerals.

By Harry F. Robertson,[1] José F. Cadilla,[2] and Roy Y. Ashizawa [3]

PUERTO RICO [4]

Mineral production in Puerto Rico was valued at $46.2 million, a gain of about 3 percent. Nonmetallic construction materials, represented by cement, sand and gravel, and stone, comprised about 50, 27, and 20 percent, respectively, of the total value.

Ponce Mining Co. and Bear Creek Mining Co., subsidiaries of American Metal Climax, Inc., and Kennecott Copper Corp., respectively, continued exploration and development of copper deposits located between Utuado and Lares on the Island's west-central mountain region. Puerto Rico Economic Development Administration (PREDA) and the principal mining companies were discussing feasibility of refining the copper concentrates and/or blister copper in Puerto Rico instead of sending it to the United States for processing. The two mines are expected to yield a total of 68,000 tons of refined copper annually.

Table 1.—Mineral production in Puerto Rico [1]

Mineral	1964		1965	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement—thousand 376-pound barrels	7,926	$23,879	7,284	$23,415
Clays—thousand short tons	341	271	357	288
Lime—do	18	574	27	867
Salt—do	5	74	8	138
Sand and gravel—do	7,816	11,492	8,147	12,405
Stone—do	5,504	8,586	5,344	9,111
Total	XX	44,876	XX	46,224

XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Value of mineral production in constant 1957–59 dollars

(Thousands)

Year	Value
1956	$16,870
1957	22,269
1958	19,248
1959	20,714
1960	30,851
1961	34,812
1962	38,818
1963	41,965
1964	r 45,836
1965	47,258

r Revised.

The U.S. Atomic Energy Commission (AEC) and the Puerto Rico Water Resources Authority continued work on a nu-

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[4] Prepared by Harry F. Robertson and José F. Cadilla.

clear powerplant near Rincón, Aguadilla District. The plant was designed to generate 16,300 kilowatts. Power production on a test basis continued during 1965.

The U.S. Geological Survey, working under a cooperative agreement with PREDA, mapped quadrangles at various locations on the island. A geologic map of the Barceloneta quadrangle was published.[5] Field mapping of the Ciales quadrangle was undertaken as a part of the continuing program for preparing geologic maps of Puerto Rico. The study was published.[6]

At yearend, the U.S. Coast and Geodetic Survey began a surveying project to determine the exact location and altitude of the island's rivers, mountains, cities, dams, and highways. The size and shape of the island will be measured by the triangulation method. The information compiled will be used to prepare maps and for charts and various engineering projects. Completion was scheduled for mid-1966.

The Puerto Rican Department of Public Works, in cooperation with the Federal Bureau of Public Roads, continued a comprehensive and systematic survey of construction materials of Puerto Rico. The report on the Bayamón quadrangle was published and preparation continued of the San Juan and Juncos quadrangles.

REVIEW BY MINERAL COMMODITIES

Nonmetals—*Cement.*—The construction industry activity accounted for an increase of 8 percent in domestic demand for cement. A substantial decrease in cement export—because of the termination of an agreement to supply cement to Universal Atlas—resulted in an overall drop of 8 percent in shipments of cement from the Puerto Rican plants. The quantity of imported cement dropped slightly to 559,000 barrels. About 83 percent of the cement was imported from Colombia; Belgium, Japan, and Denmark accounted for most of the remainder.

Table 3.—Portland cement production and shipments

Year	Production (376-pound barrels)	Shipments		
		376-pound barrels	Value	
			Thousands	Average per barrel
1956–60 (average)	5,067,195	5,077,769	$15,600	$3.07
1961	6,070,140	5,931,420	16,946	2.86
1962	6,364,736	6,346,662	20,018	3.15
1963	7,171,302	7,217,417	22,090	3.06
1964	7,910,624	7,925,781	23,879	3.01
1965	7,268,773	7,284,219	23,415	3.21

Puerto Rican Cement Co. planned to increase its portland cement capacity to 12.5 million barrels by 1967. A part of the $15 million expansion would be installation of a cement-making kiln, 622 feet long, at its Ponce plant. New grinding mills also were being installed at the plant.

Two companies announced plans to make white cement on the island. Puerto Rican Cement Co. would build a plant adjacent to its Ponce portland cement complex; Toa Cement Co. planned a similar operation at Vega Alta in the north-central part of the island.

Clays.—Most of the clay production was used in making cement. Puerto Rico Clay Products Corp. mined clay for heavy clay products and other ceramics near Carolina until September, then ceased operations. Diazlite, Inc., Puerto Rico's only lightweight aggregate plant, expanded clay at its plant near San Juan. A substantial quantity of sandy clay used for fill on various construction projects was not included as mineral production. The pit-run material usually sold for as much as 75 cents per cubic meter.

Lime.—The Puerto Rican Cement Co., Inc., produced hydrated lime and quicklime at Ponce. The hydrated lime output was principally used for mason's lime. The remaining was used for sugar refining, leather tanning, water purification and softening, and sanitation.

Salt.—Recovery of evaporated salt increased substantially. Salt ponds were operated by Carlos Ramirez, Puerto Rico Salt Works, Inc., and other smaller producers in the Mayaguez District. Crude salt, imported from Gran Inagua, was refined to table salt for domestic use.

Sand and Gravel.—Increased construction activity accounted for a corresponding in-

[5] Briggs, Reginald P. Miscellaneous Geological Investigation Map No. I–421. U.S. Geol. Survey, 1965.

[6] Berryhill, H. L. Geology of the Ciales Quadrangle, Puerto Rico. U.S. Geol. Survey Bull. 1184, 1965, 116 pp.

Table 4.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1964		1965	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	2,012	$3,456	2,074	$3,970
Paving	1,539	1,904	1,572	1,964
Fill	500	453	592	524
Other	25	35	38	53
Total	4,076	5,848	4,276	6,511
Gravel:				
Building	1,379	2,578	1,442	2,772
Paving	957	1,789	971	1,792
Fill	589	482	576	479
Total	2,925	4,849	2,989	5,043
Total sand and gravel	7,001	10,697	7,265	11,554
Government-and-contractor operations:				
Sand:				
Paving	201	256	234	263
Fill	472	409	502	450
Total	673	665	736	713
Gravel:				
Paving	18	22	21	30
Fill	124	108	125	108
Total	142	130	146	138
Total sand and gravel	815	795	882	851
Grand total	7,816	11,492	8,147	12,405

Table 5.—Stone sold or used by producers

(Thousand short tons and thousand dollars)

Year	Dimension limestone		Crushed limestone [1]	
	Quantity	Value	Quantity	Value
1956–60 (average)	90	$178	2,292	$3,296
1961	[2] 77	[2] 213	3,718	4,546
1962	61	130	4,270	5,829
1963	65	152	3,918	5,306
1964	75	191	4,347	6,009
1965	74	180	4,236	6,607

Year	Miscellaneous stone		Total	
	Quantity	Value	Quantity	Value
1956–60 (average)	178	$400	2,560	$3,874
1961	1,254	2,525	5,049	7,284
1962	1,258	2,592	5,589	8,551
1963	1,351	2,779	5,334	8,237
1964	1,082	2,386	5,504	8,536
1965	1,034	2,324	5,344	9,111

[1] Includes limestone for cement and lime.

[2] Includes dimension marble.

crease of about 4 percent in sand and gravel production. Most of the material was used as concrete aggregate. Silica sand produced from inland beds west of San Juan was used in the nearby cement and glass plants. Lesser amounts were used in foundries, as abrasives, in commercial sandblasting, and in marble-polishing operations. Puerto Rico Glass Corp. was the principal user of the white, high-grade sands. Feldspar and other raw materials used in glassmaking were imported.

Stone.—Limestone, classified as marble in many deposits, was produced in all seven districts. Andesite, tuffaceous siltstone, and miscellaneous volcanic stone were produced in all districts except Arecibo. Granite was produced in Humacao and Guayama Districts. Stone output was 79 percent crushed limestone, 2 percent crushed granite, and

16 percent crushed miscellaneous stone. The remaining 3 percent was rough dimension stone and crushed marble. Crushed marble was used in making terrazzo. The two cement plants reported the largest crushed stone output, totaling 2 million tons, about 9 percent less than that of 1964.

Mineral Fuels.—The quantity of crude and unfinished oil imported from Venezuela and the Netherlands Antilles averaged 126,000 barrels per day, a 13-percent increase over that of 1964. The oils were refined at the Cataño plant of Caribbean Gulf Refining Corp. and the Guayanilla plant of Commonwealth Oil Refining Co.

Caribbean Gulf inaugurated a $7 million expansion program, the last phase of an $11 million project initiated in 1960. New refining units under construction include a catalytic reforming unit, a gasoline stabilizer, a boiler, and auxiliary equipment.

Commonwealth Oil Refining Co. continued work on its first satellite project, tying in with its petrochemical plant. The project, named Hercor Chemical Corp., was a joint venture with Hercules Co. The $10 million plant will produce paraxylene, a petrochemical which is further processed to synthetic clothing fiber and transparent wrapping film. Completion of the plant was scheduled for mid-1966.

Puerto Rico Chemical Co., a subsidiary of Hooker Chemical Corp., completed a new phthalic anhydride plant at Arecibo. The capacity of the new plant was 50 million pounds per year. Feedstock was obtained from the nearby petrochemical plant of Commonwealth Oil Refining Co. Phillips Petroleum Co. announced plans to build a $45 million oil refinery in Guayama. The contract was awarded to Procon, Inc., to design and construct the first plant in the petrochemical complex.

Texaco Industries, Inc., announced plans to construct a $24 million oil refinery on Punta Verraco, just south of Guayanilla.

Table 6.—Value of mineral production in Puerto Rico, by districts

Senatorial district	1964	1965	Minerals produced in 1965, in order of value
Aguadilla	$1,436,900	$1,308,300	Stone, sand and gravel.
Arecibo	1,415,200	1,261,850	Do.
Guayama	1,270,250	1,295,650	Sand and gravel, stone.
Humacao	778,200	859,500	Stone, sand and gravel.
Mayaguez	2,600,400	2,825,090	Sand and gravel, stone, salt.
Ponce	16,021,748	16,827,822	Cement, sand and gravel, stone, lime, clay.
San Juan	21,353,302	21,845,788	Cement, sand and gravel, stone, clay.
Total	44,876,000	46,224,000	

Scheduled starting capacity of the proposed plant was 25,000 barrels of crude oil per day.

Metals.—Industrial Siderurgica, Inc., produced steel reinforcing bars for concrete construction from domestic and imported iron and steel scrap. The company began operating one of its two 20-ton electric furnaces. The second unit was scheduled for operation in mid-1966. Operation of the two furnaces would enable the company to increase its output to more than 70,000 tons annually.

The Mining Commission and various mining companies studied various proposals on mining, concentrating, and smelting Puerto Rican copper ores. Ponce Mining Co. and Bear Creek Mining Co. planned excavation of open pits in the Lares-Utuado area.

PANAMA CANAL ZONE [7]

Table 7.—Mineral production in the Panama Canal Zone and Virgin Islands [1]

Mineral	1964		1965	
	Short tons	Value	Short tons	Value
Canal Zone:				
Sand and gravel	84,000	$82,000	83,000	$85,000
Stone [2]	152,708	348,540	153,418	366,098
Total	XX	430,540	XX	451,098
Virgin Islands: Stone (basalt)	68,550	341,720	67,948	301,975

XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Includes basalt.

The value of mineral production in the Panama Canal Zone gained about 5 percent over that of 1964. Sand and gravel was produced by the Panama Sand Co., Inc. Basalt was quarried by Panama Canal Co.; andesite by the U.S. Army—Caribbean.

[7] Prepared by Harry F. Robertson.

VIRGIN ISLANDS [8]

Production of basalt in the Virgin Islands dropped slightly. Caribbean Material Supply Co. was the major stone producer. Principal use of the crushed stone was for concrete aggregate, roadstone, and riprap.

The alumina plant of Harvey Aluminum, Inc., on St. Croix neared completion and was scheduled to be onstream and producing alumina at the rate of 220,000 tons per year in early 1966. Nearly 500,000 tons of bauxite will be imported and processed annually to produce the alumina. A 750,000-gallon-per-day-water-desalting plant, the first to use titanium tubing, was placed in operation. The multistage flash evaporator will provide water required in the alumina plant. Water delivered from the plant to the alumina complex will contain less than 5 parts per million of dissolved solids. For equipment cooling, the Harvey plant will use salt water pumped through at the rate of 70,000 gallons per minute. The water will be discharged back into the ocean without waste or residue.

A combination electric power and water-desalting plant was opened in St. Thomas. The facility will provide 1 million gallons of fresh water daily, plus 7,500 kilowatts of electrical power. Westinghouse Electric International Co., division of Westinghouse Electric Corp., built the plant in less than 1 year at a cost of $2.65 million. Production costs of the water will be about $1.00 per thousand gallons.

Puerto Rican Cement Co. constructed a distribution plant in St. Thomas and announced that a similar plant would be erected in St. Croix by the end of 1966.

[8] Prepared by Harry F. Robertson.

PACIFIC ISLAND POSSESSIONS [9]

REVIEW BY ISLANDS

American Samoa.—Appreciable tonnages of coral limestone and sand, which were dredged during 1965, and basalt rock, which was quarried, crushed, and stockpiled during previous years, were utilized for the continued improvement of roads and utilities and for the construction of buildings. Coral aggregate and fill material was used for the construction of a new 100-room luxury hotel and for the installation of an extensive water supply and distribution system.

Guam.—Military and civilian construction activities on Guam resulted in sizable demands for concrete aggregate and roadstone during 1965. A substantial quantity of coral limestone was quarried by commercial producers and public works maintenance crews. Hawaiian Rock Products, Inc., at Barrigada, and Perez Bros., at Agana, operated large-scale aggregate plants and supplied much of the crushed rock and sand used in asphalt and portland cement concrete.

Wake.—Coral limestone was quarried by Government crews and contractors for use in maintenance of roads, and for construction or rehabilitation of facilities on the islands.

Other Pacific Island Possessions.—No mineral production was reported on the Islands of Canton, Enderbury, Jarvis, Johnston, Midway, and Palmyra. Mineral materials used for construction of facilities on Canton and Johnston, were supplied by contractors from Hawaii.

[9] Prepared by Roy Y. Ashizawa.

Table 8.—Mineral production in the Pacific Island possessions

Area and mineral	1964		1965	
	Short tons	Value	Short tons	Value
American Samoa:				
Sand	22,000	$20,000	60,000	$55,000
Stone (crushed)	157,180	233,500	60,000	60,000
Total	XX	253,500	XX	115,000
Guam: Stone (crushed)	469,206	868,126	482,839	925,030
Wake: Stone (crushed)	1,755	5,400	1,253	3,807

XX Not applicable.

TRUST TERRITORY OF THE PACIFIC ISLANDS [10]

The Trust Territory of the Pacific Islands is administered by the United States under a trusteeship agreement with the United Nations Security Council. The territory is made up of 2,100 islands, a land area of 700 square miles, scattered in an ocean area of 3 million square miles.

None of the phosphate or bauxite deposits in the territory was mined during 1965. Mineral output was confined to the quarrying of volcanic rock and coral in the districts of Mariana Islands, Yap, and Palau, and of coral in the districts of Truk, Ponape, and Marshall Islands. These materials were produced and processed by public works crews and several commercial enterprises for use in construction of buildings, expansion of public utilities, and for improvement of roads, airfields, and harbors.

At Kwajalein, contractors for the U.S. Department of Defense missile testing facility utilized, dredged, and quarried coral for land fill, concrete aggregate, and riprap for shore protection. The coral was dredged from the lagoon or quarried on several of the nearby islets, which form the large atoll.

[10] Prepared by Roy Y. Ashizawa.

The Mineral Industry of Rhode Island

By Harold F. York [1]

The value of minerals in Rhode Island was 15 percent greater than in 1964, reversing a 4-year downward trend. The total mineral output was valued at $2.9 million. Of this total, sand and gravel accounted for 62 percent, with sales of dimension and crushed granite, crushed conglomerate, and crushed limestone constituting most of the remainder. Providence County, with over one-half of the State's total production, continued as the principal producer, followed by Kent, Washington, and Newport Counties. Bristol County reported no production.

REVIEW BY MINERAL COMMODITIES

Gem Stones.—Semiprecious stones were collected from various sites including mine dumps and quarries, mostly in the northern part of the State. Specimens included actinolite, agate, fluorescent calcite, and pegmatite minerals.

Sand and Gravel.—The 1965 production of sand and gravel totaled 1.68 million tons, 2 percent greater than that of 1964. The value of $1.8 million was one of the highest of record. Providence County produced over one-half of the sand and gravel, followed by Kent, Washington, and Newport Counties. About 53 percent of the production was used for building purposes, while 26 percent was used for paving. The remainder was used for miscellaneous purposes including drainage and ice control. A relatively small tonnage of sand was used industrially as molding sand. Seventy-five percent of the production was processed by washing and screening in stationary plants. The average unit price per short ton for processed sand and gravel was $1.23, and for unprocessed material, $0.61. The average unit price per short ton of sand and gravel was $1.08, compared with $0.98 in 1964, reflecting selective price increases for paving and molding sand and for gravel for fill purposes. Most of the production was transported by truck. Only a minor amount was moved by railroad.

Stone.—The production of stone declined about 3 percent in quantity but increased 20 percent in value, comparing 1965 with 1964. Valued at $1.1 million, stone accounted for 38 percent of the State's mineral production. The output of both crushed and dimension granite increased

[1] Geologist, Bureau of Mines, Pittsburgh, Pa.

Table 1.—Value of mineral production in Rhode Island, by counties [1]

(Thousands)

County	1964	1965	Minerals produced in 1965, in order of value
Kent	W	W	Sand and gravel.
Newport	$36	$19	Sand and gravel, stone.
Providence	1,666	1,617	Do.
Washington	198	540	Stone, sand and gravel.
Undistributed [2]	649	755	
Total	2,549	2,931	

W Withheld to avoid disclosing individual confidential data; included with "Undistributed."

[1] Bristol County is not listed because no production was reported.

[2] Includes value of gem stones and sand and gravel that cannot be assigned to specific counties and values indicated by symbol W.

Table 2.—Value of mineral production in constant 1957–59 dollars

(Thousands)

Year	Value
1956	$1,647
1957	1,391
1958	2,269
1959	2,281
1960	5,687
1961	3,085
1962	3,018
1963	2,864
1964	r2,603
1965	2,997

r Revised.

over that of the past year. Miscellaneous stone consisting of granitized schist and crushed conglomerate decreased in output. The production of crushed limestone decreased 9 percent from that of 1964. The output of dimension limestone, although relatively minor, increased. Crushed miscellaneous stone was the principal stone commodity produced and was used mostly for concrete and roadstone. A lesser quantity was used for riprap.

Dimension granite, both rough and dressed, was quarried mostly for monumental stone. A small amount was used for construction purposes. Crushed granite was marketed for riprap.

Most of the limestone production was used for agricultural purposes. Other miscellaneous uses were for decorative and special aggregate, roofing gravel, flux, and fertilizer filler. Some dimension limestone was quarried for building stone.

Of the total stone value, miscellaneous stone accounted for 42 percent, granite 36 percent, and limestone 22 percent.

There was no production of stone by Government-and-contractor operators in 1965.

REVIEW BY COUNTIES

Kent.—Sand and gravel was the only mineral commodity commercially produced in Kent County during 1965. Compared with 1964, the output declined 20 percent while the value of the production increased 16 percent. The price per short ton generally increased in all use categories, but especially for building and paving gravel. Building and molding sand increased in unit price while fill sand declined. Paving sand was virtually unchanged from 1964. The production of sand for building purposes decreased again as it did in 1964, while sand output for the purposes of paving, fill, and ice control increased. The market for molding sand also increased.

The value of construction gravel increased for building and drainage purposes. The use of gravel for paving and fill declined.

During 1965, 62 percent of the sand and gravel was processed by washing and screening, compared with 80 percent in 1964. The average unit price of processed sand and gravel was $1.62 per ton in 1965, compared with $1 per ton the previous year. Transportation was almost all by truck; only a minor amount was shipped by rail. Whitehead Brothers Co., Washington, produced molding sand. The Rhode Island Sand & Gravel Co., Warwick, also produced molding sand in addition to sand and gravel for building, paving, and fill purposes. Luigi Vallone, Inc., also at

Table 3.—Employment and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1964:								
Sand and gravel	131	198	26	209	---	5	23.87	1,456
Stone	46	239	11	88	1	1	22.73	68,219
Total	177	209	37	297	1	6	23.57	21,239
1965: p								
Sand and gravel	140	193	27	214	---	5	23.36	70
Stone	45	267	12	97	---	1	10.31	155
Total	185	211	39	311	---	6	19.29	96

p Preliminary.

Warwick, produced sand and gravel for building, paving, fill, ice control, and other construction purposes.

Newport.—The mineral production of Newport County declined 50 percent in tonnage and 48 percent in value, compared with 1964. Peckham Bros., Inc., Middletown, was the only commercial producer of sand and gravel and stone during the year. Gravel for paving purposes declined 36 percent in volume and 42 percent in value compared with 1964. The entire output was processed by washing and screening. Transportation was all by truck. The production of crushed conglomerate for concrete aggregate and roadstone decreased 56 percent in quantity and 45 percent in value during 1965.

Providence.—The total value of all minerals produced in Providence County was $1.6 million—over one-half of the State total. Compared with 1964, the volume of the total county production of minerals increased 8 percent, but decreased 3 percent in value. Sand and gravel accounted for 56 percent of value; stone production accounted for the remainder. The value of the sand and gravel was 10 percent greater than in 1964; the value of the stone output was 16 percent less.

The output of sand increased for both building and paving purposes and the revenue therefrom more than offset the loss of market for other uses, mainly ice control. The production of sand for fill was relatively unchanged from 1964. The value of gravel produced was 15 percent greater than in the previous year. Gravel for building purposes increased in production but declined in value due to an average unit price decrease from $1.44 to $1.22 per ton. Gravel for paving and fill purposes increased in both output and value, more than offsetting the decline in value of building gravel.

Eighty percent of the sand and gravel output was processed by washing and screening. Transportation was entirely by truck. The principal producers of sand and gravel in Providence County during 1965 were A. Cardi Construction Co., Inc., at Coventry; Del Bonis Sand & Gravel Co., Cranston; Forte Bros., Inc., and Mack Sand & Gravel Co., both near Cumberland; Silvestri Bros., Inc., Johnston; Tasca Sand & Gravel Co., at Smithfield, and Town Line Sand & Gravel, Slatersville. The Andrews Sand & Gravel, Cranston, reported no production as their pit was condemned as part of a Federal highway system.

Compared with 1964, the output of stone in Providence County during 1965 decreased 6 percent in volume and 16 percent in value. The M. A. Gammino Construction Co., Cranstan, produced granitized schist, classed as "miscellaneous stone," for concrete aggregate, roadstone, and riprap. At its Lincoln quarry, The Conklin Limestone Co., produced crushed limestone for agricultural purposes, white marble pebbles for decorative aggregate, roofing gravel, special aggregate, blast furnace flux, and fertilizer filler. Some dimension limestone was produced for rubble. Transportation was principally by truck.

Washington.—The value of mineral production in Washington County increased significantly during 1965, and accounted for 18 percent of the State total for the year. Sand and gravel, while declining in volume, increased 16 percent in value, the result of a generally improved price per ton. The county ranked third in sand and gravel production. The production of stone increased in both output and value. Price increases were made on both crushed granite and dressed dimension granite for monumental stone. In stone output, the county ranked second in the State.

The production of sand for building purposes declined 55 percent in volume and 47 percent in value. The price per ton increased 16 percent over that of 1964. The output and value of paving sand remained the same. Gravel for building purposes increased 60 percent in tonnage and 115 percent in value due to a 35-percent increase in the price per ton. Paving gravel decreased 21 percent in tonnage but only 14 percent in value because of a 9-percent increase in the price per ton of material. There was no production of sand and gravel for the purpose of fill. The average unit price per ton of processed sand and gravel was $1.52 in 1965, compared with $1.11 in 1964. Unprocessed material sold for $0.44 during both years. Of the production, 84 percent was washed and screened during 1965. Transportation was entirely by truck. The South County Sand & Gravel Co., South Kingstown, produced sand and gravel for building and paving.

Louis B. Schaeffer at Peace Dale produced gravel for paving purposes. J. Romanella, Westerly, was idle during the year.

Westerly Granite Corp., Westerly, produced dressed granite monumental stone from its Bradford quarry. Some stone was also produced for construction purposes. Gencarelli, Inc., at Westerly, removed granite from its stockpile for use as riprap. Rough dimension granite for monumental stone was quarried during the year. Effective January 1, 1966, the Providence Granite Co. will assume operation of the Westerly quarry.

The Mineral Industry of South Carolina

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the South Carolina Geological Survey for collecting information on all minerals except fuels.

By Robert C. Johnson [1] and Henry S. Johnson, Jr.[2]

Mineral production in 1965 increased $2.5 million over that of 1964, setting a new record with a total value of $41 million. The increase in value was due mainly to greater production of sand and gravel, masonry and portland cement, and vermiculite. Values also increased for crushed limestone, barite, feldspar, scrap mica, and pyrite.

Commodities establishing record highs were sand and gravel, miscellaneous clay, crushed limestone, barite, masonry and portland cement, pyrite and vermiculite. Leading companies mining and processing minerals were Giant Portland Cement Co. (masonry and portland cement, miscellaneous clay, and crushed limestone); J. M. Huber Corp. (kaolin); Campbell Limestone Co. (crushed limestone and crushed granite); Becker County Sand & Gravel Co. (sand and gravel); Palmetto Quarries Co. (crushed granite); and Zonolite Co. (vermiculite).

Among the States, South Carolina ranked second in the production of kaolin, with 16 percent of the national total, and second in the production of kyanite.

Trends and Developments.—The Division of Geology, State Development Board, continued geologic and mineral resource studies of the State. At yearend, 21 projects were at various stages of completion. Specific county studies were of Edgefield, Newberry, Oconee, Orangeburg, Pickens, and York Counties. Quadrangles mapped or being mapped for publication in MS Series were Clemson (7½ minute), La France (7½ minute), Blaney (7½ minute), Blythewood (7½ minute), Eutawville (15 minute), Sumter West (7½ minute), Irmo (7½ minute), Wampee (7½ minute), Myrtle Beach (15 minute), James Island (7½ minute), Six Mile (7½ minute), and Lake View

[1] Geologist, Bureau of Mines, Knoxville, Tenn.
[2] State geologist, South Carolina Geological Survey, Columbia, S.C.

Table 1.—Mineral production in South Carolina [1]

Mineral		1964		1965	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Clays	thousand short tons	1,743	$8,309	1,837	$8,539
Pyrites	thousand long tons	W	W	4	67
Sand and gravel	thousand short tons	4,622	5,262	5,248	6,688
Stone [2]	do	6,109	9,176	5,948	8,447
Value of items that cannot be disclosed: Barite, cement, feldspar, kyanite, scrap mica, peat, stone (dimension granite, 1965, and crushed limestone), vermiculite and value indicated by symbol W		XX	15,966	XX	17,520
Total		XX	38,713	XX	41,261

W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed."
XX Not applicable.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Excludes certain stone; included with "Value of items that cannot be disclosed."

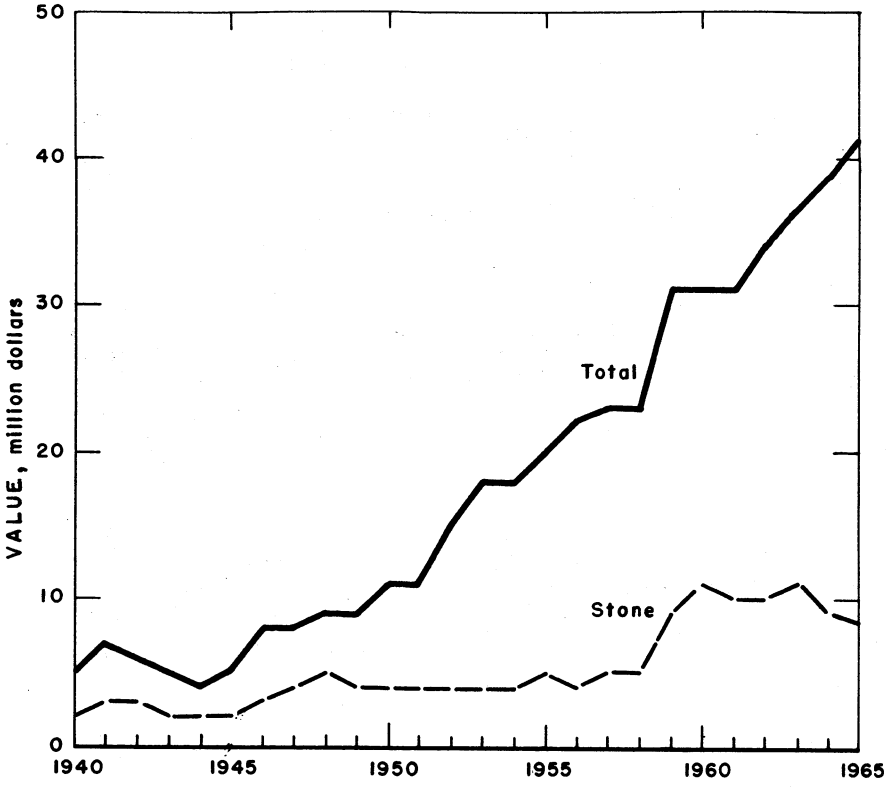

Figure 1.—Value of stone, and total value of mineral production in South Carolina.

Table 2.—Value of mineral production in constant 1957–59 dollars

(Thousands)

Year	Value
1956	$20,917
1957	22,513
1958	22,360
1959	30,033
1960	30,426
1961	30,336
1962	33,941
1963	r 35,641
1964	r 39,024
1965	p 40,278

r Revised. p Preliminary.

(7½ minute). Reports published during 1965 were "Clays and Opal-Bearing Claystones of the South Carolina Coastal Plain", Bulletin 31; "Geology of the Clemson Quadrangle, South Carolina", MS–9; "Geology of the LaFrance Quadrangle, South Carolina", MS–10; "Geology of the Blaney Quadrangle, South Carolina", MS–11; "Geologic Notes", Volume 8, Numbers 5 and 6; and "Geologic Notes", Volume 9, Numbers 1 through 3.

At yearend, 346 miles of South Carolina's total Interstate Highway System was open to traffic. Work was in progress on the remaining 333 miles designated for the State.

Carolina Power & Light Co. finished preliminary research and economic studies on its proposed 700,000-kilowatt nuclear power generating plant to be constructed near Hartsville. The project will cost about $70 million and is expected to be in operation by the early summer of 1970.

Table 3.—Employment and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1964:								
Nonmetal and peat	960	261	251	2,091	----	41	19.60	732
Sand and gravel	289	253	73	590	1	13	23.75	10,543
Stone	819	253	207	1,687	----	25	14.82	564
Total	2,068	257	531	4,368	1	79	18.32	1,991
1965: p								
Nonmetal and peat	1,202	265	319	2,650	----	35	13.21	2,182
Sand and gravel	435	242	105	845	1	27	33.14	11,989
Stone	740	272	201	1,636	----	28	17.11	527
Total	2,377	263	625	5,131	1	90	17.74	3,269

p Preliminary.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Nonmetals accounted for virtually the entire mineral production of the State. A small quantity of peat was mined and sold for use in agriculture.

Barite.—Industrial Minerals, Inc., at Kings Creek in Cherokee County, the only barite producer in South Carolina, established a record year, with a small increase in production. The barite was ground and used as rubber filler.

Cement.—Carolina Giant Division of Giant Portland Cement Co., near Harleyville, Dorchester County, increased production of both masonry and portland cement, establishing a new record year. Masonry cement shipments increased 14 percent and value increased 7 percent. Unit prices continued to decrease with increases in production and value, a trend which extends back to 1957. Portland cement shipments increased 7 percent in output and 4 percent in value. A decrease in unit price also continued to accompany increased production and value of portland cement. Finished products were shipped to nearby marketing areas, some of which are out of the State.

Santee Portland Cement Corp. started construction of a $10 million cement plant near Holly Hill.[3] The plant will be able to produce 2 million barrels of cement per year after completion.

Clays.—South Carolina continued to rank second among the States in the production of kaolin. Clay production in 1965 accounted for 21 percent of the State's total mineral production value. Production increased 5 percent and value increased 3 percent over that of 1964. As in 1964, 6 companies operated 11 mines in Aiken County. In Richland County two companies operated two mines. Producers in Aiken County, listed in order of decreasing production, were J. M. Huber Corp., Dixie Clay Co., National Kaolin Products Corp., Southeastern Clay Co., Cyprus Mines Corp., and Bell Kaolin Co. Richland County producers were Columbia Pipe Co. and D. T. Duncan. Kaolin was used primarily as rubber filler and in the manufacture of paper, fertilizers, whiteware, saggers, insecticides, firebrick, paint, plaster, and other products. Exports of kaolin totaled 26,000 tons.

Miscellaneous clay production established a new record with increases of 7 percent in production and value. Output was 1.3 million tons valued at $1.2 million. Miscellaneous clay was produced by 16 companies from 20 mines in 13 counties. Leading counties were Dorchester, Richland, Aiken, and Greenwood. Leading producers were Giant Portland Cement Co., Georgia-Carolina Brick Co., Columbia Brick & Tile Co., and Southern Brick Co. Miscellaneous clay was used primarily manufacturing cement, brick, draintile, and sewer pipe.

Pee Dee Ceramics, Inc., announced plans for doubling brick production within 5

[3] Rock Products. V. 68, No. 9, September 1965, p. 128.

Table 4.—Kaolin sold or used by producers, by uses

Use	1964			1965		
	Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per ton
Rubber	361,974	$5,236,761	$14.47	261,940	$3,027,958	$11.56
Fertilizers	W	W	W	32,891	288,200	8.76
Whiteware, etc	W	W	W	26,165	528,050	20.18
Paper filling	W	W	W	13,659	294,400	21.55
Insecticides and fungicides	9,011	112,561	12.49	8,654	108,080	12.49
Firebrick and block	54,759	394,321	7.20	7,508	54,100	7.21
Architectural terracotta	3,450	69,000	20.00	W	W	W
Plaster and plaster products	3,800	66,366	17.46	3,350	58,460	17.45
Mortar	W	W	W	2,350	17,000	7.23
Other uses [1]	88,107	1,287,920	14.62	162,376	2,941,320	18.11
Total	521,101	7,166,929	13.75	518,893	7,317,568	14.10

W Withheld to avoid disclosing individual company confidential data; included with "Other uses."

[1] Includes foundries and steelworks, linoleum and oil cloth, paint, paper coating, other fillers, kiln furniture, exports (1965), other uses, and uses indicated by symbol W.

years, with initial goals set at 10 million brick per year.

Announcement was made that Waccamaw Clay Products Co. planned construction of a $1,232,000 brick plant in Horry County.

Feldspar.—Spartan Minerals Co., Pacolet, continued production of a feldspar-silica product from Campbell Limestone Co., Pacolet granite quarry. The material, obtained from granite screenings, was ground and shipped out of the State for various uses.

Kyanite.—Commercialores, Inc., continued production of kyanite in York County. The material was ground and shipped to refractories manufacturers.

Lime.—Regenerated or recirculated lime was produced by four companies for use in paper manufacture and wood processing. Production in 1965 totaled 311,000 tons valued at $348,000, reflecting a unit price decrease in comparison with 1964 values.

Mica.—Mineral Mining Corp., Kershaw, Lancaster County, continued to mine a mica schist deposit for recovery of scrap mica. Production increased for the second consecutive year but did not exceed the record output of 1962. The mica was dry ground and shipped to manufacturers for use in pipeline enamel, paint, plastics, welding rods, and electrical products.

Pyrite.—Commercialores, Inc., York County, established another record year in production and value of pyrite recovered as a byproduct of kyanite ore milling. The pyrite was shipped out of the State.

Sand and Gravel.—An alltime record was established in 1965 for sand and gravel with production of 5.2 million tons valued at $6.7 million. Sand and/or gravel was produced by 21 companies in 18 counties from 26 mines. Sand constituted 68 percent of total production and represented 55 percent of the total value. Of the sand and gravel, 77 percent was processed before shipment. Fifty-three percent was shipped by truck and 47 percent by rail. Leading counties producing sand and gravel in order of decreasing output were Marlboro, Lexington, Sumter, Lancaster, Chesterfield, and Aiken. Total production from these counties accounted for 79 percent of the State's sand and gravel output. Leading individual producers in order of decreasing rank were Becker County Sand & Gravel Co., with mines in Chesterfield, Dorchester, Marlboro, and Sumter Counties; Columbia Silica Sand Co., in Lexington County; and Brewer Sand Co., in Lancaster County. Construction sand was used for building, paving, railroad ballast, and other uses.

Southern Silica Mining & Mfg. Co., with operations in Lexington County, reported for the first year.

Stone.—Both production and value of dimension granite and crushed granite decreased slightly in 1965. Crushed limestone production and value increased over previous years and set an alltime high record.

Crushed granite was produced in 8 counties by 9 companies from 10 quarries. Leading producing counties were Pickens, Lexington, Richland, Greenville, Fairfield, and Spartanburg. Leading producers in

Table 5.—Sand sold or used by producers, by uses [1]
(Thousand short tons and thousand dollars)

Use	1964			1965		
	Quantity	Value		Quantity	Value	
		Total	Average per ton		Total	Average per ton
Structural	2,015	$1,221	$0.61	2,628	$1,713	$0.65
Paving	823	380	.46	418	199	.48
Fill	39	25	.64	27	17	.63
Blast	9	41	4.56	10	45	4.50

[1] Excludes glass, molding, fire or furnace, engine, filtration, chemical, pottery, filler, and other sands; withheld to avoid disclosing individual company confidential data.

Table 6.—Sand and gravel sold or used by producers, by counties
(Thousand short tons and thousand dollars)

County	1964		1965	
	Quantity	Value	Quantity	Value
Aiken	228	$203	284	$252
Greenville	61	34	58	32
Greenwood	110	73	W	W
Lancaster	533	198	400	200
Lexington	751	1,065	936	1,467
Pickens	11	13	W	W
Richland	88	39	77	28
Other counties [1]	2,840	3,637	3,493	4,709
Total	4,622	5,262	5,248	6,688

W Withheld to avoid disclosing individual company confidential data; included with "Other counties."
[1] Includes Cherokee, Chesterfield, Dorchester, Florence, Horry, Jasper, Kershaw, Marion, Marlboro, Spartanburg, and Sumter Counties, and counties indicated by symbol W.

order of descending rank were Campbell Limestone Co., with four quarries in four counties; Palmetto Quarries Co., who operated five quarries in four counties, and Weston & Brooker Co., who operated one quarry. Of the crushed granite, 72 percent was transported by truck and the remainder by railroad.

Dimension granite was mined in two counties, at three quarries, by two companies. Total production dropped slightly. Comolli Granite Co. operated Carolina Mahogany quarry and Carolina Diamond Grey quarry, both in Kershaw County. Winnsboro Granite Co. operated the Winnsboro Quarry in Fairfield County. All dimension granite was produced for use as rough monumental stone.

Crushed limestone was produced by three companies from three quarries in Cherokee and Dorchester Counties. The producers were Carolina Giant Division of Giant Portland Cement Co. (Dorchester County, Harleyville quarry) who produced for their own use in cement manufacture; Campbell Limestone Co. (Cherokee County, Blacksburg quarry), and Ideal Cement Co. (Dorchester, Carolina quarry). Chief uses for crushed limestone were in cement, roadstone, agricultural stone (agstone), and as flux for foundries. Of the crushed limestone, 89 percent was transported by truck and the remainder by rail.

Campbell Limestone Co. announced plans to construct an $80,000 accounting department building along with their $2 million expansion which was already underway in 1965.[4]

[4] The Dixie Contractor. V. 40, No. 19, Oct. 22, 1965.

Table 7.—Crushed granite sold or used by producers, by uses

Use	1964			1965		
	Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per ton
Concrete and roadstone	5,242,496	$7,651,578	$1.46	5,187,815	$7,230,838	$1.39
Railroad ballast	367,242	447,952	1.22	341,975	406,723	1.19
Other uses [1]	491,803	871,785	1.77	417,974	809,839	1.94
Total	6,101,541	8,971,315	1.47	5,947,764	8,447,400	1.42

[1] Includes stone sand, poultry grit, riprap, and other uses.

Vermiculite.—South Carolina established a new record high in vermiculite production and ranked second to Montana for the seventh consecutive year. The leading producer was Zonolite Division of W. R. Grace & Co., who mined in Laurens County and shipped the vermiculite to its Traveler's Rest exfoliating plant and out of the State. Other producers were American Vermiculite Co. and Patterson Vermiculite Co., both of which operated mines and exfoliating plants in Laurens County. Vermiculite was used as loose fill insulation, in concrete, in building plaster, and for other uses.

METALS

Ferroalloys.—V–C Chemical Co., a division of Socony–Mobil Oil Co., Inc., Charleston, continued production of ferrophosphorus as a byproduct of elemental phosphorus furnace operations. Pittsburgh Metallurgical Co., Charleston, continued to produce ferrosilicon, ferrochromium, and ferrochromium-silicon.

Zirconium.—M & T Chemicals, Inc., near Andrews, Georgetown County, continued production of dry-milled and granular zircon for foundry refractory, ceramic, and glass industry use.

MINERAL FUELS

Peat.—Peat production was down from the record set in 1964. Ti–Ti Peat Humus Co., Colleton County, continued production of reed–sedge peat for use as a soil conditioner.

REVIEW BY COUNTIES

Mineral production was reported from 23 of the State's 46 counties, 1 county less than in 1964. Of the State's total mineral production value, 60 percent was from Dorchester, Aiken, Lexington, and Marlboro Counties, listed in order of decreasing value. Other counties with production value in excess of $1 million were Laurens, Fairfield, Pickens, Richland, Spartanburg, York, and Cherokee. The 10 leading counties accounted for 86 percent of the total State mineral production value, compared with 84 percent in 1964.

Aiken.—Aiken continued as one of the State's two counties with kaolin production. Kaolin producers, in order of decreasing output, were J. M. Huber Corp. (Barden, Ideal, and Paragon mines), Dixie Clay Co. (McNamee mine), National Kaolin Products Co. (Aiken County mine), Southeastern Clay Co. (Seigler Johnson, Rodgers, and Toole mines), Cyprus Mines Corp. (No. 7 mine), and Bell Kaolin Co. (Batesburg mine).

Two companies, Perry Minerals Co. Inc. (Clearwater mine) and Augusta Sand & Gravel Co. (Clearwater mine) mined sand and gravel. Miscellaneous clay was mined by Georgia-Carolina Brick & Tile Co. for use in brick manufacture.

Charleston.—West Virginia Pulp & Paper Co. (Charleston limekiln) continued production of recirculated industrial lime for use in pulp and paper manufacture. Both production and value increased over that of 1964. The company reported crude iodine consumption for the second year. Ferroalloys continued to be produced by Pittsburgh Metallurgical Co. Inc. and V–C Chemical Corp., a division of Socony-Mobil Oil Co. Inc.

Cherokee.—Campbell Limestone Co. (Blacksburg quarry) remained the leading mineral producer in the county, with increased output and value over that of 1964. The company shipped crushed limestone for use as flux, agricultural lime, and fertilizer filler. Jobe Sand Co. mined industrial sand from its Blacksburg mine. Industrial Minerals, Inc. (Kings Creek mine), remained the State's only barite producer. Output of barite was about the same as in 1964. Miscellaneous clay for use in manufacturing building brick was mined by Broad River Brick Co.

Chesterfield.—Becker County Sand & Gravel Co. mined sand and gravel at its Cash mine for use in building and paving. Output and value decreased from that reported for 1964. F. T. Williams Co. (Pageland mine) produced building sand. Both production and value decreased.

Colleton.—Ti–Ti Peat Humus Co., the only peat producer in the State, produced reed-sedge peat for use as a soil conditioner. Both tonnage and value decreased considerably from figures reported for 1964.

Table 8.—Value of mineral production in South Carolina, by counties [1]

County	1964	1965	Minerals produced in 1965 in order of value
Aiken	$6,905,049	$7,350,208	Kaolin, sand and gravel, miscellaneous clay.
Anderson	W		
Cherokee	963,935	1,150,000	Limestone, barite, sand and gravel, miscellaneous clay.
Chesterfield	W	W	Sand and gravel.
Colleton	W	W	Peat.
Dorchester	W	W	Cement, limestone, miscellaneous clay, sand and gravel.
Edgefield	W	W	Granite, miscellaneous clay.
Fairfield	W	W	Do.
Florence	W	W	Sand and gravel.
Greenville	W	W	Granite, sand and gravel.
Greenwood	W	W	Granite, miscellaneous clay, sand and gravel.
Horry	W	W	Sand and gravel.
Jasper	W	W	Do.
Kershaw	W	W	Sand and gravel, granite, miscellaneous clay.
Lancaster	W	W	Mica, sand and gravel, miscellaneous clay.
Laurens	W	W	Vermiculite.
Lexington	W	3,203,757	Sand and gravel, granite, kaolin, miscellaneous clay.
Marion	W	W	Miscellaneous clay, sand and gravel.
Marlboro	W	W	Sand and gravel, miscellaneous clay.
Pickens	W	W	Granite, sand and gravel.
Richland	1,765,330	W	Granite, kaolin, miscellaneous clay, sand and gravel.
Spartanburg	W	W	Granite, feldspar, sand and gravel.
Sumter	W	W	Sand and gravel, miscellaneous clay.
York	W	W	Kyanite, granite, pyrites.
Undistributed	29,078,686	29,557,035	
Total	38,713,000	41,261,000	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed"
[1]The following counties are not listed because no production was reported: Abbeville, Allendale, Bamberg, Barnwell, Beaufort, Berkeley, Calhoun, Charleston, Chester, Clarendon, Darlington, Dillon, Georgetown, Hampton, Lee, McCormick, Newberry, Oconee, Orangeburg, Saluda, Union, and Williamsburg.

Dorchester.—Dorchester County, for the 10th consecutive year, led the State in value of mineral production. Carolina Giant Division of Giant Portland Cement Co., the largest producer in the county, produced crushed limestone and miscellaneous clay and used them in the manufacture of masonry and portland cement. Production and value of all four of these commodities increased over that of 1964. Becker County Sand & Gravel Co. (Summerville mine) and Murray Mines Co. (Murray mine) mined sand for use in building and paving. Production and value increased over that of 1964. Ideal Cement Co. (Carolina quarry) crushed limestone for use as asphalt filler and agricultural lime. Salisbury Brick Co. (Salisbury mine) and Dorchester Ceramics, Inc., mined miscellaneous clay for use in brick manufacture.

Edgefield.—Palmetto Quarries Co. (McCormick quarry) produced crushed granite for its second year. Merry Bros. Brick & Tile Co. mined miscellaneous clay for use in building brick manufacture. Output and value of its miscellaneous clay was greater than in 1964.

Fairfield.—Palmetto Quarries Co. (Blair quarry) and Rion Crushed Stone Co. (Rion quarry) produced crushed granite for use mainly in concrete and as roadstone. Output and value remained at about the same level as reported for 1964. Winnsboro Granite Co. (Winnsboro quarry) produced dimension granite for use as monumental stone. Richland Shale Products Co. (Richtex mine) and Carolina Ceramics, Inc., mined miscellaneous clay for building brick manufacture.

Florence.—Coastal Sand Co. (Johnsonville mine) and Lanford Sand Co. (Florence mine) produced building sand, with output and value increasing for Coastal and decreasing for Lanford, in comparison with 1964 figures. South Carolina Industries, Inc. (Florence limekiln), produced regenerated industrial quicklime for use in pulp and paper manufacture.

Georgetown.—International Paper Co. (Georgetown limekiln) continued production of regenerated quicklime for use in manufacturing pulp and paper. Production decreased slightly, but value decreased substantially.

Greenville.—Campbell Limestone Co. (Lakeside quarry crushed granite for concrete, roadstone, and railroad ballast. Production and value of crushed granite were lower than that of 1964. Zupan Sand Co. (Greenville mine) and W. M. Barber Sand Co. (Greenville mine) produced sand for use in building, fill, and paving; production and value decreased. Zonolite Co. (Traveler's Rest plant), a division of W. R. Grace & Co., exfoliated vermiculite shipped from its Enoree mine in Laurens County. The exfoliated vermiculite was used in building plaster, in concrete, as loose fill insulation, and in agriculture.

Greenwood.—Palmetto Quarries Co. (Stoney Point and Coronaca quarries) produced crushed granite for use in concrete and as stone sand. Coronaca quarry was a new operation in 1965. Production and value decreased slightly at the Stoney Point quarry. Southern Brick Co. (Ninety-Six mine) produced miscellaneous clay for use in building brick manufacture. Production and value decreased slightly under 1964 figures. Wilson Bros. Sand Co. (Hodges mine) and Perry Minerals Co. Inc. (Ware Shoals mine) continued production of paving sand and Perry Minerals Co. Inc. reported gravel production for the first year.

Horry.—E. P. Pitts Sand Corp. (Pitts mine) mined sand for glass manufacture. Production remained at about the same level as in 1964.

Jasper.—Deerfield Sand & Mining Co. (Deerfield mine) produced sand for use in building and paving. Production and value dropped markedly in 1965.

Kershaw.—Whitehead Bros. Co. (Lugoff mine) produced sand for use in building and for fill and molding purposes; production and value increased. Mineral Mining Corp. (Kershaw grinding plant) ground scrap mica obtained from a schist deposit in Lancaster County; output and value increased. Comolli Granite Co. produced dimension granite for monumental use at two mines (Carolina Mahogany and Carolina Diamond Gray quarries); production and value increased. Carolina Ceramics, Inc. (Kershaw mine), and Eastern Brick & Tile Co. (new mine) produced miscellaneous clay for use in building brick manufacture.

Lancaster.—The Mineral Mining Corp. (Kershaw strip mine) mined scrap mica from a schist deposit for grinding in its Kershaw grinding plant in Kershaw County; production and value increased. The processed mica was used in the manufacture of paint, electrical insulation, plastics, welding rods, and pipeline enamel. Brewer Sand Co. (Brewer mine) produced building sand; production decreased and value increased. Ashe Brick Co. (Van Wyck mine) mined miscellaneous clay for use in manufacturing brick. Both production and value decreased slightly.

Laurens.—Vermiculite was mined by three companies and exfoliated by two in Laurens County. Zonolite Division of W. R. Grace & Co. (Enoree mine) mined and shipped processed vermiculite to its exfoliating plant near Traveler's Rest and to other exfoliating plants in the Southeastern States. Production and value increased over that of 1964. Patterson Vermiculite Co. (Laurens County mine) produced crude vermiculite and exfoliated it at its Enoree plant; production and value increased. American Vermiculite Co. (Donnon and Courtney mines) produced crude ore and exfoliated it at its Enoree plant; production and value increased. Vermiculite was used mainly in building plaster, in concrete, and in agriculture.

Lexington.—Weston & Brooker Co. (Cayce quarry) produced and crushed granite for use in concrete and as railroad ballast, stone sand, and riprap. Pennsylvania Glass Sand Corp. (Columbia mine) produced industrial sand for glass, molding, blast, engine, and chemical uses. Sand was ground for use as filler and in glass, pottery, building products, and chemical products. Columbia Silica Sand Co. (Edmund mine) mined sand for paving, building, filtration, engine, fertilizer filler, and furnace uses. Foster Bros. Dixiana Sand Co. (Dixiana mine) produced sand for building, blast, filtration, and filler use. Southern Silica Mining & Manufacturing Co. (Dixiana mine) produced building sand. Sand production and value in the county increased over that of 1964. Guignard Brick Co. produced kaolin at its new kaolin mine and miscellaneous clay at its Columbia mine. Production and value of miscellaneous clay decreased from 1964 figures. Primary use of the company's output from both mines was in brick manufacture.

Marion.—Pee Dee Ceramics, Inc. (Pee Dee mine), mined miscellaneous clay for use in building brick manufacture. Produc-

tion and value decreased in 1965. Sandy Bluff Sand Co. (Snipes mine) produced sand for use in building; production and value increased.

Marlboro.—Becker County Sand & Gravel Co. (Marlboro mine) produced sand and gravel for paving and building purposes. Gravel was also used for railroad ballast and in the chemicals and metals industries. Both production and value increased substantially in 1965. Palmetto Brick Co. (Irby mine) and Cheraw Brick Works, Inc. (Cheraw mine), produced miscellaneous clay for building brick manufacture; production and value was about the same as that for 1964.

Pickens.—Campbell Limestone Co. (Beverly quarry) crushed granite for use as riprap and stone sand and in concrete. The Beverly quarry continued to have the largest crushed granite production in the State. Both production and value increased. Horton & Holliday (Pickens mine) produced building sand for the second year; production and value decreased.

Richland.—Palmetto Quarries Co. (Columbia quarry) crushed granite for use in concrete and as railroad ballast and stone sand; production and value increased slightly. Columbia Brick & Tile Co. (Columbia mine), Eastern Brick & Tile Co. (601 mine), and Carolina Ceramics, Inc. (Richland mine) produced miscellaneous clay for brick manufacture; production and value decreased from 1964 figures for these three mines. Columbia Pipe Co. (Ridgewood mine) and D. T. Duncan produced kaolin used mainly for manufacture of firebrick. Harrison Sand Corp. (Harrison mine) produced sand for building and filler purposes. Columbia Organic Chemical Co. Inc. reported crude iodine consumption for the second consecutive year.

Spartanburg.—Campbell Limestone Co. (Pacolet quarry) crushed granite for use as riprap and railroad ballast and in concrete; production and value increased. Spartan Minerals Co. (Pacolet mine) recovered feldspar from granite screenings at Campbell Limestone Co.'s Pacolet quarry and ground the feldspar at its Pacolet grinding plant. The feldspar was used in glass and pottery manufacture and for rubber filler. Production and value increased over that of 1964. L. G. Chapman Sand Pit, Inc. (Chapman mine), produced sand for building and fill and gravel for paving; production and value increased.

Sumter.—Becker County Sand & Gravel Co. (Camden mine) increased production of sand and gravel for use in building and paving and as railroad ballast. Value increased also in 1965. Eastern Brick & Tile Co. (Wedgefield mine) mined miscellaneous clay for use in building brick manufacture.

York.—Commercialores, Inc. (Henry Knob mine), produced kyanite and recovered pyrite from mill tailings. Production and value increased for pyrite and decreased for kyanite. Kyanite was used in refractory manufacture. Superior Stone Co. (Pineville quarry) crushed granite; production and value decreased below figures reported for 1964. Bowater Carolina Corp. (Catawba limekiln) produced regenerated quicklime for pulp and paper manufacture; production increased but value decreased.

237-043 O-67—47

The Mineral Industry of South Dakota

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the South Dakota State Geological Survey for collecting information on all minerals except fuels.

By R. B. Stotelmeyer,[1] William C. Henkes,[2] and Duncan J. McGregor [3]

Mineral production valued at $50.2 million, declined for the second year from the record high of $54.1 million recorded in 1963. Decreased demand for some mineral products resulted in a 5-percent decline in value, compared with the 1964 value.

Nonmetals decreased $1.8 million, 6 percent, in value of production, mainly because of a decline in cement shipments and a drop in production of crushed sandstone for road construction. Metals declined 3 percent in value ($775,000) chiefly because of greatly reduced uranium ore output. Fuels declined 13 percent but, as the dollar value was insignificant, this decline did not affect the over-all total. The State was the leading gold producer in the Nation for the 17th consecutive year.

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Table 1.—Mineral production in South Dakota [1]

Mineral		1964		1965	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:					
Masonry	thousand 280-pound barrels	57	$200	55	$180
Portland	thousand 376-pound barrels	2,001	6,873	1,575	5,127
Clays	thousand short tons	245	1,076	223	1,220
Coal (lignite)	do	13	63	10	49
Feldspar	long tons	26,980	180	51,560	346
Gem stones		NA	20	NA	20
Gold (recoverable content of ores, etc.)	troy ounces	616,913	21,592	628,259	21,989
Gypsum	thousand short tons	19	76	7	27
Lithium minerals	short tons	W	W	150	5
Mica (scrap)	do	996	32	W	W
Petroleum (crude)	thousand 42-gallon barrels	247	495	219	438
Sand and gravel	thousand short tons	13,770	13,641	13,998	14,155
Silver (recoverable content of ores, etc.)	thousand troy ounces	133	172	129	167
Stone	thousand short tons	2,118	6,245	1,554	5,387
Uranium ore	short tons	110,147	1,551	44,738	303
Value of items that cannot be disclosed: Beryllium concentrate, lime, molybdenum, vanadium, and values indicated by symbol W		XX	608	XX	762
Total		XX	52,824	XX	50,175

W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed." NA Not available. XX Not applicable.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

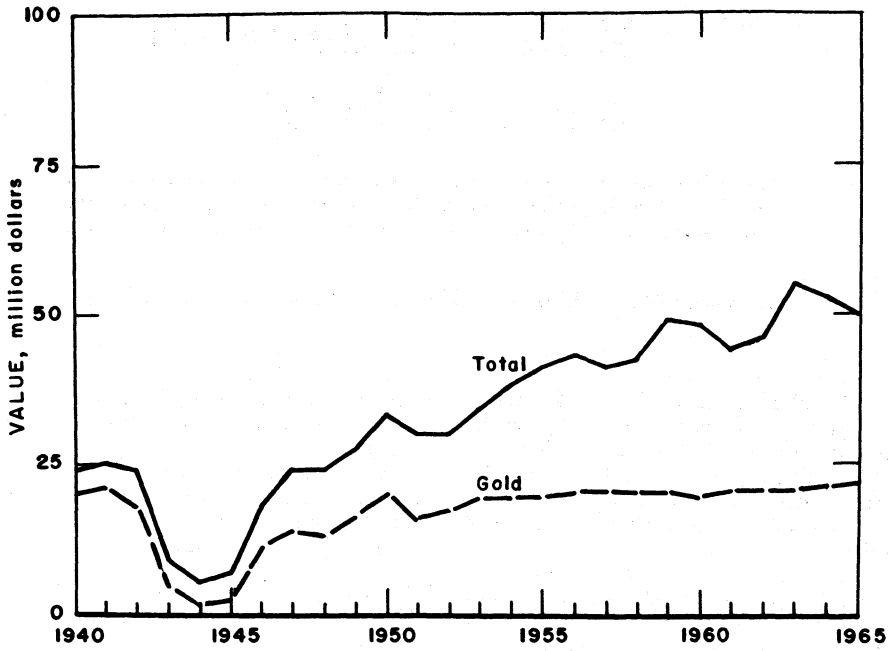

Figure 1.—Value of gold and total value of mineral production in South Dakota.

Table 2.—Value of mineral production in constant 1957–59 dollars

(Thousands)

Year	Value
1956	$41,836
1957	40,241
1958	41,733
1959	48,009
1960	46,638
1961	43,785
1962	44,378
1963	r 51,517
1964	r 49,708
1965	47,308

r Revised.

Employment and Injuries.—Final statistics of employment and injuries in the mineral industries for 1964, excluding the petroleum industry, and preliminary data for 1965, are given in table 3.

Government Programs.—A study of the mineral industries of South Dakota was completed by the Federal Bureau of Mines and was being reviewed for publication. The study was conducted to determine the economic factors bearing on the production, utilization, and marketing of minerals in the State. An investigation of occurences of iron ore disclosed the probability of large resources of taconite iron ore in Pennington and Lawrence Counties.[4] A report was published on experiments with liquid-plastic bonding of fractured rock walls at the Homestake gold mine at Lead.[5] A joint study of the natural resources of the Black Hills by the U.S. Departments of Agriculture and Interior was nearly completed. A report was to be published in late 1966.

[4] Harrer, C. M. Iron Resources of South Dakota. BuMines Inf. Circ. 8278, 1966, 160 pp.

[5] Oitto, Richard H., Jr. Use of Polyester-Type Resin to Stabilize Fractured Rock: A Progress Report. BuMines Rept. of Inv. 6626, 1965, 16 pp.

Table 3.—Employment and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1964:								
Coal	3	333	1	6	-------	-------	-------	-------
Metal	2,037	302	616	4,928	1	70	14.41	2,020
Nonmetal	225	258	58	471	-------	9	19.12	894
Sand and gravel	935	167	156	1,278	1	28	22.70	5,519
Stone	500	230	115	954	-------	30	31.43	898
Total	3,700	256	946	7,637	2	137	18.20	2,406
1965:p								
Coal	5	200	1	4	-------	-------	-------	-------
Metal	1,865	299	558	4,465	3	82	19.04	6,621
Nonmetal	210	290	61	501	-------	9	17.96	437
Sand and gravel	1,130	163	184	1,512	-------	21	13.89	389
Stone	470	219	103	850	1	20	24.71	7,911
Total	3,680	246	907	7,332	4	132	18.55	5,059

p Preliminary.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Cement.—A decrease in construction activity effected a 21-percent decline in portland cement shipments from the South Dakota Cement Commission cement plant at Rapid City. Production was 61 percent of the annual plant capacity of 2.6 million barrels. Shipments of masonry cement declined 4 percent. Lower prices also contributed to a decline in the value of shipments.

Ready-mixed concrete companies received 39 percent of the portland cement shipped; highway contractors 27 percent; building material dealers 20 percent; and concrete product manufacturers, other contractors, Government agencies, and miscellaneous customers the remaining 14 percent. Sixty-three percent of the cement shipments was by railroad.

Raw materials consumed included 417,000 tons of limestone, shale, gypsum, sand, and iron ore. More than 29 million kilowatt-hours of electrical energy was used in the operation of the plant.

Clays.—American Colloid Co. produced bentonite from leased State-owned land in Butte County. The bentonite was processed at the company plant near Belle Fourche, as was crude material mined by the company in Wyoming. Bentonite from other Wyoming deposits was processed at the International Minerals & Chemical Corp. (IMC) plant, also near Belle Fourche. Bentonite was used as a refractory in foundries and as a filler in manufacturing paper and insecticides; for reservoir, pond, and ditch lining, filtering, briquet binding, and enameling; and in preparing rotary drilling mud, animal feed, plasters, and adhesives. A substantial portion of the total output was exported.

Miscellaneous clay was produced by Black Hills Clay Products Co. The company manufactured building brick at its plant at Belle Fourche. Shale was produced by Light Aggregates, Inc., of Rapid City, for use in manufacturing lightweight aggregate and by the South Dakota Cement Commission, for manufacturing cement.

Feldspar.—A 92-percent increase was recorded in the value of feldspar output. Production was from 35 mines, 8 in Pennington County and 27 in Custer County, compared with 24 mines in 1964. All the feldspar was of the potash variety.

IMC mined or purchased most of the output, which was ground at its plant near Custer. Crude ore (handsorted or handpicked) was shipped for special uses, principally porcelain, glass, and pottery. Other uses were for enamel and brick, and tile. Flotation concentrates were used for welding rod and in soaps and abrasives. The feldspar was shipped to users in more than 16 States and to Canada and Mexico.

Gypsum.—The South Dakota Cement Commission mined gypsum from an open-pit mine in Pennington County. The gypsum was added to portland cement to retard the rate of setting. Output declined 63 percent. This decline necessitated the use of stockpiled material and caused a decrease in cement production.

Lime.—Although the quantity of lime produced in the State declined 4 percent, a 3-percent increase in production value was recorded. Hydrated lime, most of which was used as a soil stabilizer in highway construction, was produced by Pete Lien & Sons, near Rapid City. Quicklime output was reported by the company for the first time. The plant began operations in 1964.

In Custer County, Black Hills Lime Co. at Pringle continued to produce quicklime for metallurgical uses. In Butte County, Utah-Idaho Sugar Co. discontinued lime production used in manufacturing beet sugar at the company Belle Fourche plant. Constructed in 1927, the plant was closed in January 1965.

Lithium.—Lithium mineral output from the Ingersoll mine near Keystone, Pennington County, was 50 tons of lepidolite and 25 tons of amblygonite. L. W. Judson produced 75 tons of amblygonite from the Hugo mine, also in Pennington County.

Mica.— Output of scrap mica came from three mines near Keystone. Keystone Chemical Co. operated the Ingersoll mine, and the Northwest Beryllium Corp. operated Hugo and Peerless mines. The Peerless mine was converted entirely to

Table 4.—Sand and gravel sold or used by producers by classes of operations and uses
(Thousand short tons and thousand dollars)

Class of operation and use	1964		1965	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Construction:				
Building	381	$395	420	$503
Paving	301	293	200	249
Fill	20	16	39	30
Other	35	35	--	--
Total	737	739	659	782
Gravel:				
Construction:				
Building	276	354	305	364
Paving	1,468	1,326	1,547	1,796
Railroad ballast	24	21	32	38
Fill	54	34	57	38
Other	--	--	8	8
Miscellaneous	--	--	2	1
Total	1,822	1,735	1,951	2,245
Total sand and gravel	2,559	2,474	2,610	3,027
Government-and-contractor operations:				
Sand:				
Building	12	12	(1)	1
Paving	2,423	2,423	2,772	2,773
Other	--	--	7	6
Total	2,435	2,435	2,779	2,780
Gravel:				
Building	46	46	66	55
Paving	8,730	8,686	8,543	8,293
Total	8,776	8,732	8,609	8,348
Total sand and gravel	11,211	11,167	11,388	11,128
All operations:				
Sand	3,172	3,174	3,438	3,562
Gravel	10,598	10,467	10,560	10,593
Total	13,770	13,641	13,998	14,155

[1] Less than ½ unit.

opencut mining. During the year both underground and opencut methods had been used.

Table 5.—Sand and gravel production in 1965, by counties

(Thousand short tons and thousand dollars)

County	Quantity	Value
Aurora	392	$382
Beadle	99	99
Bennett	77	77
Bon Homme	269	289
Brookings	515	543
Brown	385	464
Brule	746	747
Buffalo	4	4
Butte	347	400
Campbell	80	83
Charles Mix	475	472
Clark	232	197
Clay	62	62
Codington	653	631
Corson	758	644
Custer	8	8
Davison	173	176
Day	314	371
Deuel	135	141
Dewey	19	19
Douglas	259	266
Edmunds	70	70
Fall River	W	W
Faulk	166	166
Grant	135	135
Gregory	246	256
Haakon	30	30
Hamlin	10	17
Hand	50	50
Hanson	363	363
Harding	48	48
Hughes	67	67
Hutchinson	293	295
Hyde	25	25
Jackson	15	15
Jerauld	42	42
Kingsbury	270	268
Lake	97	99
Lawrence	179	182
Lincoln	552	561
Lyman	184	200
Marshall	136	127
McCook	659	659
McPherson	161	161
Meade	237	186
Mellette	65	65
Miner	30	30
Minnehaha	856	905
Moody	262	229
Pennington	318	325
Perkins	331	335
Roberts	404	438
Sanborn	98	87
Shannon	37	37
Spink	284	284
Stanley	27	27
Sully	108	108
Todd	26	26
Tripp	57	57
Turner	273	259
Union	209	209
Walworth	451	496
Washabaugh	47	47
Yankton	W	W
Undistributed	78	94
Total	13,998	14,155

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

The mica was shipped to consumers in four other States. Mica was used mainly for paint and roofing materials.

Sand and Gravel.—Output of sand and gravel increased slightly. Minnehaha County led the State with a production of 856,000 tons; only Jones, Potter, and Ziebach Counties reported no production. The largest producers were Concrete Materials Co. of Sioux Falls in Minnehaha County and Liming Contracting of Belle Fourche, Butte County. Seven commercial operations in the State had an output of 100,000 tons or more.

Commercial operations, 79 in 34 counties, accounted for 19 percent of the production. There were 244 Government-and-contractor operations in 62 counties. The Government-and-contractor sand and gravel was produced for county and city highway departments, the State highway deparement, the U.S. Bureau of Public Roads, Federal Bureau of Indian Affairs, the U.S. Forest Service, and the South Dakota Cement Commission.

Construction gravel was 75 percent of the output, and the remainder was construction sand. The principal use for the sand and gravel was for paving (93 percent); other uses were for building, railroad ballast, and fill.

Essentially all of the sand and gravel was washed, sized, or otherwise prepared. The processing plants included 210 with portable and 23 with stationary equipment; 2 operators reported 1 of each type.

Stone.—Production of stone declined in value 14 percent. No crushed sandstone for use at Government-and-contractor operations was reported in 1965. A decline also was noted in output of crushed limestone. Partly offsetting the declines was an increase in output of dimension granite from Grant County. The granite operations at seven quarries accounted for 55 percent of the value of all stone produced in the State. Output of a small amount of dimension limestone (flagstone) in Pennington County was recorded. Crushed miscellaneous stone was produced in six counties for use as riprap and for concrete or roadstone.

All of the crushed limestone, produced for commercial use, was from eight quarries in Custer, Fall River, Lawrence, and Pennington Counties. Uses were for con-

Table 6.—Stone sold or used by producers, by kinds

Year	Granite		Limestone		Sandstone [1]	
	Short tons	Value	Short tons	Value	Short tons	Value
1961	26,476	$2,823,441	1,378,062	$1,939,293	984,512	$1,493,464
1962	25,923	2,442,181	1,572,300	2,184,374	1,119,655	1,779,639
1963	24,630	2,761,546	1,652,571	2,427,016	1,033,749	2,070,837
1964	17,803	2,807,851	1,179,551	1,734,812	920,361	1,702,349
1965	20,129	2,944,586	868,726	1,411,917	650,847	1,006,609

Year	Other stone		Total	
	Short tons	Value	Short tons	Value
1961	417,391	$385,953	2,806,441	$6,642,151
1962	[2] 134,056	[2] 126,373	2,851,934	6,532,567
1963	82,618	79,310	2,793,568	7,338,709
1964	----------	----------	2,117,715	6,245,012
1965	14,068	24,117	1,553,770	5,387,229

[1] Includes quartz and quartzite.
[2] Includes slate.

Table 7.—Stone sold or used by producers, by uses

Use	1964		1965	
	Quantity	Value	Quantity	Value
Dimension stone:				
Rough construction and rubble---short tons	----------	----------	4,000	$6,000
Rough architectural---cubic feet	4,000	$15,810	W	W
Dressed architectural---do	16,410	110,136	116,335	[1] 869,679
Rough monumental---do	23,000	77,190	·	W
Dressed monumental---do	176,382	2,604,715	131,903	2,074,907
Flagging---do	----------	----------	25,000	3,000
Total (approximate, in short tons)	17,803	2,807,851	26,129	2,953,586
Crushed and broken stone:				
Riprap---short tons	258,242	529,044	33,858	45,915
Railroad ballast---do	220,958	330,974	285,167	392,220
Concrete and roadstone---do	1,108,020	1,778,340	821,577	1,294,181
Cement---do	431,680	647,520	312,564	562,615
Other---do	[2] 81,012	[2] 151,283	[3] 74,475	[3] 138,712
Total---do	2,099,912	3,437,161	1,527,641	2,433,643
Grand total stone (approximate, in short tons)	2,117,700	6,245,012	1,553,800	5,387,229

W Withheld to avoid disclosing individual company confidential data; included with "Dressed architectural."
[1] Includes rough architectural and rough monument.
[2] Includes stone used in asphalt filler, filter, lime, refractory, and roofing granules.
[3] Includes stone used in other filler, lime, and refractory.

crete and roadstone, manufacturing cement and lime, railroad ballast, riprap, and asphalt filler. Crushed limestone for use at Government-and-contractor operations was produced in Custer County for the Federal Bureau of Reclamation, in Lawrence County for the U.S. Forest Service, and in Pennington County for the U.S. Forest Service and the State highway department.

Commercial crushed sandstone from Hanson, Minnehaha, and Tripp Counties was quarried for use as ganister, riprap, railroad ballast, and in concrete or roadstone.

METALS

Beryllium. — Beryllium concentrate (beryl) production, continuing to increase, was more than double the 1964 figure.

Production was reported from five mines in Pennington County and two in Custer County. Major producers were George Bland at the White Mica mine, Walter Hough at the Hugo mine, and Taylor Brothers at the Dan Patch mine. All of the beryl was purchased by Beryl Ores Co. of Arvada, Colo.

Gold and Silver. — Gold production reached an alltime high at the Homestake Mining Co. operations at Lead, Lawrence County. Value of gold output increased 2 percent; tonnage of ore processed was essentially unchanged. Recovered value of bullion was $10.88 per ton of ore, compared with $10.68 in 1964. Metallurgical recovery was 95.7 percent, a slight decrease from the 1964 figure. Amalgamation accounted for 68 percent of the recovered gold; the remaining 32 percent was recovered by cyanidation. A 3-percent decrease was noted in the production of silver, also from the Homestake mine.

All of the State production of gold and silver was from the Homestake mine.

Iron Ore. — Iron ore, previously mined from deposits near Nemo and stockpiled, was used in manufacturing cement at Rapid City. None was produced in 1965.

Molybdenum.—Overall State production of molybdenum increased 148 percent. Treatment of ash from lignite coal yielded all the molybdenum produced in the State. The lignite, from mines in Harding County, was mined principally for its uranium content with molybdenum as a byproduct. The ash was shipped to the Kerr-McGee Corp. uranium mill in New Mexico for treatment.

Uranium.—With 22 fewer mining operations than in 1964, output of uranium ore declined 59 percent. The number of operations dropped from 5 to 2 in Custer County, from 29 to 19 in Fall River County, and from 15 to 6 in Harding County. The decrease in production was accompanied by a decline in average grade of ore mined, from 0.19 percent to 0.12 percent U_3O_8. Because of lower production and grade, value of ore output was only 20 percent of the 1964 figure.

Production included sandstone ores mined in Custer and Fall River Counties and uraniferous lignite mined in Harding County. The sandstone ores and ash from some of the lignite were treated at the Edgemont uranium mill operated by Mines Development, Inc., a subsidiary of Susquehanna-Western, Inc. Other ash was shipped to a New Mexico uranium mill, and a small amount of lignite was shipped to North Dakota for burning and subsequent processing at a Colorado uranium mill.

Sandstone ores from Wyoming and lignite ores from North Dakota also were treated at the Edgemont mill. The Government purchase contract was to expire December 31, 1966.

Vanadium.—Vanadium oxide was recovered as a coproduct at the Edgemont uranium mill operated by Mines Development, Inc. Vanadium was contained in sandstone uranium ores mined in Custer and Fall River Counties and in Wyoming. Tailings from the uranium operations were treated by the solvent-extraction method to dissolve the vanadium, which was recovered by precipitation. The concentrate, after conversion to fused vanadium oxide (black flake), was shipped in drums to consumers. The quantity recovered declined mainly because of decreased uranium ore output.

MINERAL FUELS

Coal (Lignite). — Coal (lignite), other than uraniferous lignite, was mined by Dewey Coal Co. at a strip mine near Firesteel. Production was from the 54-inch-thick Hellcreek seam, which is overlain by 25 to 35 feet of overburden.

Petroleum.—Production of crude petroleum was 218,876 barrels, valued at $438,000, down 12 percent from the value in 1964; of this quantity, 189,538 barrels was from 24 wells in the Buffalo field, Harding County, and the remainder from 4 wells in the Barker Dome field, Custer County. Buffalo field also yielded 13.5 million cubic feet of natural gas, used for field fuel or flared.

At the three lease sales of State acreage, a total of 379,505 acres was leased for bonus payments of $43,508. Inaddition, 25,465 acres of Indian lands was leased for a bonus of $40,998. At yearend, 717,650 acres of Federal lands and 59,022 acres of Indian lands were under lease.

Drilling activity increased as 33 wells were drilled compared with 26 in 1964. Exploratory drilling accounted for 29 of the wells in 1965; all of the exploratory wells were unsuccessful. At yearend 1964, a

wildcat well, drilled by Pendac, Ltd., in Dewey County, had reportedly yielded oil and water on tests of the Red River formation (Ordovician). Because further testing in early 1965 indicated that the production was noncommercial, the well was plugged and abandoned.

Gulf Oil Corp. drilled nine exploratory wells during the year. Eight of the wells, in the southcentral part of the State, apparently were attempts to evaluate the stratigraphic trap possibilities of the Paleozoic formations wedging-out against the Siouxia Landmass in the southeastern part of the State.

The Kaneb Pipe Line Co. extended its 6-inch products pipeline 175 miles from Wolsey to Jamestown, N. Dak. It also built a 166-mile, 8-inch loop from Geneva, Nebr., to Yankton, S. Dak.

Table 8.—Mine production of gold and silver in terms of recoverable metals

Year	Mines producing		Material sold or treated [1] (thousand short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Troy ounces	Value (thousands)	Troy ounces (thousands)	Value (thousands)
1956–60 (average)	2	------	1,778	567,997	$19,880	131	$119
1961	2	------	1,781	557,855	19,525	127	118
1962	2	------	1,869	577,232	2C,203	113	123
1963	3	1	1,909	576,726	20,185	117	150
1964	1	1	2,033	616,913	21,592	133	172
1965	1	------	2,032	628,259	21,989	129	167
1876–1965	NA	NA	NA	31,207,892	873,873	12,137	9,287

NA Not available.
[1] Excludes placer gravel.

Table 9.—Drilling for petroleum in 1965, by counties

County	Oil	Dry	Total	Footage
Exploratory completions:				
Butte	--------	5	5	21,773
Corson	--------	1	1	5,000
Dewey	--------	2	2	10,759
Fall River	--------	11	11	25,322
Haakon	--------	1	1	5,000
Harding	--------	1	1	3,961
Jackson	--------	1	1	3,334
Jones	--------	3	3	8,600
Lyman	--------	1	1	2,100
Meade	--------	1	1	4,673
Spink	--------	1	1	945
Stanley	--------	1	1	4,000
Total	--------	29	29	95,467
Development completions:				
Custer	1	--------	1	1,349
Harding	3	--------	3	25,637
Total	4	--------	4	26,986
Total all drilling	4	29	33	122,453

Source: Oil and Gas Journal.

REVIEW BY COUNTIES

Mineral output was reported by 64 of the 67 counties. Jones, Potter, and Ziebach were the only counties not having production. However, only those counties with significant production or activity in the mineral industry are discussed.

Butte.—Bentonite was the principal mineral commodity produced. American Colloid Co. operated its processing plant at Belle Fourche, using raw material from Wyoming as well as from a State-owned deposit in the county. IMC processed Wyoming bentonite at the company Belle Fourche plant. The principal use was for refractories in foundries.

Other clay was produced by Black Hills Clay Products Co., also at Belle Fourche, for manufacturing building brick.

Lime production ended when Utah-Idaho Sugar Co. closed its beet sugar refinery in January. The plant had been opened in 1927.

Sand and gravel, from 11 operations, was produced, principally for paving. Value of all mineral commodities increased 40 percent; increased clay and sand and gravel output offset the effect of the ending of lime production.

Custer.—Decreases were recorded in the production of petroleum, sand and gravel, stone, uranium ore, and vanadium. Only feldspar and lime showed increases. The net effect of the changes was a 24-percent decline in mineral output value. Resumption of beryllium concentrate production did not significantly affect the county mineral production total.

Feldspar from 27 operations, 8 more than in 1964, was mined or purchased by IMC and ground at the company Custer plant. Major mines were the Shamrock, Tip Top, and White Elephant. George Bland and J. D. Morgan sold beryllium concentrates (beryl) to Beryl Ores Co.

Uranium ore and associated vanadium production declined considerably because mines were closed and output was curtailed. Uranium ore purchase contracts were to expire in 1966. Mining operations decreased from five to two. Black Hills Uranium Co. and Susquehanna-Western, Inc., shipped ore to Edgemont for milling.

Limestone was quarried for manufacturing lime by Black Hills Lime Co. near Pringle. Hills Materials Co. mined limestone for use as riprap and in concrete or roadstone. The Federal Bureau of Reclamation used limestone, produced by contractors, as riprap. A small amount of sand and gravel output was used for paving.

Crude oil production at the Barker Dome field declined by 44 percent, to 29,338 barrels for the year. The field yielded oil from the First Leo sandstone (Pennsylvanian) at a depth of about 1,400 feet.

Fall River.—Value of mineral production declined 47 percent. Output of all commodities decreased.

Oral Sand Co. and Flyte Sand and Gravel Co. produced sand and gravel for building construction. Flyte Rock Products produced crushed limestone for use in concrete or roadstone.

Uranium ore, produced from 19 operations, 10 less than in 1964, was shipped to the Edgemont mill of Mines Development, Inc., for treatment to recover uranium and vanadium concentrates. Shippers were Susquehanna-Western, Everett Chord, Roy Chamberlain, Robert E. Gull, and Melvin Hanson. Other sandstone ores from Custer County and two Wyoming counties also were treated at the mill. Uranium-bearing lignite ash from Harding County and two North Dakota counties was processed at the plant. Although shipments of molybdenum had been noted in 1964, none was reported as recovered from the ash in 1965.

The county again had the largest number of exploratory oil well completions in the State—11 wells, the same number as in 1964.

Grant.—Output of granite from seven quarries near Milbank and Big Stone City was valued at $2.9 million, an increase of 5 percent. Production of sand and gravel more than doubled.

Granite was quarried near Milbank and Big Stone City for use as architectural and monumental stone. Producers were Cold Spring Granite Co., Dakota Granite Co., Delano Granite Works, Inc., North Star Granite Corp., Robert Hunter Granite Co., Inc., and Steiner-Rausch Granite Co. Most of the granite was shipped to Minnesota plants for finishing.

Harding.—Value of mineral production declined by $1.3 million, or 60 percent,

Table 10.—Value of mineral production in South Dakota, by counties [1]

County	1964	1965	Minerals produced in 1965 in order of value
Aurora	$205,000	$382,000	Sand and gravel.
Beadle	404,000	99,000	Do.
Bennett	187,000	77,000	Do.
Bon Homme	191,000	289,000	Do.
Brookings	247,000	543,000	Do.
Brown	580,000	W	Sand and gravel, stone.
Brule	1,036,000	752,970	Do.
Buffalo	116,000	4,000	Sand and gravel.
Butte	W	W	Clays, sand and gravel.
Campbell	2,000	83,000	Sand and gravel.
Charles Mix	533,000	474,480	Sand and gravel, stone.
Clark	220,000	197,000	Sand and gravel.
Clay	75,000	62,000	Do.
Codington	124,000	631,000	Do.
Corson	450,000	644,000	Do.
Custer	614,380	464,628	Feldspar, petroleum, lime, stone, uranium ore, sand and gravel, vanadium, beryllium concentrate.
Davison	93,000	176,000	Sand and gravel.
Day	328,000	371,000	Do.
Deuel	70,000	141,000	Do.
Dewey	162,050	67,700	Coal, sand and gravel.
Douglas	237,000	266,000	Sand and gravel.
Edmunds	414,000	70,000	Do.
Fall River	474,893	250,187	Vanadium, uranium ore, sand and gravel, stone.
Faulk	89,000	166,000	Sand and gravel.
Grant	2,863,851	3,079,586	Stone, sand and gravel.
Gregory	75,000	256,000	Sand and gravel.
Haakon	r 50,000	30,000	Do.
Hamlin	13,000	17,000	Do.
Hand	25,000	50,000	Do.
Hanson	r 522,575	969,781	Stone, sand and gravel.
Harding	2,117,697	838,689	Petroleum, uranium ore, molybdenum, sand and gravel.
Hughes	89,000	70,608	Sand and gravel, stone.
Hutchinson	353,100	295,000	Sand and gravel.
Hyde	198,000	25,000	Do.
Jackson	----------	15,000	Do.
Jerauld	89,000	42,000	Do.
Kingsbury	174,000	268,000	Do.
Lake	172,000	99,000	Do.
Lawrence	22,122,992	22,381,179	Gold, sand and gravel, silver, stone.
Lincoln	160,000	561,000	Sand and gravel.
Lyman	151,000	200,000	Do.
Marshall	228,000	127,000	Do.
McCook	138,000	659,000	Do.
McPherson	114,000	161,000	Do.
Meade	310,000	186,000	Do.
Mellette	15,000	65,000	Do.
Miner	105,000	30,000	Do.
Minnehaha	2,192,098	1,239,430	Sand and gravel, stone.
Moody	615,000	229,000	Sand and gravel.
Pennington	9,622,948	7,557,035	Cement, stone, lime, sand and gravel, clays, mica (scrap), feldspar, gypsum, lithium, beryllium concentrate.
Perkins	200,000	335,000	Sand and gravel.
Potter	116,000	----------	
Roberts	391,000	438,000	Sand and gravel.
Sanborn	50,000	87,000	Do.
Shannon	37,000	37,000	Do.
Spink	269,000	284,000	Do.
Stanley	----------	27,000	Do.
Sully	47,000	108,000	Do.
Todd	78,000	26,000	Do.
Tripp	W	W	Stone, sand and gravel
Turner	418,000	259,000	Sand and gravel.
Union	95,000	209,000	Do.
Walworth	150,000	496,000	Do.
Washabaugh	74,000	47,000	Do.
Yankton	181,000	W	Sand and gravel, stone.
Undistributed [2]	1,349,866	2,160,044	
Total	52,824,000	50,175,000	

r Revised. W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] Jones and Ziebach Counties not listed because no production was reported.

[2] Includes production of gem stones and some beryllium concentrate (1964) that cannot be assigned to specific counties, and values indicated by symbol W.

because of decreased petroleum, uranium ore, and sand and gravel output. Output of molybdenum, contained in uranium-bearing lignite ash, was the only mineral commodity that increased (195 percent).

Production at the Buffalo oilfield declined slightly (3 percent) from that of 1964. Three more producing oil wells were completed in the field, bringing the total number to 24 on December 31, 1965.

Uraniferous lignite was burned under controlled conditions to yield an ash containing uranium and molybdenum. Burning was done at either portable or stationary burners. (The nearest stationary burner was that of Kerr-McGee Corp., near Bowman, N. Dak.) At the Kerr-McGee mining operations, near Ludlow in the North Cave Hills, the lignite was in a bed 6 inches to 2-feet thick and overlain by up to 110 feet of overburden. The lignite lay on top of the basal Tongue River member of the Fort Union formation (Paleocene). This hard sandstone provided a floor for scooping off the lignite with little dilution by barren rock. Overburden was easily stripped by scrapers and bulldozers to within approximately 1 foot of the lignite. A self-loading pan then completed the removal. A small front-end loader removed small pockets of ore not recovered by the larger machines.[6]

Susquehanna-Western, Inc., mined uraniferous lignite, which was burned in place, and shipped the ash to Edgemont for treatment. W. L. Munkers shipped ore to the Union Carbide Corp. burner near Belfield, N. Dak.

Lawrence.—The county led the State in value of mineral production ($22.4 million). All of the gold and silver produced in the State was from the Homestake mine. Gold production increased 2 percent; silver decreased 3 percent.

According to the annual report to the Homestake Mining Co. stockholders, progress was made in the program to mine below the 4,850-foot level; the planned objective of 250,000 tons per year of ore was exceeded for the first time. Problems of grade and cost controls prompted early development of this lower area. Development drilling during the year found several prospective mining areas; the company announced a very substantial discovery of above average grade ore between the 5,300- and 6,800-foot levels.

According to the annual report, the measured ore reserves on December 31, 1965, was 16.4 million tons, with an estimated millhead grade of 0.315 ounces ($11.01) of gold per ton. In addition, an indicated reserve of 761,000 tons was estimated at $12.70 per ton.

The Brookhaven National Laboratories obtained permission from Homestake to conduct underground research on neutrinos, nuclear particles discharged from the sun. The experimental area was on the 4,850-foot level of the Homestake mine, where a tank chamber 30 feet by 65 feet and 32 feet high was excavated to hold a 100,000-gallon tank of perchloroethylene, containing chlorine. The neutrinos strike the chlorine atoms, changing then to radioactive argon-37 that can be quantitatively measured. The underground location enables a screening out of unwanted cosmic rays.

[6] Metal Mining and Processing. V. 2, No. 3, March 1965, pp. 18–20.

Table 11.—Homestake mine ore milled, receipts, and dividends [1]

Year	Ore milled (thousand short tons)	Receipts for bullion product		Dividends (thousands)
		Total (thousands)	Per ton	
1961	1,781	$19,590	$11.00	$4,030
1962	1,869	20,271	10.85	3,242
1963	1,909	20,278	10.62	3,265
1964	2,033	21,703	10.68	3,288
1965	2,032	22,094	10.88	3,445

[1] From 1876 to 1965, inclusive, this mine yielded bullion and concentrates that brought a net return of $802 million and paid $228.1 million in dividends.
Source: Homestake Mining Co. annual report to stockholders.

Other mineral commodities produced in the county were sand and gravel and stone. Sand and gravel was produced at six operations. Contractors provided material for the State and county highway departments; Cole Construction Co. mined sand and gravel for commercial use. The company also produced crushed limestone, as did Northwestern Engineering Co., a contractor for the Federal Forest Service.

Pennington. — Mineral production declined 22 percent in value or more than $2 million. Most of the decline was due to decreased cement shipments; however, production decreases also were noted for clays, gold, gypsum, lithium, sand and gravel, and stone. Mineral commodities showing increases were beryllium concentrates (beryl), feldspar, and scrap mica, all from pegmatite mines. Lime production also increased.

The clay (shale), gypsum, sand, and limestone, used to manufacture cement, were produced near the State-owned cement plant at Rapid City. Other clay was used for manufacturing lightweight aggregates. Limestone, other than that used for cement manufacture, was produced by Hills Materials Co., L. G. Everist, Inc., and Pete Lien & Sons. Uses were for highway construction, riprap, railroad ballast, flagstone, and for manufacturing lime. The lime was produced by Pete Lien & Sons at a plant near Rapid City. Most of the output from the 2-year-old plant was used as a soil stabilizer in road construction.

Portions of the Hugo mine, operated by L. W. Judson, Walter Hough, and Northwest Beryllium Corp., were the source of beryllium, feldspar, lithium, and mica. These minerals also were produced at the Ingersoll mine by Keystone Chemical Co., and, except for lithium, at the Peerless mine by Northwest Beryllium Corp. Beryllium output was reported from five operations and feldspar from eight. Value of pegmatite production increased 101 percent. Northwest Beryllium Corp. continued to operate its flotation mill at Keystone.

Sand and gravel was produced at 20 operations. Government users were the U.S. Bureau of Public Roads, U.S. Forest Service, South Dakota Cement Commission, and State and county highway departments. Commercial operation was by Wasta Sand and Gravel.

The Mineral Industry of Tennessee

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U. S. Department of the Interior, and the Tennessee Division of Geology for collecting information on all minerals except fuels.

By James R. Boyle [1] and William D. Hardeman [2]

RECORD production of portland cement, ball clay, miscellaneous clay, phosphate rock, pyrite, sand and gravel, crushed limestone, copper, and zinc highlighted the mineral industry of Tennessee in 1965. Tennessee led the Nation in production of ball clay, pyrite, and zinc, ranked third in production of phosphate rock and dimension marble, and fourth in production of fuller's earth and dimension sandstone. The total value of mineral production was 5 percent greater than the previous record production in 1964. Increased zinc production accounted for 47 percent of the increased value, and increased phosphate rock production for 37 percent.

Leading industries, which together furnished 93 percent of the total value of production, follow: Copper and zinc mining, stone quarrying, cement manufacturing, phosphate rock mining and processing, coal mining, and sand and gravel mining. Leading companies were Monsanto Co. (phosphate rock), Tennessee Copper Co. (copper, gold, pyrite, silver, and zinc),

[1] Mining engineer, Bureau of Mines, Knoxville, Tenn.

[2] State geologist, Division of Geology, Department of Conservation, Nashville, Tenn.

Table 1.—Mineral production in Tennessee [1]

Mineral	1964		1965	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Barite—short tons	39,188	$519	30,532	$442
Cement:				
Portland—thousand 376-pound barrels	8,343	26,791	8,724	27,535
Masonry—thousand 280-pound barrels	1,212	3,228	1,185	3,140
Clays—thousand short tons	[2] 1,310	[2] 5,576	1,495	6,103
Coal (bituminous)—do	5,990	22,674	5,865	20,930
Copper (recoverable content of ores, etc.)—short tons	13,889	9,056	14,823	10,495
Gold (recoverable content of ores, etc.)—troy ounces	133	5	122	4
Natural gas—million cubic feet	77	15	85	16
Petroleum (crude)—thousand 42-gallon barrels	10	W	11	W
Phosphate rock—thousand long tons	2,441	18,971	2,637	22,296
Sand and gravel—thousand short tons	7,972	10,245	8,193	10,690
Silver (recoverable content of ores, etc.) thousand troy ounces	91	117	94	122
Stone [3]—thousand short tons	26,497	38,239	28,888	38,859
Zinc (recoverable content of ores, etc.)—short tons	115,943	31,536	122,387	35,737
Value of items that cannot be disclosed: Clay (fuller's earth 1964), lime, pyrite, stone (crushed sandstone), and values indicated by symbol W	XX	6,993	XX	6,572
Total	XX	173,965	XX	182,941

W Withheld to avoid disclosing individual company confidential data.

XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes fuller's earth; included with "Value of items that cannot be disclosed."

[3] Excludes crushed sandstone; included with "Value of items that cannot be disclosed."

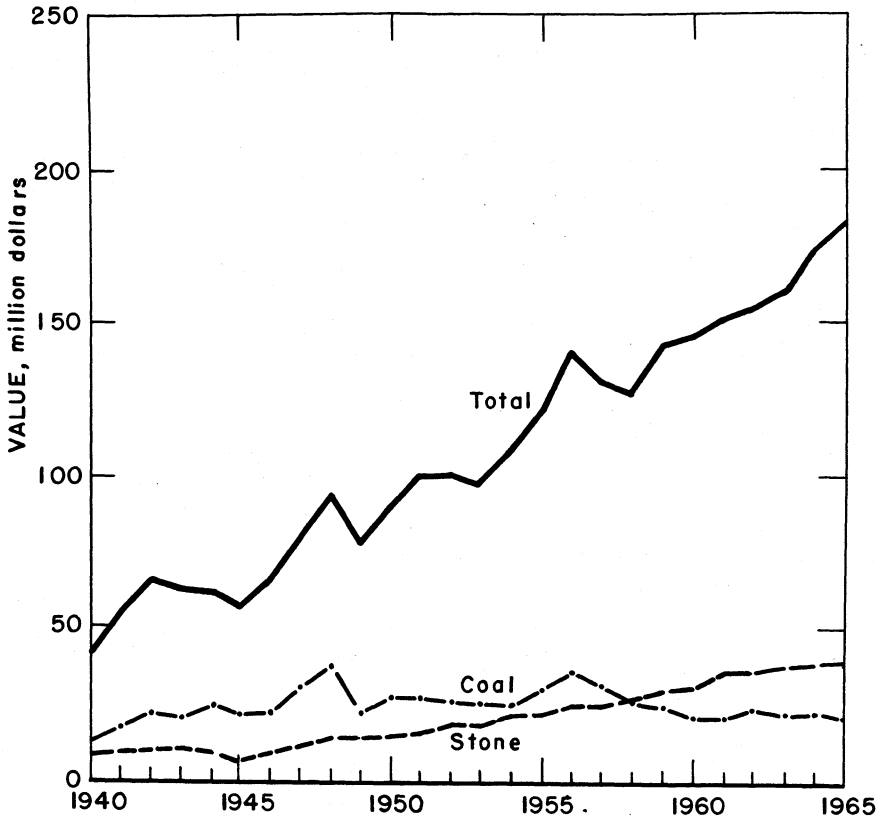

Figure 1.—Value of stone, coal, and total value of mineral production in Tennessee.

Table 2.—Value of mineral production in constant 1957–59 dollars
(Thousands)

Year	Value
1956	$135,601
1957	130,190
1958	129,526
1959	141,534
1960	142,823
1961	151,067
1962	154,268
1963	163,360
1964	r 172,641
1965	p 175,923

p Preliminary. r Revised.

American Zinc Co. of Tennesee (limestone and zinc), Marquette Cement Manufacturing Co. (cement, clay, and limestone), New Jersey Zinc Co. (limestone and zinc), Ideal Cement Co. (cement, clay, and limestone), General Portland Cement Co. (cement and limestone), and Vulcan Materials Co. (limestone).

Trends and Developments.—General Shale Products Corp. has announced plans for the construction of a new tunnel kiln at the Johnson City plant. The new kiln, with an annual capacity of 28 million brick, will replace the present beehive kilns. Scheduled completion date is mid-1966. General Shale's total capacity will then be 418 million brick per year.

Tennlite, Inc. will build a $1.4 million light aggregate plant at Greenbrier in 1966 to supply concrete and brick industries. The company will strip mine green shale near Baker's Station in Davidson County.

American Zinc Co. continued development of the Immel mine in Knox County. The 1,660-foot shaft was completed, and construction of surface facilities and under-

ground development will continue in 1966. Small scale production is scheduled in March 1967 with full scale production of 2,000 to 3,000 tons per day scheduled within 2 years. Primary crushing will be done underground and ore will be trucked to the Mascot mill. The capacity of the Mascot mill will be expanded to 6,800 tons per day early in 1966.

Consolidated aluminum Corp. (Conalco) announced a $20 million expansion program at its reduction plant at New Johnsonville. Annual capacity will be increased from 66,000 to 106,000 tons with construction of a new potline which will be completed by late 1966. Conalco's plans call for an eventual capacity of 300,000 tons. Alumina used at the plant is shipped from Surinam.

Tennessee Copper Co., Copperhill, had ordered equipment for pelletizing sinter plant feed, which studies indicate will materially improve the sinter quality. Installation of the unit is expected early in 1966.

Consolidation Coal Co., Pocahontas Fuel Co. Division, was developing a $15 million mine in Claiborne County. Reserves are estimated at 35 million tons. The mine site is 10 miles southwest of Middlesboro, Ky. Mining is scheduled to start in 1967 and the entire annual production of 1.5 million tons will be shipped by rail to Georgia Power Co.'s plant at Milledgeville, Ga.

Foote Mineral Co. announced the construction of a $9 million electrolytic manganese plant at New Johnsonville. Construction was scheduled to begin early in 1966. The manganese ores, which come from Africa and South America, will eventually be barged to the plant.

Tennessee Valley Authority will test operate the new 900,000-kilowatt Bull Run Steam Plant early in 1966. The plant, on the shore of Melton Hill reservoir, was expected to consume an estimated 2.2 million tons of coal annually and was scheduled for commercial operation in mid-1966.

At yearend, 408 miles of Tennessee's total Interstate Highway System mileage was open to traffic. Of the remaining mileage of interstate highway designated for the State, work was in progress on 579 miles and preliminary status on 63 miles.

Government Programs.—The Federal Bureau of Mines, with a Mineral Resource Office at Knoxville and a Mineral Resource Field Office at Tuscaloosa, Ala. continued its widespread and comprehensive study of the mineral industry in Alabama, Florida, Georgia, Kentucky, North Carolina, South Carolina, and Tennessee.

Mineral resource studies were made of bituminous coal in Alabama, Kentucky, and Tennessee and of metal and nonmetal resources of the area, including a general mineral survey of Appalachia.

Table 3.—Employment and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1964:								
Coal	2,340	190	445	3,606	3	107	30.51	6,123
Metal	1,538	272	418	3,368	3	93	28.50	7,712
Nonmetal	821	259	213	1,743	---	32	18.36	607
Sand and gravel	615	262	161	1,371	1	34	25.53	8,519
Stone	2,773	261	723	6,027	3	99	16.92	3,366
Total	8,087	242	1,960	16,115	10	365	23.27	5,031
1965: p								
Coal	2,265	184	416	3,388	11	105	34.24	20,658
Metal	1,640	271	444	3,544	3	107	31.04	8,611
Nonmetal	660	264	174	1,425	---	31	21.75	2,356
Sand and gravel	630	246	155	1,319	1	26	20.47	7,430
Stone	2,925	266	777	6,487	---	114	17.57	3,476
Total	8,120	242	1,966	16,163	15	383	24.62	8,427

p Preliminary.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Production of nonmetals accounted for 63 percent of the total value of mineral production, compared with 64 percent in 1964. The five principal commodities in order of value were stone, cement, phosphate rock, sand and gravel, and clays.

Barite.—Tennessee ranked fifth in the Nation in production of barite, and produced 4 percent of the National total. Three operators mined crude barite from five mines in two counties for oil-well-drilling muds, chemicals, and other uses. The leading producer was Godsey Mines, Inc. (Athens, Niota, and Calhoun mines). Production decreased 22 percent and was 71 percent below the record total of 1941.

Cement.—Tennessee ranked fifth in the Nation in production of masonry cement and produced 5 percent of the national total. Four companies produced masonry cement at five plants in five counties; the leading producer was Marquette Cement Manufacturing Co. Shipments decreased 2 percent below those of 1964, the record year. Consumption in Tennessee was 60 percent, and shipments were made to Georgia (13 percent), North Carolina (11 percent), Alabama (4 percent), South Carolina (4 percent), Kentucky (3 percent), Virginia (3 percent), and other States (2 percent).

Four companies produced portland cement at six plants in six counties. The leading producer was Penn-Dixie Cement Co. Shipments set a new record with a 5-percent increase over those of 1964, and a 3 percent increase over those of 1962, the previous record year. Consumption in Tennessee was 48 percent, and shipments were made to North Carolina (20 percent), Georgia (17 percent), Alabama (5 percent), Virginia (3 percent), Kentucky (2 percent), South Carolina (2 percent), Texas (2 percent), and other States (1 percent). Raw materials used in cement included limestone (60 percent), cement rock (26 percent), clays and shales (9 percent), gypsum (3 percent), and other (2 percent). All limestone and cement rock were produced from captive operations.

Portland cement was used as follows: In ready-mixed concrete (60 percent), in concrete products (19 percent), by highway contractors (8 percent), by building-materials dealers (6 percent), and in other ways (7 percent).

Clays.—Tennessee led the Nation in the production of ball clay and produced 66 percent of the national total. Five companies operated six mines in Henry and Weakley Counties; leading producers were H. C. Spinks Clay Co., Inc., and Bell Clay Co. Production was 5 percent greater than that of 1964, the previous record year.

Tennessee ranked fourth in the production of fuller's earth and produced 4 percent of the national total. Southern Clay Co., Inc., and Tennessee Absorbent Clay Co. mined fuller's earth in Henry County for absorbent uses. Production increased 20 percent, but was 44 percent below 1956, the record year.

Miscellaneous clay was mined by 9 companies at 12 mines in 9 counties for building brick, heavy clay products, lightweight aggregate, and cement. Leading counties were Knox, Davidson, and Sullivan; leading producers were General Shale Products Corp., W. G. Bush & Co., Inc., and John A. Denies Sons Co. Record production increased 15 percent over that of 1964 and 4 percent over that of 1956, the previous record year.

Lime.—Foote Mineral Co., Knoxville, and Williams Lime Manufacturing Co., Knoxville, produced quicklime and hydrated lime for building and chemical uses. Production increased 1 percent. Consumption in Tennessee was 34 percent, and shipments were made to North Carolina (46 percent), Kentucky (10 percent), Virginia (4 percent), South Carolina (3 percent), and other States (3 percent).

Perlite.—Chemrock Corp. expanded crude perlite at the Nashville plant for concrete aggregate, filter aids, loose fill insulation, building plaster, and soil conditioning. Production decreased 41 percent.

Phosphate Rock.—Seven companies mined and processed phosphate rock in Maury, Giles, and Hickman Counties. Leading producers were Monsanto Co., Stauffer Chemical Co., and Hooker Chemical Co. Marketable production increased 8 percent over that of 1964, the previous record year. Tennessee ranked third in the Nation in the production of phosphate rock and produced 10 percent of the national total.

Table 4.—Ball clay sold or used by producers, by uses

Use	1964			1965		
	Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per ton
Whiteware, etc.	220,490	$3,156,177	$14.31	228,484	$3,377,147	$14.78
Floor and wall tile	W	W	W	64,700	874,828	13.52
Firebrick and block	28,750	433,000	15.06	W	W	W
Other uses [1]	121,375	1,343,500	11.07	95,460	940,766	9.86
Total	370,615	4,932,677	13.31	388,644	5,192,741	13.36

W Withheld to avoid disclosing individual company confidential data; included with "Other uses."

[1] Includes heavy clay products; enameling; saggers, pins, stilts, and wads; art pottery; other uses; and uses indicated by symbol W.

Table 5.—Phosphate rock sold or used by producers, by uses

Use	1964			1965		
	Long tons	Value		Long tons	Value	
		Total	Average per ton		Total	Average per ton
Elemental phosphorus, ferrophosphorus, phosphoric acid	2,372,698	$18,227,988	$7.68	2,561,970	$21,535,543	$8.41
Ordinary superphosphate [1]	86,130	845,705	9.82	88,646	849,269	9.58
Total	2,458,828	19,073,693	7.76	2,650,616	22,384,812	8.45

[1] Includes direct application to the soil.

Pyrite.—Tennessee Copper Co. recovered pyrite concentrate from sulfide ore mined in Polk County. Production increased 5 percent and was 1 percent over the previous record total of 1957. Tennessee continued to lead the Nation in output of pyrite.

Sand and Gravel.—Sand and gravel was mined by 38 commercial operators at 42 locations in 26 counties. Government-and-contractor production amounted to 10 percent of the total mined. There were seven Government-and-contractor operators at seven locations in seven counties. Leading counties were Shelby, Davidson, Benton, and Humphreys. Leading commercial producers were Ingram Materials, Inc., W. S. Jordan Gravel Co., Cordova Sand and Gravel Co., and Sangravel Co., Inc., which together produced approximately one-third of the commercial production of sand and gravel. Ten operators mined from 200,000 to 400,000 tons and accounted for an additional 42 percent of the commercial production of sand and gravel. Total production increased 3 percent over that of 1964, the previous record year. Of the total production, 90 percent was washed. Thirty-four of the commercial operators and three of the Government-and-contractor operators had stationary plants. Transportation was as follows: 68 percent was hauled by truck, 28 percent by rail, and 4 percent by water.

Stone.—Record production of crushed limestone was produced by 57 commercial operators at 82 locations in 51 counties. Government-and-contractor production amounted to 6 percent of the total crushed limestone and was produced at 27 quarries in 19 counties. Leading commercial producers were Lambert Bros. (Blount, Claiborne, Davidson, Hawkins, Humphreys, Knox, Sevier, Sullivan, Union, and Williamson Counties), Chattanooga Rock Products (Hamilton and Marion Counties), and American Zinc Co. (Jefferson and Knox Counties). Production increased 9 percent over that of 1964 and 8 percent over that of 1963, the previous record year. Crushed limestone was used for concrete and roads (80 percent), agricultural stone (agstone) (8 percent), cement (8 percent), and other uses (4 percent).

Table 6.—Sand and gravel sold or used by producers, by counties
(Thousand short tons and thousand dollars)

County	1964		1965	
	Quantity	Value	Quantity	Value
Benton	774	$1,387	858	$1,457
Cumberland	53	83	60	75
Davidson	633	1,100	W	W
Fayette	97	85	65	67
Giles	175	142	306	270
Greene	28	42	W	W
Grundy	135	169	152	23
Hardeman	58	72	75	90
Hardin	-----	-----	25	25
Haywood	84	68	60	51
Lauderdale	56	45	112	95
Loudon	W	W	4	8
Monroe	23	34	45	53
Obion	129	104	294	289
Polk	W	W	31	55
Shelby	1,427	1,390	1,540	1,449
Other counties [1]	4,300	5,524	4,566	6,683
Total	7,972	10,245	8,193	10,690

W Withheld to avoid disclosing individual company confidential data; included with "Other counties."
[1] Includes Bradley (1964), Carroll, Decatur, Franklin, Gibson, Hamilton, Henderson, Humphreys, Knox, McMinn (1965), McNairy, Putnam, Sevier, Stewart, Tipton, Unicoi, and Wayne Counties, and counties indicated by symbol W.

Table 7.—Sand and gravel sold or used by producers, by uses
(Thousand short tons and thousand dollars)

Use	1964			1965		
	Quantity	Value		Quantity	Value	
		Total	Average per ton		Total	Average per ton
Sand:						
Structural	1,922	$2,858	$1.49	2,344	$3,372	$1.44
Paving	1,096	1,576	1.44	1,062	1,581	1.49
Molding	285	853	2.99	301	906	3.01
Fill	W	W	W	29	19	.66
Fire or furnace	20	40	2.00	26	51	1.96
Engine	2	3	1.50	1	2	2.00
Other sands [1]	465	908	1.95	423	864	2.04
Total sand	3,790	6,238	1.65	4,186	6,795	1.62
Gravel:						
Paving	2,810	2,378	.85	2,557	2,197	.86
Structural	1,038	1,286	1.24	1,140	1,367	1.20
Fill	W	W	W	229	242	1.06
Railroad ballast	W	W	W	60	60	1.00
Other [2]	334	343	1.03	21	29	1.38
Total gravel	4,182	4,007	.96	4,007	3,895	.97
Total sand and gravel	7,972	10,245	1.29	8,193	10,690	1.30

W Withheld to avoid disclosing individual company confidential data.
[1] Includes glass, grinding and polishing, other sands, and sands indicated by symbol W.
[2] Includes miscellaneous gravel and other gravel as indicated by symbol W.

John J. Craig Co., Knoxville Crushed Stone Co., and Appalachian Marble Co. crushed marble for terrazzo and other uses. Production increased 52 percent but was 13 percent below the record of 1948. Gray Knox Marble Co. (Brown and Gray Knox quarries), Tennessee Marble Co. (Endsley, Eagle, and Luttrell quarries), Appalachian Marble Co. (Bond and Appalachian quarries), John J. Craig Co. (Hamil, Marmor, Crisp, and Lee quarries), and Imperial Black Marble Corp. (Thornhill quarry) quarried dimension marble in Blount, Grainger, Knox, and Union Counties. Production decreased 29 percent and was 61 percent below the record of 1957. Tennes-

see ranked third in the Nation in production of dimension marble and produced 22 percent of the national total. Gray Knox Marble Co. ceased operations at the end of 1965.

Sewanee Silica Co., White Silica Sand Co., and Turner Bros. Stone Co., Inc., crushed sandstone for glass, concrete and roads, abrasives, cement, and other uses. Production increased 7 percent over that of 1964, but was 3 percent below the record of 1962. Dimension sandstone was quarried by 13 companies at 13 quarries in Cumberland and Fentress Counties for rough architectural stone, sawed and dressed building stone, and flagging. Leading producers were Crab Orchard Stone Co., Inc., Turner Bros. Stone Co., Inc., and Daddy's Creek Quarries, Inc. Production decreased 14 percent and was 55 percent below the record of 1955. Tennessee ranked fourth in the Nation in production of dimension sandstone and produced 9 percent of the national total.

METALS

Production of metals accounted for 25 percent of the total value of mineral production compared with 23 percent in 1964. Zinc production accounted for 77 percent of this value and copper production for nearly 23 percent.

Copper.—Tennessee Copper Co. recovered copper concentrate from sulfide ore mined in Polk County; mines operated were Boyd, Calloway, Cherokee, Eureka, and Mary. Record production of recoverable copper was 7 percent greater than that of 1964 and 4 percent greater than that of 1962, the previous record year. Development at the Cherokee-School Property orebody continued; stoping for increased production is scheduled to begin early in 1966. Development has continued at the Calloway mine, and production from this mine has continued to increase. Development at the Calloway mine was extended to the 28 level, which is the deepest mining activity in the basin.

Gold.—Tennessee Copper Co. recovered gold as a byproduct from smelting copper concentrate. Production decreased 8 percent and was 82 percent below the record set in 1930.

Silver.—Tennessee Copper Co. recovered silver as a byproduct from smelting copper concentrate. Production increased 4 percent

Table 8.—Crushed limestone sold or used by producers, by counties

County	1964		1965	
	Short tons	Value	Short tons	Value
Blount	343,841	$491,113	W	W
Claiborne	212,660	285,815	W	W
Clay	84,000	126,000	W	W
Cocke	91,369	95,023	75,000	$97,500
Cumberland	W	W	442,200	737,800
Davidson	3,192,814	3,729,291	4,112,030	4,789,482
Decatur	976,291	1,127,851	1,074,140	1,168,548
Fentress	198,700	271,200	213,005	299,947
Franklin	766,045	1,037,107	791,416	1,078,020
Grainger			40,657	60,232
Hamblen	433,863	592,430	W	W
Hawkins	136,274	195,847	W	W
Humphreys	552,252	697,697	W	W
Knox	2,150,655	3,075,200	2,108,024	2,983,404
Marion	1,151,863	1,493,081	1,829,989	2,049,557
Monroe	W	W	568,609	708,128
Pickett			28,288	35,360
Rhea	W	W	141,050	191,600
Sevier	238,606	346,519	W	W
Sullivan	650,544	894,242	W	W
Sumner	W	W	682,666	829,034
Unicoi	130,000	160,000	125,000	162,000
Union	28,628	34,600	W	W
Washington	258,867	323,943	123,826	160,850
White	124,389	124,389	W	W
Williamson	420,474	521,401	W	W
Other counties [1]	14,264,913	19,173,163	16,445,291	21,212,784
Total	26,407,048	34,795,912	28,801,191	36,564,246

W Withheld to avoid disclosing individual company confidential data; included with "Other counties."

[1] Includes Anderson, Bedford, Bradley, Campbell, Cannon, Carter, Coffee, Giles, Greene, Grundy, Hamilton, Hancock, Hardin, Jefferson, Johnson, Lincoln, Macon, Marshall, Maury, McMinn, Meigs, Montgomery (1964), Overton, Putnam, Roane, Robertson, Rutherford, Sequatchie, Warren, Wayne, and Wilson Counties, and counties indicated by symbol W.

Table 9.—Crushed limestone sold or used by producers, by uses

Use	1964			1965		
	Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per ton
Concrete and roads	21,660,276	$28,111,532	$1.30	23,101,188	$29,086,521	$1.26
Cement	2,070,227	2,503,153	1.21	2,231,729	2,591,657	1.16
Agstone	1,551,103	2,181,411	1.41	2,208,537	2,810,964	1.27
Railroad ballast	W	W	W	304,275	369,828	1.22
Stone sand	246,519	378,867	1.54	282,181	401,438	1.42
Lime	195,079	294,569	1.51	168,382	248,400	1.48
Mineral food	W	W	W	116,000	232,000	2.00
Paper				22,000	31,900	1.45
Rock dust for coal mines	W	W	W	8,500	42,500	5.00
Whiting				3,500	26,150	7.47
Alkali				3,000	4,500	1.50
Other uses [1]	683,844	1,326,380	1.94	351,899	718,388	2.04
Total	26,407,048	34,795,912	1.32	28,801,191	36,564,246	1.27

W Withheld to avoid disclosing individual company confidential data; included with "Other uses."
[1] Includes riprap, fluxing stone, glass, asphalt filler, fertilizer filler, other fillers (1964), other uses, and uses indicated by symbol W.

Table 10.—Dimension marble sold or used by producers, by uses

Use	1964			1965		
	Cubic feet	Value		Cubic feet	Value	
		Total	Average per cubic foot		Total	Average per cubic foot
Building stone:						
Rough	118,271	$388,058	$3.28	116,218	$357,929	$3.08
Sawed, dressed	182,780	752,214	4.12	W	W	W
Total [1]	340,757	2,135,672	6.27	243,412	1,155,519	4.75

W Withheld to avoid disclosing individual company confidential data; included in "Total."
[1] Includes monumental stone (1964); cut, dressed building stone; and uses indicated by symbol W.

over that of 1964, but was 16 percent below the record set in 1962.

Zinc.—Tennessee zinc production set a record for the sixth time in the last 8 years. Tennessee continued to be the leading zinc producing State with 20 percent of the national production.

American Zinc Co. of Tennessee operated the Young, Coy, Grasselli, and North Friends Station mines in Jefferson County and, the Mascot No. 2 mine in Knox County. The Federal Bureau of Mines published a report on the Young mine.[3] The North Friends Station mine reopened late in 1964, completed a 410-foot shaft and is expected to achieve planned production of 500 tons per day in 1966. New Jersey Zinc Co. operated the Jefferson City mine in Jefferson County and the Flat Gap mine in Hancock County. New Jersey Zinc Co. planned to develop a new mine in the Copper Ridge District; shaft sinking is expected to start early in 1966. United States Steel Corp. operated the Zinc Mine Works in Jefferson County. Tennessee Copper Co. recovered zinc concentrate from copper-zinc ores mined in Polk County. New Market Zinc Co. operated the New Market mine in Jefferson County. Production is scheduled to increase in 1966 from the present 2,400 tons per day to 3,600 tons per day, the capacity of the concentrator. The New Market concentrator continued to treat ores from American Zinc Co.'s Young mine.

Total crude ore milled in the State was 5,527,837 tons, an increase of 8 percent over that of 1964; total waste material handled was 364,813 tons. Zinc concentrates

[3] Boyle, James R. and Lloyd Williams. Mining Methods and Practices at the Young Mine, American Zinc Co. of Tennessee, Jefferson County, Tenn. BuMines Inf. Circ. 8269, 1965, 27 pp.

were shipped to Illinois, Ohio, Oklahoma, Pennsylvania, and Texas. American Zinc Co. continued development of the Immel mine in Knox County. The shaft was completed and underground development and construction of surface facilities continued.

Reported exploration and development at zinc and copper mines included the following: Diamond drilling, 118,002 feet; percussion drilling, 130,874 feet; long-hole drilling, 12,066 feet; churn drilling, 900 feet; drifting and crosscutting, 48,027 feet; raising, 7,276 feet; and shaft sinking, 2,427 feet.

Table 11.—Mine production of recoverable gold, silver, copper, lead, and zinc

Commodity	1964		1965		Earliest record to date	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Gold_____troy ounces__	133	$5	122	$4	24,574	$603
Silver_____do____	90,539	117	94,142	122	4,263,277	3,354
Copper_____short tons__	13,889	9,056	14,823	10,495	575,807	222,475
Lead_____do____					27,143	3,185
Zinc_____do____	115,943	31,536	122,387	35,737	1,931,191	411,699
Total_____	XX	40,714	XX	46,358	XX	641,316

XX Not applicable.

MINERAL FUELS

Production of mineral fuels accounted for 12 percent of the total value of mineral production compared with 13 percent in 1964.

Coal (Bituminous).—Bituminous coal was mined at 230 mines in 17 counties, compared with 253 in 16 counties in 1964. Leading producing counties were Anderson, Campbell, and Marion. Leading producers were Consolidation Coal Co. (Morco mine), Tennessee Auger Co. Inc. (Walnut Mountain Deep mine), and Tennco, Inc. (No. 1 strip mine). Production was 2 percent less than that of 1964 and 34 percent below the record of 1956. Average production per mine increased from 23,700 to 25,500 tons.

Tennessee Valley Authority (TVA) purchased 55 percent of the coal mined in Tennessee compared with 68 percent in 1964. This amounted to 14 percent of TVA coal purchases compared with 18 percent in 1964.

In the northern part of the State (District 8), 156 mines in 10 counties produced 4,585,000 tons of coal, compared with 177 mines in 9 counties that produced 4,704,000 tons in 1964. Average production per mine increased from 26,600 to 29,400 tons. Underground mines produced 63 percent of the total tonnage; strip mines, 32 percent; and auger mines, 5 percent. Shipments were 61 percent by rail or water and 39 percent by truck. Captive tonnage was 1 percent of the total tonnage.

Equipment used at 117 underground mines included 107 cutting machines that cut 76 percent of the total tonnage; 131 power drills that drilled 77 percent; 34 mobile loading machines that loaded 51 percent; 9 continuous mining machines that loaded 19 percent; 33 face conveyors that loaded 6 percent; and 74 locomotives; 47 shuttle cars; 38 shuttle buggies; and 1 mother conveyor. Equipment used at 30 strip mines included 52 power shovels, 2 draglines, 41 bulldozers, 17 power drills, and 56 trucks. Equipment used at 9 auger mines included 10 coal recovery augers, 1 power shovel, and 6 bulldozers. Forty-two percent of the coal was crushed, and 2 percent was cleaned.

In the southern part of the State (District 13), 74 mines in 7 counties produced 1,280,000 tons, compared with 76 mines in 7 counties that produced 1,286,000 tons in 1964. Average production per mine increased from 16,900 to 17,300 tons. Underground mines produced 55 percent of the total tonnage; strip mines produced 45 percent. Shipments were 71 percent by rail or water and 29 percent by truck. The coal was sold in the open market, mainly to TVA.

Equipment used in 63 underground mines included 32 cutting machines that cut 79 percent of the total tonnage; 56 power drills that drilled 86 percent; 3 mobile loading machines that loaded 24 per-

cent; 2 face conveyors that loaded 2 percent; 20 locomotives; 6 shuttle cars; and 1 shuttle buggy. Equipment used at 11 strip mines included 21 power shovels, 7 draglines, 18 bulldozers, 11 power drills, and 53 trucks. Of the total tonnage, 32 percent was crushed.

Coke.—Woodward Iron Co., Chattanooga Division, was the only coke and coal chemical producer in Tennessee. Coke and breeze was produced by 44 coke ovens; coke was used in foundries and blast furnaces and breeze was used and sold. Coal chemicals produced included coke oven gas, ammonium sulfate, tar, and crude light oil that was converted to industrial grade benzene, toluene, and crude naphtha.

Natural Gas.—At the end of the year, 20 gas wells were producing, compared with 35 in 1964. Cumulative production of natural gas since 1916 was 3,681 million cubic feet.

Petroleum.—At yearend, 33 oil wells were producing compared with 38 in 1964. Cumulative production since 1916 was 682,000 barrels. According to the Oil and Gas Journal, exploratory drilling continued in Tennessee and 20 holes were completed in 8 counties. The total footage drilled was 23,061. Crude oil was hit in 4 holes in clay and Scott Counties and gas was hit in 3 holes in Scott County. Exploration drilling in 1964 resulted in 19 completions with a total footage of 14,020; all holes were dry.

Table 12.—Coal (bituminous) production, by counties

County	1964		1965	
	Short tons	Value	Short tons	Value
Anderson	1,782,390	$6,886,655	2,032,067	$7,343,480
Bledsoe	9,719	32,157	11,569	50,046
Campbell	1,008,060	3,462,421	1,075,219	3,205,684
Claiborne	364,189	1,292,967	261,931	967,285
Cumberland	16,635	52,400	4,000	14,000
Fentress	50,328	188,730	58,560	238,924
Grundy	332,424	1,303,102	203,958	828,462
Hamilton	29,618	114,249	42,258	174,557
Marion	538,244	2,495,758	634,565	2,960,977
Morgan	366,052	1,288,270	383,690	1,224,574
Overton	38,423	119,495	25,759	99,944
Pickett	----	----	3,024	11,733
Putnam	477,776	1,783,914	219,612	803,779
Rhea	24,400	95,160	24,000	106,560
Scott	600,654	2,276,420	521,298	1,593,549
Sequatchie	67,141	229,622	113,891	431,340
Van Buren	284,352	1,052,996	249,772	874,850
Total	5,990,405	22,674,316	5,865,173	20,929,744
Earliest record to date	418,600,000	NA	424,465,000	NA

NA Not available.

REVIEW BY COUNTIES

Mineral production was reported from 78 counties; leading counties were the zinc, copper, and phosphate producers, Jefferson, Polk, Knox, Maury, and Davidson, which supplied 49 percent of the total mineral production value. In addition to the commodities listed in table 12, small quantities of oil and gas were produced; the county origin of these was undetermined. The number of wells and footage drilled by counties in this section were published in The Oil and Gas Journal.[4]

Anderson.—Consolidation Coal Co. (Morco Colliery), Tennessee Auger Co., Inc. (Walnut Mountain Deep mine), and Tennco, Inc. (No. 1 strip mine), were the leading producers of the 37 active coal mines. Of these coal mines, 27 were underground, 8 strip, and 2 auger. Ralph Rogers & Co., Inc. (Oak Ridge quarry) and Anderson County Highway Department (Taylor's quarry No. 1) crushed limestone for concrete, roads, and stone sand. Lalite Corp. (Briceville mine) mined miscellaneous clay for lightweight aggregates.

[4] Oil and Gas Journal. V. 64, No. 5, Jan. 31, 1966, p. 203.

Table 13.—Value of mineral production in Tennessee, by counties [1]

County	1964	1965	Minerals produced in 1965 in order of value
Anderson	W	W	Coal, limestone, miscellaneous clay.
Bedford	W	W	Limestone.
Benton	$1,387,000	$1,457,000	Sand and gravel.
Bledsoe	32,157	50,046	Coal.
Blount	W	W	Limestone, marble.
Bradley	W	W	Limestone.
Campbell	W	W	Coal, limestone, sandstone.
Cannon	W	W	Limestone.
Carroll	W	W	Sand and gravel.
Carter	W	W	Limestone.
Claiborne	1,578,782	W	Coal, limestone.
Clay	126,000	W	Limestone.
Cocke	95,023	97,500	Do.
Coffee	W	W	Do.
Cumberland	W	1,625,182	Sandstone, limestone, sand and gravel, coal.
Davidson	9,671,876	12,593,797	Limestone, cement, phosphate rock, miscellaneous clay, sand and gravel.
Decatur	W	W	Limestone, sand and gravel.
Fayette	85,000	67,000	Sand and gravel.
Fentress	461,530	542,371	Limestone, coal, sandstone.
Franklin	W	W	Cement, limestone, sandstone, sand and gravel, miscellaneous clay.
Gibson	W	W	Sand and gravel.
Giles	W	W	Phosphate rock, limestone, sand and gravel.
Grainger	40,000	96,232	Limestone, marble.
Greene	W	W	Limestone, sand and gravel.
Grundy	W	W	Coal, limestone, sand and gravel.
Hamblen	592,430	W	Limestone.
Hamilton	9,426,057	9,676,019	Cement, limestone, sand and gravel, coal, miscellaneous clay.
Hancock	W	W	Zinc, limestone.
Hardeman	72,000	90,000	Sand and gravel.
Hardin	W	W	Limestone, sand and gravel.
Hawkins	195,847	W	Limestone.
Haywood	68,000	51,000	Sand and gravel.
Henderson	W	W	Do.
Henry	W	3,002,511	Ball clay, fuller's earth.
Hickman	W	W	Phosphate rock.
Humphreys	W	W	Limestone, sand and gravel.
Jefferson	W	W	Zinc, limestone.
Johnson	W	W	Limestone.
Knox	16,377,951	16,700,923	Cement, zinc, limestone, lime, marble, sand and gravel, miscellaneous clay.
Lauderdale	45,000	95,000	Sand and gravel.
Lincoln	W	W	Limestone.
Loudon	W	W	Barite, sand and gravel, miscellaneous clay.
Macon	W	W	Limestone.
Marion	W	W	Cement, coal, limestone.
Marshall	W	W	Limestone.
Maury	W	W	Phosphate rock, limestone.
McMinn	W	W	Limestone, barite, sand and gravel.
McNairy	W	W	Sand and gravel.
Meigs	W	W	Limestone.
Monroe	W	761,128	Limestone, sand and gravel.
Montgomery	W	----------	
Morgan	1,288,270	1,224,574	Coal.
Obion	104,000	289,000	Sand and gravel.
Overton	W	W	Limestone, coal.
Pickett	----------	47,093	Do.
Polk	W	W	Copper, pyrites, zinc, silver, sand and gravel, gold.
Putnam	W	W	Coal, limestone, sand and gravel.
Rhea	W	298,160	Limestone, coal.
Roane	W	W	Limestone.
Robertson	W	W	Do.
Rutherford	W	W	Do.
Scott	2,276,420	1,593,549	Coal.
Sequatchie	W	W	Limestone, coal.
Sevier	W	W	Sand and gravel, limestone.
Shelby	W	W	Sand and gravel, miscellaneous clay.
Stewart	W	W	Sand and gravel.
Sullivan	W	W	Cement, limestone, miscellaneous clay.
Sumner	W	W	Phosphate rock, limestone.
Tipton	W	W	Sand and gravel.
Unicoi	W	W	Sand and gravel, limestone.
Union	W	W	Marble, limestone.
Van Buren	1,052,996	874,850	Coal.
Warren	W	W	Limestone.
Washington	W	W	Limestone, miscellaneous clay.
Wayne	W	W	Limestone, sand and gravel.

See footnotes at end of table.

Table 13.—Value of mineral production in Tennessee, by counties [1]—Continued

County	1964	1965	Minerals produced in 1965 in order of value
Weakley	$2,488,500	$2,579,750	Ball clay.
White	124,389	W	Limestone.
Williamson	W	W	Phosphate rock, limestone.
Wilson	W	W	Limestone.
Undistributed [2]	126,375,772	129,128,315	
Total	173,965,000	182,941,000	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] The following counties are not listed because no production was reported: Cheatham, Chester, Crocket, De Kalb, Dickson, Dyer, Houston, Jackson, Lake, Lawrence, Lewis, Madison, Moore, Perry, Smith, and Trousdale.

[2] Includes value of petroleum, natural gas, and values indicated by symbol W.

Bedford.—Lambert & Lambert Stone Co. (Shelbyville quarry) crushed limestone for concrete, roads, and agstone.

Benton.—Four mines produced sand for glass and molding; the leading producer was Hardy Sand Co. (Silica and Camden mines). Camden Gravel Co. and Memphis Stone & Gravel Co. mined gravel for paving.

Bledsoe.—Burchard Coal Co. (Burchard No. 2 mine), Peacock Coal Co. (No. 1 mine), and State Vocational Training School (No. 4 mine), all underground mines, were the only active coal producers.

Blount.—Lambert Bros. Division of Vulcan Materials Co. (Maryville quarry) crushed limestone for concrete and roads. John J. Craig Co. (Marmor, Hamil, Lee, and Crisp quarries), Gray Knox Marble Co. (Brown quarry), and Tennessee Marble Co. (Endsley quarry) quarried dimension marble for rough and dressed building stone and dressed monumental stone. The Brown and Crisp quarries ceased operations during the year. John J. Craig Co. crushed marble for terrazzo and other uses.

Bradley.—Bradley Limestone Co. Inc. (Welch quarry) and Bradley County Highway Department crushed limestone for concrete, roads, and agstone.

Campbell.—Coal was produced at 36 mines—24 underground, 9 strip, and 3 auger. Leading producers were Howard Ensley Coal Co. (Rich Mountain strip mine), Cox-Jellico Coal Corp. (No. 1 strip mine), and Hurricane Mountain Coal Co. (No. 4 mine). Jellico Stone Co., Inc. (Jellico quarry) and Claiborne Construction & Supply Co. (LaFollette quarry) crushed limestone for concrete, roads, agstone, and stone sand. White Silica Sand Co. (Silica quarry) crushed sandstone for concrete, roads, abrasives, and other uses.

Cannon.—Woodbury Stone Co. crushed limestone from its Norvell quarry near McMinnville for concrete, roads, and agstone.

Carroll.—Hardy Sand Co. (Bruceton mine) mined sand for grinding and polishing and for fertilizer filler.

Carter.—Watauga Stone Co. (Watauga quarry) crushed limestone for concrete, roads, and stone sand.

Claiborne.—Coal was produced at 18 mines—14 underground, 2 strip, and 2 auger. Leading producers were Four Leaf Coal Co., Inc. (No. 2 strip mine), Tacket Coal Corp. (No. 3 strip mine), and Harris Branch Coal Co. (No. 1 mine). Lambert Bros. (Tazewell quarry) crushed limestone for concrete and roads.

Clay.—Dixie Limestone Co. (Celina quarry) crushed limestone for concrete, roads, and agstone. Three oil wells totaling 2,453 feet were drilled.

Cocke.—Cocke County Highway Department crushed limestone from its Smith Quarry near Newport for concrete and roads.

Coffee.—Ralph Rogers & Co., Inc. (Coffee County quarry) and Coffee County Highway Department (Winton quarry) crushed limestone for concrete, roads, and agstone.

Cumberland.—Twelve companies quarried dimension sandstone for rough architectural, sawed and dressed building stone, and flagging. Leading producers were Crab Orchard Stone Co. Inc. (Peck quarry),

Turner Bros. Stone Co., Inc. (Turner Bros. quarry), and Daddy's Creek Quarries, Inc. (Crab Orchard quarry). Southern States Lime Corp. (Crab Orchard mine) and Cumberland County Highway Department (County quarry) crushed limestone for fluxing stone, concrete, roads, railroad ballast, agstone, glass, rock dust for coal mines, mineral food, lime, and other uses. Potter Sand & Gravel Co. (Crossville mine) mined sand and gravel for structural and paving uses. George Kilby Coal Co. mined coal from its Cox Valley underground mine. Turner Bros. Stone Co., Inc. crushed sandstone for refractory use.

Davidson.—Davidson County ranked fifth in the State in total value of mineral production. Lambert Bros. (Danley, Hermitage, and River Road quarries), Menefee Crushed Stone Co. (Nashville quarry), Eller & Olson Crushed Stone Co. Inc. (E & O Quarry), and Hoover, Inc. (Nashville quarry) crushed limestone for concrete, roads, agstone, asphalt filler, and fertilizer filler. Marquette Cement Manufacturing Co. produced masonry and portland cements at the Nashville plant throughout the year. Monsanto Co. mined phosphate rock from the Davidson County mine. Ingram Materials, Inc. (Nashville mine) mined sand and gravel for structural and paving uses. Chemrock Corp. expanded crude perlite from Western States at the Nashville processing plant for building plaster, concrete aggregate, soil conditioners, insulation, filter aids, and other uses. W. G. Bush & Co., Inc. (Nashville mine) mined miscellaneous clay for heavy clay products and cement.

Decatur.—Western Materials, Inc. (Parsons quarry) crushed limestone for concrete, roads, and agstone. Teague Bros. Sand & Gravel Co. (Decaturville mine) and Tinker Sand & Gravel Co. (Perryville mine) mined sand and gravel for structural use.

Fayette.—Fayette County Highway Department (County mine) mined paving sand and gravel.

Fentress.—Frogge & Williams, Inc. (Wright quarry) crushed limestone for concrete, roads, and agstone. Fentress County Coal Co. (Fentress mine). Sells & Gibson Coal Co. (P. No. 2 mine), and Hollis Miller Coal Co. (No. 4 mine) were the leading producers of the 12 active coal mines, all underground operations. Crossville Stone Co. (Jamestown quarry) quarried dimension sandstone for rough architectural stone and flagging. One oil well totaling 850 feet was drilled.

Franklin.—Marquette Cement Manufacturing Co. produced masonry and portland cements at the Cowan mill throughout the year. Cowan Stone Co. (Anderson mine and Cowan quarry), Marquette Cement Manufacturing Co. (Cowan quarry), and Franklin County Highway Department (Bostick quarry) crushed limestone for concrete, roads, fluxing stone, agstone, glass, lime, and cement. Sewanee Silica Co. (Monteagle quarry) crushed sandstone for concrete, roads, abrasives, and other uses. Estill Springs Sand-Gravel Co. (Estill Springs mine) mined sand for structural and paving uses and gravel for paving and other uses. Marquette Cement Manufacturing Co. (Cowan mine) mined miscellaneous clay for use in cement manufacture.

Gibson.—Hadley Contracting Co., Inc. (Humboldt mine) mined sand and gravel for paving.

Giles.—Monsanto Co. (Giles County mine), M. C. West (Giles County mine), and Stauffer Chemical Co. (Wales mine) mined phosphate rock. Cedar Grove Lime Co. (Cedar Grove quarry) crushed limestone for concrete, roads, and agstone. Giles County Highway Department (County mine) mined paving sand and gravel.

Grainger.—Grainger County Highway Department (Mitchell's and Capp's quarries) crushed limestone for concrete and roads. Imperial Black Marble Corp. (Thornhill quarry) quarried dimension marble for rough building stone.

Greene.—Malone Bros. Quarry, Inc. (Malone Bros. quarry), Greene County Highway Department (Midway, Dog Walk, and Cove Creek quarries), and Agricultural Lime Co., Inc. (Greeneville quarry) crushed limestone for concrete, roads, and agstone. Busler Sand Co. (Greeneville mine) mined sand for structural uses.

Grundy.—Phipps & Sons Coal Co. (Commando strip mine) and Ramsey Coal Co. (No. 1 strip mine) were the leading producers of the four active coal mines—three strip and one underground. Viola White Lime Co. (Old State quarry) crushed limestone for concrete, roads, and agstone. Cumberland Mountain Sand Co. (McMinn-

ville mine) mined structural and paving sand.

Hamblen.—White Pine Stone Co. crushed limestone from the Hamblen quarry near White Pine for concrete and roads.

Hamilton.—Signal Mountain Portland Cement produced masonry and portland cements at the Chattanooga mill throughout the year. Chattanooga Rock Products (Chattanooga quarry) crushed limestone for concrete, roads, and agstone. Dixie Sand & Gravel Corp. (Dixie mine) mined sand and gravel for structural, paving, fill, and other uses. Six mines—five underground and one strip—produced coal. Leading producers were Tentex Coal Corp. (Oak Hill mine), Dunwody Coal Co. (No. 1 mine), and Russell Mining Co. (No. 7 strip mine). General Shale Products Co. (Chattanooga mine) mined miscellaneous clay for heavy clay products. Woodward Iron Co. produced coke and coal chemicals at the Chattanooga plant.

Hancock.—New Jersey Zinc Co. (Flat Gap mine) mined zinc ore and recovered limestone as a byproduct. The limestone was used for concrete, roads, and agstone.

Hardeman.—Bolivar Sand Co. (Bolivar mine), Tri-State Sand Co. (Saulsbury mine), and Marcel Baudre (Saulsbury mine) mined structural sand and gravel.

Hardin.—Hardin Limestone Co. crushed limestone for concrete, roads, and agstone. Davis Contracting Co. (Savannah mine) mined structural sand. Tennessee River Pulp & Paper Co. reclaimed lime for industrial uses.

Hawkins.—Lambert Bros. (McCloud quarry) crushed limestone for concrete and roads.

Haywood.—Haywood County Highway Department mined paving gravel from the County mine near Brownsville.

Henderson.—Ayers Mineral Co. mined molding sand from the Zane mine.

Henry.—H. C. Spinks Clay Co., Inc. (Henry County mine), Kentucky-Tennessee Clay Co. (Tennessee mine), and Laird Brick Co. (Puryear mine) mined ball clay for whiteware, floor and wall tile, refractories, heavy clay products, and exports. Southern Clay Co., Inc. (Henry County mine) and Tennessee Absorbent Co. (Henry County mine) mined fuller's earth for absorbent uses.

Hickman.—M. C. Boyle Phosphate Co. (Bratton mine) mined phosphate rock for agricultural uses.

Humphreys.—Lambert Bros. (Rock Hill quarry) crushed limestone for concrete and roads. Sangravel Co., Inc. (Johnsonville mine) mined sand and gravel for structural and paving uses.

Jefferson.—Jefferson County ranked first in the State in total value of mineral production. American Zinc Co. of Tennessee (Young, Coy, Grasselli, and North Friends Station mine), Tennessee Coal & Iron (Zinc Mine Works), New Jersey Zinc Co. (Jefferson City mine), and New Market Zinc Co. (New Market mine) mined zinc ores. Limestone was produced by the Jefferson County Highway Department and also recovered as a byproduct from zinc mines; this material was used for concrete, roads, railroad ballast, agstone, and stone sand.

Johnson.—Maymead Lime Co., Inc. crushed limestone from the Dowell quarry near Shouns for use in concrete and roads.

Knox.—Knox County ranked third in the State in total value of mineral production. Ideal Cement Co. produced masonry and portland cements at the Knoxville mill throughout the year. American Zinc Co. of Tennessee (Mascot No. 2 mine) mined zinc ore and recovered limestone as a byproduct. Seven quarries and one mine crushed limestone for concrete, roads, cement, lime, glass, railroad ballast, agstone, stone sand, and other uses. Leading producers were Lambert Bros. (City, Halls, and Dixie Lee quarries), Ideal Cement Co. (Knoxville quarry), and Williams Lime Manufacturing Co. (Knoxville quarry). Foote Mineral Co. and Williams Lime Manufacturing Co. produced lime for construction and chemical uses.

Knoxville Sand & Gravel Co. (Knoxville mine) and Oliver King Sand & Lime Co., Inc. (King mine) mined sand and gravel for structural, paving, grinding and polishing, and engine uses. Appalachian Marble Co. (Appalachian and Bond quarries), Gray Knox Marble Co. (Gray Knox quarry), and Tennessee Marble Co. (Eagle quarry) quarried dimension marble for rough and dressed building stone and dressed monumental stone. Knoxville Crushed Stone Co. (Stone Road quarry) and Appalachian Marble Co. crushed marble for terrazzo and other uses. Shalite

Corp. (Shalite mine), General Shale Products Corp. (Knoxville mine), and Ideal Cement Co. (Knoxville Clay mine) mined miscellaneous clay for lightweight aggregate, heavy clay products, and cement.

Lauderdale.—Lauderdale County Highway Department mined paving gravel from the County mine near Ripley.

Lincoln.—Clark & Stephenson crushed limestone from the Fayetteville quarry for concrete, roads, and agstone.

Loudon.—B. C. Wood mined barite at the Cedar Fork mine. West Knoxville Sand Co. (Concord mine) mined sand for grinding, polishing, and structural uses. Old Hickory Brick Co., Inc. (Greenback mine) mined miscellaneous clay for heavy clay products.

Macon.—Dixon-Stubblefield Limestone Co. crushed limestone from the Hillsdale quarry for concrete, roads, and agstone.

Marion.—Penn-Dixie Cement Corp. produced portland cement at the Richard City mill throughout the year. Coal was produced by 32 mines—31 underground and 1 strip. Leading producers were Grundy Mining Co. (Grays Creek No. 11 mine), Bone Ridge Coal Co. (Dogwood No. 20 strip mine), and Walnut Coal Co., Inc. (Walnut No. 12 mine). Chattanooga Rock Products (Marion quarry), Signal Mountain Portland Cement (Bennetts Lake quarry), and Penn-Dixie Cement Corp. (Richard City quarry) crushed limestone for concrete, roads, agstone, and cement.

Marshall.—Lewisburg Limestone Co. crushed limestone from the Lewisburg quarry for concrete, roads, and agstone.

Maury.—Maury County ranked fourth in the State in total value of mineral production. Five operators produced phosphate rock; leading producers were Monsanto Co. (Monsanto mine) and Hooker Chemical Corp. (Columbia mine). Columbia Rock Products Corp. (Theta Pike mine) crushed limestone for concrete, roads, agstone, stone sand, and other uses. Union Carbide Corp. manufactured carbon and graphite products at the columbia plant.

McMinn.—Floyd D. Webb Stone Co. (Webb quarry) and McMinn County Highway Department (Athens quarry) crushed limestone for concrete and roads. National Lead Co. (Ballard mine) and Godsey Mines, Inc. (Athens, Niota, and Calhoun mines) mined barite. Hiwassee Sand Co., Inc. (Athens mine) mined structural sand. Bowaters Southern Paper Corp. reclaimed lime for industrial uses.

McNairy.—Worsham Bros. (Worsham mine) mined sand and gravel for structural, paving, and other uses.

Meigs.—Ten Mile Stone Co., Inc. (Ten Mile quarry) and Meigs Stone Co. (Posey quarry) crushed limestone for concrete, roads, riprap, and agstone.

Monroe.—Creighead Limestone Co. (Creighead quarry), Monroe County Highway Department (Madisonville quarry), and Simpson Stone Co. crushed limestone for concrete, roads, and agstone. Vonore Sand Co. (Vonore mine) and Tennessee River Sand Co. (Wood & Johnson mine) mined structural and paving sand.

Montgomery.—One oil well totaling 590 feet was drilled.

Morgan.—Coal was produced at 20 mines—13 underground and 7 strip. Leading producers were G & F Coal Co., Inc. (G & F strip mine), Lueking Coal Co. (No. 1-A strip mine), and Brushy Mountain Mines (No. 7 mine).

Obion.—Reelfoot Materials, Inc. (Troy mine) and Obion County Highway Department (County mine) mined paving sand and gravel.

Overton.—Livingston Limestone Co. (East and South quarries) crushed limestone for concrete, roads, and agstone. Six mines, all underground operations, produced coal; leading producers were Mountain Land Product Co. (No. 1 mine), Holly John Coal Co., Inc. (No. 1 mine), and H & H Coal Co. (Twin mine). Two oil wells totaling 3,446 feet were drilled.

Pickett.—Pickett County Highway Department crushed limestone for concrete and roads. Upchurch Coal Co. mined coal from the No. 1 underground mine. Two oil wells totaling 1,146 feet were drilled.

Polk.—Polk County ranked second in the State in total value of mineral production. Tennessee Copper Co. mined sulfide ore at the Boyd, Calloway, Eureka, Mary, and Cherokee mines. The ore was concentrated at the London Flotation mill and yielded copper, iron (pyrite), and zinc concentrates. Gold and silver were recovered as byproducts from smelting the copper concentrates. The iron concentrate or pyrite

concentrate was roasted, yielding sulfur dioxide, which was used mainly in manufacturing sulfuric acid, and iron oxide, which was sintered for use by iron and steel mills. Campbell Sand & Gravel Co. (Isabella mine) mined sand for structural and fire or furnace use and gravel for paving.

Putnam.—Clinchfield Coal Co. (Meadow Creek mine) and Cedar Creek Coal Co. (Clear Creek No. 2 mine) were the only active coal producers—both underground operations. R. E. Poteet (Poteet quarry) crushed limestone for concrete, roads, and agstone. Sand, Inc. (Monterey mine) mined structural and paving sand.

Rhea.—Rhea County Limestone Co. (Dayton quarry) cushed limestone for concrete and roads. Rocky Creek Coal Co. (RC No. 1 and RC No. 6 mines) and B & H Coal Co. (No. A-1 mine), all underground operations, were the active coal producers.

Roane.—A. B. Long Quarries (Swan Pond quarry) crushed limestone for concrete, roads, agstone, and stone sand.

Robertson.—Porter Brown Limestone Co. (Springfield No. 1 quarry) crushed limestone for concrete, roads, and agstone. Two oil wells totaling 840 feet were drilled.

Rutherford.—Lambert & Lambert Stone Co. (Murfreesboro quarry) and Rutherford County Highway Department crushed limestone for concrete, roads, and agstone.

Scott.—Coal was produced at 23 mines—17 underground, 4 strip, and 2 auger. Leading producers were Pee Wee Mining Co., Inc. (Pee Wee mine), Royal Dean Coal Co., Inc. (No. 1 mine), and Poor Mountain Coal Co. (No. 1-A mine). Seven oil wells totaling 14,010 feet were drilled.

Sequatchie.—Dunlap Stone Co. (Sequatchie quarry) crushed limestone for concrete, roads, and agstone. Eighteen mines, 17 underground and 1 strip, produced coal; leading producers were Walden Ridge Coal Co. (Walden Ridge No. 1 strip mine), Herman Johnson Coal Co. (No. 7-235 mine), and Ed Nunley Coal Co. (No. 1 mine).

Sevier.—Hodges Sand & Soil Co. (Sevierville mine) and Cameron Sand & Gravel Corp., Inc. (Boyds Creek mine) mined structural and paving sand. Lambert Bros. (Sevierville quarry) crushed limestone for concrete and roads.

Shelby.—Five mines produced sand and gravel for structural, paving, fill, and other uses; leading producers were Cordova Sand & Gravel Co. (Cordova mine), W. S. Jordan Gravel Co. (Jordan mine), and Allen Sand & Gravel Co., Inc. John A. Denies Sons Co. mined miscellaneous clay for lightweight aggregate.

Stewart.—T. L. Herbert & Sons, Inc. mined structural sand and gravel from the Dover mine.

Sullivan.—Penn-Dixie Cement Corp. produced masonry and portland cements at the Kingsport mill throughout the year. Lambert Bros. (New Kingsport quarry) and Rock-Way Corp. (Rockway quarry) crushed limestone for concrete and roads. General Shale Products Corp. (Kingsport mine) and Penn-Dixie Cement Corp. (Kingsport shale mine) mined miscellaneous clay for use in heavy clay products and cement. The Mead Corp. reclaimed lime for industrial use.

Sumner.—Monsanto Co. mined phosphate rock from the Sumner County mine. Ralph Rogers & Co., Inc. (Pilot Knob mine), Sumner County Highway Department, and Lambert & Lambert Stone Co. (Bethpage quarry) crushed limestone for concrete, roads, and agstone. Two oil wells totaling 726 feet were drilled.

Tipton.—Clyde W. Owens Sand & Gravel Co. (Covington mine) and Tipton County Highway Department (Tipton County mine) mined sand and gravel for structural, paving, fill, and other uses.

Unicoi.—Brooks Sand-Gravel (Erwin mine) mined sand for structural uses and gravel for paving and railroad ballast. Unicoi County Highway Department (Rex Lewis quarry) crushed limestone for concrete and roads.

Union.—Lambert Bros. and Union County Highway Department (Luttrell and Welch) quarries) crushed limestone for concrete and roads. Tennessee Marble Co. (Luttrell No. 3 quarry) quarried dimension marble for rough and dressed building stone.

Van Buren.—Coal was produced at 8 mines—3 underground and 5 strip; leading producers were Walden Ridge Coal Co. (Walden Ridge No. 1 strip mine), Allen Bros. Coal Co. (No. 1 strip mine), and C R & B Coal Co. (No. 11 strip mine).

Warren.—Warren Limestone Co. (Warren quarry) and Lambert & Lambert Stone Co. (McMinnville quarry) crushed limestone for concrete and roads.

Washington.—Washington County Highway Department (Dillow, Boones Creek, Corby, Gray, and Taylor Bridge quarries) crushed limestone for concrete and roads. General Shale Products Corp. (Johnson City mine) mined miscellaneous clay for use in heavy clay products.

Wayne.—Universal Limestone Co. (Waynesboro quarry) crushed limestone for concrete, roads, and agstone. Hassell & Dowdy (Baker mine) mined structural sand and gravel.

Weakley.—Bell Clay Co. (Collins mine), Cyprus Mines Corp. (No. 6 mine), and H. C. Spinks Clay Co., Inc. mined ball clay for whiteware, enameling, floor and wall tile, firebrick and block, and heavy clay products.

White.—Sparta Limestone Co. (Sparta quarry) and White County Highway Department (White County quarry) crushed limestone for concrete, roads, and agstone.

Williamson.—TVA (Franklin mine) and Monsanto Co. (Williamson County mine) mined phosphate rock. Lambert Bros. (Franklin quarry) and Williamson County Highway Department (Globe quarry) crushed limestone for concrete and roads.

Wilson.—Marquette Cement Manufacturing Co. (Martha quarry) and Wilson County Rock Products, Inc. (Lebanon and No. 2 quarries) crushed limestone for cement, concrete, roads, and agstone.

The Mineral Industry of Texas

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and Bureau of Economic Geology, The University of Texas, for collecting information on all minerals except fuels.

By F. F. Netzeband [1] and Roselle Girard [2]

A record mineral value of $4.7 billion was established in 1965 as all sectors of the State's industrial and business environment continued to expand. Much of the State's economy was contingent upon its vast reserves of minerals. Record highs also were achieved in employment, income, and sales. Growth also was evident in the number of new establishments and expansion of existing facilities, especially in petroleum, chemical, fabricated metals, machinery, and transportation equipment industries.

The ever-growing national and State markets for oil, natural gas, and sulfur stimulated additional gains for Texas production. Texas oilfields yielded over 1 billion barrels of crude oil for the fourth time in the industry's history in 1965—1 percent greater than in 1964, but 9 percent under the 1956 record output of 1,108 million barrels. Texas gasfields yielded a record 6,637 billion cubic feet of natural gas, 2 percent more than in 1964. The industry completed 12,741 new wells, 411 fewer completions, or 3.5 percent under 1964 totals, according to the Oil and Gas Journal. The number of producing oil wells declined to 197,924. The drilling activity, according to the American Petroleum Institute, helped sustain the State's crude oil reserve at 14,303 million barrels, representing over 45 percent of the Nation's total. Demand for Texas crude oil, including export, advanced a modest 1.6 percent compared with 1964 demand and was indicative of the severe competitive position of crude oil and its products as a source of primary energy in the Nation's economy; both natural gas and coal sustained much greater gains. Demand for refinery products improved moderately over that of 1964 and significant changes were noted in the demand pattern. Among the refined products, jet fuel advanced 56 percent over 1964 output. Since World War II, jet fuel has grown from a small-volume specialty product to the fourth major refined product. Residual fuel oil demand was the next greatest with an 8 percent increase over the 1964 total; increased manufacturing activities and larger electric power production, along with colder than normal weather during much of the heating season, were responsible for the significant increase. Demand for gasoline advanced 3.4 percent, somewhat lower than the national increase for gasoline. Distillate fuel oil demand increased 2.7 percent, due to colder weather and an extended heating season and to increased rail and truck traffic, since diesel engines in trucks burn distillate instead of gasoline.

Natural gas production continued expanding at a rapid rate as interstate pipelines continued to increase in mileage and size. The pipelines carried gas from Texas to nearly every other State in the country. The spectacular growth of ethylene, polyethylene, and butadiene (rubber) industries of Texas were in large measure responsible for the rise in natural gas demand. Singularly, Texas not only remained the Nation's leading natural gas producer, but its leading consumer as well

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Table 1.—Mineral production in Texas [1]

Mineral	1964 Quantity	1964 Value (thousands)	1965 Quantity	1965 Value (thousands)
Cement:				
Portland ---thousand 376-pound barrels--	30,030	$94,492	30,820	$97,598
Masonry ---thousand 280-pound barrels--	930	2,805	968	3,011
Clays [2] ---thousand short tons--	4,156	6,695	4,469	6,865
Gem stones	NA	140	NA	150
Gypsum ---thousand short tons--	1,131	4,049	1,045	3,794
Helium:				
Refined ---thousand cubic feet--	r 358,747	r 11,107	338,996	11,398
Crude ---do--	r 1,026,504	r 10,381	1,015,708	10,330
Lime ---thousand short tons--	1,350	17,201	1,338	19,663
Natural gas ---million cubic feet--	r 6,490,202	809,180	6,636,555	858,396
Natural gas liquids:				
Natural gasoline and cycle products thousand gallons--	3,512,460	232,245	3,772,471	256,959
LP gases ---do--	5,521,236	167,492	5,847,601	204,666
Perlite (crude) ---short tons--	300	3	1,000	8
Petroleum (crude) ---thousand 42-gallon barrels--	989,525	2,928,994	1,000,749	2,962,119
Salt ---thousand short tons--	6,410	28,797	6,964	30,771
Sand and gravel ---do--	29,155	33,394	32,649	36,075
Stone ---do--	40,240	52,070	39,520	53,659
Sulfur (Frasch process) ---thousand long tons--	r 3,302	r 65,780	3,674	74,955
Talc and soapstone ---short tons--	89,334	395	64,211	204
Value of items that cannot be disclosed: Asphalt (native), barite, bromine, clays (kaolin and fuller's earth 1964), coal (lignite), graphite, iron ore (usable), magnesium chloride (for metal), magnesium compounds (except for metal), mercury, pumice, sodium sulfate, and uranium ore	XX	r 83,604	XX	78,088
Total	XX	r 4,548,824	XX	4,708,709

r Revised. NA Not available. XX Not applicable.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers.
[2] Excludes certain clays, included with "Value of items that cannot be disclosed."

because of the vast petrochemical industry along the gulf coast.

In summary, 1965 was another banner year for the Texas mineral industry. Output increased, in most instances product value also increased, employment and income rose, mineral consuming and manufacturing industries expanded, and capital expenditures and bank credits grew. Demand trends showed that State markets for State-produced minerals were consuming greater amounts of these outputs than heretofore. The State's mineral industry was more productive at a more uniform rate and employed more workers at higher wages in 1965 than in any previous year.

Employment and Injuries.—Total income and hours worked reached record highs in 1965, but individual segments of the industries, such as petroleum refining, reported a decline. Employment statistics compiled by the Texas Employment Commission, in cooperation with the Federal Bureau of Labor Statistics, are reported in table 4.

Consumption, Trade, and Markets.—Texas continued to be the Nation's principal mineral-producing State for such individual commodities as petroleum, natural gas, natural gas liquids, and magnesium; it also was among the leaders as a mineral consumer.

Table 2.—Value of mineral production in constant 1957–59 dollars

(Millions)

Year	Value
1956	$4,593
1957	4,448
1958	4,038
1959	4,279
1960	4,126
1961	4,186
1962	4,212
1963	4,300
1964	r 4,448
1965	4,584

r Revised.

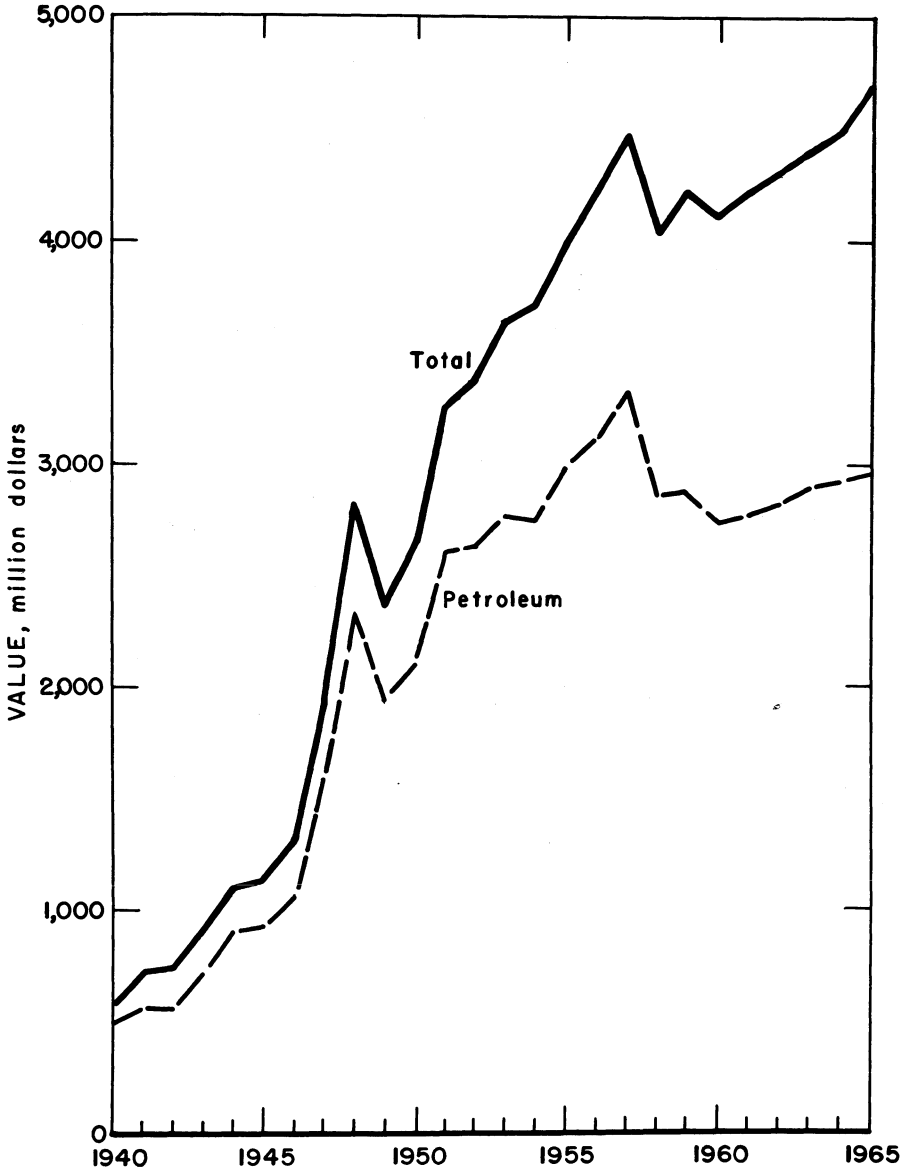

Figure 1.—Value of petroleum and total value of mineral production in Texas.

Some operations produced only raw or crude products such as ores or concentrates; others smelted or refined the crude product into an intermediate mineral product or metal ingot. Some operations produced the crude ore or concentrate, smelted, refined, or processed it in some manner to an intermediate product, which was then fabricated or manufactured into a finished article.

Table 3.—Employment and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1964:								
Coal	107	271	29	234	---	6	25.59	1,425
Metal	736	215	158	1,261	1	19	15.86	6,271
Nonmetal and native asphalt	2,808	291	816	6,693	3	167	25.40	5,008
Sand and gravel	2,740	220	602	5,277	---	111	21.03	909
Stone	4,121	314	1,292	10,866	4	220	20.61	2,720
Total	10,512	276	2,897	24,331	8	523	21.82	3,128
1965: p								
Coal	105	286	30	238	---	7	29.41	1,647
Metal	675	200	135	1,087	---	6	5.52	178
Nonmetal and native asphalt	2,846	295	840	6,870	---	159	23.14	898
Sand and gravel	2,875	208	599	5,251	4	130	25.52	5,610
Stone	4,095	303	1,240	10,466	2	228	21.98	1,857
Total	10,596	268	2,844	23,912	6	530	22.42	2,327

p Preliminary.

Integrated operations included such industries as sand and gravel and ready-mixed concrete producers; oil and gas producers with pipelines, refineries or gas processing plants, and possible petrochemical plants; and metal mining companies with producing mines, mills, smelters, refineries, and fabricating plants.

Trends and Developments.—The mineral industry of Texas contributed $568 million in tax revenue during the 1965 fiscal year according to the Comptroller's Office. Production taxes on oil and gas amounted to $199.1 million. Taxes on sulfur, cement, shell, and sand and gravel amounted to $7.3 million; oil and gas mineral leases, rentals, and royalties added another $115.2 million. Taxes on motor fuels (mostly gasoline) amounted to $229.2 million. The State's oil and gas industry paid about 37 percent of the State's property tax, 30 percent of its franchise tax and public education costs, and 27 percent of local property taxes according to the Texas Mid-Continent Oil and Gas Association. Local tax contributions by the oil and gas industry, not including taxes on services and supplies, were paid to 208 counties of the State's total 254 counties in 1965. Counties and

Table 4.—Employment data in mining and related industries

Industry	Employment		Weekly hours worked		Weekly earnings	
	1964	1965 p	1964	1965	1964	1965
Manufacturing	537,900	571,500	41.7	41.9	$100.91	$103.91
Primary metals	27,700	29,500	41.6	41.4	120.64	122.54
Stone, clay, and glass products	26,500	27,900	44.1	44.0	88.20	90.64
Chemicals	50,400	51,400	42.1	42.2	138.51	142.21
Petroleum and related industries	36,300	36,800	41.4	41.9	140.76	146.23
Transportation equipment	54,200	58,300	42.0	42.7	130.20	134.93
Nonmanufacturing	2,251,700	2,341,400	---	---	---	---
Mining	112,200	109,900	42.8	42.7	120.70	124.68
Crude petroleum and natural gas	105,800	103,800	42.6	42.5	122.69	126.23
Other mining	6,400	6,100	40.4	43.5	122.01	138.77
Construction	179,600	188,300	---	---	---	---

p Preliminary.
Source: Texas Employment Commission in cooperation with U.S. Bureau of Labor Statistics.

local communities also received indirect tax benefits through lease and royalty payments and from the service and supply sectors of the oil and gas industry.

The Railroad Commission subdivided District 8 into two parts to improve administration of oil and gas conservation laws. The new division designated as District 8–A consisted of 21 counties: Bailey, Lamb, Hale, Floyd, Motley, Cottle, Cochran, Hockley, Lubbock, Crosby, Dickens, King, Yoakum, Terry, Lynn, Garza, Kent, Gaines, Dawson, Borden, and Scurry. The District office for 8–A was located in Lubbock.

A "Mineral Interest Pooling Act" to permit the Commission to cope with small-tract drilling problems and to allow pooling of leases into units of up to 160 acres for oil and 640 acres for gas became effective on August 30, 1965. The act does not apply to any reservoir discovered and producing prior to March 8, 1961.

Two of the State's largest oil and gas lease sales were held in February and June of 1965 by the General Land Office. In February, 436,520 acres of nearly 1 million acres offered brought $39.3 million, a near record average of $90 per acre. Offshore leases, out to the 3-league limit, totaled 369,707 acres of the 436,520 acres. Most of the leases were off Matagorda and Brazoria Counties. In the June offering, 212,611 acres brought $17.7 million.

Legislation and Government Programs.—The 59th Texas Legislature enacted a number of important bills, and the U.S. Army Corps of Engineers and a number of State agencies initiated or continued projects influencing the State's mineral industry in 1965.

On September 1, 1965, the name of the Texas Water Commission was changed to Texas Water Rights Commission and a number of its principal functions were redistributed—planning and related engineering and hydrologic functions were transferred to the Texas Water Development Board. The Texas Water Rights Commission was responsible for continuing protection of the State's water in the public interest and for private rights in the course of water development and use. The Texas Water Development Board was responsible for protection of ground water; investigation of pollution complaints involving ground water; recommendations to the Railroad Commission and oil and gas operators regarding disposal of oilfield brines into subsurface aquifers and the depth to which ground water of usable quality should be protected in areas of oilfield development; and issuance of permits to municipalities and industry for subsurface disposal of municipal and industrial waste.

The Texas Department of Health was charged with research training, planning, and other functions presently conducted by it in matters concerning pollution.

The Texas Parks and Wildlife Department was responsible for enforcing the provision of the pollution control act relating to violations which affect fish and wildlife.

The Railroad Commission was charged with the responsibility for the control of surface and subsurface disposal of oilfield brines and other oilfield wastes.

The Legislature also enacted the "Water-well Drillers Act" to prevent the pollution of ground water aquifers by providing minimum water well driller qualifications and standards of conduct. This act would be administered by a newly created Texas Waterwell Drillers Board.

During 1965, the Texas Water Commission conducted an extensive program for collecting comprehensive basic data on the occurrence, quantity, quality, and availability of surface and ground water resources of the State, suspended sediment in streams, pan evaporation, reservoir stratification, tidal flow in estuaries, and water use. An important contract was made between the Commission, the Office of Saline Water, and the Southwest Research Institute for investigation of about 37 acres in the State to determine the potential water supply from demineralization projects of brackish waters in relation to the production capacities and economics of the various desalination methods.

The Texas Parks and Wildlife Department began a study of shell dredging in a number of shallow bays along the gulf coast and its impact on live oystershell beds and other marine life.

The U.S. Army Corps of Engineers had six major dam projects under construction and six authorized water-resource projects in advanced planning.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

New records for production and value were established by the mineral fuels industry of Texas in 1965, reflecting the economic growth of the State and the Nation. The 1965 combined output of crude oil, natural gas, natural gas liquids, helium, and lignite represented 91.5 percent of the State's mineral value, substantially the same as that in 1964.

Inasmuch as crude oil and natural gas compete for energy markets, the change in relative progress of each in 1965 was of particular significance. The market for crude oil, for the first time in over 10 years, grew faster than that for natural gas. The energy markets advanced about 4 percent in 1965; crude oil accounted for nearly 40 percent of the demand compared with 25 percent for natural gas.

The domestic crude oil industry matched supply with demand at an average output of 11.5 million barrels of crude oil per day in 1965. The growth in demand, which amounted to 449,000 barrels per day, coincided with a supply increase of 452,000 barrels daily. Texas and Louisiana were responsible for most of the supply increase.

During the year, 12,741 wells were completed in the State; average well depth was 4,744 feet. Exploratory drilling led to discovery of 297 new oilfields and 189 new gasfields and additions of 63.8 million barrels to crude oil reserves, 65.9 million barrels to natural gas liquids reserves, and 3,349 billion cubic feet to natural gas reserves. Analysis of the oil industry's drilling projects revealed that the industry was unable to maintain a constant ratio of crude reserves to demand (as expressed by crude oil production). The cost of drilling and finding one barrel of new oil increased, and reserves found per dollar spent on exploration diminished.

In 1965, 197,924 wells were producing crude oil, a decrease of 1,195 wells from 1964. Average daily production per well was 13.8 barrels.

Though total refining capacity of Texas remained unchanged at 2.6 million barrels per stream day in 1965, according to the Oil and Gas Journal, the State's oil refining industry improved or expanded internal processes to increase both efficiency and product output.

Much of the State exploration drilling was centered in Pecos County where five drill projects exceeding 20,000 feet were in progress or being planned.

Asphalt, Native.—An accelerated highway construction program in 1965 resulted in improved output by two producers in Uvalde County.

Carbon Black.—Increased demand for natural and synthetic rubber products caused a moderate increase in carbon black production. Natural gas as a raw material in manufacturing carbon blcak was progressively replaced by petroleum liquids. The channel-type plant with its familiar black

Table 5.—Production trends of crude oil, natural gas, and natural gas liquids for select years

(Million barrels of oil equivalent)

Year	Production [1]				Percentage of—						
					Annual total			Change of reported year			
	Oil	Gas	Liquids	Total	Oil	Gas	Liquids	Oil	Gas	Liquids	Total
1940	493	190	16	699	70.5	27.1	2.4	---	---	---	---
1950	830	558	69	1,457	57.0	38.3	4.7	68.4	193.7	331.3	108.4
1956	1,108	892	116	2,116	52.4	42.1	5.5	33.5	59.9	68.1	54.2
1960	927	1,052	128	2,107	44.0	49.9	6.1	—16.3	17.9	10.3	—0.4
1961	939	1,065	137	2,141	43.9	49.7	6.4	1.3	1.2	7.0	1.6
1962	943	1,086	143	2,172	43.4	50.0	6.6	0.4	2.0	4.4	1.4
1963	978	1,108	151	2,237	43.7	49.5	6.8	3.7	2.0	5.6	3.0
1964	990	r 1,159	157	r 2,306	r 42.9	r 50.3	6.8	1.2	r 4.6	4.0	r 3.1
1965	1,001	1,185	168	2,354	42.5	50.4	7.1	1.1	2.2	7.0	2.1

r Revised.

[1] One barrel of crude oil equivalent to 5,600 cubic feet of natural gas or 57.4 gallons of natural gas liquids, a composite of 52.7 gallons of natural gasoline and 60.8 gallons of LP gases.

Table 6.—Comparison of mineral fuels production in Texas and the United States

Fuel	Production [1] as oil equivalent				Percent of fuels				Texas percent of United States		Percent change from 1964	
	Texas		United States		Texas		United States					
	1964	1965	1964	1965	1964	1965	1964[r]	1965	1964	1965	Texas	United States
Crude oil	990	1,001	2,787	2,849	[r] 42.9	42.5	47.6	47.2	35.5	35.1	+1.1	+2.2
Natural gas	[r] 1,159	1,185	[r] 2,761	2,864	[r] 50.3	50.4	47.1	47.4	42.0	41.4	+2.2	+3.7
Natural gas liquids	157	168	309	323	6.8	7.1	5.3	5.4	50.8	52.0	+7.0	+4.5
Total equivalent	[r] 2,306	2,354	[r] 5,857	6,036	100	100	100	100	39.4	39.0	+2.1	+3.1

[r] Revised.
[1] Million barrels of oil equivalent, derived by gas and liquids factors reported in table 5.

plume was being replaced with the more efficient and less obnoxious furnace-type plant. Natural gas was the source material for 15 percent of the carbon black produced in Texas in 1965 compared with 16 percent in 1964.

Helium.—At two Bureau of Mines plants, in Amarillo and Excell, grade-A helium (purity 99.995 percent) was produced for direct sale to other Federal agencies and to private consumers. Production from the two plants was 339.0 million cubic feet, valued at $11.4 million. Shipments (sales) totaled 331.1 million cubic feet in 1965, an increase of about 8.6 percent over 1964 shipments. The helium produced in excess of shipments was placed in underground storage as part of the national helium conservation program.

The Phillips Petroleum Co. produced "crude" helium (50 to 80 percent purity) in plants at Dumas and Gruver. The helium was extracted from natural gas before the gas was transported to its ultimate market. It was purchased by the Bureau of Mines and transported, via a Federally owned pipeline, to the Government's Cliffside gasfield near Amarillo, for storage in a partially depleted underground gas reservoir until needed. The two Phillips plants produced and delivered to the Bureau of Mines 1,015.7 million cubic feet of helium, valued at $10.3 million.

Lignite.—Lignite production increased over that of 1964, owing to increased demand for its use as a fuel to generate electric power and as a raw material in manufacturing activated carbon. Lignite was mined from open pits in Harrison and Milam Counties.

Natural Gas.—Output of marketed natural gas increased 2 percent to a record 6,636.6 billion cubic feet and value advanced 6 percent to a record $858.4 million as local and domestic markets increased

Table 7.—Fuels reserves ratio to production in Texas and the United States

Fuel	Reserves [1]				Percent—				Reserve ratio			
	Texas		United States		Texas of United States		Change from 1964		Texas		United States	
	1964	1965	1964	1965	1964	1965	Texas	United States	1964	1965	1964	1965
Crude oil	14,300	14,303	30,991	31,352	46.1	45.6	+	+1.2	14.4	14.3	11.1	11.0
Natural gas	21,224	21,539	50,223	51,155	42.3	42.1	+1.5	+1.9	18.2	17.7	18.1	17.4
Natural gas liquids	2,897	2,970	5,668	5,871	51.1	50.6	+2.5	+3.6	18.5	17.7	18.3	18.2
Total oil equivalent	38,421	38,812	86,882	88,378	44.2	43.9	+1.0	+1.7	16.6	16.3	14.8	14.5

[1] Million barrels of oil equivalent, derived by gas and liquids factors reported in table 5.

substantially. During the year, 3,698.6 billion cubic feet of gas was consumed in Texas and 2,648 billion cubic feet was exported from the State. Over 70 percent of gas produced entered transmission lines, nearly 7 percent was used as plant or lease fuel, less than 1 percent was consumed in the production of carbon black, about 8 percent was cycled, nearly 5 percent used in pressure maintenance and repressuring operations, and about 1 percent was vented or flared. Gas production originated from 33,436 wells located in 191 counties in 1965, according to the Railroad Commission of Texas.

Estimated proved recoverable reserves of natural gas in the State increased from 118,855 billion cubic feet at the end of 1964 to 120,617 billion cubic feet in December 1965, according to the Committee on Natural Gas Reserves of the American Gas Association.

These reserves were enhanced through the following significant gas discoveries: A deep Ellenburger completion in the Val Verde Basin of Crockett County; two important Atoka completions in Palo Pinto County and one Atoka in Shackelford County; a Des Moines discovery in Parker County; one Miocene completion in Cameron County; a Wilcox completion in Goliad County; two Frio completions in Nueces and Willacy Counties; significant Frio discoveries in Jefferson, Matagorda, and Newton Counties; Yegua completions in Polk and Tyler Counties; and a Glen Rose discovery in Walker County.

Shell Oil Co. began delivering 100 million cubic feet per day from its Buccaneer gasfield offshore from Galveston to the Freeport chemical complex of The Dow Chemical Co. in Brazoria County.

Industrial, commercial, and residential markets for gulf coast gas increased in 1965, being responsible for nearly 60 percent of the gas produced in the gulf region with only 40 percent moving in interstate commerce. Gulf coast petrochemical plants accounted for the major portion of the demand and for practically all of the increase.

Natural Gas Liquids.—The 1965 output of 9,620 million gallons of natural gas liquids valued at $462 million established a new record for Texas. This was a 6.5 percent advance in volume and 15.5 percent advance in value over the previous record in 1964. LP gases advanced nearly 6 percent in volume and 22 percent in value

Table 8.—Production and value of mineral fuels

Year	Crude petroleum		Natural gas [1]	
	Thousand barrels	Value (thousands)	Million cubic feet	Value (thousands)
1956–60 (average)	1,004,260	$2,996,723	5,389,175	$547,295
1961	939,191	2,791,377	5,963,605	733,523
1962	943,328	2,818,709	6,080,210	747,866
1963	977,835	2,908,380	6,205,034	775,629
1964	989,525	2,928,994	r 6,490,202	809,180
1965	1,000,749	2,962,119	6,636,555	858,396

Year	Natural gas liquids					
	Natural gasoline and cycle products		LP gas		Total	
	Thousand gallons	Value (thousands)	Thousand gallons	Value (thousands)	Thousand gallons	Value (thousands)
1956–60 (average)	2,890,328	$207,825	4,035,759	$165,177	6,926,087	$373,002
1961	3,111,427	214,279	4,768,222	185,558	7,879,649	399,837
1962	3,205,517	233,345	5,012,291	189,382	8,217,808	422,727
1963	3,320,416	218,975	5,366,831	169,695	8,687,247	388,670
1964	3,512,460	232,245	5,521,236	167,492	9,033,696	399,737
1965	3,772,471	256,959	5,847,601	204,666	9,620,072	461,625

r Revised.
[1] Marketed production, gas either sold or consumed by producers including losses in transmission, amounts added to storage, and increases in gas pipelines.

and were responsible for 61 percent of total natural gas liquids output in 1965. Principal industrial consumers of the LP gases were the petrochemical industries and synthetic rubber industries along the gulf coast.

The State had 294 natural gasoline plants and 36 cycling plants operating in 1965. The industry added about 180 million cubic feet daily to installed gasoline plant capacity and 740 million cubic feet per day in seven new plants. New construction included the following: A 500-million-cubic-foot-per-day refrigerated adsorption plant of Coastal States Gas Producing Co. at Bay City; a 15-million-cubic-foot-per-day adsorption plant by Houston Natural Gas Production Co. in the Pavey field of Tyler County; an 80-million-cubic-foot-per-day refrigerated-adsorption plant by Humble Oil & Refining Co. in the Sarita field of Kenedy County; and a 10-million-cubic-foot-per-day refrigeration plant of Pure Oil Co. at Ozona, Crockett County. Additional capacity was being added to existing plants as follows: 50-million-cubic-foot-per-day addition to Block 31 field plant of Atlantic Refining Co. in Crane County; a 45-million-cubic-foot-per-day addition to the Anahuac plant in Chambers County and an 80-million-cubic-foot-per-day addition to the Hawkins plant in Wood County by Humble Oil & Refining Co.; a 33-million-cubic-foot-per-day expansion to Pan American Petroleum Corp. Luby plant in Nueces County; and a 16.5-million-cubic-foot-per-day expansion to the Groves plant of Petro Gas Producing Co. in Jefferson County.

Estimated proved recoverable reserves of natural gas liquids increased to over 4 billion barrels and amounted to 51 percent of the Nation's natural gas liquids reserves according to the American Gas Association.

Petroleum.—Production of crude oil increased for the fifth consecutive year to 1.0 billion barrels, 1 percent greater than in 1964 but 9 percent below the record 1956 production of 1.1 billion barrels. Production was reported in 204 counties in 1965; 76 counties reported production exceeding 10 million barrels and 72 counties had output over 1 million barrels. The five leading counties, in order of production, were Andrew, Ector, Crane, Gaines, and Scurry.

Average daily production amounted to 2,741,778 barrels per well in 1965 compared with 2,711,027 barrels per well in 1964. Texas crude averaged $2.96 per barrel in 1965, the same as that in 1964.

Estimated proved recoverable reserves of crude oil in the State increased to 14.3 billion barrels according to the American Petroleum Institute. Exploration drilling added 63.8 million barrels to reserves; extensions and revisions to existing fields added 865.6 million barrels. Over 45 percent of the Nation's total crude oil reserves were located in Texas.

Indicated demands for crude oil in Texas in 1965 amounted to 1,011 million barrels compared with 994.8 million barrels in 1964. Daily average demand in 1965 advanced to 2,769,348 barrels from the 1964 daily average of 2,725,375 barrels. Crude oil stocks in Texas refineries as of December 31, 1965, amounted to 80.5 million barrels of which 61 million were in tank farms and pipelines, 12.7 million barrels were in refineries, and 6.9 million barrels were in lease tanks.

There were 49 crude oil refineries in Texas at yearend with a total daily crude capacity of 2.8 million barrels per stream day, about 26 percent of the national total. Individual refinery capacity varied from less than 5,000 barrels to over 300,000 barrels per stream day. Nearly 90 percent of the capacity was located along the gulf coast, centering around the Houston-Beaumont-Port Arthur areas, extending south to the Corpus Christi area. Gulf coast refinery locations offered cheap water

Table 9.—Crude petroleum production, indicated demand, and stocks, in 1965, by months
(Thousand 42-gallon barrels)

Month	Production	Indicated demand	Stocks originating in Texas
January	85,601	87,466	92,347
February	77,604	78,386	91,565
March	85,332	80,393	96,504
April	83,414	78,465	101,453
May	83,305	82,756	102,002
June	82,624	83,303	101,323
July	84,534	87,543	98,314
August	84,721	86,456	96,579
September	81,170	84,282	93,467
October	85,464	86,898	92,033
November	82,980	82,666	92,347
December	84,000	92,198	89,729
Total 1965	1,000,749	1,010,812	XX
1964	989,525	994,762	XX

XX Not applicable.

Table 10.—Petroleum daily average production and runs to stills

(Thousand 42-gallon barrels)

Month	1964		1965	
	Crude production	Runs to stills	Crude production	Runs to stills
January	2,706	2,452	2,761	2,760
February	2,729	2,453	2,772	2,816
March	2,759	2,410	2,753	2,746
April	2,755	2,451	2,780	2,622
May	2,727	2,465	2,687	2,636
June	2,714	2,465	2,754	2,756
July	2,675	r 2,536	2,727	2,818
August	2,660	2,499	2,733	2,693
September	2,720	2,417	2,706	2,800
October	2,741	2,438	2,780	2,752
November	2,727	r 2,372	2,783	2,822
December	2,794	2,482	2,890	2,901

r Revised.

Table 11.—Runs to stills and output of refineries in 1965, by months

(Thousand 42-gallon barrels)

Month	Runs			Output					
						Fuel oil			
	Crude	Products	Rerun	Gasoline [1]	Kerosine	Distillate	Residual	Jet fuel	Miscellaneous
January	74,723	9,375	—1,622	40,733	3,953	19,259	2,825	3,978	11,728
February	69,288	8,123	—770	36,698	3,320	18,407	2,912	3,879	11,425
March	74,262	9,127	—2,615	38,796	3,181	18,090	3,309	4,574	12,824
April	72,020	9,141	—2,042	38,191	3,165	17,007	3,745	4,267	12,744
May	74,089	8,932	—547	39,710	2,985	18,102	3,589	4,483	13,605
June	73,468	9,434	—1,010	40,143	2,824	18,225	3,206	4,445	13,049
July	75,410	10,082	335	41,430	3,075	19,798	3,785	4,381	13,358
August	74,284	10,102	—680	41,560	3,489	19,232	3,028	3,767	12,630
September	73,777	9,749	—1,431	39,844	3,470	18,995	2,768	4,271	12,747
October	76,108	10,351	—2,826	40,893	3,796	19,632	3,316	4,271	11,725
November	74,526	10,191	—1,309	40,715	3,779	19,088	3,228	4,516	12,082
December	77,724	10,875	—437	42,846	4,157	20,269	3,879	4,896	12,115
Total:									
1965	889,679	115,482	—14,954	481,559	41,194	226,104	39,590	51,728	150,032
1964	898,023	94,105	—29,150	465,815	58,286	220,120	36,591	33,027	149,139

[1] Includes special naphthas.

Table 12.—Stocks of crude petroleum at refineries, tank farms, and gathering systems in 1965, by months

(Thousand 42-gallon barrels)

Month	Refineries	Tank farms and pipelines	Lease tanks	Total
January	13,499	59,840	7,297	80,636
February	14,255	59,908	7,354	81,517
March	15,509	63,522	7,118	86,149
April	16,561	67,812	7,006	91,379
May	16,580	69,100	7,194	92,874
June	16,155	67,794	6,911	90,860
July	15,992	66,375	6,955	89,322
August	14,883	65,508	6,880	87,271
September	14,324	62,360	6,818	83,502
October	13,703	62,319	6,957	82,979
November	13,160	62,567	6,944	82,671
December	12,656	61,008	6,891	80,555

Table 13.—Stocks of refined products by refineries with plants and pipelines in 1965, by months

(Thousand 42-gallon barrels)

Month	Gasoline [1]	Kerosine	Fuel oil		Jet fuel	Natural gas liquids	Miscellaneous products
			Distillate	Residual			
January	37,932	3,465	13,102	5,140	4,118	1,290	29,709
February	40,674	3,286	12,490	5,719	3,944	1,195	29,850
March	39,259	3,155	11,826	5,958	3,801	1,372	30,716
April	36,709	3,387	11,478	5,723	4,023	1,261	31,624
May	32,233	3,336	12,675	6,248	3,675	1,085	31,309
June	31,299	3,999	17,501	6,820	4,457	1,085	31,328
July	29,492	3,487	18,676	6,931	4,983	1,048	30,478
August	29,286	3,514	20,868	7,185	3,946	909	30,470
September	29,165	3,772	22,374	7,350	3,171	1,069	30,829
October	27,744	3,369	21,733	8,028	3,088	996	32,709
November	30,247	3,129	22,305	7,905	3,218	873	32,815
December	32,928	2,739	17,887	7,062	3,530	868	32,762

[1] Includes naphtha.

transportation to east coast markets by ocean tanker, to Midwest markets by barge via the Intracoastal Waterway and the Mississippi River, as well as by overland pipeline.

The Texas Railroad Commission adopted new allowables for offshore completions to compensate, in some measure, for more expensive drilling and exploration costs. The new allowables—covering oil production within the 3-league State limit and in Federal waters—scaled to well density and depth, favored wider spacing and encouraged 80 and 160 acre spacing instead of nominal 40-acre tracts. For example, an 80-acre well received 65 percent more allowable than a 40-acre well at 2,000 feet. The allowables were subject to the State's market-demand proration.

A "model" unitization and conservation project of oil operators and the Texas Railroad Commission to insure maximum recovery from the complex Fairway (James lime) unit became effective on October 1, 1965. The project provided for a single operation of the complex reservoir owned by about 220 working interest owners and more than 1,500 royalty owners. The unit's single coordinated recovery program was estimated to recover around 200 million barrels of oil as compared with only 65 million barrels by primary competitive operations.

The world's largest fluid catalytic cracker, with a capacity of 210,000 barrels of crude oil daily and costing $8 million, was being assembled at the Baytown oil refinery of Humble Oil & Refining Co. The unit included a regenerator measuring 64 feet in diameter, a 45-foot reactor, and a 30-foot fractionator. Completion was scheduled for early 1967.

Petrochemicals.—Though Texas ranked second in value of all chemicals produced annually in the United States, it was the major user of first generation or building block petrochemical products; for example, benzene, toluene, and xylenes as well as acetylene, ethylene, methylene, propylene and other aliphatics. Capital investment by the State's chemical industry amounted to over $3 billion and continued to grow.

The petrochemical industry comprised 18 major producers including most of the giants in the petroleum and chemical industries. Most of the industry was located along the gulf coast because of availability of water transportation and raw materials such as natural gas, petroleum refinery-products, liquid petroleum gases, salt, sulfur, and lime.

Important new facilities or expansions to existing operations occurring in the petrochemical industry in 1965 were as follows: Amoco Chemicals Corp. planned a 200-million-pound-per-year paraxylene unit at its Texas City complex; Celanese Chemical Co. was building a 25-million-pound-per-year pentaerythritol plant and a 40-million-pound-per-year methanol unit at its Bishop chemical plant; and El Paso Natural Gas Products Co. added a 200-ton-per-day ammonia plant, a 40-million-pound-per-year hexamethylene diamine adipic

acid unit, and a 180-ton-per-day nitric acid unit to its Odessa chemical complex. E. I. du Pont de Nemours & Co., Inc., was building a 600-million-pound-per-year ethylene plant at its Orange facility, Enjay Chemical Co. completed a 20-million-gallon-per-year cyclohexane plant at its Baytown refinery, and Ethyl Corp. expanded synthetic primary alcohol and vinyl chloride monomer capacities at its Pasadena plant. Gulf Oil Corp. added a 100-million-pound-per-year alpha olefin unit to its Cedar Bayou complex, Mobil Chemical Co. was adding terephthalic acid and an ammonia plant with facilities for producing urea and a nitrogen-containing solution to its Beaumont chemical plant, and Monsanto Co. was completing the second phase of a 280-million-pound-per-year expansion to its acrylonitrile plant. Phillips Petroleum Co. added 12,500 long tons capacity to its synthetic polymer unit at Borger, Shamrock Oil & Gas Corp. expanded its Sunray ammonia plant capacity by 200 tons per day, and Shell Chemical Co. added a large chlorine-caustic unit to its Houston chemical complex. Signal Oil & Gas Co. completed a 350-barrel-per-day ethylbenzene unit and 150-barrel-per-day paraxylene unit at its Houston complex. Gulf Oil Corp. planned a 200-million-pound-per-year polyethylene unit for its Cedar Bayou complex. Suntide Refining Co. of Corpus Christi added a 1,400-barrel-per-day unit for producing 85- to 90-percent-pure propylene and a special propane unit replacing its present tetramer products facility. Texaco Inc. expanded its aromatics capacity by 10 million gallons per year; Texas Eastman Co. of Longview was adding facilities to produce acetaldehyde and ethylene oxide and convert to ethylene glycol, high-purity ethylene, and a light and heavy aromatic distillate; and Union Carbide Corp. Chemical Division at Texas City planned to double its ethylene amines capacity.

An important gas and petrochemical complex comprising a 1,000-million-cubic-foot-per-day gas processing plant and a 500-million-pound-per-year ethylene plant was being built in Brazoria County by Phillips Petroleum Co. and two subsidiaries of Houston Natural Gas Production Co. The gasoline plant was expected to recover 22,000 barrels of natural gas liquids per day.

NONMETALS

Improved output of 12 of the State's 18 nonmetals resulted in a 9-percent increase in value over that of 1964. Production declines were reported for six nonmetals—gypsum, lime, pumicite, stone, barite, and talc. Significant advances occurred in the number of industrial, commercial, and public works construction awards in contrast to the declining number of new starts in home building. Record outputs were established for bromine, magnesium compounds, sodium sulfate, and salt.

Descriptions of nonmetallic mineral deposits in 42 Texas counties are contained in a publication issued in 1965 by the Bureau of Economic Geology of The University of Texas.

Barite.—Production of crude barite from the Seven Heart Gap area of Culberson County decreased from that of 1964. Continental Minerals, the State's only producer, also operated a barite processing plant near Van Horn. Plants in Houston, Corpus Christi, and Brownsville processed barite that was mined outside of Texas.

Bromine.—Ethyl-Dow Chemical Co. extracted ethylene dibromide from sea water at its Freeport plant. Output increased 32 percent and value increased 36 percent over that of 1964. Chief use of ethylene dibromide was as an additive in antiknock gasoline to prevent deposition of lead in engines.

Cement.—The quantity and value of portland cement shipped during the year reached a record high. Eighteen plants, with combined total capacity of 43.6 million barrels, operated at about 71 percent of capacity, up from the rate of 69 percent of combined total capacity in 1964. Average price in 1965 was $3.17 per barrel.

The new cement plant of Capitol Cement Division of Capitol Aggregates, Inc., began operations on the site of a former Government lithium plant in San Antonio. The new 1.25 million-barrel-per-year cement plant of Gifford-Hill Portland Cement Co. was under construction near Midlothian in the Dallas metropolitan area. In southeast Texas, the Texas Portland Cement Co., Division of Alpha Portland Cement Co., began constructing a new 2.4-million-barrel-per-year plant at Orange to replace its present facility. Shareholders

Table 14.—Portland cement production, shipments, and consumption

(Thousand 376-pound barrels and thousand dollars)

Year	Production	Shipments		Consumption (quantity)
		Quantity	Value	
1956–60 (average)	24,653	24,385	$75,088	21,249
1961	24,889	25,101	80,808	21,566
1962	26,443	26,204	83,162	22,900
1963	29,150	29,104	92,734	24,618
1964	29,792	30,030	94,492	26,156
1965	30,771	30,820	97,598	26,371

of Longhorn Portland Cement Co. of San Antonio and Kaiser Cement and Gypsum Corp. approved plans to merge the two companies. On July 1, Halliburton Portland Cement Co. of Corpus Christi was renamed Centex Cement Corp.

Clays.—The tonnage of clays sold and used in Texas increased 7 percent and the total value increased 2 percent over that of 1964. Bentonitic clay accounted for about 2 percent of the quantity and 12 percent of the total value of clays sold or used. About 56 percent of the bentonite was used for filtering and decolorizing, 33 percent was used for drilling muds, and 3 percent was used as a carrier for insecticides and fungicides. The remainder was used in foundries and steelworks, in animal feed, as an absorbent, and for unspecified purposes.

Consumption of fire clay was about 10 percent greater than in 1964. About 88 percent of the fire clay was used in heavy clay products, and about 9 percent in firebrick. The remainder was used in stoneware, art pottery, and mortar, and as an insecticide carrier and a fertilizer.

Miscellaneous clay, including clay used in cement, increased almost 7 percent in quantity and value over that of 1964. Unit value remained at $1.06 per short ton. Almost 1.3 million short tons (about 35 percent) of the total miscellaneous clay was used in building brick and other heavy clay products. Nearly 35 percent of the miscellaneous clay was used in cement. Tonnage of miscellaneous clay used for preparing lightweight aggregate increased slightly over that of 1964. Percentage, however, remained the same—about 28 percent of the total miscellaneous clay was used for lightweight aggregate during both years.

Near Wharton, Calag Co. began mining and processing miscellaneous clay for use chiefly as highway construction material. Rio Clay Products was expanding its brick-making facility at Rio Grande City. At its new plant in Denton, Acme Brick Co. was building a second tunnel kiln of an estimated production capacity of 25 million brick per year.

Gem Stones.—A variety of gem stones and rock and mineral specimens including agate, jasper, cinnabar, fluorite, topaz, calcite, opal, petrified wood, and tektites was produced in Texas during the year.

Graphite.—Value of graphite mined from open pits and processed in the mill of

Table 15.—Clays sold or used by producers, by kinds

(Thousand short tons and thousand dollars)

Year	Bentonite		Fire clay		Miscellaneous clay		Total [1]	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1956–60 (average)	132	$971	575	$1,293	2,699	$2,913	3,406	$5,177
1961	122	900	676	1,660	2,988	3,177	3,786	5,737
1962	118	873	615	1,558	3,011	3,203	3,744	5,634
1963	120	1,366	808	2,054	3,271	3,429	4,199	6,849
1964	111	1,294	666	1,815	3,379	3,586	4,156	6,695
1965	114	829	735	1,999	3,605	3,832	[2] 4,469	[2] 6,865

[1] Incomplete total (1956–64), excludes kaolin (1964) and fuller's earth.
[2] Includes ball, kaolin, and fuller's earth.

Southwestern Graphite Co. near Burnet was 10 percent greater than that of 1964.

Gypsum.—Production of crude gypsum decreased 8 percent from that of the previous year; total value decreased about 6 percent. Georgia-Pacific Corp. of Portland, Oregon, acquired Bestwall Gypsum Co., the Hardeman County producer, and designated it their Bestwall Division. Six companies reported production of Texas gypsum during 1965.

Lime.—The tonnage of lime produced in the State decreased slightly, the total value, however, increased more than 14 percent. Chemical and other industrial uses consumed 67 percent of total lime output. The proportion of lime used for construction continued to increase. In contrast with the 28 percent of total lime output used for construction in 1965 and the 23 percent used 4 years ago (1961), only 10 percent of total production was used for that purpose in 1957. The rise was due to the greater use of lime as a soil stabilizer in highway and airport-runway construction.

During the year, Texas Lime Co. was building a second lime plant in Johnson County with a daily capacity of about 200 tons. U.S. Gypsum expanded its lime-producing facilities at New Braunfels, Comal County.

Magnesium Compounds.—Production of magnesium compounds increased during 1965. Dow Chemical Company's Texas Division in Freeport prepared magnesium compounds extracted from waters of the Gulf of Mexico. E. J. Lavino & Co. processed magnesium hydroxide to obtain refractory magnesia at a plant in Freeport.

Natural Salines.—Production of natural salines (sodium sulfate) increased 21 percent during the year. The new Cedar Lake plant of Ozark-Mahoning Co. to extract sodium sulfate from brines, began operations in Gaines County. The company also produced natural salines at facilities near Brownfield and Monahans.

Table 16.—Crude gypsum mined

(Thousand short tons and thousand dollars)

Year	Quantity	Value
1956–60 (average)	1,184	$3,963
1961	1,074	3,832
1962	1,120	3,956
1963	1,099	3,999
1964	1,131	4,049
1965	1,045	3,794

Perlite.—The only producer of crude perlite in Texas, Perlite Producers, Inc., moved its crushing, grinding, and drying facilities from Marfa to the site of its perlite mining operation in the Pinto Canyon area of Presidio County. Expanded perlite, produced by seven other plants in five other counties, was used for filter aids, 60 percent; and concrete aggregate, 31 percent. The remainder was used as loose-fill insulation, in building-plaster, as soil conditioner, as a filler, and for other purposes.

Pumicite (Volcanic Ash).—Pozzolana, Inc., produced pumicite from open pits near Rio Grande City in Starr County. The material was used as a concrete admixture.

Salt.—Total value of salt produced in 1965 increased about 7 percent over that of 1964. During the past decade, the total production value more than doubled—the 1965 value was 114 percent greater than that of 10 years ago. This rise was due chiefly to increased requirements of chemical and other industries within the State. Salt in brine constituted 94 percent of the tonnage sold or used in 1965. It accounted, however, for only 79 percent of the total

Table 17.—Lime sold or used by producers

Year	Quicklime (short tons)	Hydrated lime (short tons)	Total	
			Short tons	Value (thousands)
1956–60 (average)	434,176	307,706	741,882	$7,838
1961	412,063	377,475	789,538	8,703
1962	585,214	461,042	1,046,256	11,999
1963	571,515	559,690	1,131,205	13,026
1964	764,250	586,115	1,350,365	17,201
1965	716,574	621,377	1,337,951	19,663

value, reflecting the lower unit value of brine compared with that of evaporated and rock salt.

Sand and Gravel.—Total production of commercial and Government-and-contractor sand and gravel increased about 12 percent over that of 1964, and total value increased 8 percent. About 84 percent of the output was furnished by commercial operators at an average price of $1.22 per short ton. Commercial production increased about 9 percent in tonnage and value over that of 1964.

Stone.—The $53.7 million value of stone production during 1965 was second only to the record $54 million value of 1963. About 29 percent of the total represented value of shell produced from bays along the gulf coast. Other kinds of stone produced included basalt, granite, marble, limestone, graphitic schist, metarhyolite, and sandstone. Slightly more than one-forth of the total output of shell was used in cement and lime; construction uses accounted for most of the remainder.

Lone Star Cement Co. acquired the Texas Construction Material Co. with plants in Burnet County and in southeast Texas. Bilbrough Marble Co., a subsidiary of Marble Products Co., expanded its Burnet plant and acquired the Texas Marble Co. plant at Marble Falls. Ideal Cement Co. purchased Thorstenberg Materials Co., a sand and gravel producer on the Texas Gulf Coastal Plain. Van Horn Stone Corp. opened a building-stone quarry in volcanic tuff about 18 miles south of Van Horn. Texas Ledgestone, Inc., opened a limestone quarry east of Dryden in Terrell County to produce ledgestone, flagstone, and other building stone. Palo Pinto Stone Co. opened a new 500-ton-per-day-capacity plant near Palo Pinto to prepare crushed limestone. General Stone & Materials Corp. of Roanoke, Va., purchased San-Tex Stone Quarry, Inc., a producer of limestone in Williamson County.

Table 18.—Salt sold or used by producers

(Thousand short tons and thousand dollars)

Year	Quantity	Value
1956–60 (average)	4,338	$16,462
1961	4,695	17,582
1962	5,553	19,485
1963	5,965	22,355
1964	6,410	23,797
1965	6,964	30,771

Sulfur.—Demand exceeded production of Frasch sulfur, and shipments from Texas mines showed an 11 percent increase over those of 1964. Sulfur consumption in the United States and the remainder of the free world continued to rise, and an even greater demand was forecast. Uses by the fertilizer industry accounted for much of the consumption, but other industrial uses also increased.

The average unit price of Texas Frasch sulfur rose from $19.92 in 1964 to $20.40 per long ton in 1965. Texas Gulf Sulphur Co. began production at the site of an old sulfur mine at Gulf salt dome (Big Hill) in Matagorda County. Salt domes in Fort Bend, Jefferson, Liberty, and Wharton Counties also yielded Frasch sulfur.

In addition, sulfur was recovered from sour natural gas, and during the year, 621,364 long tons was shipped from 32 Texas plants. National Sulphur Co. began recovering sulfur at its new 12-ton-per-day-capacity plant near Canton in Van Zandt County. A 15-ton-per-day-capacity sulfur extraction unit was being added to the Mount Pleasant refinery of American Petrofina Co. Shell Oil Co. increased the sulfur recovery unit at its Person plant in

Table 19.—Sand and gravel sold or used by producers

(Thousand short tons and thousand dollars)

Year	Commercial		Government-and-contractor		Total sand and gravel	
	Quantity	Value	Quantity	Value	Quantity	Value
1956–60 (average)	25,184	$27,630	5,022	$1,755	30,206	$29,385
1961	23,272	27,975	4,126	2,716	27,398	30,691
1962	25,619	29,948	4,457	3,149	30,076	33,097
1963	27,511	32,085	5,745	4,226	33,256	36,311
1964	25,249	30,896	3,906	2,498	29,155	33,394
1965	27,488	33,572	5,161	2,503	32,649	36,075

Table 20.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1964		1965	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	8,645	$8,650	9,376	$9,873
Paving	2,423	2,639	3,096	3,709
Fill	817	384	523	204
Other [1]	580	2,478	994	3,072
Total	12,465	14,151	13,989	16,858
Gravel:				
Building	8,258	11,080	8,792	10,842
Paving	4,055	5,146	4,257	5,403
Fill	157	85	160	89
Other [2]	314	434	290	380
Total	12,784	16,745	13,499	16,714
Total sand and gravel	25,249	30,896	27,488	33,572
Government-and-contractor operations:				
Sand:				
Building	1	2	2	2
Paving	411	173	475	231
Fill	11	4	40	20
Other [3]	---	---	40	7
Total	423	179	557	260
Gravel:				
Paving	3,297	2,245	4,487	2,196
Fill	186	74	---	---
Other [4]	---	---	117	47
Total	3,483	2,319	4,604	2,243
Total sand and gravel	3,906	2,498	5,161	2,503
Grand total	29,155	33,394	32,649	36,075

[1] Includes other construction sand and industrial sand (unground and ground).
[2] Includes railroad ballast, miscellaneous, and other construction gravel.
[3] Includes other construction sand.
[4] Includes other construction gravel.

Table 21.—Stone sold or used by producers, by kinds

(Thousand short tons and thousand dollars)

Year	Limestone		Sandstone		Shell		Total [1]	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1961	24,439	$25,718	2,266	$1,511	10,531	$15,373	38,316	$45,874
1962	25,717	27,851	1,266	2,045	10,073	14,701	38,067	48,988
1963	31,375	34,682	1,412	1,756	9,804	14,026	43,142	54,007
1964	28,263	31,950	1,304	1,753	9,990	15,077	40,240	52,070
1965	27,882	31,095	881	1,423	9,689	15,356	39,520	53,659

[1] Includes other stone to avoid disclosing individual company confidential data.

Table 22.—Sulfur produced and shipped from Frasch mines

(Thousand long tons and thousand dollars)

Year	Production	Shipments	
		Quantity	Value
1956–60 (average)	3,029	2,930	$70,945
1961	2,778	2,730	62,720
1962	2,622	2,655	57,297
1963	2,413	2,550	50,109
1964	2,489	r 3,302	r 65,780
1965	2,534	3,674	74,955

r Revised.

Karnes County by 32 tons per day, and Texaco Inc. was building a contact sulfuric acid plant at its Port Arthur refinery.

Talc and Soapstone.—Production and value declined sharply in 1965. Six talc producers in Hudspeth County and one soapstone producer in Gillespie County reported an output of 64,211 tons, which was a 28 percent decrease from that of 1964. The unit value of mined production declined from $4.42 per ton in 1964 to $3.18 in 1965. Over half of the talc was used for ceramics; the remainder was used in paint, insecticides, and roofing and for other purposes.

Vermiculite.—Crude vermiculite, mined in other States, was exfoliated at plants in Dallas, Houston, and San Antonio.

Water.—Water supply remained one of the major mineral problems and much of the State's continued economic development depended upon water development programs. The State likewise faced a serious legal problem due to a dual water rights system—the Riparian system and the Appropriative system. The duplicity resulted in a conflict between industrial and irrigation uses of ground water. The mineral industry was interested in the legal development inasmuch as the oil, petrochemical, and metals processing and refining industries consumed large volumes of water.

Although ground water resources of Texas were extensive and the State had four major underground aquifers, the rapid increases in irrigation, industrial, and municipal requirements created serious depletion problems. An estimated 10 million acre-feet of water was pumped from underground aquifers for irrigation purposes. Ground water and irrigation data released by the Texas Water Commission showed 83 percent of the 7.7 million acres being irrigated in the State in 1965 received water from underground sources. Major subsurface aquifers in Texas included the Carrizo-Wilcox sand in the "Winter Garden" area in south Texas, the Ogallala Formation underlying much of the High Plains, the Edwards Limestone and Trinity Sand of the Edwards Plateau area, and the Gulf Coast sand. Water volumes pumped from the Ogallala Fromation for irrigation purposes greatly exceeded the average annual recharge rate of 30,000 acre-feet and resulted in a continued serious decline in the water table.

Of the 130 major conservation and flood control reservoirs in Texas and on border streams at mid-1965, 7 with a total storage capacity of 7,352,000 acre-feet were completed in 1965. In addition, 10 major reservoirs were under construction in the State or on border streams having a combined storage capacity of 10,556,000 acre-feet. When reservoirs under construction are completed, the State's conservation capacity will be increased to 26,830,000 acre-feet from 13,792,000 acre-feet and flood control storage capacity from 12,823,000 acre-feet to 17,793,000 acre-feet.

An "underground reservoir" for the San Antonio area was planned by the U.S. Army Corps of Engineers. The proposed project included three dams for the control of waterflow in the Nueces, Frio, and Sabine Rivers and for the slow release of the impounded waters into a water-bearing limestone layer 175 miles long, 40 miles wide, and 400 feet thick.

One of the major reservoir projects in progress in Texas was the International Amistad Dam and Reservoir located on the Rio Grande River 12 miles northwest of Del Rio, Texas. The earthen dam with concrete gravity section in the river channel will be 32,022 feet long; 9,585 feet will be under U.S. jurisdiction and the remainder under Mexican control. Construction features include 3.1 million cubic yards of rock excavation, 13.5 million cubic yards of embankment development, 1.8 million cubic yards of riprap, 1.7 million cubic yards of concrete, 6,000 tons of reinforcing steel and 6,500 tons of structural steel. The dam, excluding powerplant, was estimated to cost $78 million with completion sched-

uled for 1968. By yearend, overall dam construction prgress was 32.3 percent complete.

METALS

Metal mining was not a major factor in the Texas mineral economy. Individually, two of the four metals produced in 1965—iron and magnesium—were important in their own industry. Uranium, the third metal, was dependent upon open markets for its demand because of the termination of the Government purchase program with the State's single producer.

Despite the limited metal mining industry, Texas had a substantial and diversified metals extractive and fabricating industry. Eighteen metallurgical plants processed ores and other raw materials from other States and from foreign countries. Over 300 facilities processed State-produced metals into semi-finished and finished products. The metals extractive industry included aluminum from imported bauxite ores, antimony, cadmium, copper, lead, manganese, silver, gold, tin, tungsten, tantalum, and zinc from foreign ores and concentrates, iron from domestic and foreign ores, and magnesium from sea water.

Iron Ore.—Iron ore was produced from open pits in three counties—Cass, Cherokee, and Morris—by five producers. Iron ore pellets from Missouri and Canada largely replaced the locally mined ores as blast furnace feed.

Lone Star Steel Co. improved washing and sintering facilities at its Lone Star washing plant and was building a new, modern laboratory for quality control and research purposes. Armco Steel Corp. expanded and improved its plate mill and various smelting facilities.

Magnesium.—Improved magnesium markets and depleted metal stocks resulted in capacity operations of the two plants of The Dow Chemical Co. at Freeport. Metal capacities increased during the year through improvements in cell design and internal processing methods.

Mercury.—The high price of mercury during 1965 resulted in renewed exploratory activity in the Terlingua mercury district resulting in a small production of mercury from development ores—the first in several years.

Tin.—Output at the Texas City smelter of Wah Chang Corp. was slightly greater in 1965 than in 1964. Rare-earth and other metals also were recovered at the Texas City plant.

Uranium.—Though uranium mining and milling in the Falls City area were stopped temporarily in the first quarter of 1965, Susquehanna-Western, Inc., reactivated the mill to supply a significant order from a West German firm.

Zinc.—A considerable part of the Nation's primary and secondary zinc-smelting capacity was in Texas. Three primary plants (two horizontal retort and one electrolytic) processed foreign and Western States ores and concentrates. Secondary smelters in the Fort Worth-Dallas area and in the Houston-Beaumont area treated scrap material. Texas zinc smelters operated at near capacity, while domestic demand continued at high levels.

REVIEW BY COUNTIES

Mineral production was reported in 239 of the 254 counties. Only those counties with significant production or mineral industry activity are discussed; see table 23 for additional details.

Andrews.—Andrews County, with a total mineral value of $255.6 million, ranked first in total mineral value and petroleum and fourth in natural gas liquids. Natural gas liquids were recovered at seven gas-processing plants. Sulfur was recovered at the Parker-Andrews plant of Parker-Andrews Co. and at the Midland Farms plant of Pan American Petroleum Corp. Exploratory drilling by the oil and gas industry resulted in the discovery of nine oil reservoirs. Of 202 development wells drilled, 175 were completed as oil wells and 4 as gas wells.

Aransas.—Carbon black was recovered from liquid hydrocarbons at the Aransas Pass furnace plant of United Carbon Co. Heldenfels Bros. dredged shell from shallow bays bordering the county. Two gas reservoirs were discovered from exploratory drilling. Development drilling proved three oil wells and nine gas wells.

Table 23.—Value of mineral production in Texas, by counties [1]

County	1964 [r]	1965	Minerals produced in 1965 in order of value
Anderson	$25,899,130	$26,006,140	Petroleum, natural gas.
Andrews	253,233,400	255,602,640	Petroleum, natural gas liquids, natural gas.
Angelina	531,811	475,950	Clays, natural gas, petroleum.
Aransas	11,358,164	11,657,231	Petroleum, natural gas, natural gas liquids, shell.
Archer	29,901,031	30,119,380	Petroleum, natural gas liquids, natural gas.
Atascosa	16,211,640	16,717,180	Petroleum, natural gas, natural gas liquids, sand and gravel.
Austin	6,566,510	6,557,520	Do.
Bastrop	966,083	931,805	Clays, petroleum, natural gas.
Baylor	5,809,104	5,988,000	Petroleum, sand and gravel, natural gas.
Bee	16,945,541	18,960,655	Natural gas, natural gas liquids, petroleum, stone.
Bell	W	W	Sand and gravel, stone.
Bexar	21,429,388	22,880,757	Cement, stone, sand and gravel, petroleum, natural gas liquids, clays, natural gas.
Blanco	25,000	16,000	Sand and gravel.
Borden	25,505,160	25,861,260	Petroleum, natural gas, sand and gravel.
Bosque	111,679	5,000	Sand and gravel.
Bowie	192,760	22,860	Sand and gravel, petroleum.
Brazoria	180,876,917	196,409,525	Petroleum, natural gas, bromine, magnesium chloride, salt, natural gas liquids, lime, magnesium compounds, sand and gravel, stone.
Brazos	70,080	87,910	Natural gas, sand and gravel, petroleum.
Brewster	W	W	Clays, mercury.
Briscoe	W	W	Clays.
Brooks	29,623,990	30,713,550	Natural gas, petroleum, natural gas liquids.
Brown	2,004,239	2,192,626	Stone, petroleum, natural gas, clays.
Burleson	267,880	157,980	Stone, sand and gravel, petroleum.
Burnet	3,548,208	5,926,879	Stone, graphite, sand and gravel.
Caldwell	11,738,680	11,871,440	Petroleum.
Calhoun	22,946,153	24,474,968	Natural gas, petroleum, natural gas liquids, shell, lime.
Callahan	6,977,570	7,142,173	Petroleum, natural gas liquids, natural gas, stone.
Cameron	1,189,360	1,260,750	Natural gas, petroleum.
Camp	2,331,680	2,358,340	Petroleum, natural gas.
Carson	28,272,020	29,083,980	Natural gas, petroleum, natural gas liquids.
Cass	7,761,060	14,661,216	Natural gas liquids, petroleum, natural gas, iron ore.
Chambers	67,696,363	69,899,049	Petroleum, natural gas, shell, salt, natural gas liquids.
Cherokee	4,599,777	2,709,369	Petroleum, natural gas, natural gas liquids, iron ore, clays.
Childress	254,410	238,650	Petroleum, sand and gravel, natural gas.
Clay	11,100,137	11,220,870	Petroleum, natural gas, stone.
Cochran	21,087,520	21,372,480	Petroleum, natural gas, natural gas liquids.
Coke	24,718,330	24,927,600	Petroleum, natural gas liquids, natural gas, sand and gravel.
Coleman	8,829,839	8,191,335	Petroleum, natural gas, natural gas liquids, clays, stone.
Collin	169,170	178,172	Petroleum, stone, sand and gravel.
Collingsworth	1,651,670	1,747,220	Natural gas, petroleum, sand and gravel.
Colorado	24,358,150	29,933,167	Natural gas, natural gas liquids, sand and gravel, petroleum, stone.
Comal	3,884,838	3,779,843	Stone, lime, sand and gravel.
Comanche	614,140	229,053	Petroleum, natural gas, stone.
Concho	1,089,180	1,294,420	Petroleum, natural gas liquids, natural gas.
Cooke	31,550,060	31,714,225	Petroleum, natural gas liquids, natural gas, sand and gravel, stone.
Coryell	88,707	4,996	Petroleum, stone.
Cottle	224,150	233,690	Petroleum, sand and gravel, natural gas.
Crane	155,262,730	157,857,430	Petroleum, natural gas, natural gas liquids.
Crockett	25,869,900	26,978,160	Do.
Crosby	1,339,350	1,344,180	Sand and gravel, petroleum, natural gas.
Culberson	4,183,825	4,268,407	Petroleum, natural gas, stone, barite.
Dallam	93,400	99,070	Natural gas.
Dallas	18,351,466	20,076,591	Cement, sand and gravel, stone, clays.
Dawson	25,135,991	25,437,550	Petroleum, natural gas, natural gas liquids, stone.
Denton	369,654	451,726	Petroleum, sand and gravel, natural gas, clays.
De Witt	12,094,930	14,123,570	Natural gas, petroleum, natural gas liquids, stone.
Dickens	111,850	151,160	Petroleum, sand and gravel, natural gas.
Dimmit	880,240	892,410	Petroleum, natural gas.
Donley	---	33,000	Sand and gravel.
Duval	37,332,311	36,581,833	Petroleum, natural gas, salt, natural gas liquids.
Eastland	5,090,491	5,190,089	Petroleum, natural gas liquids, natural gas, stone, clays.

See footnotes at end of table.

Table 23.—Value of mineral production in Texas, by counties [1]—Continued

County	1964 r	1965	Minerals produced in 1965 in order of value
Ector	$235,661,568	$236,748,423	Petroleum, natural gas liquids, natural gas, cement, stone, sand and gravel.
Edwards	20,720	20,950	Petroleum.
Ellis	11,144,950	12,305,913	Cement, stone, clays, sand and gravel.
El Paso	4,687,475	5,733,545	Cement, stone, sand and gravel.
Erath	1,948,560	1,946,160	Natural gas, natural gas liquids, petroleum.
Falls	1,100	20,122	Stone, sand and gravel, petroleum.
Fayette	1,953,736	1,681,797	Petroleum, sand and gravel, clays, natural gas, stone.
Fisher	17,999,584	18,447,659	Petroleum, gypsum, natural gas liquids, natural gas, clays
Floyd	13,700	13,850	Petroleum.
Foard	3,154,280	3,227,960	Petroleum, natural gas, sand and gravel.
Fort Bend	35,575,044	38,397,660	Petroleum, sulfur, natural gas, salt, natural gas liquids, clays, sand and gravel, stone.
Franklin	15,063,250	14,406,810	Petroleum, natural gas liquids, natural gas.
Freestone	3,571,016	3,571,224	Natural gas, petroleum, stone, natural gas liquids, clays.
Frio	4,670,750	4,706,430	Petroleum, natural gas, natural gas liquids.
Gaines	93,361,760	94,893,696	Petroleum, natural gas, natural gas liquids, sodium sulfate, stone.
Galveston	52,956,883	57,612,283	Petroleum, natural gas, natural gas liquids, shell, clays, sand and gravel.
Garza	14,413,740	14,637,830	Petroleum, sand and gravel, natural gas.
Gillespie	139,693	114,005	Sand and gravel, soapstone, stone.
Glasscock	7,924,140	8,052,970	Petroleum, natural gas.
Goliad	9,851,210	10,211,480	Natural gas, petroleum, natural gas liquids.
Gonzales	452,937	391,370	Clays, petroleum, natural gas.
Gray	58,054,370	58,323,820	Petroleum, natural gas liquids, natural gas.
Grayson	27,993,632	27,883,981	Petroleum, natural gas, natural gas liquids, stone, sand and gravel.
Gregg	86,554,450	87,161,350	Petroleum, natural gas liquids, natural gas.
Grimes	137,290	108,510	Natural gas.
Guadalupe	9,529,580	9,735,648	Petroleum, sand and gravel, clays, natural gas.
Hale	6,119,410	6,181,250	Petroleum, natural gas, natural gas liquids.
Hall	72,000	---	
Hamilton	83,493	108,078	Natural gas, stone, petroleum.
Hansford	29,754,553	28,971,732	Natural gas, natural gas liquids, petroleum, helium.
Hardeman	5,049,195	5,283,749	Petroleum, gypsum, natural gas liquids, sand and gravel, natural gas.
Hardin	20,593,620	21,059,740	Petroleum, natural gas, natural gas liquids, sand and gravel.
Harris	99,679,812	113,011,350	Petroleum, cement, natural gas liquids, natural gas, salt, sand and gravel, lime, clays, barite.
Harrison	17,403,416	16,969,552	Petroleum, natural gas, natural gas liquids, coal, clays.
Hartley	1,982,270	2,098,430	Natural gas, petroleum.
Haskell	11,984,640	12,122,250	Petroleum, natural gas.
Hays	504,000	W	Sand and gravel.
Hemphill	1,688,800	1,728,230	Petroleum, natural gas.
Henderson	14,104,789	14,577,643	Petroleum, natural gas, natural gas liquids, sand and gravel, clays.
Hidalgo	33,725,971	36,604,605	Natural gas, natural gas liquids, petroleum, sand and gravel, stone, clays.
Hill	143,786	716,106	Lime, stone, sand and gravel, petroleum.
Hockley	50,304,460	50,572,910	Petroleum, natural gas liquids, natural gas.
Hood	52,503	24,000	Stone, sand and gravel.
Hopkins	5,315,747	6,857,552	Petroleum, natural gas, natural gas liquids, clays.
Houston	4,525,853	4,334,360	Petroleum, natural gas liquids, natural gas, sand and gravel.
Howard	46,110,620	46,072,800	Do.
Hudspeth	571,424	388,983	Talc, stone, sand and gravel, gypsum.
Hunt	194,259	182,980	Natural gas, petroleum, natural gas liquids.
Hutchinson	55,103,124	53,876,543	Petroleum, natural gas liquids, natural gas, sand and gravel, salt.
Irion	4,857,350	5,160,770	Petroleum, natural gas liquids, natural gas.
Jack	15,921,910	16,179,450	Petroleum, natural gas, natural gas liquids.
Jackson	49,196,350	50,409,390	Do.
Jasper	2,491,817	2,588,840	Petroleum, natural gas, lime, clays.
Jefferson	66,191,667	66,293,485	Petroleum, natural gas, sulfur, natural gas liquids, salt, sand and gravel, clays.
Jim Hogg	19,575,520	21,382,120	Petroleum, natural gas, natural gas liquids.
Jim Wells	64,375,090	67,304,210	Do.
Johnson	3,168,809	1,959,905	Lime, stone, petroleum, sand and gravel.
Jones	13,549,770	13,636,800	Petroleum, natural gas liquids, sand and gravel, natural gas.

See footnotes at end of table.

Table 23.—Value of mineral production in Texas, by counties [1]—Continued

County	1964 [r]	1965	Minerals produced in 1965 in order of value
Karnes	$17,674,115	$17,346,254	Petroleum, natural gas, natural gas liquids, uranium.
Kaufman	2,142,601	1,830,926	Petroleum, stone, natural gas.
Kendall	17,982	245,114	Stone.
Kenedy	8,334,390	9,501,140	Petroleum, natural gas, natural gas liquids.
Kent	33,666,010	34,081,040	Petroleum, natural gas, natural gas liquids, sand and gravel.
Kerr	W	63,000	Sand and gravel.
Kimble	25,530	33,080	Sand and gravel, natural gas, petroleum.
King	3,305,860	3,355,040	Petroleum, natural gas, sand and gravel.
Kleberg	91,587,242	100,456,232	Petroleum, natural gas, natural gas liquids, stone.
Knox	6,280,440	6,352,890	Petroleum, natural gas.
Lamb	970,638	904,560	Petroleum, stone, natural gas.
Lampasas	357,237	47,069	Sand and gravel, stone.
La Salle	1,130,690	1,159,690	Petroleum, natural gas.
Lavaca	11,665,237	13,660,764	Natural gas liquids, natural gas, petroleum, stone.
Lee	49,120	49,760	Petroleum, natural gas.
Leon	6,692,980	6,971,890	Petroleum, natural gas, natural gas liquids.
Liberty	41,550,692	43,243,050	Petroleum, sulfur, natural gas, sand and gravel, natural gas liquids.
Limestone	1,791,295	2,577,599	Natural gas, petroleum, sand and gravel, clays.
Lipscomb	8,372,280	8,562,170	Petroleum, natural gas.
Live Oak	19,479,250	22,910,220	Natural gas, natural gas liquids, petroleum.
Llano	2,279,858	2,273,562	Stone.
Loving	11,666,380	11,848,030	Petroleum, natural gas.
Lubbock	1,043,920	1,049,774	Petroleum, sand and gravel, stone, natural gas.
Lynn	1,685,490	1,697,150	Petroleum, natural gas.
McCulloch	1,422,528	W	Sand and gravel, stone.
McLennan	7,392,463	7,570,979	Cement, sand and gravel, stone, clays, petroleum.
McMullen	8,915,700	9,652,030	Natural gas, petroleum, natural gas liquids.
Madison	3,101,700	3,217,030	Do.
Marion	4,035,880	4,170,810	Petroleum, natural gas, natural gas liquids.
Martin	6,437,180	6,511,550	Petroleum, natural gas.
Mason	14,000	23,000	Sand and gravel.
Matagorda	54,443,189	57,153,975	Natural gas, petroleum, natural gas liquids, shell, sulfur, sand and gravel, clays, stone.
Maverick	2,160,520	2,173,570	Petroleum, natural gas liquids, natural gas.
Medina	1,382,148	1,394,140	Petroleum, clays, natural gas.
Menard	597,880	604,970	Petroleum, natural gas.
Midland	49,878,719	49,849,600	Petroleum, natural gas liquids, natural gas.
Milam	W	W	Coal, petroleum.
Mills	6,430	17,600	Stone.
Mitchell	5,102,710	5,176,960	Petroleum, natural gas, sand and gravel.
Montague	22,722,771	23,173,210	Petroleum, natural gas, natural gas liquids, stone, sand and gravel.
Montgomery	26,007,910	28,291,840	Petroleum, natural gas liquids, natural gas, sand and gravel.
Moore	60,731,577	63,628,041	Natural gas, natural gas liquids, helium, petroleum.
Morris	W	W	Iron ore.
Motley	1,155,460	1,077,520	Petroleum, sand and gravel, natural gas.
Nacogdoches	4,021,840	4,252,408	Natural gas, clays, natural gas liquids, petroleum.
Navarro	7,238,680	7,275,161	Petroleum, natural gas, sand and gravel, stone, clays.
Newton	5,316,660	5,366,130	Petroleum, natural gas, natural gas liquids.
Nolan	26,938,070	27,795,099	Petroleum, cement, natural gas liquids, natural gas, gypsum, stone, sand and gravel.
Nueces	77,715,565	82,958,871	Natural gas, petroleum, natural gas liquids, cement lime shell, sand and gravel.
Ochiltree	24,595,250	25,114,010	Petroleum, natural gas, natural gas liquids.
Oldham	W	W	Sand and gravel, clays.
Orange	11,361,435	12,040,675	Petroleum, natural gas, cement, natural gas liquids, clays, sand and gravel.
Palo Pinto	3,306,805	3,199,253	Natural gas liquids, natural gas, petroleum, clays, stone, sand and gravel.
Panola	42,415,150	47,349,110	Natural gas, natural gas liquids, petroleum.
Parker	3,055,942	2,741,593	Natural gas liquids, natural gas, stone, clays, petroleum, sand and gravel.
Parmer	189,320	191,460	Petroleum.
Pecos	63,982,640	70,180,931	Petroleum, natural gas, natural gas liquids, stone.
Polk	4,792,024	4,730,632	Petroleum, natural gas, stone.
Potter	17,125,355	17,692,040	Natural gas, helium, natural gas liquids, cement, sand and gravel, stone.
Presidio	26,700	8,250	Perlite.
Rains	1,100	1,170	Natural gas.

See footnotes at end of table.

Table 23.—Value of mineral production in Texas, by counties [1]—Continued

County	1964 r	1965	Minerals produced in 1965 in order of value
Reagan	$25,458,370	$26,331,620	Petroleum, natural gas liquids, natural gas.
Real	59	---	
Red River	77,290	78,160	Petroleum.
Reeves	11,620,420	11,863,010	Petroleum, natural gas, natural gas liquids, sand and gravel.
Refugio	75,615,580	77,318,700	Petroleum, natural gas, natural gas liquids.
Roberts	5,521,900	5,707,610	Petroleum, natural gas.
Robertson	490,940	141,240	Sand and gravel, petroleum.
Runnels	13,526,090	13,783,780	Petroleum, natural gas liquids, natural gas.
Rusk	58,102,270	58,590,530	Petroleum, natural gas, natural gas liquids, clays.
Sabine	18,000	7,000	Sand and gravel.
San Augustine	23,040	2,060	Petroleum.
San Jacinto	1,999,540	1,918,560	Petroleum, natural gas, sand and gravel.
San Patricio	43,888,301	45,118,020	Petroleum, natural gas, natural gas liquids, sand and gravel, stone, clays.
San Saba	W	103,790	Stone, sand and gravel.
Schleicher	11,277,480	11,232,590	Petroleum, natural gas, natural gas liquids.
Scurry	99,594,865	100,912,550	Petroleum, natural gas liquids, natural gas, clays.
Shackelford	10,445,160	10,546,370	Petroleum, natural gas, natural gas liquids.
Shelby	666,830	706,800	Natural gas, petroleum.
Sherman	15,809,700	16,768,040	Do.
Smith	8,468,810	8,578,640	Petroleum, natural gas, natural gas liquids, clays, sand and gravel.
Somervell	46,500	W	Sand and gravel.
Starr	28,923,580	29,172,829	Petroleum, natural gas, natural gas liquids, pumicite, clays.
Stephens	8,557,341	8,109,090	Petroleum, natural gas, natural gas liquids.
Sterling	2,701,930	2,733,510	Petroleum, natural gas.
Stonewall	19,295,970	19,505,680	Petroleum, natural gas liquids, natural gas, sand and gravel.
Sutton	1,155,040	1,224,670	Natural gas, petroleum.
Tarrant	9,839,518	7,678,060	Cement, sand and gravel, stone, sodium sulfate.
Taylor	16,125,110	17,096,627	Petroleum, natural gas liquids, natural gas, stone, sand and gravel, clays.
Terrell	6,927,580	7,366,796	Natural gas, stone, sand and gravel.
Terry	15,690,371	15,848,018	Petroleum, sodium sulfate, natural gas, natural gas liquids.
Throckmorton	7,961,330	8,062,930	Petroleum, natural gas, sand and gravel.
Titus	10,748,320	10,870,010	Petroleum, natural gas.
Tom Green	7,012,830	7,029,500	Petroleum, natural gas, natural gas liquids, sand and gravel.
Travis	3,804,185	3,645,246	Lime, sand and gravel, stone, petroleum.
Trinity	14,113	70,603	Stone, clays, petroleum, natural gas.
Tyler	2,799,700	2,748,820	Petroleum, natural gas.
Upshur	5,762,850	5,820,720	Petroleum, sand and gravel, natural gas.
Upton	53,923,010	54,017,440	Petroleum, natural gas liquids, natural gas.
Uvalde	W	W	Asphalt, sand and gravel, stone.
Val Verde	472,030	495,100	Natural gas, petroleum.
Van Zandt	22,762,865	26,733,452	Petroleum, natural gas liquids, salt, natural gas.
Victoria	24,458,850	25,912,960	Petroleum, natural gas, sand and gravel, natural gas liquids.
Walker	373,448	65,432	Clays, petroleum, natural gas.
Waller	20,998,830	27,503,090	Natural gas liquids, natural gas, petroleum, sand and gravel.
Ward	81,786,444	82,912,148	Petroleum, natural gas, natural gas liquids, sodium sulfate, salt, sand and gravel, stone.
Washington	673,110	626,080	Petroleum, stone, natural gas.
Webb	12,176,632	12,207,836	Petroleum, natural gas liquids, natural gas, clays, sand and gravel.
Wharton	66,156,200	75,866,007	Sulfur, petroleum, natural gas, natural gas liquids, clays.
Wheeler	9,709,960	9,789,960	Petroleum, natural gas, natural gas liquids.
Wichita	36,480,622	36,588,620	Petroleum, natural gas liquids, natural gas, sand and gravel.
Wilbarger	17,927,780	18,107,530	Do.
Willacy	8,510,130	8,751,150	Petroleum, natural gas, natural gas liquids.
Williamson	4,877,721	5,257,977	Stone, lime, petroleum, sand and gravel.
Wilson	1,616,978	1,643,634	Petroleum, clays, natural gas.
Winkler	96,425,750	98,426,160	Petroleum, natural gas, natural gas liquids.
Wise	33,796,151	34,251,392	Natural gas, petroleum, natural gas liquids, stone, clays.
Wood	48,984,190	54,665,725	Petroleum, natural gas liquids, natural gas, clays, sand and gravel.
Yoakum	64,403,813	65,092,854	Petroleum, natural gas, natural gas liquids, salt.
Young	15,104,750	15,378,840	Petroleum, natural gas, natural gas liquids, stone, sand and gravel.

See footnotes at end of table.

Table 23.—Value of mineral production in Texas, by counties[1]—Continued

County	1964 [r]	1965	Minerals produced in 1965 in order of value
Zapata	$4,802,320	$4,995,850	Natural gas, petroleum.
Zavala	1,013,800	1,039,800	Petroleum, natural gas.
Undistributed	30,498,902	20,567,873	
Total	4,548,824,000	4,708,709,000	

[r] Revised.
W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] The following counties were not listed because no production was reported in 1964 or 1965: Armstrong, Bailey, Bandera, Castro, Deaf Smith, Delta, Fannin, Jeff Davis, Kinney, Lamar, Randall, Rockwall, and Swisher.

Atascosa.—All mineral commodities contributed to a modest gain in value over that of 1964. Sulfur was recovered from sour natural gas at the Fashing plants of Gillring Oil Co. and National Sulphur Co. Ground, washed, and crude silica sand was recovered and processed by Espey Silica Sand Co. Exploratory drilling proved 1 oil well and development drilling proved 16 oil wells. The Jourdanton gasoline plant of Humble Oil & Refining Co. processed gas from the Jourdanton field to recover natural gas liquids.

Austin.—Natural gas liquids were recovered at the Sealy gas processing plant of Shell Oil Co. Two new gas reservoirs—at Orange Hill, South and New Ulm fields—were discovered as the result of two exploratory wells. Through development drilling 20 oil wells and 1 gas well were completed. Building, paving, and industrial sand and gravel were prepared by Brazos River Sand and Gravel and by crews of District 12 of the Texas Highway Department.

Bastrop.—The 4-percent decline in 1965 mineral value was the result of declines in fire clay production by three producers—Elgin-Standard Brick Mfg. Co., Elgin-Butler Brick Co., and Payne Brick Co.—that offset moderate advances in petroleum and crude oil. Bastrop County was the second largest clay producer in the State.

Bee.—A 12-percent increase in 1965 mineral value over that of 1964 resulted from moderate increases in petroleum, natural gas, natural gas liquids, and stone output. Limestone was quarried and prepared for concrete aggregate by Heldenfels Bros. Natural gas liquids were recovered at the gas-processing plant of Tidewater Oil Co. and the cycling plants of Pan American Petroleum Corp. and Houston Natural Gas Production Co. There were 17 oil wells and 18 gas wells completed from 80 development wells; 1 new gas pool was discovered through exploratory drilling.

Bexar.—Bexar County was first in value of clay and stone, third in cement, and fifth in sand and gravel, with a total mineral value of $22.9 million, 7 percent greater than in 1964. All commodities contributed to the advance in value except natural gas liquids.

Natural gas liquids were recovered at the 130 million-cubic-foot-per-day Junction gasoline plant of Lavaca Gathering Co. Crude oil was refined at the 600-barrel-per-day refinery of Flint Chemical Co., the 3,600-barrel-per-day Howell Refining Co. refinery and the 4,500-barrel-per-day Monarch Refining Co. refinery, all in San Antonio. The oil and gas industry completed 63 oil wells out of 97 development wells drilled and discovered 1 new oil pool in 7 exploratory tests.

Portland and masonry cements were produced at the San Antonio plant of Longhorn Portland Cement Co., the San Antonio Portland Cement Co., and the Capitol Cement Division of Capitol Aggregates, Inc., the latter a new producer in 1965. All three companies quarried limestone for cement from open pits. Other limestone quarried was crushed for concrete aggregate, roadstone, railroad ballast, and riprap by four producers. Sand and gravel, used principally for building and paving, was processed by 10 producers.

Clay and shale used in manufacturing vitrified sewer pipe and other heavy clay products was processed by the Southern Co., for building brick by Alamo Clay

Products Co., and for lightweight aggregate by Barlite, Inc., and Featherlite Co. of San Antonio.

Brazoria.—The abundant natural mineral resources of Brazoria County included three mineral fuels and seven non-metallic minerals and supplied an important mineral industry whose output value was 9 percent greater than that of 1964. Mineral fuels—petroleum, natural gas, natural gas liquids—accounted for nearly 60 percent of the total mineral value. The county was first in natural gas, lime, and salt values, third in total mineral value, and fifth in natural gas liquids value. Four gas processing plants, having a combined capacity of 607 million cubic feet per day, recovered natural gas liquids from local gasfields. Crude oil was refined at the 95,000-barrel-per-day Sweeny refinery of Phillips Petroleum Co. The oil and gas industry completed 35 oil wells and 7 gas wells out of a total of 61 development wells; no discoveries were found with the drilling of 24 exploratory wells.

The Dow Chemical Co., a major chemical producer, recovered magnesium metal and magnesium compounds from sea water at plants in Freeport. The company expanded its metal capacity to 120,000 tons during the year. It also produced lime and salt in brine, the latter used in the production of chlorine and sodium compounds. Bromine used in manufacturing ethylene dibromide was recovered from sea water at the Freeport plant of Ethyl-Dow Chemical Co. Refractory magnesia (periclase) was prepared at the Freeport plant of E. J. Lavino & Co. A second refractory producer, A. P. Green Fire Brick Co., was building a similar plant in the Freeport area. Limestone for use as concrete aggregate was quarried and prepared by various producers for District 12 of the Texas Highway Department; crews of District 12 prepared sand and gravel for paving use.

Brewster.—A carbonaceous shale was mined from open pits south of Alpine for use as a soil conditioner and fertilizer by Manning Minerals Corp. Exploration for mercury deposits in the Terlingua district was reactivated as the price for the metal rose when supplies failed to meet expanded market demand. Exploration and development activity resulted in a small production of mercury, the first in nearly 5 years.

Brooks.—The Falfurrias channel-type carbon black plant of United Carbon Co. was shut down during the year. The oil and gas industry proved 3 gas discoveries through exploratory drilling of 8 holes and completed 27 oil wells and 9 gas wells out of 44 development wells drilled during 1965. Natural gas liquids were recovered at the 42-million-cubic-foot-per-day cycling plant of Humble Oil & Refining Co.

Brown.—All mineral commodities contributed to a 9-percent advance in value over that of 1964. Exploratory drilling of 3 holes resulted in discovery of 1 gasfield which was shut in; development drilling proved 20 oil wells and 7 gas wells out of 44 wells drilled.

Limestone was quarried and crushed for concrete aggregate, riprap, etc., by White's Mines, Inc., and by various producers for District 23 of the Texas Highway Department. Miscellaneous clay used in building brick and floor and wall tile was recovered from open pits by The Texas Brick Co.

Burnet.—Significant increase in stone value coupled with modest advances in graphite and sand and gravel resulted in a 67-percent increase in 1965 mineral value of Burnet County. The county ranked third in stone production. Limestone was quarried and prepared for concrete aggregate, riprap, and industrial markets by Pure Stone Co. and Texas Construction Material Co. Dimension granite was quarried and prepared by Texas Granite Corp. for monuments and for architectural uses; granite was quarried and crushed for riprap and construction purposes by Texas Crushed Stone Co. and Texas Construction Material Co.

Calhoun.—Five gasoline plants and one cycling plant with a combined daily throughput of 221 million cubic feet recovered natural gas liquids. The oil and gas industry drilled 25 onshore exploratory wells, 1 offshore exploratory well, and 22 development wells. Exploratory drilling proved 1 oil pool and 3 gas pools; development drilling resulted in 2 oil well completions and 12 gas well completions.

Alumina was refined from bauxitic ores from Surinam, South America, and the Dominican Republic at the Point Comfort refinery of Aluminum Company of America. The U.S. Army Corps of Engineers completed a deep-draft navigation channel

from the Gulf of Mexico to Victoria, with a slip to the Alcoa docks and turning basin.

Shell was dredged from shallow bays by Bauer Dredging Co. for production of lime by Aluminum Company of America and for construction purposes.

Cameron.—Though mineral output was limited to petroleum and natural gas, the county contained a number of mineral processing industries. Exploratory drilling of 12 tests resulted in discovery of the San Martin gasfield and 1 new gas reservoir. Two development wells proved unproductive.

Drilling mud was prepared by Magnet Cove Barium Corp. from barite imported from Canada, Ireland, and Mexico. Glazed tile was prepared by Olympic Ceramic Tile Corp. Union Carbide Corp., Chemicals Division, produced methyl ethyl ketone, acetic acid, and numerous derivatives. Drilling mud and phosphoric feed additive were prepared by Victoria Gin Co., Inc. Agricultural insecticides, fungicides, and fertilizers were prepared by Agricultural Chemicals, Kipfer Chemical Co., Niagara Chemical Division of FMC Corp., and Swift & Co.

Cass.—Petroleum, natural gas, natural gas liquids, and iron ore was nearly 90 percent greater than total mineral value in 1964. The oil and gas industry completed two oil wells and two gas wells and proved a new oil pool during 1965. Shell Oil Co. recovered natural gas liquids and sulfur at its Bryans Mill gasoline plant, and natural gas liquids were recovered by the Breckenridge Gasoline Co. at its Lodi gasoline plant.

Brown iron ores were recovered from open pits by Lone Star Steel Co. and Mathis & Mathis. Lone Star production was used as raw material feed for its integrated steel mill blast furnace; Mathis & Mathis output was used as mineral additive.

Chambers.—The county was the ranking shell producer and was fourth in sulfur value. Shell was recovered from shallow bays by W. D. Haden Co., and Parker Bros. & Co., Inc., for use as aggregate in cement and for lime, asphalt filler, and poultry grit. Salt in brine for use in making chlorine and sodium compounds was recovered from the Barbers Hill Salt Dome by Diamond Alkali Co. One new oilfield—Double Bayou, South—was the result of exploratory drilling of 22 holes. The oil and gas industry completed 56 oil wells and 22 gas wells from 121 development wells drilled. Gasoline plants of Humble Oil & Refining Co. and Warren Petroleum Corp. recovered natural gas liquids from county gasfields.

Cherokee.—A significant decline of 41 percent in mineral value was the result of a marked decline in iron ore production and a small decline in value of natural gas liquids. Humble Oil & Refining Co. recovered natural gas liquids at its Neches gasoline plant. Iron ore was recovered from open pits by L. B. Haberle Mining Corp. and Jennings & Halbert for use in portland cement. Fire clay used in firebrick was recovered from open pits by General Refractories Co. and by A. P. Green Fire Brick Co. Southern Clay Products, Inc., recovered ball clay used in the manufacture of wall and floor tile.

Clay.—The oil and gas industry discovered five new oilfields during the year—Burns-Browning/Missippian; Joy, South/Conglomerate; Plaxco/Ellenburger; Halsell, West/Vogtsberger; and Dillard, South/Marble Falls. The industry completed 83 oil wells out of 107 development wells totaling 211,113 feet.

Coke.—Value increases of petroleum and natural gas offset the decline in natural gas liquids value. The mineral fuels industry discovered 5 new oil and 1 new gas reservoirs from drilling of 24 exploratory wells. Development drilling of 14 wells proved 11 oil wells. Natural gas liquids were recovered at gasoline plants of Sun Oil Co. and Union Texas Petroleum Division of Allied Chemical Corp. Building and paving sand and gravel were recovered and prepared from open pits by Montgomery Sand & Gravel Co.

Coleman.—A substantial decline in values of stone and natural gas liquids resulted in a 7-percent loss in total mineral value when compared with that of 1964. Gasoline plants of Coker Gasoline Co., Luling Oil & Gas Co., Inc., and Valera Oil Co. recovered natural gas liquids. One new oil pool and 2 new gas pools were discovered in the Coleman County regular field, the result of drilling 31 exploratory wells. Seven gas wells and 22 oil wells were completed from 63 development wells.

Miscellaneous clay for use in floor and wall tile and building brick was recovered from open pits by Martin Brick Co. Various producers quarried and crushed limestone for concrete aggregate for District 23 of the Texas Highway Department.

Colorado.—Total mineral value increased 23 percent while all mineral commodities produced advanced slightly. Exploratory drilling of 10 holes discovered a new Sheridan gas reservoir. Four oil wells and 7 gas wells were completed out of 20 development wells drilled. Natural gas liquids were recovered at the Tenneco Oil Co. gasoline plant and the Shell Oil Co. cycling plant.

Colorado County was the ranking sand and gravel producer in value in 1965. Building, paving, blast, and engine sand and gravel were prepared from open pits by Horton & Horton, Parker Bros. & Co., Inc., Texas Construction Material Co., and Thorstenberg Materials Co. Various producers quarried and crushed sandstone for concrete aggregate and roadstone for District 3 of the Texas Highway Department.

Cooke.—Improvement in petroleum, natural gas, and stone values compensated for value losses in natural gas liquids and sand and gravel resulting in the 1965 value approximating that of 1964. The oil and gas industry discovered 1 new oilfield—Dexter, Southwest/Lower Strawn—and 4 new reservoirs from 26 exploratory wells. The industry completed 88 oil wells of 140 development wells. Gasoline plants of Union Texas Petroleum Co. and Standard Oil Co. of Texas recovered natural gas liquids.

Three producers quarried and crushed limestone for concrete aggregate for District 3 of the Texas Highway Department. Building and paving sand and gravel were recovered by Nelson Bros., Inc.

Crane.—Crane County was the third ranking producer of petroleum and the fourth ranking mineral producer in total value. Six gasoline plants, with installed capacity of 460.5 million cubic feet per day, recovered natural gas liquids from a number of county gasfields. Three of the gasoline plants—Waddell and Sand Hills of Warren Petroleum Corp., and the Crane plant of Phillips Petroleum Co.—recovered sulfur from the processed gas. Exploratory drilling of 24 wells resulted in discovery of 2 oilfields—BarMar/Devonian and BarMar/Tubb, 9 new oil reservoirs and 1 new gas pool. The industry completed 138 oil wells and 6 gas wells in drilling 166 development wells.

Dallas.—Limestone used in cement was quarried and crushed by Lone Star Cement Corp. and General Portland Cement Co. Sand and gravel, used principally for building and paving purposes, was produced by 14 companies. Miscellaneous clay was recovered from open pits for building brick by Ferris Brick Co. and for lightweight aggregate by Dallas Lightweight Aggregate Co. Crude perlite from other States was expanded by Texas Lightweight Products Co. and Perlite Products Co. for use as loose insulation, soil conditioning, building plaster, and as lightweight aggregate for concrete and roof decks. Crude oil was refined at the 2,000-barrel refinery of Petroleum Industries, Inc., in Irving. Aluminum ingots and alloys were prepared from scrap metal by ABASCO, Inc., and lead and zinc slabs were recovered from metal scrap by American Smelting & Refining Co.

Dawson.—Exploratory drilling of 16 wells by the oil and gas industry resulted in 2 oil discoveries—The Gin/Mississippian and Gin/Sprayberry oilfields. The industry completed 92 oil wells out of 99 development wells drilled. Texaco Inc. recovered natural gas liquids from county gasfields at its Lamesa gasoline plant. Limestone was quarried and crushed for concrete aggregate by Lone Star Materials, Inc.

Denton.—Improved output of petroleum, natural gas, sand and gravel, and clay resulted in a 22-percent increase in mineral value compared with that of 1964. Exploratory drilling proved one gas discovery out of seven exploratory wells; three development wells were abandoned as dry holes. Acme Brick Co. recovered miscellaneous clay from open pits for manufacturing building brick. The company installed a second tunnel kiln at its new Denton plant during the year.

Duval.—Mineral value was 2 percent under the 1964 value, the result of a substantial decline in value of natural gas liquids as limited advances were reported for values of petroleum, natural gas, and salt. The county was the third-ranking producer of salt in 1965. Exploratory drilling by the

oil and gas industry proved 6 new oil pools and 2 new gas pools from a total of 44 wells. Development drilling of 83 holes resulted in 31 oil well completions and 22 gas well completions. Natural gas liquids were recovered at gasoline plants of Mobil Oil Co. and Humble Oil & Refining Co. and at the cycling plant of Trinity Gas Corp. Salt in brine, used in the manufacture of chlorine and sodium compounds, was recovered from wells near San Diego by Pittsburgh Plate Glass Co.

Eastland.—The county was the fifth-ranking clay producer in 1965. Miscellaneous clay was recovered from open pits for lightweight aggregate by Texas Lightweight Aggregate Co. and Featherlite Corp. and for wall and floor tile by Texeramics, Inc. Fire clay used in art pottery was recovered from open pits by N. D. Gallagher Clay Products Corp. Various producers quarried and prepared limestone for concrete aggregate for Districts 23 and 18 of the Texas Highway Department. One new gas reservoir was discovered as the result of five exploratory wells. The industry completed 4 oil wells and 4 gas wells from a total of 11 development wells. Three gasoline plants with a combined daily capacity of 20 million cubic feet recovered natural gas liquids from county gasfields.

Ector.—The county was first in natural gas liquids output value and second in petroleum and total mineral value in 1965. Crude oil was refined at the 25,000-barrel-per-day Odessa refinery of Shell Oil Co. Six gasoline plants and one cycling plant having a combined capacity of 634 million cubic feet per day recovered natural gas liquids. Five of the gasoline plants had associated sulfur units which recovered sulfur from the sour gas. One new oil pool—Cowden, South/Devonian—was discovered from 11 exploratory wells. Development drilling proved 228 oil wells and 15 gas wells out of a total of 275 wells drilled.

A progressive chemical complex located at Odessa, which included El Paso Natural Gas Products Co., Rexall Chemical Co., Magna Corp., General Tire & Rubber Co., Western Chemicals Co., and Nocor Chemical, Inc., expanded some of its existing facilities and increased some of its product output. Sid Richardson Carbon & Gasoline Co. recovered carbon black at its channel black plant.

Southwestern Portland Cement Co. quarried and prepared limestone and clay for cement at its plant southwest of Odessa. Limestone was also quarried and crushed for concrete aggregate at the Moss Quarry of Permian Sand and Gravel Co., Inc. Building and paving sand and gravel were prepared by Portable Aggregates, Inc.

Ellis.—The value of nonmetallic minerals produced in 1965 was over 10 percent greater than that of 1964. One exploratory oil well was abandoned at 1,550 feet. Miscellaneous clay used in building brick was recovered and prepared by Barron Brick Co. and Ferris Brick Co. Texas Industries, Inc., quarried and prepared limestone and clay for use in portland and masonry cements at its Midlothian plant. A 1-million-barrel-per-year plant was being built near Midlothian by Gifford Hill & Co., Inc. Three producers quarried and prepared limestone for concrete aggregate for District 18 of the Texas Highway Department. District 18 highway crews recovered and prepared paving sand and gravel.

El Paso.—Advances in cement, stone, and sand and gravel output in 1965 resulted in a 22-percent increase in total mineral value. Crude oil was refined at the 65,000-barrel-per-day refinery of Standard Oil Co. of Texas and at the 16,000-barrel-per-day refinery of Texaco Inc. Portland and masonry cement were prepared from limestone quarried by Southwestern Portland Cement Co. at its El Paso plant. Limestone was quarried and crushed for concrete aggregate and riprap by McMillan Quarry, Inc., Vowell Material Co., and by various producers for District 24 of the Texas Highway Department. Sandstone was quarried and prepared for dimension stone and crushed for roadstone and concrete aggregate by H & H Materials, Inc. Building and paving sand and gravel were recovered from open pits by El Paso Sand Products, Inc., General Redi-Mix, Inc., H & H Materials, Inc., and Hoake Construction Co.

Fayette.—Significant declines in clays, stone, and sand and gravel production in 1965 resulted in a 14-percent decline in total mineral value, offsetting moderate advances in petroleum and natural gas. The oil and gas industry completed five oil wells out of nine development wells; six exploration wells were abandoned.

Bentonitic clays used as a drilling mud additive and for foundry, insecticide carriers, and absorbents were recovered and prepared from open pits by Baroid Division of National Lead Co. and The Milwhite Co., Inc. Fuller's earth, used as an absorbent and for soil conditioning, was recovered from open pits by Flatonia Fullers Earth Co. and Balcones Minerals Corp. Building and paving sand and gravel were recovered from open pits by Thorstenberg Materials Co. Various producers quarried and prepared sandstone for concrete aggregate and roadstone for District 13 of the Texas Highway Department.

Fisher.—The 2-percent increase in mineral value resulted from advances in petroleum, natural gas, and natural gas liquids value which offset a decline in gypsum output value. The county ranked second in gypsum output. Gypsum used in manufacturing plaster, lath, and wallboard was quarried and prepared from open pits by the National Gypsum Co. and The Celotex Corp. Five new oil discoveries—McCaulley, North/Flippen; Andy/3885/Swastika; Kemp/Canyon Sand; La Paloma; and G. A. Poe/U. Strawn—were the result of 33 exploratory wells. The industry completed 24 oil wells and 1 gas well out of 41 development wells. Four gasoline plants recovered natural gas liquids from county gasfields. Lone Star Cement Corp. recovered clay from open pits for use in portland and masonry cement.

Fort Bend.—Total mineral value advanced 8 percent. The county ranked third in sulfur output with Frasch production from the Orchard Dome by Duval Corp. and the Long Point Dome by Jefferson Lake Sulphur Co. The oil and gas industry completed 19 oil wells and 1 gas well out of 29 development wells. Salt was recovered from the Blue Ridge Dome by United Salt Corp. Miscellaneous clay used in lightweight aggregate and other products was recovered from pits near Stafford by Texas Lightweight Aggregate Co. and near Pleak south of Rosenberg by Calag Co., Inc. Various producers quarried and crushed limestone for concrete aggregate for District 12 of the Texas Highway Department. Crews of District 12 recovered sand and gravel for paving uses.

Freestone.—Exploratory drilling by the oil and gas industry proved two new gas discoveries out of eight wells drilled. Out of 19 development wells drilled, 13 gas wells were completed. Sunray DX Oil Co. recovered natural gas liquids at its Freestone gasoline plant. Teague Brick & Tile Co. recovered miscellaneous clay from open pits for use in building brick. East Texas Stone Co. quarried and crushed sandstone from open pits for use as concrete aggregate, roadstone, and riprap.

Gaines.—The county was the fourth largest producer of petroleum in 1965. Exploratory drilling proved 4 oil pools; 110 development wells proved 86 oil wells and 2 gas wells. Gasoline plants of Cities Service Oil Co. and Phillips Petroleum Co., with a combined capacity of 49 million cubic feet per day, recovered natural gas liquids.

Natural salines were recovered from Cedar Lake brine at the Seagraves plant of Ozark-Mahoning Co. Columbian Fuel Corp. recovered sulfur from sour gas at its No. 67 plant. Pioneer Pavers, Inc., quarried and prepared limestone for concrete aggregate.

Galveston.—Mineral value advanced 9 percent; gains in petroleum, natural gas, natural gas liquids, and clay offset a decline in shell production. The oil and gas industry proved one oilfield and one gasfield out of eight onshore exploratory wells and one oilfield out of four offshore exploratory wells. The industry completed 36 oil wells and 8 gas wells out of 59 onshore development wells; 7 offshore development wells were drilled and abandoned. The Alta Loma gasoline plant of Margaret Hunt Trust Estate recovered natural gas liquids. Crude oil was recovered at the 177,600-barrel-per-day American Oil Co. refinery, the 40,000-barrel-per-day refinery of Marathon Oil Co., and the 35,000-barrel-per-day Texas City Refining, Inc., refinery, all in Texas City.

Horton & Horton recovered shell from shallow Galveston Bay for concrete aggregate, poultry grit, and cement. Clay used in portland and masonry cements was recovered from open pits by Ideal Cement Co. and Gulf Coast Portland Cement Co. Building and paving sand and gravel were recovered from open pits by crews of District 12 of the Texas Highway Department.

Gillespie.—Total mineral value of the county declined about 18 percent due to

production losses in soapstone and sand and gravel. Building and paving sand and gravel were recovered from open pits by Alvin Usener, Weirich Bros., Inc., Alfred E. Wunderlich, James Moellendorf, and Gilbert Gold. Dimension limestone for curbing, flagging, and building block was quarried and prepared by Doebbler's Quarry. Sierra Talc & Chemical Co. recovered and prepared soapstone from open pits.

Goliad.—Exploratory drilling of 35 wells resulted in two gasfield discoveries, Emma Haynes and Live Oak Lake, nine gas reservoirs, and two oil reservoirs. The industry completed 8 oil wells and 43 gas wells out of 70 development wells. Gasoline plants of Coastal States Gas Producing Co., Continental Oil Co., and Houston Natural Gas Production Co. recovered natural gas liquids.

Gonzales.—A 14-percent decline in total mineral value resulted from a decline in clay output and no production of sand and gravel in the county in 1965, notwithstanding slight increases in petroleum and natural gas production. One new oilfield—Colony/Poth—was discovered out of 50 exploratory wells. Three oil and two gas wells were completed out of six development wells. Bentonitic clay used as carriers for insecticides, drilling mud additives, and absorbents, was recovered from open pits and prepared by Southern Clay Products, Inc.

Grayson.—A new reservoir was discovered in the Sherman oilfield out of 20 exploratory wells drilled; 1 gas well and 9 oil wells were completed out of 20 development wells. Limestone was quarried and crushed for riprap, agricultural lime, and concrete aggregate by Crushers, Inc., S. E. Evans, Inc., and by various producers for the U.S. Army Corps of Engineers. M & K Sand & Gravel recovered and prepared building and paving sand from open pits. Standard Oil Co. of Texas recovered natural gas liquids at its Sherman gasoline plant and its New Mag cycling plant.

Hansford.—Total mineral value of Hansford County declined 3 percent compared with 1964 due to declines in natural gas liquids and helium values. Exploration drilling of four tests resulted in two gas discoveries and one oil discovery. Development drilling of 31 wells proved 5 oil and 15 gas wells. Phillips Petroleum Co. recovered natural gas liquids at its 120-million-cubic-foot-per-day Hansford plant and its 350-million-cubic-foot-per-day Sherman gasoline plant. Crude helium was recovered at the Phillips Sherman plant and sold to the Federal Government for storage in the Cliffside gasfield.

Hardeman.—Mineral output increased 5 percent in 1965 compared with that of 1964. Six new oilfields were discovered through exploratory drilling of 14 wells—Quanah, Southwest/Chappel; Thrash/Chappel, Thrash/Palo Pinto, and Thrash/Osage; and Chillicothe, North/Mississippian. Three oil wells were completed out of five development wells drilled. Gypsum was mined from open pits near Acme for use in plaster, wallboard, and other building products by Georgia-Pacific Corp. Crews of District 25 of the Texas Highway Department recovered and prepared sand and gravel for paving purposes.

Hardin.—Output of mineral fuels and sand and gravel was valued at slightly more than that of 1964. Moderate advances in petroleum, natural gas, and sand and gravel values were partly offset by a loss in natural gas liquids value. Two cycling plants of Sinclair Oil & Gas Co. and a gasoline plant of Amata Gas Corp. recovered natural gas liquids. Crude oil was recovered at the 2,500-barrel-per-day Silsbee refinery of South Hampton Co. All 15 exploration wells were abandoned as dry holes, and 87 of 105 development wells were completed as oil wells. Industrial sand was recovered and prepared by Barry & Barry Sand Co.

Harris.—Nine minerals were produced in Harris County in 1965 with a total value 13 percent greater than that of 1964. The county was the leading cement producer, third in carbon black, and fifth in total mineral value and value of salt produced. Portland and masonry cements were prepared from oyster shell by Ideal Cement Co., Lone Star Cement Corp., and General Portland Cement Co. Portland cement alone was prepared by Gulf Coast Portland Cement Co. Miscellaneous clay was recovered for cement by Lone Star Cement Corp. and General Portland Cement Co. Miscellaneous clay recovered from open pits was used in building brick by J. M. Cordell & Sons, Inc., Houston Brick & Tile

Co., Acme Brick Co., Andy Cordell Brick Co., and Aztec Brick Co.

The oil and gas industry discovered 1 new oilfield—Taylor Lake—and 1 new gas pool out of 12 exploratory wells and completed 36 oil wells and 8 gas wells out of 71 development wells. Sulfur was recovered from refinery off-gases and sour crude oil by Shell Chemical Co., Signal Oil & Gas Co., Sinclair Refining Co., and Stauffer Chemical Co. Crude oil was refined and processed at seven oil refineries with a daily capacity of 730,000 barrels. Five gasoline plants with a combined capacity of 280 million cubic feet per day and two cycling plants with a combined capacity of 90 million cubic feet daily recovered natural gas liquids. Carbon black was recovered at the Eldon furnace plant of J. M. Huber Corp., located at Baytown.

U.S. Gypsum Co. imported crude gypsum for use in calcining. Building and paving sand and gravel were recovered from open pits by Horton & Horton, Parker Brothers & Co., Inc., and by crews of District 12 of the Texas Highway Department. Perlite from foreign countries and from other States was expanded for use as lightweight aggregate, roof decks, building plasters, and loose fill insulation by Perlite of Houston, Inc., and Filter-Media, Inc. National Lead Co. prepared barite for drilling muds from crude material imported from foreign countries. United Salt Corp. mined rock salt from Hockley Dome and Texas Brine Corp. recovered salt in brine from Pierce Junction Dome for the chemical industry.

Harrison.—The 2-percent decline in mineral value was due to declines in natural gas liquids and clays exceeding modest advances in petroleum, natural gas, and coal (lignite). Two new oil discoveries were made by the oil and gas industry—Bethany/6260 Hansell; and Scottsville, Northeast/Pettit—from four exploration wells. The industry completed 72 oil wells and 13 gas wells out of 101 development wells. ARKLA Chemical Corp. recovered natural gas liquids from the North Lansing field at its North Lansing gasoline plant and from the Waskom gasfield at its Waskom gasoline plant.

Fire clay used in stoneware and art pottery was recovered from open pits by Marshall Pottery Co., and miscellaneous clay used in building brick was recovered from open pits by Marshall Brick Co. Coal (lignite) used in manufacturing activated carbons was recovered from open pits by Atlas Chemical Industries, Inc.

Henderson.—One new oilfield—DAK/Rodessa 6—was the result of six exploratory wells. Four oil wells and 5 gas wells were completed out of 13 development wells. Firebrick and mortar were prepared from fire clay obtained from open pits by Harbison-Walker Refractories Co. Miscellaneous clay was recovered from open pits for use in art pottery by Athens Tile & Pottery Co. and for building brick by Texas Clay Products, Inc., Acme Brick Co., and Athens Brick Co., Inc. The county ranked fourth in clay value. Building and paving sand and gravel were recovered from open pits by Southwest Construction Materials Co. Three gasoline plants recovered natural gas liquids from county gasfields.

Hidalgo.—The county was fourth in production of natural gas. Exploration drilling of 24 holes resulted in 1 new gas pool. Development drilling of 54 holes proved 1 oil well and 42 gas wells. Natural gas liquids were recovered at gasoline plants of Coastal States Gas Producing Co., Shell Oil Co., Sinclair Oil & Gas Co., Tenneco Oil Co.. and Anchor Gasoline Corp. Crude oil was processed by Delta Refineries, Permian Corp., and Rado Refining Co. Limestone was quarried and crushed for concrete aggregate by Heldenfels Bros. Building and paving sand was recovered from open pits for construction by The Fordyce Co. Miscellaneous clay for building brick was recovered from open pits by Valley Brick & Tile Co.

Hockley.—Increased petroleum and natural gas values were offset by a decline in natural gas liquids value resulting in 1965 value approximating the 1964 value. Three gasoline plants with a total daily capacity of 144 million cubic feet recovered natural gas liquids from the Slaughter, Ropes, and Levelland gasfields. Sulfur was recovered from sour gas at the Slaughter plant of Pan American Petroleum Corp. Exploration drilling of 13 holes proved 4 oil discoveries, while 53 development wells resulted in 48 oil completions.

Hopkins.—Increased output of petroleum, natural gas, and natural gas liquids resulted in a 29-percent increase in value. Five

exploratory wells proved one oilfield discovery—Birthright/Smackover. Six oil wells and 3 gas wells were completed out of 10 development wells. Sulfur was recovered from sour gas at the Como gasoline plant of Warren Petroleum Corp. Natural gas liquids were recovered at the 54-million-cubic-foot-per-day Pickton gasoline plant of Humble Oil & Refining Co. and at the 50-million-cubic-foot-per-day Como gasoline plant of Warren Petroleum Corp. Fire clay used for firebrick was recovered from open pits near Sulphur Springs by A. P. Green Fire Brick Co.

Houston.—A 4-percent decline in total mineral value was the result of declines in natural gas liquids, sand and gravel, and stone. The oil and gas industry discovered 2 new oilfields—Austonio and Halman—from drilling 15 exploratory wells. Twenty oil wells were completed out of 24 development wells. Two gasoline plants recovered natural gas liquids. Paving sand and gravel was recovered and prepared by crews of the U.S. Forest Service.

Howard.—Improvement in petroleum and natural gas was offset by losses in natural gas liquids and stone values. The county ranked second in value of carbon black output. Two oil discoveries and 1 gas discovery resulted from 6 exploratory wells; 73 oil wells were completed out of 93 development wells. Reef Corp. recovered natural gas liquids from the E. Vealmoor gasfield. Sid Richardson Carbon & Gasoline Co. recovered carbon black from liquids at its furnace plant. Crude oil was processed and refined at the Big Spring refinery of Cosden Oil & Chemical Co. Building and paving sand and gravel were recovered from open pits and processed by R. E. Janes Gravel Co., Inc., and West Texas Sand & Gravel Co.

Hudspeth.—Production losses in talc and stone offset rises in sand and gravel and gypsum, resulting in a 32-percent decline in total mineral value compared with that of 1964. The county was the State's fourth-ranking gypsum producer in 1965. Southwestern Portland Cement Co. recovered crude gypsum from open pits for use as a retarder in cement. Various producers quarried and prepared limestone as concrete aggregate for District 24 of the Texas Highway Department. Crews of District 24 recovered and prepared sand and gravel for paving uses. Rhyolite was quarried and crushed by Gifford-Hill & Co., Inc., for riprap, railroad ballast, and roadstone. Six producers recovered talc from open pits in the Allamoore district of west Texas for various uses including ceramics, insecticides, paint, and roofing granules.

Hutchinson.—Declines in 1965 mineral value of natural gas liquids and sand and gravel offset advances in petroleum, natural gas, and salt, resulting in a 2-percent decline in 1965 total mineral value. The county was the State's principal producer of carbon black in 1965. Furnace black was recovered at the Borger plants of Phillips Petroleum Co. and furnace and channel blacks were recovered at the J. M. Huber Corp. plant. The oil and gas industry completed 41 oil wells and 17 gas wells out of 63 development wells; 14 exploration wells were abandoned as dry holes. Eight gasoline plants recovered natural gas liquids. Crude oil was processed and refined at the 85,000-barrel-per-day Borger refinery of Phillips Petroleum Co. Salt in brine was used by Phillips Petroleum Co. at its Borger chemical complex. Building and paving sand and gravel were recovered from open pits by Tri-City Sand & Gravel Co.

Jack.—Three gasoline plants recovered natural gas liquids from natural gas in the Alco-Caddo field, the Jack County Regular field, and the Jupiter field. Crude oil was processed and refined at the Bryson refinery of Bryson Pipeline & Refining Co. The oil and gas industry discovered 4 new oil reservoirs and 1 gas reservoir from 31 exploratory wells. New oilfields discovered included Weir/2200 Cooper/Sand; Gilley, West/Atoka Conglomerate; Cary-Mag, North/Conglomerate/Upper; and other oilfields. The industry completed 56 oil and 22 gas wells out of 115 development wells.

Jasper.—A 4-percent increase in total mineral value was the result of small increases in value of petroleum, natural gas, lime, and clays outputs. The oil and gas industry discovered 1 new oil reservoir—La Verte Switch—from 10 exploratory wells. One oil well and two gas wells were completed out of six development wells. Miscellaneous clay used in cement was recovered from open pits by Alpha Portland Cement Co. Lime used in the production

of wood pulp was produced by East Texas Pulp & Paper Co.

Jefferson.—Mineral value was slightly more than that of 1964; small increases in petroleum, natural gas, natural gas liquids, and salt values offset substantial losses in sulfur and sand and gravel. The county ranked second in sulfur production. Sulfur was recovered by the Frasch process from Fannett Dome and Spindletop Dome by Texas Gulf Sulphur Co. Sulfur was recovered from sour crudes and from refinery off-gases by Atlantic Refining Co. Atreco plant, Gulf Oil Corp. Port Arthur plant, and the Beaumont plant of Olin Mathieson Chemical Corp. The oil and gas industry discovered 1 new oil pool—McFaddin Ranch—and 1 new gas pool—LaBelle—out of 11 exploratory wells; offshore drilling of 6 exploratory wells resulted in 1 new gas pool. Onshore development drilling of 99 holes resulted in 55 oil wells and 21 gas wells; offshore development drilling of 17 holes resulted in 9 gas completions. Gasoline plants of San Jacinto Gas Processing Corp. and Union Texas Petroleum Co. recovered natural gas liquids.

Beaumont Brick Co., Inc., recovered miscellaneous clay from open pits for use in building brick. C. A. McKinley Sons, Inc., recovered sand and gravel from open pits for use as building and paving material. Salt in brine used in chemicals, rubber, oil, and paper, was recovered by Texas Brine Corp.

Significant petrochemical capacity was located in the county and adjoining areas and included such large producers as E. I. du Pont de Nemours & Co., Inc., Goodyear Tire & Rubber Co., Mobil Chemical Co., Olin Mathieson Chemical Corp., Gulf Oil Corp., Goodrich-Gulf Chemicals, Inc., Jefferson Chemical Co., Inc., and Koppers Co., Inc. Crude oil was processed and refined at six oil refineries with a daily capacity of 986,000 barrels.

Jim Hogg.—Each of the three mineral fuels—petroleum, natural gas, and natural gas liquids—contributed to a 9-percent increase in value. The oil and gas industry proved 2 oil extensions and 3 gas extensions from 36 exploratory wells. Out of 34 development wells, 23 oil wells and 3 gas wells were completed. Sohio Petroleum Co. recovered natural gas liquids from the Prado gasfield.

Johnson.—A decline in stone, sand and gravel, and lime output exceeded the advance in petroleum; thus there was a 38-percent decline in mineral value. Limestone was quarried and crushed for lime and aglime by Texas Lime Co. and for concrete aggregate by Trinity Concrete Products Co. and by various producers for District 18 of the Texas Highway Department. Industrial sand was recovered and prepared from open pits by Capital Aggregates, Inc., and for building and paving purposes by W. O. Pelphrey.

Jones.—Gains in petroleum and natural gas output and value matched losses in natural gas liquids and sand and gravel. One new oil reservoir was discovered from 36 exploratory wells. One gas well and 28 oil wells were completed out of 54 development wells. Sunray DX Oil Co. recovered natural gas liquids from the Hamlin gasfield. Building and paving sand and gravel were recovered and prepared from open pits by R. E. Janes Gravel Co., Inc.

Karnes.—Declines in 1965 value of uranium ore and natural gas liquids were greater than advances in petroleum and natural gas values, resulting in a 2-percent decline in county total mineral value. The oil and gas industry proved 1 gas discovery out of 11 exploratory wells drilled and completed 3 oil and 3 gas wells out of 7 development wells. Three gasoline plants operated by Warren Petroleum Corp., Shell Oil Co., and United Gas Pipe Line Co., with daily capacity of 240 million cubic feet, recovered natural gas liquids. Sulfur was recovered from sour natural gas by Shell Oil Co. and Warren Petroleum Corp. Susquehanna-Western, Inc., reactivated its Falls City uranium mill after receiving a substantial contract to supply a West German company with "yellow cake".

Kenedy.—Production advances by the mineral fuels industry resulted in a 14-percent advance in total mineral value. Exploration drilling of 11 wells resulted in discovery of 1 dual gasfield—Murdock Pass, East; the lone offshore exploration well was abandoned. Eight gas wells and 15 oil wells were completed out of 28 development wells. Humble Oil & Refining Co. recovered natural gas liquids at its Julian Pasture cycling plant and its Sarita gasoline plant.

Kleberg.—Mineral value was 10 percent greater than the 1964 value as mineral fuel output and value advanced during the year. The county was the second-ranking producer of natural gas liquids and third-ranking producer of natural gas during 1965. Five new oil reservoirs were discovered in the Big Caesar oilfield from 18 exploration tests. Four new gas reservoirs were also proved by the exploration program. The industry completed 62 oil wells and 16 gas wells out of 102 development wells. Natural gas liquids were recovered at a gasoline and cycling plant of Humble Oil & Refining Co. and at the May gasoline plant of Cities Service Oil Co. Limestone was quarried and crushed for concrete aggregate by Heldenfels Bros.

Lavaca.—Improvement in mineral fuel output and value in 1965 resulted in a 17-percent advance in total mineral value. The industry completed 2 oil and 6 gas wells out of 12 development wells with exploration drilling of 12 wells resulting in 4 gas discoveries. Gasoline plants operated by George Mitchell & Associates, Inc., Mobil Oil Co., Shell Oil Co., and San Jacinto Gas Processing Corp. recovered natural gas liquids from county gasfields. Various producers quarried and prepared sandstone for concrete aggregate and roadstone for District 13 of the Texas Highway Department.

Liberty.—Mineral value advanced 4 percent compared with that of 1964 and all minerals and mineral fuels improved their positions. The county was the fourth-ranking sulfur producer in the State in 1965. The oil and gas industry completed 78 oil and 10 gas wells from 122 development wells drilled; 13 exploratory wells proved 1 oil pool. Gasoline plants of Humble Oil & Refining Co., Sinclair Oil & Gas Co., and Southwest Industries, Inc., recovered natural gas liquids from county gasfields. Industrial sand and building and paving sand and gravel were recovered from open pits by Texas Construction Material Co. Texas Gulf Sulphur Co. recovered sulfur from the Moss Bluff Dome by the Frasch process.

Limestone.—All minerals reported improved output and value resulting in a 44 percent increase in the county's total mineral value. The oil and gas industry completed 9 gas wells out of 12 development wells.

Kaolin clay for use in the rubber and fertilizer industries was recovered from open pits at the Kosse plant of Magcobar Minerals. Miscellaneous clay used in cement was recovered from open pits by General Portland Cement Co. Barron Brick Co. recovered miscellaneous clay for use in building brick, and Teague Brick & Tile Co. recovered fire clay for building brick. Silica sand used for industrial purposes and for glass manufacture was processed at the Kosse mill of Magcobar Minerals.

McLennan.—The county's mineral industry increased its total production value 2 percent over that of 1964. Petroleum and all nonmetallic minerals except clays reported improvement. Portland and masonry cement were prepared by Universal Atlas Cement Division of U.S. Steel Corp. from limestone and miscellaneous clay quarried from local county deposits. Various producers quarried limestone for use as concrete aggregate for District 9 of the Texas Highway Department. Waco Aggregate Co. recovered miscellaneous clay from open pits for building brick and lightweight aggregate. Building and paving sand and gravel were recovered from open pits by Southwest Construction Materials Co., Kleberg Sand & Gravel Co., C. F. Binner & Son, Neeley Sand & Gravel, Inc., and crews of the Texas Highway Department. The county was the fourth-ranking sand and gravel producer in the State.

McMullen.—The 8-percent advance in total mineral value was the result of improvement in mineral fuels output and value. The oil and gas industry completed 13 oil and 4 gas wells from 28 development wells. No exploration projects were reported during 1965. Gasoline plants of Atlantic Refining Co. and Transcontinental Gas Pipe Line Co. recovered natural gas liquids from the East Rhode Ranch field. Sulfur was recovered from sour gases by Trans-Jeff Chemical Corp.

Marion.—Two new oilfields—Excelsior, Southwest and Excelsior—were discovered by the oil and gas industry from four exploratory wells. One new gas pool was also proved. The industry completed 2 gas and 23 oil wells from 40 development wells. ARKLA Chemical Corp. recovered natural gas liquids from the Jefferson gasfield.

Matagorda.—All mineral fuels and most nonmetallic minerals contributed to an increase of 5 percent over that of 1964. The county ranked second in shell production and fifth in natural gas and sulfur production. The oil and gas industry proved 2 new gas pools—Baer Ranch and Wadsworth, West—from 25 exploratory wells. Eight oil and 16 gas wells were completed from 36 development wells. Offshore drilling of both exploration and development wells failed to complete any producers. Miscellaneous clay used in building brick was mined from open pits by Sunset Brick & Tile, Inc. Limestone was quarried and prepared for concrete aggregate by various producers for District 12 of the Texas Highway Department. Shell used in cement was recovered from adjoining shallow bays by Matagorda Shell Co., Inc. Paving sand and gravel was produced from open pits by crews of District 12 of the Texas Highway Department.

Medina.—The industry completed 15 oil wells from 31 development wells; all 4 exploration wells were abandoned. Miscellaneous clay was mined for building brick and other heavy clay products by D'Hanis Brick & Tile Co. Perlite from adjoining States was expanded and sized for use as lightweight aggregate in concrete by Medina Perlite Co.

Midland.—The oil and gas industry discovered two new oilfields—Parks, East/Ellenburger; Warfield, East/Devonian—and four oil reservoirs through exploration drilling of six wells. Development drilling proved 13 oil and 8 gas wells from 22 wells drilled. Natural gas liquids were recovered from the Dora Roberts, Virey, and WarSan gasfields at a Cities Service Oil Co. gasoline plant, from the Pegasus gasfield by Mobil Oil Co. and Sinclair Oil & Gas Co., from the Azalea and Tex-Harvey gasfields by Phillips Petroleum Co., and from various fields by Warren Petroleum Corp. Combined capacity of the five gasoline plants totaled 98 million cubic feet per day with an additional 50-million-cubic-foot-per-day capacity at Cities Service cycling plant. Crude perlite from adjoining States was expanded and processed by Perlite Industries, Inc., for use as building plaster, loose fill insulation, soil conditioner, and lightweight concrete aggregate.

Milam.—The 4-percent increase in total mineral value in 1965 compared with 1964 resulted from increased petroleum and lignite output. One gas well and 12 oil wells were completed out of 19 development wells drilled. Industrial Generating Co. recovered and processed lignite from open pits for use as a fuel in generating electric power for the Rockdale reduction works of Aluminum Company of America. Aluminum ingots and alloys were produced at the smelting works from alumina shipped in from the company's Point Comfort refinery. The company planned to install facilities to produce aluminum pellets for use in powder metallurgy.

Montague.—Eight new oil reservoirs were proved from 31 exploratory wells. One gas and 49 oil wells were completed out of 70 development wells. Union Texas Petroleum Division of Allied Chemical Corp. recovered natural gas liquids from various county gasfields at its 22-million-cubic-foot-per-day gasoline plant. Various producers quarried and prepared limestone for concrete aggregate for District 3 of the Texas Highway Department. Sadler Sand & Gravel Co. recovered and prepared building and paving sand and gravel from open pits.

Montgomery.—The oil and gas industry proved one new gas pool from eight exploratory wells and completed one gas well out of four development wells drilled. Natural gas liquids were recovered from the Conroe gasfield at gasoline plants of Humble Oil & Refining Co. and Midland Gasoline Corp.; from the Bender gasfield by Sinclair Oil & Gas Co.; from the Lake Creek gasfield by Superior Oil Co.; and from various county gasfields by Warren Petroleum Corp. Columbian Carbon Co. recovered carbon black from liquid hydrocarbons at its Conroe No. 63 furnace plant. Building and paving sand and gravel were recovered from open pits and prepared by various contractors for District 12 of the Texas Highway Department.

Moore.—The 5-percent increase in total mineral value in 1965 resulted from advances in petroleum, natural gas, and natural gas liquids output offsetting a slight decline in helium output. The county was the third-ranking natural gas liquids producer in the State in 1965. The oil and gas industry completed 10 gas and 20 oil wells

out of 38 development wells. Both exploration wells drilled in 1965 were dry and abandoned. Eight gasoline plants operated by five oil companies recovered natural gas liquids. The Shamrock Oil & Gas Corp. recovered sulfur from sour crudes and sour natural gas at its McKee refinery. Continental Carbon Co. recovered carbon black from liquid hydrocarbons at its Sunray furnace plant. American Zinc Co. of Illinois recovered slab zinc from ores and concentrates from other States and from foreign countries at its Machovec zinc retort smelter located near Dumas. Helium was recovered at the Bureau of Mines Exell plant and at the Dumas plant of Phillips Petroleum Co. The Dumas plant production was sold to the Federal Government and stored in the Cliffside gasfield in Potter County.

Navarro.—Mineral output of petroleum, natural gas, clays, stone, and sand and gravel in 1965 approximated that of 1964. The oil and gas industry discovered 2 new oilfields—Richland, South and Richland, East—from 9 exploratory wells, and completed 9 oil wells out of 14 development wells drilled. Miscellaneous clay used in building brick was obtained from open pits by Whiteselle Brick & Lumber Co. Various producers quarried and crushed limestone and sandstone for concrete aggregate for District 18 of the Texas Highway Department. Building and paving sand and gravel were produced by District 18 of the Texas Highway Department.

Nolan.—Increased value of petroleum, natural gas, sand and gravel, stone, and cement combined to offset value losses in gypsum and natural gas liquids production. The county ranked first in gypsum and fifth in cement production. The oil and gas industry discovered three new oilfields—White Hat/Ellenburger; Jackie Grim/Fry, Lower; and Sweetwater/Swastika, South. The industry completed 13 oil wells out of 17 development wells drilled. Seven gasoline plants with a combined daily capacity of 40 million cubic feet recovered natural gas liquids from county fields such as Rowan & Hope, Lake Trammell, White Flat, and others.

Lone Star Cement Corp. quarried and prepared limestone for portland and masonry cements. Gypsum was quarried for use as a cement retarder and for plaster, lath, and wallboard by U.S. Gypsum Co. and Flintkote Co. Building and paving sand and gravel were prepared by Hillsdale Gravel Co.

Nueces.—The county was the State's second ranking producer of natural gas and lime, and fourth in shell. The oil and gas industry discovered two new gasfields—Encinal Channel and Mobil-David. The 42 exploratory wells proved 2 oil discoveries and 6 additional new gas pools. The industry completed 84 oil and 44 gas wells out of 182 development wells. Natural gas liquids were recovered from a number of county gasfields by four cycling plants and seven gasoline plants with a combined daily capacity of 717 million cubic feet. Champlin Petroleum Co. shut down and dismantled its Agua Dulce gasoline plant. Oystershell dredged from shallow bays in the county was used for cement by Centex Cement Co. Shell used for cement and as concrete aggregate was recovered from adjoining shallow bays by Corpus Christi Shell Co., Inc., General Dredging Corp., and Heldenfels Bros. Building and paving sand and gravel were recovered from open pits and prepared by Heldenfels Bros. and M. P. Wright, Jr. Crude oil was processed and refined at seven local oil refineries with a daily capacity approximating 250,000 barrels. Petrochemical intermediates and products were produced at the Bishop chemical complex of Celanese Chemical Co. Zinc concentrates and ores obtained from other States and foreign countries were processed into slab zinc at the electrolytic refining plant of American Smelting & Refining Co. Pittsburgh Plate Glass Co. manufactured lime for industrial, chemical, and building purposes from shell obtained from local shallow bays.

Ochiltree.—Two oil discoveries and one gas discovery resulted from five exploratory wells. Seven gas wells and 54 oil wells were completed out of 67 development wells drilled. Natural gas liquids were recovered from the Hansford-Ochiltree gasfield by Northern Natural Gas Co. and from the Hansford by Skelly Oil Co.

Orange.—Total mineral value was 6 percent greater than in 1964 as advances in petroleum, natural gas, and cement values exceeded losses in natural gas liquids and clay. The oil and gas industry discovered new oil reservoirs—in Hartsburg, South; and Doyt, Southwest fields—from 12 ex-

ploratory wells drilled. Two gas and 9 oil wells were completed out of 15 development wells drilled. Marathon Oil Co. recovered natural gas liquids from Phoenix Lake gasfield, and Union Texas Petroleum Division of Allied Chemical Corp. recovered natural gas liquids from the North Port Neches field. Portland cement was prepared from oystershell and miscellaneous clay at the Echo plant of Alpha Portland Cement Co. Paving sand was recovered from open pits and prepared by Texas Sand Pit.

Palo Pinto.—Substantial losses in natural gas liquids, clays, and sand and gravel output were greater than advances in production of petroleum, natural gas, and stone, resulting in a 3 percent decline in county total mineral value. One new oil pool and 3 new gas pools—Johnston Gap, and 2 shut-in discoveries—were proved from 11 exploratory wells. Five oil and 15 gas wells were completed out of 26 development wells. Natural gas liquids were recovered from various county gasfields by Lone Star Gas Co. and Southwestern Gas Pipeline, Inc.

Limestone was quarried and crushed for concrete aggregate by Palo Pinto Stone Co. Building and paving sand and gravel were recovered from open pits by Mineral Wells Sand & Gravel, Inc. Miscellaneous clay was recovered from open pits and prepared for manufacture of building brick by Reliance Clay Products Co., for vitrified sewer pipe by Can-Tex Industries, Inc., and for floor and wall tile by Texeramics, Inc.

Parker.—Mineral value declined 10 percent compared with that of 1964 as combined losses of natural gas liquids, stone, and sand and gravel exceeded gains in petroleum, natural gas, and clays values. The oil and gas industry discovered 3 new gasfields—Millsap, North; Millsap, East; and other reservoirs—from drilling 6 exploratory wells, and completed 2 oil and 23 gas wells from 25 development wells. Gas processing plants, with a combined capacity of 260 million cubic feet per day, of Lone Star Gas Co. and Parker County Pipeline Co. recovered natural gas liquids from the Toto; Brazos, East; and other county gasfields. Miscellaneous clay used in building brick was recovered from open pits by Acme Brick Co. and Mineral Wells Clay Products, Inc. Dimension sandstone was quarried by Ben Roy Gholson for use in rough building construction. Limestone was quarried and crushed for concrete aggregate by Industrial Concrete & Supply Co., Inc., and by various producers for Districts 9, 18, and 23 of the Texas Highway Department.

Potter.—One oil and 14 gas wells were completed out of 18 development wells drilled; 2 exploratory wells were abandoned by the industry. Natural gas liquids were recovered from the West Panhandle gasfield at the 150-million-cubic-foot-per-day Fain plant and the 100-million-cubic-foot-per-day Turkey Creek plant of Amarillo Oil Co. Helium was produced and refined at the Federal Bureau of Mines Amarillo plant.

Portland cement was prepared from limestone quarried from adjoining deposits at the Bushland cement plant of Southwestern Portland Cement Co. Panhandle Gravel, Inc., and Texas Sand & Gravel Co. produced sand and gravel from open pits for building and paving purposes.

Reagan.—The oil and gas industry discovered 3 new oilfields out of 13 exploratory wells and completed 181 oil wells out of 189 development wells drilled. Natural gas liquids were recovered from the Big Lake gasfield by Dorchester Gas Producing Co., from the Sprayberry gasfield by El Paso Natural Gas Co., and from the Barnhart gasfield by Northwest Production Corp. Northwest Production Corp. recovered sulfur from sour gas at the Barnhart plant.

Reeves.—Combined advances in mineral value of petroleum, natural gas, and sand and gravel offset a substantial decline of natural gas liquids, resulting in a value comparable to that of 1964. The oil and gas industry proved 6 new gasfields and 3 oil reservoirs from 22 exploratory wells and proved 5 gas and 22 oil wells out of 43 development wells. Continental Oil Co. recovered natural gas liquids from various gasfields and Phillips Petroleum Co. recovered natural gas liquids from the Tunstill gasfield.

Building and paving sand and gravel were recovered from open pits by Five Fifty Land Co. and by Permian Sand & Gravel Co., Inc.

Refugio.—The mineral value of Refugio County advanced slightly as improvement

in petroleum and natural gas output offset a modest loss in natural gas liquids output. The oil and gas industry proved 1 oil pool and 2 gas pools from 21 exploratory wells and completed 19 oil and 25 gas wells out of 59 development wells. Humble Oil & Refining Co., Hunt Industries, Pan American Petroleum Corp., Valley Gas Transmission Co., and C. E. Starrett recovered natural gas liquids from the Tom O'Connor, Fulton Beach, and La Rosa gasfields.

Rusk.—The county ranked third in clay production. Fire clay mined from open pits was used in building brick by Henderson Clay Products Co. and Major Brick Co.

One oil discovery was made by the industry in drilling 9 exploratory wells. Six gas and 22 oil wells were completed out of 34 development wells drilled. Natural gas liquids were recovered from East Texas oilfield at the 105-million-cubic-foot-per-day plant of Humble Oil & Refining Co., the 12-million-cubic-foot-per-day plant of Parade Co., the 17-million-cubic-foot-per-day plant of Sinclair Oil & Gas Co., and the 15-million-cubic-foot-per-day dehydration plant of United Gas Pipe Line Co.

San Patricio.—The oil and gas industry discovered 2 new oilfields and 2 new gasfields from 20 exploratory wells drilled. Sixteen gas wells and 30 oil wells were completed from 64 development wells. Eight natural gas processing plants, with a combined daily capacity of 310 million cubic feet per day, recovered natural gas liquids. Clay used in cement was recovered from open pits by Centex Cement Co. Limestone for concrete aggregate was recovered from open quarries by Heldenfels Bros. and Claude Hughes. Building and paving sand and gravel and railroad ballast gravel were recovered from open pits by The Fordyce Co.

Scurry.—Two new oil discoveries were made out of 10 exploratory wells and 17 oil wells were completed out of 21 development wells. Natural gas liquids were recovered at four gasoline plants with a combined daily capacity of 200 million cubic feet by Monsanto Co., Standard Oil Co. of Texas, Sunray DX Oil Co., and Texaco Inc. Scurry County ranked fifth in petroleum production. Southwestern Brick & Tile Co. recovered and prepared miscellaneous clay from open pits for building brick.

Shackelford.—A decrease in natural gas liquids output was offset by a combined rise in petroleum and natural gas production, resulting in a slight increase in total mineral value. The oil and gas industry discovered three new oilfields—Oxford/4260 Caddo; Oxford/4590 Mississippian; and Pannel, West/Caddo—and two gasfields, one in the Shackelford County Regular field. The industry drilled 54 exploratory wells. Of 205 development wells, 112 were completed as oil wells. Marshall Young Drilling Co. recovered natural gas liquids from the Cook Ranch field at its 6-million-cubic-foot-per-day gasoline plant.

Smith.—One gas and 4 oil wells were completed from 17 development wells. The Etexas Producers Gas Co. recovered natural gas liquids from county gasfields at its 15-million-cubic-foot-per-day gasoline plant. Reliance Clay Products Co. mined and processed miscellaneous clay from open pits for building brick. Foundry and other industrial sands were mined from open pits by H. J. Ellis Sand Co.

Starr.—Losses in natural gas liquids, clays, and pumicite production were offset by the combined advances in petroleum and natural gas output, resulting in a slight increase in total mineral value. Exploratory drilling of 32 holes resulted in 1 oil discovery and 3 gas discoveries; 17 gas wells and 59 oil wells were completed out of 126 development wells. Six gasoline plants, with a total daily capacity of about 150 million cubic feet, of Clark Fuel Producing Co., George H. Coates, Continental Oil Co., Shell Oil Co., and Sun Oil Co. recovered natural gas liquids from the South Kelsey, Simmons, Rincon, Jay, and Sun gasfields located in the county.

Miscellaneous clay for building brick was recovered from open pits from Rio Clay Products Co. Volcanic ash was recovered from open pits by Pozzolana, Inc.

Stephens.—Three new oilfields—Wayland/2175 Strawn; Harding Brothers, North/Mississippian; Bernice; Jill, North; and other oil and gas reservoirs were proved from 23 exploratory wells. The industry completed 9 gas wells and 28 oil wells from 63 development wells. Five gasoline plants of Breckenridge Gasoline Co., Lone Star Producing Co., Petroleum Corporation of Texas, Southwestern Gas Products Co., and

Warren Petroleum Corp. recovered natural gas liquids.

Tarrant.—The 22-percent loss in the county's mineral value compared with that of 1964 resulted from significant production losses in stone and cement. Trinity Portland Cement Division of General Portland Cement Co. produced portland and masonry cements from limestone quarried in the vicinity of the cement plant. Sand and gravel was recovered from open pits and prepared for building and paving purposes by six producers. Sil-Flo Corp. prepared perlite as a filter aid from crude material imported from adjoining States. Crude mica imported from other States and scrap mica were ground and prepared for various industrial uses by Western Mica Corp. American Cyanamid Co. recovered sodium sulfate as a byproduct at its Fort Worth chemical and fertilizer plant.

Taylor.—Minerals and mineral fuels produced contributed in varying degree to the 6-percent increase in total mineral value. The oil and gas industry proved 6 oil discoveries—Lake Abilene/Cross Cut and 5 oil pools in the Taylor County Regular oilfield; 1 gas discovery—Bradshaw/Gray—was also proved from exploration drilling of 45 wells. Three gas wells and 93 oil wells were completed out of 131 development wells. Natural gas liquids were recovered from the Taylor County Regular gasfield by Gulf Central Oil & Gas Co. and the McWood Corp. and from various county gasfields by Valera Oil Co. Miscellaneous clay was mined from open pits for building brick by Abilene Brick Co. Limestone was quarried and crushed for concrete aggregate by H. B. Zachry Co. and by various producers for Districts 8 and 23 of the Texas Highway Department. Building and paving sand and gravel were recovered from open pits by Atlas Sand & Gravel Co., Inc., Caton Sand & Gravel Co., and R. E. Janes Gravel Co., Inc.

Terry.—Rises in production of petroleum, natural gas, and sodium sulfate offset declines in natural gas liquids production, resulting in a slight increase in total mineral value. The oil and gas industry completed two oil wells out of five development wells drilled. Natural gas liquids were recovered from the Adair field at the 3-million-cubic-foot-per-day gasoline plant of Amerada Petroleum Corp. Natural saline (natural sodium sulfate) was recovered from subsurface brines and processed into salt cake.

Tom Green.—Moderate increases in petroleum, natural gas, and sand and gravel production were offset by loss in natural gas liquids output, resulting in mineral value approximating that of 1964. Three new oil pools were discovered out of 27 exploratory wells and 27 oil wells were completed from 42 development wells. Building and paving sand and gravel were prepared from open pits by Montgomery Sand & Gravel, Inc. Midland Petrochemical Co. recovered natural gas liquids from the Strawn field, and Service Gas Products Co. recovered liquids from the North Susan Peak field.

Travis.—Improvement in petroleum and lime production failed to compensate for losses in stone and sand and gravel output, resulting in a 4-percent decline in mineral value. The county was ranked fourth in lime production. Five exploratory wells and one development well drilled by the oil and gas industry were abandoned during 1965. Austin White Lime Co. quarried and crushed limestone for industrial lime, agricultural lime, and flux. Texas Crushed Stone Co. quarried and crushed limestone for concrete aggregate. Building and paving sand and gravel were recovered from open pits by Capitol Aggregates, Inc., and Travis Materials Co.

Upshur.—Improved output of petroleum and natural gas more than offset loss of sand and gravel production, resulting in a slight increase in total mineral value compared with that of 1964. The oil and gas industry discovered one new gasfield—Indian Rock—from three exploratory wells and completed one oil and one gas well out of six development wells. Molding, furnace, and other industrial sands were mined from open pits by Big Sandy Sand Co.

Upton.—Mineral value of Upton County approximated that of 1964 as combined advances in petroleum and natural gas production offset losses in natural gas liquids. The oil and gas industry proved 2 oilfields —Heluma, North/Ellen, and Bloxon/Wolfcamp—and 3 new reservoirs from 17 exploratory wells and completed 79 oil wells from 84 development wells. Natural gas

liquids output declined as Mesquite Gas Products, Inc., shut down its gasoline plant in the Davis gasfield. Six producers, with a combined daily capacity of 174 million cubic feet, recovered natural gas liquids from various county gasfields.

Uvalde.—The oil and gas industry brought in two new gasfields—Kincaid and Woodley—from four exploratory wells. Only minor production was reported in 1965 since most of the wells were shut in upon completion. Various producers quarried and prepared limestone for concrete aggregate for Districts 9, 10, 18, and 22 of the Texas Highway Department. Native asphalt was quarried and prepared for concrete, roadstone, and railroad ballast by White's Uvalde Mine and Uvalde Rock Asphalt Co. Southwest Stone Co. quarried and prepared basalt for roadstone and concrete aggregate. Building and paving sand and gravel were recovered from open pits by D & D Gravel Co.

Van Zandt.—Considerable advances in petroleum, natural gas, and natural gas liquids output were greater than the decline in salt production, resulting in a 17-percent increase in total mineral value. The county was the State's second-ranking producer of salt. One gas well was completed from seven development wells; four exploratory wells were abandoned. Pan American Petroleum Corp. recovered natural gas liquids from the Edgewood gasfield and Union Oil Co. of California recovered liquids from the Van gasfield in 1965. Pan American also recovered sulfur from the sour gases at facilities adjacent to its gasoline plant. Morton Salt Co. mined rock salt and prepared it for various industrial and culinary uses.

Ward.—Gasoline plants of Cabot Corp., El Paso Natural Gas Co., and Warren Petroleum Corp. recovered natural gas liquids from the North Ward-Estes and various other gasfields in the county. Natural sodium sulfate was recovered from subsurface brines for use in the manufacture of salt cake by Ozark-Mahoning Co. Various producers quarried and prepared limestone for concrete aggregate for District 6 of the Texas Highway Department. Building and paving sand and gravel were recovered from open pits by Permian Sand & Gravel Co., Inc. Brine used by the oil refining industry was recovered from subsurface brines by Montex Chemical Co.

Webb.—Losses in natural gas liquids output balanced combined advances of petroleum, natural gas, sand and gravel, and clays, resulting in total county mineral value approximating the 1964 value. The oil and gas industry proved 2 oil discoveries and 4 gas discoveries from 40 exploratory wells and completed 12 gas wells and 21 oil wells from 52 development wells. Phillips Petroleum Co. recovered natural gas liquids at its 200-million-cubic-foot-per-day gasoline plant. Laredo Brick & Tile Co. recovered miscellaneous clay from open pits for building brick. Building sand and gravel was recovered by Aldape Sand & Gravel Co. and by Solis Sand & Gravel Co.

Wharton.—The 15 percent increase in the county's total mineral value was the result of modest output advances in petroleum, natural gas, sulfur, and clays. The county was the State's leading sulfur producer. Sulfur was recovered by the Frasch process from Boling Dome by Texas Gulf Sulphur Co. Exploration drilling of 34 wells proved 1 new oilfield—Cox/Fri. D—and 2 new gas reservoirs. The industry completed 28 oil wells and 31 gas wells out of 80 development wells.

Calag Co., Inc., recovered miscellaneous clay from open pits for use in heavy clay products and other items.

Wheeler.—Improvement of petroleum and natural gas output was offset by decline of natural gas liquids production, resulting in total mineral value approximating the 1964 value. One new gas pool was proved by the oil and gas industry from exploration drilling of three wells. The industry completed 3 gas wells and 67 oil wells out of 86 development wells. Warren Petroleum Co. recovered natural gas liquids at its McLean-28 gasoline plant. United Carbon Co. recovered carbon black from natural gas and hydrocarbon liquids at its Shamrock furnace plant.

Wichita.—Production losses of natural gas liquids and sand and gravel offset advances in petroleum and natural gas, resulting in the 1965 total mineral value approximating the 1964 value. One gas well and 337 oil wells were completed out of 452 development wells; 6 exploratory wells were abandoned. Gasoline plants of Texa-

co, Inc., Mobil Oil Co., and Continental Oil Co. recovered natural gas liquids from county gasfields. Crude oil was processed and refined at the Burkburnett refinery of Williams Petroleum Co.

Building and paving sand and gravel were recovered from open pits by Gifford-Hill & Co., Inc., and by crews of the Wichita Falls city engineer and District 3 of the Texas Highway Department.

Williamson.—Total mineral value advanced 8 percent as gains in petroleum, stone, and sand and gravel output exceeded a loss in lime output. The county ranked third in lime production and fourth in stone production. The oil and gas industry proved one oil discovery from seven exploratory wells and completed one gas well out of two development wells.

Limestone was quarried and crushed for lime by Round Rock White Lime Co. and White Stone & Lime Co. Superior Stone Products, Inc., and Texas Carbonate Co. quarried and prepared limestone for agricultural use, paint filler, mineral food, glass, and other industrial uses. Dimension limestone was quarried and prepared for rough and dressed building stone by Leander Limestone Corp., San-Tex Stone Quarry, Inc., and Texas Quarries, Inc. Building and paving sand was recovered from open pits by Transmix of Taylor.

Wise.—The county was the State's second largest stone producer. Limestone was quarried and crushed for riprap, flux, agricultural lime, filler, and concrete aggregate by Trinity Concrete Products Co. and for concrete aggregate by Bridgeport Stone Co., Crushers, Inc., and Gifford-Hill & Co., Inc. Acme Brick Co. recovered miscellaneous clay from open pits and prepared it for building brick. The oil and gas industry discovered 2 new oilfields—Cottondale/2915 Strawn and Tidwell/Atoka, Lower—2 new oil pools, and 1 new gas pool from 10 exploratory wells. The industry completed 38 oil and 49 gas wells from 97 development wells. Gasoline plants of Cities Service Oil Co., Upham Oil & Gas Co., and Warren Petroleum Corp. recovered natural gas liquids.

Wood.—One new oilfield—the Yantis, South—was discovered from 13 exploratory wells drilled. Six gas wells and 32 oil wells were completed out of 49 development wells. Natural gas liquids were recovered from the Manziel gasfield by ARKLA Chemical Corp., from the Quitman gasfield by Caska Corp., from the Hawkins gasfield by Humble Oil & Refining Co., and from the West Yantis gasfield by Pan American Petroleum Corp. The latter company also recovered sulfur from the processed sour gas.

A. P. Green Fire Brick Co. recovered fire clay from open pits for use in manufacture of firebrick at its Sulphur Springs plant. Building and paving sand and gravel were recovered from open pits by Big Sandy Sand Co.

Yoakum.—The oil and gas industry discovered 2 new oil pools from 10 exploratory wells, and completed 80 oil wells from 86 development wells. Pan American Petroleum Corp. recovered natural gas liquids from its 14-million-cubic-foot-per-day gasoline plant in the Prentice field and Shell Oil Co. recovered natural gas liquids from the Wasson field at its 157-million-cubic-foot-per-day gasoline plant.

Salt in brine was recovered from subsurface salt beds by Frontier Chemical Co., Division of Vulcan Materials Co. for use in the manufacture of chlorine and other sodium compounds.

Young.—The oil and gas industry proved 3 oil discoveries—the James, North/Mississippian; the Bunger, Southwest/3960 Bend Conglomerate; and the Koester/Mississippian—as well as 12 new oil reservoirs from 61 exploratory wells. The industry completed 2 gas wells and 67 oil wells from a total of 128 development wells.

Sandstone and limestone were quarried and prepared for concrete aggregate and for roadstone by various producers for District 3 of the Texas Highway Department. Building and paving sand and gravel were recovered from open pits by Pitcock Bros. and by various producers for District 3 of the Texas Highway Department. Natural gas liquids were recovered from the South Bend field at the 8-million-cubic-foot-per-day gasoline plant of Petroleum Corporation of Texas.

The Mineral Industry of Utah

This chapter has been prepared under a cooperative agreement for collecting mineral data, except mineral fuels, between the Bureau of Mines, U.S. Department of the Interior, and the Utah Geological and Mineralogical Survey.

By Herman W. Sheffer[1] and William C. Henkes[2]

Value of mineral production in Utah in 1965 increased 10 percent over that of 1964. Metal and nonmetal production increased $53 million in value; mineral fuel production, however, decreased $13.1 million in value.

Copper output increased 30 percent and, with an increase in the price of copper during the year, contributed heavily to the overall rise in mineral value. Copper again was the leading mineral commodity produced in the State. Other metals that increased in value were gold, lead, molybdenum, silver, and vanadium.

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Table 1.—Mineral production in Utah[1]

Mineral	1964 Quantity	1964 Value (thousands)	1965 Quantity	1965 Value (thousands)
Carbon dioxide (natural)—thousand cubic feet	96,432	$7	86,201	$6
Clays[2]—thousand short tons	127	330	149	332
Coal (bituminous)—do	4,720	33,184	4,992	31,811
Copper (recoverable content of ores, etc.)—short tons	199,588	130,131	259,138	183,470
Gem stones	NA	75	NA	75
Gold (recoverable content of ores, etc.)—troy ounces	287,674	10,069	426,299	14,921
Iron ore (usable)—thousand long tons, gross weight	2,082	14,306	2,139	14,229
Lead (recoverable content of ores, etc.)—short tons	40,249	10,545	37,700	11,762
Lime—thousand short tons	163	2,917	189	3,470
Natural gas (marketed)—million cubic feet	79,739	10,904	71,616	8,952
Perlite—short tons	2,003	12	W	W
Petroleum (crude)—thousand 42-gallon barrels	28,575	74,867	25,298	66,045
Salt—thousand short tons	371	3,848	384	3,591
Sand and gravel—do	10,218	10,405	10,032	10,464
Silver (recoverable content of ores, etc.) thousand troy ounces	4,552	5,886	5,636	7,287
Stone—thousand short tons	3,105	6,930	2,158	4,552
Sulfur ore—long tons	------	------	2,156	3
Uranium ore—short tons	761,180	26,385	377,989	9,014
Vanadium—do	405	1,214	387	1,353
Zinc (recoverable content of ores, etc.)—do	31,428	8,548	27,747	8,102
Value of items that cannot be disclosed: Asphalt and related bitumens, cement, clays (fire clay and halloysite), fluorspar, gypsum, molybdenum, natural gas liquids, phosphate rock, potassium salts, pumice, and values indicated by symbol W	XX	[3] 40,867	XX	[4] 51,939
Total	XX	391,430	XX	431,378

NA Not available. W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed." XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes fire clay and halloysite; included with "Value of items that cannot be disclosed."

[3] Value of metals and mineral fuels, $24,848,000; value of nonmetals, $16,019,000.

[4] Value of metals and mineral fuels, $31,416,000; value of nonmetals, $20,523,000.

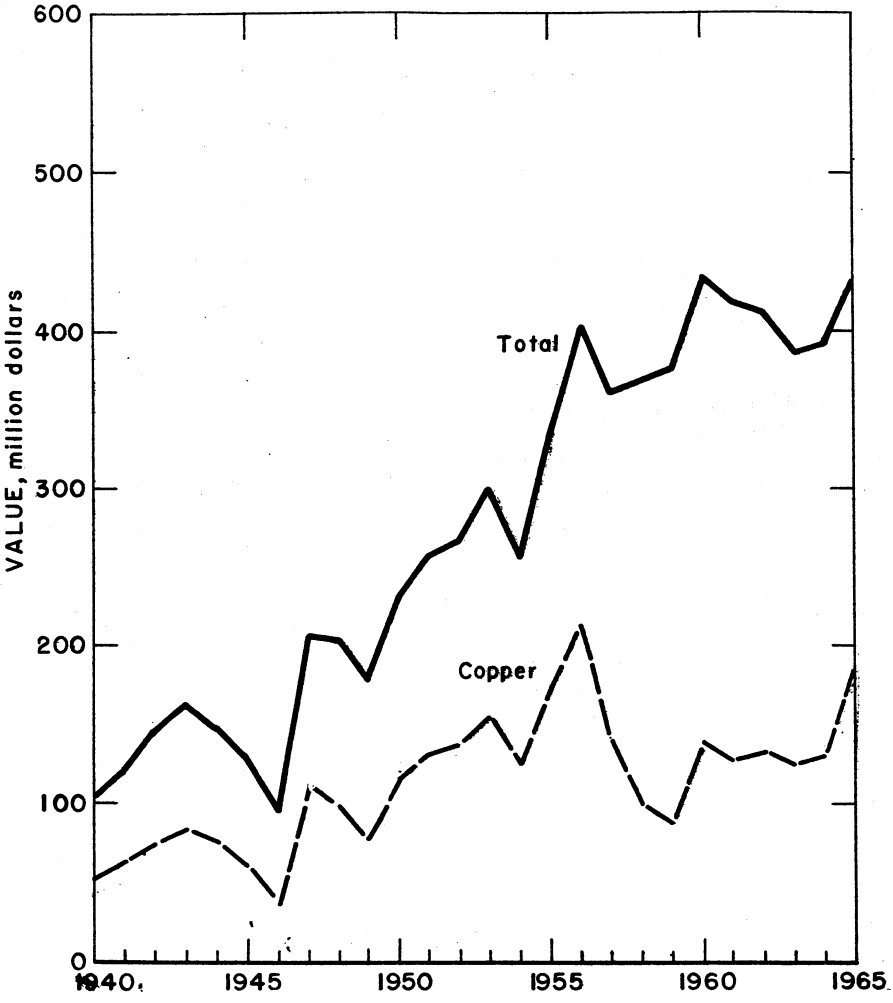

Figure 1.—Value of copper, and total value of mineral production in Utah.

Table 2.—Value of mineral production in constant 1957-59 dollars
(Millions)

Year	Value
1956	$337
1957	350
1958	380
1959	372
1960	417
1961	412
1962	397
1963	r 357
1964	r 364
1965	381

r Revised.

The increases in the production values of nonmetals such as portland cement, clays, fluorspar, lime, phosphate rock, potassium salts, pumice, and sand and gravel were largely offset by decreases in production values of gypsum, perlite, salt, and stone.

The $13.1 million decrease in the value of mineral fuels production was due principally to a decrease in petroleum production in San Juan County and to a sharp drop in natural gas production.

Employment and Injuries.—Final employment and injury data for 1964 and preliminary data for 1965—excluding all mineral fuels industries except the coal and asphalt (gilsonite) industries—compiled by the Federal Bureau of Mines are shown in table 3.

Legislation and Government Programs.—Two contracts were approved for exploration of mineral deposits by the Office of Mineral Exploration. Escalante Silver Mines Company, Inc., Salt Lake City, was granted a loan to explore for silver at the Escalante mine in Iron County. The total cost of the work was estimated at $49,780. Government participation was $37,335. Cardiff Industries, Inc., Salt Lake City, was granted a loan to explore for silver-bearing ore bodies, occurring at fissure intersections in the Maxfield limestone. The total cost of the work was estimated at $10,500. Government participation was $7,875.

According to a Federal Bureau of Public Roads report,[3] Utah completed 158.9 miles of road that met interstate highway standards. An additional 28.1 miles was improved to standards adequate for present traffic.

Utah was awarded a total of $37.3 million for highway construction in 1965: $29.2 million for interstate contracts, $6.9 million for Federal-Aid Primary and Secondary (ABC) contracts, and $1.2 million for 100-percent State-financed contracts. Contract plans for 1966 were $61 million total: $48 million for interstate, $12 million for ABC, and $1 million for State financed.[4]

The Utah State Board of Examiners approved a contract with Wasatch Construction Co. to build an experimental peninsula into Great Salt Lake by using selected mill tailings from Kennecott Copper Corp. A maximum cost of $78,446 was to be shared by Kennecott Copper Corp. and the Salt Lake Authority. An estimated 500,000 tons of tailings was to be placed in a 1½-mile-long embankment extending into Great Salt Lake.

A strike by members of the Steelworkers Union at the Kennecott Copper Corp. Garfield smelter idled 1,100 men for 2 days during September. United Park City Mines Co. was forced to shut down its operations for 4 days when it was informed that The Anaconda Company, purchaser of its ore, could not handle the ore because of the strike and shutdown of the Midvale mill of United States Smelting Refining and Mining Co. (USSR&M Co.). Following the 2½-month strike, a settlement was reached between USSR&M Co. and three locals of the United Steelworkers.

The Atomic Energy Commission (AEC) and Atlas Minerals Division, Atlas Corp., Salt Lake City, signed a new contract for purchasing uranium concentrate. The con-

[3] Bureau of Public Roads. Quarterly Report on the Federal-Aid Highway Program. Dec. 31, 1965. Press Release BPR 66-5, Feb. 9, 1966.

[4] Engineering News-Record. State Highway Contracting Plans: 1966 Will be a Record Breaker. V. 176, No. 14, Apr. 7, 1966, pp. 74-76.

Table 3.—Employment and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1964:								
Coal	1,636	199	326	2,580	6	78	32.56	17,243
Asphalt	195	241	47	374	---	15	40.15	1,151
Metal	5,322	262	1,396	11,090	3	256	23.35	2,769
Nonmetal	661	234	155	1,236	1	84	68.75	6,191
Sand and gravel	549	202	111	909	---	22	24.21	779
Stone	527	247	129	1,036	---	22	21.23	389
Total	8,890	244	2,164	17,225	10	477	28.27	4,900
1965: p								
Coal	1,565	217	339	2,713	2	82	30.96	7,718
Asphalt	239	247	59	470	1	19	42.53	14,954
Metal	5,060	304	1,540	12,232	6	255	21.34	3,903
Nonmetal	945	260	246	1,882	3	111	60.57	13,747
Sand and gravel	495	202	100	818	1	20	25.67	7,922
Stone	515	258	133	1,065	---	17	15.96	244
Total	8,819	274	2,417	19,180	13	504	26.96	5,647

p Preliminary.

tract was to defer a portion of the output scheduled for delivery in the 1963–66 period to 1967–68.

AEC, at the request of Vitro Chemical Co. Division, Vitro Corporation of America, operator of a uranium-processing mill at Salt Lake City, terminated a uranium purchase contract, which would have expired December 31, 1966.

Utah Senate Bill 139 was to give the State road commission discretion to raise the maximum load for trucks from 40 to 60 net tons, and to designate overweight routes. The bill influenced Stauffer Chemical Co. to expand its operation and to invest more than $17 million in a phosphate fertilizer complex near Vernal. Stauffer was to process the phosphate at the Vernal complex, transport it by truck to Keetley, and ship by rail from Keetley to fertilizer markets throughout the West and Canada.

Lithium Corporation of America, Inc. (LCA), executed an agreement with the Utah State Land Board giving rights to the company to extract magnesium chloride and its derivatives from the waters of Great Salt Lake from and after March 8, 1969.

Seventeen lawsuits seeking damages caused by the explosion at the Cane Creek mine of Texas Gulf Sulphur Co. (TGS) near Moab in 1963 were settled for $1.3 million. The settlements were announced in the U.S. district court shortly before the cases were to go to trial.

New forms for bituminous-sands and oil-shale leases on State land were developed. Under terms of the new leases, the primary lease was for 20 years. Royalty was 5 percent of the gross value of production for the first 5 years, and was gradually to increase to 12.5 percent during the next 15 years; and annual rental was $0.50 per acre for the first 10 years, and $1.50 per acre for the second 10 years. Provisions for unitization were included.

REVIEW BY MINERAL COMMODITIES

METALS

Beryllium.—Some beryllium ore was shipped by The Anaconda Company from its Spor Mountain property to its pilot-plant electrolytic beryllium-refining operation at Anaconda, Mont.

Copper.—Utah was ranked second to Arizona in the output of copper in the Nation. The increase in production with an increase of 2.8 cents per pound in the weighted average price in 1965—to 35.4 cents per pound—resulted in a total value of $183.5 million (an increase of 41 percent). This value was second only to the 1956 record high value for copper production in Utah, when the price was 42.5 cents per pound. The open pit mine of the Utah Copper Division of Kennecott Copper Corp. again was the largest copper-producing mine in the nation. Other leading copper-producing mines were the American Mining Co. Bawana mine, USSR&M Co. U.S. and Lark mine, and Hecla Mining Co. Mayflower mine.

The $100 million expansion program of Utah Copper continued with the construction of a 27,000-ton-per-day crushing and grinding facility at a cost of $20 million. An increase from 90,000 to 108,000 tons in daily ore production was expected by 1967. A new converter, part of the $20 million smelter modernization program, was installed during the year. Construction began on the new precipitate plant, consisting of 26 cones for precipitating copper and of additional facilities such as filter plant, solution pipelines, 500-million-gallon dam and reservoir, pumping stations, acid-storage tanks, and material-handling facilities. Copper precipitate production was expected to increase from 2,250 tons to 6,000 tons per month upon completion of the new plant.

Gold.—Increases in gold output from the Utah Copper Bingham Canyon mine and the Hecla Mining Co. Mayflower mine more than offset decreases in output from the USSR&M Co. U.S. and Lark mine and the United Park City Mines Co. United Park City mines. Gold was obtained principally as a byproduct from copper and lead-zinc ores.

Iron Ore.—Production of iron ore came from six mines, all in Iron County: the Blowout, Comstock, and Duncan mines of The Colorado Fuel and Iron Corp. (CF&I); the Desert Mound mine operated by United States Steel Corp. (USS); and the Iron Springs and McCahill-Thompson Alluvial mines operated by Utah Construc-

Table 4.—Mine production of gold, silver, copper, lead, and zinc, in terms of processed and methods of recovery, in terms of recoverable metals

Year	Mines producing		Material sold or treated [2] (thousand short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Troy ounces	Value (thousands)	Troy ounces (thousands)	Value (thousands)
1956–60 (average)	59	1	27,776	342,013	$11,970	5,313	$4,809
1961	34	-------	28,542	342,988	12,005	4,798	4,435
1962	25	-------	29,981	311,924	10,917	4,628	5,022
1963	31	-------	27,035	285,907	10,007	4,791	6,128
1964	28	-------	25,279	287,674	10,069	4,552	5,886
1965	34	-------	32,887	426,299	14,921	5,636	7,287
1864–1965	NA	NA	[3] 1,110,539	17,765,288	522,012	833,437	634,172

Year	Copper		Lead		Zinc		Total value (thousands)
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	
1956–60 (average)	208,082	$136,911	42,082	$11,073	39,780	$9,504	$174,267
1961	213,534	128,120	40,894	8,424	37,239	8,565	161,549
1962	218,018	134,299	38,199	7,029	34,313	7,892	165,159
1963	203,095	125,107	45,028	9,726	36,179	8,321	159,289
1964	199,588	130,131	40,249	10,545	31,428	8,548	165,179
1965	259,138	183,470	37,700	11,762	27,747	8,102	225,542
1864–1965	9,271,898	3,883,743	5,272,599	727,166	1,680,364	315,812	6,082,905

NA Not available.
[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 or tonnage of precipitates shipped.
[3] Figures estimated for certain years before 1901.

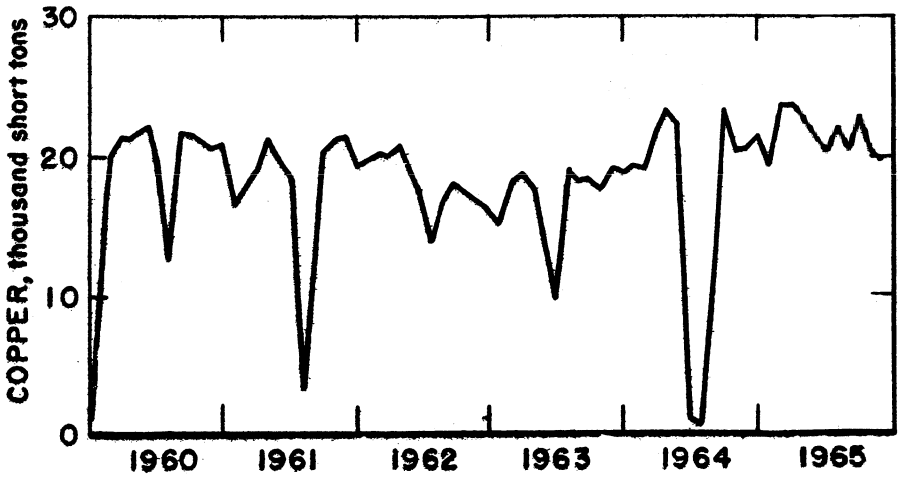

Figure 2.—Mine production of copper in Utah, by months, in terms of recoverable metals

Table 5.—Mine production of gold, silver, copper, lead, and zinc in 1965, by counties, in terms of recoverable metals

County	Mines producing [1] (lode)	Lode material sold or treated [2] (short tons)	Gold		Silver	
			Troy ounces	Value	Troy ounces	Value
Beaver	5	78,186	509	$17,815	121,719	$157,383
Iron	1	424	2	70	2,748	3,553
Juab	3	15,280	83	2,905	5,772	7,463
Millard	2	48	-------	-------	67	87
Piute	1	[3] [4] 39,080	[3] 1,233	[3] 43,155	[3] 390,613	[3] 505,063
Salt Lake	6	32,338,458	379,042	13,266,470	3,868,595	5,002,093
San Juan	1	[3]	[3]	[3]	[3]	[3]
Sanpete	2	135	-------	-------	44	57
Summit	5	272,709	2,586	90,510	611,397	790,536
Tooele	4	28,297	130	4,550	198,037	256,062
Utah	2	[3]	[3]	[3]	[3]	[3]
Wasatch	2	114,047	42,714	1,494,990	436,578	564,495
Total:						
1965	34	32,886,664	426,299	14,920,465	5,635,570	7,286,792
1964	28	25,278,870	287,674	10,068,590	4,551,960	5,885,684

County	Copper		Lead		Zinc		Total value
	Short tons	Value	Short tons	Value	Short tons	Value	
Beaver	1,861	$1,317,446	78	$24,305	28	$8,030	$1,524,979
Iron	[5]	212	-------	-------	-------	-------	3,835
Juab	3	2,407	2	593	6	1,723	15,091
Millard	-------	-------	1	265	8	2,292	2,644
Piute	[3] 279	[3] 197,992	[3] 3,910	[3] 1,219,655	[3] 2,294	[3] 670,140	[3] 2,636,005
Salt Lake	255,945	181,208,918	21,605	6,740,776	13,323	3,890,185	210,108,442
San Juan	[3]	[3]	[3]	[3]	[3]	[3]	[3]
Sanpete	-------	-------	3	951	9	2,643	3,651
Summit	199	140,397	5,143	1,604,678	6,578	1,920,703	4,546,824
Tooele	177	125,104	2,202	687,071	1,653	482,588	1,555,375
Utah	[3]	[3]	[3]	[3]	[3]	[3]	[3]
Wasatch	674	477,228	4,756	1,484,106	3,848	1,123,820	5,144,639
Total:							
1965	259,138	183,469,704	37,700	11,762,400	27,747	8,102,124	225,541,485
1964	199,588	130,131,376	40,249	10,545,238	31,428	8,548,416	165,179,304

[1] Operations at slag dumps and old mill or miscellaneous cleanups not counted as producing mines; various uranium mines from which copper was recovered as a byproduct not included as they were in the mine count of uranium.
[2] Excludes tonnage of copper precipitates shipped.
[3] Production of Piute, San Juan, and Utah Counties combined to avoid disclosing individual company confidential data.
[4] Excludes tonnage of uranium ore milled.
[5] Less than ½ unit.

tion & Mining Co. USS was the leading iron ore producer in the State. Utah Construction & Mining Co. mined iron ore for CF&I from the Blowout, Comstock, and Duncan mines and shipped the ore to the Pueblo, Colo., plant. All other iron ore was shipped to the Geneva plant of USS.

One-third of the total output from the Cedar City operations of Utah Construction & Mining Co. came from a dry-magnetic mobile concentrator which concentrated alluvial iron ore previously considered uneconomic. Iron-bearing gravel was fed by an 8-cubic-yard dragline to the mobile plant where it was crushed, screened, and magnetically separated. From 10,000 to 12,000 tons of gravel were processed daily in the 78-foot-long by 40-foot-high mobile concentrator.

Lead.—Although lead production decreased 6 percent in quantity, an increase in the weighted average price to 15.6 cents per pound, 2.5 cents per pound more than in 1964, resulted in an increase of $1.2 million (12 percent) in value. The five largest producing mines in order of rank were the U.S. and Lark mine of USSR&M Co.; the United Park City mines, United Park City Mines Co.; the Mayflower mine, Hecla Mining Co.; the Burgin mine, Tintic Division, Kennecott Copper Corp.; and the Ophir mine, USSR&M Co., McFarland & Hullinger, lessee. Output of lead decreased from three of these mines; only the Mayflower and Burgin mines had increases.

Considerable progress was made in the preparatory work for sinking the main operating incline for two more levels at

Table 6.—Mine production of gold, silver, copper, lead, and zinc in 1965, by classes of ore or other source materials, in terms of recoverable metals

Source	Number of mines [1]	Material sold or treated (short tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Lode ore:							
Dry gold	1	1,279	23	192	18,300	-------	-------
Dry gold-silver	1	15,231	83	5,705	6,800	-------	-------
Dry silver	4	178,583	1,507	219,563	169,300	8,400	5,500
Total	6	195,093	1,613	225,460	194,400	8,400	5,500
Copper	5	32,168,351	373,101	3,043,630	458,194,000	200	-------
Copper-lead-zinc and uranium [2]	[3] 2	[4] 1,076	17	25,786	594,500	339,000	273,400
Lead	8	11,280	377	209,361	52,700	3,239,400	848,900
Lead-zinc	16	486,941	51,174	2,124,643	3,816,600	71,293,200	51,813,700
Zinc	2	87	-------	32	-------	3,600	26,800
Total	29	32,667,735	424,669	5,403,452	462,657,800	74,875,400	52,962,800
Other lode material:							
Copper precipitates	1	39,070	-------	-------	55,401,800	-------	-------
Copper-lead cleanup	([5])	6	2	282	700	5,400	300
Lead-zinc mill cleanup and zinc slag [2]	([5])	23,830	15	6,376	21,300	510,800	2,525,400
Total	1	62,906	17	6,658	55,423,800	516,200	2,525,700
Total lode material	34	32,925,734	426,299	5,635,570	518,276,000	75,400,000	55,494,000

[1] Detail will not necessarily add to totals because some mines produce more than one class of material.
[2] Combined to avoid disclosing individual company confidential data.
[3] Copper-lead-zinc mines only; excludes the mine count of uranium mines from which copper was recovered as a byproduct.
[4] Excludes uranium ore tonnage.
[5] From properties not classed as mines.

Table 7.—Mine production of gold, silver, copper, lead, and zinc in 1965, by type of material processed and methods of recovery, in terms of recoverable metals

Type of material processed and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Lode:					
Concentration, and smelting of concentrates:					
Ore [1]	424,213	5,130,334	462,293,300	71,076,300	51,673,400
Cleanings	10	1,644	800	28,500	48,000
Total	424,223	5,131,978	462,294,100	71,104,800	51,721,400
Direct-smelting:					
Ore	2,069	498,578	558,900	3,807,500	1,294,900
Copper precipitates	-------	-------	55,401,800	-------	-------
Cleanings and old slag	7	5,014	21,200	487,700	2,477,700
Total	2,076	503,592	55,981,900	4,295,200	3,772,600
Grand total	426,299	5,635,570	518,276,000	75,400,000	55,494,000

[1] Includes uranium-ore concentrate.

the USSR&M Co. U.S. and Lark mine. At the Ophir mine, development on a new lower level, reached in 1964, failed to disclose any ore. Additional areas were to be explored during 1966.

The production shaft at the Burgin mine, Kennecott Copper Corp., was advanced to a depth of 1,331 feet. Shaft sinking below this level had been deferred until deepwell pumping lowered the level of hot water encountered at this depth.

Molybdenum.—Output of molybdenum increased 41 percent. The only production was the byproduct recovery of MoS_2 from

Table 8.—Usable iron ore shipments
(Thousand long tons and thousand dollars)

Year	Quantity	Value
1956–60 (average)	3,570	$25,387
1961	3,533	25,493
1962	2,630	18,242
1963	1,881	12,900
1964	2,082	14,306
1965	2,139	14,229
1906–65	72,763	341,945

copper ore processed by Utah Copper. Near the Garfield smelter of Utah Copper construction began on a $3 million plant designed to recover molybdic oxide and rhenium from molybdenum sulfide contained in the copper ore from Bingham Canyon. An estimated 10 million pounds of contained molybdenum (as molybdic oxide) was to be produced annually.

Selenium.—Selenium was produced by Utah Copper as a byproduct of the electrolytic refining of copper at Magna. The increases in copper ore processed by the company resulted in a 5-percent increase in the quantity recovered.

Silver.—Increases in production were reported by 8 of the 11 leading producers. Silver was recovered from 33 producing mines in 12 counties. The five leading silver-producing mines in order of output were the Utah Copper Bingham Canyon mine, USSR&M Co. U.S. and Lark mine, Hecla Mining Co. Mayflower mine, United Park City Mines Co. United Park City mines, and Kennecott Copper Corp. Burgin mine. These five mines supplied 88 percent of the total silver output.

Uranium Ore.—Output of uranium ore decreased in quantity and value. The average grade of ore fell from 0.40 percent (7.9 pounds per ton) in 1964 to 0.29 percent (5.7 pounds per ton) in 1965. Uranium ore was produced from 194 operations (21 fewer than in 1964) in 7 counties. San Juan County produced 87 percent of the uranium output value of the State; Emery and Grand Counties produced 5 and 6 percent, respectively.

Uranium ore was processed at three plants in Utah and at four out-of-State plants: Atlas Minerals, Mexican Hat and Moab; Vitro Chemical Co., Salt Lake City; American Metal Climax, Inc., Climax Division, Climax Uranium Co., Grand Junction, Colo.; Union Carbide Corp., Mining and Metals Division, Rifle and Uravan, Colo.; and Vanadium Corporation of America (VCA), Shiprock, N. Mex.

Humeca Exploration Co. announced the discovery of a large uranium deposit on the northeast side of the Lisbon fault in the Big Indian mining district in San Juan County. All previous production in the area had come from the southwest side of the fault.

Atlas Minerals and 21 other mining firms protested property taxes assessed against workedout or abandoned mines during the previous year. Atlas Minerals shut down its uranium processing mill at Mexican Hat on March 1 because of a decrease in the quantity of ore tributary to the mill from Atlas Minerals mines and independent producers. Atlas Minerals diverted ores formerly processed at Mexican Hat to its plant at Moab. Following the

Table 9.—Mine production of uranium ore, by counties [1]

County	1964				1965			
	Number of operations	Ore (short tons)	U_3O_8 contained (pounds)	F.o.b. mine value [2]	Number of operations	Ore (short tons)	U_3O_8 contained (pounds)	F.o.b. mine value [2]
Beaver	3	W	W	W	2	W	W	W
Emery	24	38,648	176,325	$715,468	26	28,314	115,066	$437,912
Garfield	34	1,587	13,087	56,707	37	1,615	10,651	45,071
Grand	30	15,578	77,712	318,254	27	21,256	132,720	565,722
Juab	1	W	W	W	1	W	W	W
Piute	5	W	W	W	4	W	W	W
San Juan	118	686,998	5,687,362	25,003,423	97	314,186	1,857,872	7,812,738
Undistributed	---	18,369	74,758	291,464	---	12,618	43,316	152,270
Total	215	761,180	6,029,244	26,385,316	194	377,989	2,159,625	9,013,713

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] Receipts at mills, based on data supplied to the Bureau of Mines by AEC.
[2] F.o.b. mine value; base price, grade premiums, and exploration allowances. Calculated according to AEC Circular 5, revised, price schedule.

termination of a uranium purchasing contract with AEC by Vitro in July, ores formerly processed at Salt Lake City were diverted to the Atlas Minerals plant at Moab.

Vanadium.—The quantity of vanadium metal in recovered vanadium pentoxide from uranium ores was 387 tons, 4 percent less than in 1964. An increase in the weighted value of recovered vanadium pentoxide effected an increase of $139,000 in value. Lower vanadium production resulted from the decrease in uranium output.

Ores produced in Emery, Garfield, Grand, and San Juan Counties were processed in plants at Grand Junction, Colo. (Climax Uranium Co.); Rifle and Uravan, Colo. (Union Carbide Corp.); and Shiprock, N. Mex. (VCA). The value and quantity of the vanadium recovered were credited to the mineral production of Utah.

Vitro Chemical Co. spent $450,000 in converting its Salt Lake City plant from uranium to vanadium recovery. Raw material for the plant was ferrophosphorus slag, a byproduct from the production of elemental phosphorus at the Pocatello, Idaho, plant of FMC Corp. The recovered vanadium was credited to Idaho, the State of origin.

Zinc.—The weighted average price received for zinc rose to 14.6 cents per pound, an increase of 1 cent per pound. Zinc production quantity and value decreased 12 and 5 percent, respectively, chiefly because of a 2½-month-long strike by steelworkers at the U.S. and Lark mine against USSR&M Co. (the principal producer in the State). Other leading zinc-producing mines, in decreasing order of output, were United Park City Mines Co. United Park City mines, Hecla Mining Co. Mayflower mine, USSR&M Co. (McFarland & Hullinger, lessee) Ophir mine, Kennecott Copper Corp. Burgin mine, International Smelting and Refining Co. (IS&R) Murray slag dump, and Deer Trail Mines & Arundel Mining Co. Deer Trail mine.

Zinc concentrate produced at the Midvale mill of USSR&M Co. was shipped to The Anaconda Company plant at Great Falls, Mont.

New Park Mining Co. announced that it would exercise an option to purchase, from USSR&M Co., 250 acres of land adjacent to the Mayflower mine in the Park City district.

Plata Verde Mining Co. conducted a drilling-exploration program at the Horn Silver mine, San Francisco district, Beaver County. Holes were drilled to outline additional zinc carbonate zones on the footwall side of the Horn Silver fault and to search for sulfide replacement ores adjacent to fissures in the limestone rock.

MINERAL FUELS

Asphalt and Related Bitumens.—Gilsonite production decreased 13 percent. American Gilsonite Co. (the largest producer) mined gilsonite from open pit and underground mines near Vernal in Uintah County. The company manufactured metallurgical coke, gasoline, and diesel fuel from the Utah gilsonite at its refinery at Fruita, Colo. Other producers in Uintah County were Standard Gilsonite Co. and Ziegler Chemical & Mineral Corp.; the latter company also produced gilsonite from the Castle Peak mine in Duchesne County.

Mesa Petroleum Co. acquired the properties of Standard Gilsonite Co. on September 10; Standard Gilsonite Co. continued operating as a division of Mesa Petroleum Co.

Carbon Dioxide.—Production of carbon dioxide from the Equity Oil Co. well at Farnham Dome in Carbon County decreased 11 percent.

Coal (Bituminous).—A decrease of $1.4 million in value of coal produced was caused by a decrease in the average price per ton from $9.34 to $8.00 for coal not sold in the open market. Production of coal sold in the open market was 47 percent of the total, whereas the value was only 34 percent.

Coal was produced from 31 mines in 6 counties; the most production (76 percent) came from Carbon County.

Production was derived entirely from underground mines in which coal-seam thicknesses ranged from 54 to 240 inches. Machines were used to cut 1.7 million tons (34 percent) of the total coal mined. Of this amount, 1.4 million tons was drilled by mobile drills; the remainder was drilled by hand-held and post-mounted drills. Sixty-six percent of the coal was loaded in the mines by continuous mining machines; 33 percent by mobile loading machines;

Table 10.—Coal (bituminous) production by counties
(Excludes mines producing less than 1,000 short tons)

County	1964		1965	
	Short tons	Average value per ton [1]	Short tons	Average value per ton [1]
Carbon	3,752,354	$7.43	3,779,041	$6.86
Emery	847,521	5.53	1,100,714	4.83
Iron	53,747	4.65	36,101	4.47
Kane	1,883	5.34	1,802	5.40
Sevier	47,000	6.08	61,427	5.58
Summit	17,338	4.68	12,918	4.72
Total	4,719,843	7.03	4,992,003	6.37

[1] Value received or charged for coal f.o.b. mine, including selling cost. (Includes value for coal not sold but used by producers, 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.)

and the remainder by self-loading conveyors, scraper loaders, and hand-loaded face conveyors. A total of 3.5 million tons (69 percent) of the coal produced was cleaned either by wet jigs, rigid air jigs, chance cone, heavy media, or flotation methods.

Island Creek Coal Co., one of the Nation's leading coal producers, acquired controlling interest in Heiner Coal Co. of Salt Lake City. Coal properties amounting to 5,300 acres in north and northeastern Carbon County and an exchange of stock were involved in the transaction.

The office of the State engineer approved the annual use of 102,000 acre-feet of Colorado River water allocated to Utah for use in a proposed 5-million-kilowatt, coal-fired, thermal powerplant adjacent to the Kaiparowits Plateau coalfields in south-central Kane County. An estimated $500 million was planned for constructing the facility. More than $96 million of this amount was planned for the underground coal mines and railroad. The Kaiparowits Plateau development should provide 2,400 jobs at the coal mines supplying the coal and 150 at the generating plant.

The U.S. Department of the Interior extended the contract with the University of Utah for "Project Western Coal" for 2 years. Funds amounting to $270,000 were provided for continued work on laboratory studies of the reaction characteristics of Rocky Mountain coals. The studies included the conversion of coal to liquid and gaseous fuels.

Natural Gas.—Eight counties produced a total of 71.6 billion cubic feet of natural gas, a 10-percent decrease. Leading counties and their outputs were Uintah 2.75 billion cubic feet, San Juan, 26.7 billion, and Grand 11.4 billion. The principal dry-gas field was San Arroyo, Grand County, with production of nearly 7.8 billion cubic feet of gas.

Royalties paid to State and Federal Government agencies on natural gas in the State totaled $924,821; of this amount, $351,056 was from production on Indian lands, $523,817 from Federal lands, and $49,948 from State lands.[5]

Exploratory drilling during the year resulted in three apparently small gas discoveries: Two of the wells had initial potentials of 3 million cubic feet of gas per day; and the other had a potential of 1 million cubic feet of gas per day.

Yearend estimates by the American Gas Association and the American Petroleum Institute gave Utah gas reserves of 1.4 trillion cubic feet, a decrease of 80.6 billion cubic feet.

Natural Gas Liquids.—Production of natural gas liquids declined 11 percent; output of natural gasoline was down 13 percent and that of liquefied petroleum gases decreased 10 percent. The El Paso Natural Gas Co. plant at Aneth, San Juan County, continued to be the major producer of natural gas liquids. The two plants in Uintah County (Chevron Oil Co., Western Division, and Warren Petroleum Corp.) put that county in second place, followed by Daggett County with the Clay Basin plant of Mountain Fuel Supply Co.

Petroleum.—Petroleum production for the State declined 11 percent even though production increased in the Uinta basin

[5] State of Utah, Oil & Gas Conservation Commission, 1965 Total Royalty Payments, 6 pp.

and in Garfield County. Most of the State decline resulted from lower production in the Greater Aneth area; this area produced 3.6 million barrels less than in the previous year.

Royalties paid to State and Federal government agencies on petroleum production was $9,002,816; of this amount, $5,102,411 was paid on production from Indian lands, $3,414,524 was from Federal lands, and $485,881 was from State lands.[6]

The leading oilfields in order of production were Greater Aneth (11.947 million barrels), Lisbon (3.951 million), Red Wash (3.655 million), Wonsits Valley (2.453 million), and Ismay (649,000).

Table 11.—Crude petroleum production, by counties

(Thousand 42-gallon barrels)

County	1964	1965	Principal fields in 1965 in order of production
Box Elder	[1]	[1]	Rozel Point.
Carbon	2	2	Peters Point.
Daggett	1	2	Clay Basin.
Duchesne	70	166	Monument Butte, Castle Peak, Undesignated.
Emery	24	25	Ferron.
Garfield	50	126	Upper Valley.
Grand	267	209	Long Canyon, Salt Wash.
San Juan	20,554	17,077	McElmo Creek, Aneth, Lisbon, Ratherford.
Uintah	7,607	7,691	Red Wash, Wonsits Valley.
Total	28,575	25,298	

[1] Less than ½ unit.

Source: Utah Oil & Gas Conservation Commission.

Table 12.—Drilling for petroleum in 1965, by counties

County	Oil	Gas	Dry	Total	Footage
Exploratory completions:					
Box Elder	1	--	--	1	177
Carbon	--	--	1	1	9,644
Duchesne	5	--	5	10	58,602
Emery	--	--	4	4	32,920
Garfield	--	--	3	3	16,939
Grand	--	1	5	6	26,610
San Juan	4	--	11	15	77,950
Uintah	3	2	11	16	86,170
Wasatch	--	--	1	1	5,300
Washington	--	--	1	1	1,160
Wayne	--	--	2	2	7,596
Total	13	3	44	60	323,068
Development completions:					
Daggett	1	2	--	3	17,759
Duchesne	7	--	1	8	49,616
Emery	1	3	2	6	12,815
Garfield	1	--	1	2	11,805
Grand	2	8	5	15	57,470
San Juan	6	--	9	15	95,082
Uintah	40	11	9	60	329,949
Total	58	24	27	109	574,496
Total all drilling	71	27	71	169	897,564

Source: Oil and Gas Journal.

Total drilling declined slightly from the 178 wells drilled in 1964. Development drilling increased nearly 20 percent because of the greater activity in Uintah County along the trend southwestward from the Red Wash field. Exploratory drilling was down 27 wells (31 percent). The wildcat success ratio, however, was 26.7 percent, compared with the national average of 13.5 percent.

Crude oil runs to stills at the five refineries totaled 33.2 million barrels, slightly more than in 1964. No major modification or new construction was added to the existing refineries.

A significant, new field discovery was the Phillips Petroleum Co. No. 1 River Junction Unit, sec 8, T 9 S, R 20 E, Uintah County. The discovery well on the 6,400-acre unit was completed in May, pumping 284 barrels of oil per day from the 4,337- to 4,346-foot interval in the Green River formation (Tertiary).

Another potentially important discovery

[6] Work cited in footnote 5.

Table 13.—Oil and gas discoveries in 1965

County and field	Well	Operator	Location			Producing formation	Gross producing interval (feet)	Total depth (feet)	Initial production		Date of completion	Remarks
			Section	Township	Range				Barrels of oil per day	Thousand cubic feet of gas per day		
Box Elder County:												
Rozel Point	No. 1 Rozel-State	Charles E. King	8	8 N	7 W	Tertiary	154–177	177	5	-----	Jan. 5	Pumped. New field.
Duchesne County:												
Wildcat	No. 1-A Caloil-Ute Tribal 11–18.	Chevron Oil Co	18	3 S	6 W	Green River	4,647–4,715	6,000	170	-----	Sept. 8	Do.
Do	No. 1 Nutters Canyon-Federal.	Gulf Oil Corp	10	6 S	5 W	do	3,340–3,810	5,870	30	-----	Sept. 18, 1964	Pumped. New field. Completion reported in 1965.
Do	No. 1 Allen-Federal.	Shamrock Oil & Gas Corp.	6	9 S	17 E	do	4,169–5,145	6,270	186	-----	Feb. 26	Pumped. New field.
Do	No. 8 Castle Peak Unit.	do	20	9 S	16 E	Wasatch	4,570–5,045	6,150	68	-----	Feb. 4	Old well.
Do	No. 1 Castle Draw	Pure Oil Co	10	9 S	17 E	Green River	4,792–5,432	6,034	190	-----	Sept. 18	Pumped. New field.
Do	No. 1-16 Shell-State.	International Oil & Gas Corp.	16	9 S	17 E	do	4,438–4,808	5,984	76	-----	Mar. 2	Do.
Grand County:												
Wildcat	No. 6 Lansdale-USA.	Alice Lansdale	10	21 S	23 E	Morrison	1,126–1,136	1,307	-----	44	Feb. 23	Shut-in.
San Juan County:												
Bluff	No. 8 Bluff Unit	Continental Oil Co. and Tenneco Oil Co.	29	39 S	23 E	Ismay	5,932–5,958	6,150	103	-----	June 1	Pumped. Extension-combined with Bluff field.
Do	No. 9 Bluff Unit	Continental Oil Co	30	39 S	23 E	Desert Creek	5,658–5,664	5,715	590	-----	Oct. 29	Flowed. New pay.
Anido Creek	No. 1 Navajo-111	Champlin Petroleum Co.	13	43 S	24 E	do	5,402–5,407	6,611	95	-----	May 2	Pumped. New pay. Old well work-over.

Utinah County:

Ashley Valley	No. 11 Ashley Valley.	Equity Oil Co	23	5	S	22	E	Entrada	2,028–2,035	2,075	4	-----	Mar. 22	Flowed. New pay.
Horseshoe Bend.	No. 3 Horseshoe Bend.	California Oil Co	27	6	S	21	E	Uinta	3,513–3,532	3,612	-----	3,130	Jan. 29	Do.
Gypsum Hills	No. 1 Gypsum Hills Unit.	Gulf Oil Corp	17	8	S	21	E	Green River	5,324–5,348	5,675	80	-----	Nov. 30, 1964	Pumped. New field. Completion reported in 1965; included in Red Wash Area.
Do	No. 2 Gypsum Hills Unit.	Gulf Oil Corp	8	8	S	21	E	Wasatch	5,385–5,495	5,852	12	-----	Aug. 11	Extension.
River Junction	No. 1 River Junction Unit.	Phillips Petroleum Co.	8	9	S	20	E	Green River	4,337–4,346	5,675	284	-----	May 4	Pumped. New field.
Wildcat	No. 5 Sweetwater Creek.	Skyline Oil Co	26	13	S	23	E	Wasatch	2,997–3,005	4,421	-----	1,187	July 26	Flowed. New field.

Source: State of Utah, Oil & Gas Conservation Commission. Yearly Well Completion Report, Wells Completed or Abandoned. January-December 1965. Petroleum Information Corp. 1965 Résumé, Oil and Gas Operations in the Rocky Mountain Region.

was the new pay horizon in the Bluff field. The Continental Oil Co. No. 9 Bluff Unit, sec 30, T 39 S, R 23 E, San Juan County, was completed in late October, flowing 590 barrels of oil per day from the Desert Creek formation (Pennsylvania) at 5,658 to 5,664 feet; original production in the field was from the Ismay formation (Pennsylvanian).

Probably the most important exploratory well in Utah, if not in the whole Rocky Mountain area, struck oil on the last day of the year. This well, the Phillips Petroleum Co. No. 1 Bridger Lake Fork Unit "A", sec 25, T 3 N, R 14 E, Summit County, is a few miles south of the Wyoming boundary on the extreme south flank of the Green River basin. The well flowed 1,900 barrels of oil per day on ⅛-inch choke from the Dakota formation (Cretaceous) below 15,500 feet; if successfully completed, the well would be the deepest oil source in Utah. In a relatively unexplored area of the State, the well generated much interest in that area and in the adjacent part of Wyoming.

NONMETALS

Barite.—Barite was not mined in Utah in 1965. The Yuba Minerals & Milling Co. plant in Salt Lake City ground crude barite for use in well drilling. Sources of the crude barite were the operations of D. A. Mining Co. and of Tom Norris, both in Nevada.

Cement.—Portland cement was produced by Ideal Cement Co. (major producer) at Devil's Slide in Morgan County and by Portland Cement Company of Utah at Salt Lake City, Salt Lake County. Ideal Cement Co. also produced a small quantity of masonry cement. Output of cement increased 3 percent in quantity and 4 percent in value. Bulk shipments of cement amounted to 89 percent of the total; most of the remainder was packaged. Ninety percent of the cement was shipped by truck; the remainder was shipped by rail. Principal consumers of cement were ready-mixed concrete companies (64 percent), highway contractors (12 percent), concrete product manufacturers (10 percent), building material dealers (9 percent), and others (5 percent).

Clays.—The output of halloysite, increasing 40 percent, was chiefly the cause for an overall increase in quantity and value for clays. The combined fire clay and halloysite output increased 18 percent in quantity and 35 percent in value, whereas other clays such as bentonite, fuller's earth, and miscellaneous other clays increased 17 percent in quantity and only 1 percent in value.

Clays were produced at 20 operations in 9 counties of the State. The largest use of clays was as a raw material for producing lightweight aggregate, followed closely by use as a raw material in manufacturing building bricks and as a catalyst in oil refining. Other uses of Utah clays were in refractories at foundries, as raw material in manufacturing vitrified sewer pipe, as a filler in fertilizers, and as an additive in muds for rotary-drilling operations.

Fluorspar.—The entire production of fluorspar came from the Spor Mountain area in Juab County. Production and value increased 39 percent. Fluorspar output from the three producers was sold for use at steel mills and iron foundries.

Gypsum.—Gypsum was produced entirely from open pit mines near Sigurd in Sevier County by Bestwall Gypsum Co. and United States Gypsum Co. Quantity and value of production decreased 13 percent. The gypsum was used in manufacturing wallboard, lath, plasters, and decorative materials.

Bestwall Gypsum Co. was merged with Georgia-Pacific Corp. in May. Bestwall continued operating the mine as a division of Georgia Pacific Corp., the surviving corporation.

Lime.—Output of quicklime and hydrated lime increased in quantity and value. At seven operations in five counties a total of 189,290 short tons of lime was produced; 82 percent was quicklime. Thirty-one percent of the total production was used by three producers in the State. All of this was quicklime used in sugar refining and copper-ore concentrating. Eighty-eight percent of the hydrated lime produced was used in the construction industry, chiefly in masonry work. The chief consumer of quicklime was the refractory industry.

Seventy-one percent of the lime produced was used in Utah. Shipments were made out of the State principally to California, Colorado, Idaho, Nevada, Oregon, Washington, and Canada.

Perlite.—The only production of crude perlite in Utah came from the North Pearl Queen quarry of Henry Shoo Co. in Beaver County.

Phosphate Rock.—Output of phosphate rock increased 39 percent in quantity and 37 percent in value. San Francisco Chemical Co. operated three mines, two near Randolph in Rich County and one north of Vernal in Uintah County. FMC Corp. operated the Jeffs mine in Rich County. Phosphate rock from the mines of San Francisco Chemical Co. in Rich County was processed at the company Leefe plant at Sage, Wyo. All phosphate rock mined was processed and sold for agricultural and industrial uses.

Hatch Co., a Woods Cross trucking firm, was awarded a 5-year contract to transport phosphorite concentrates from San Francisco Chemical Co. near Vernal to Phoston and Garfield. Special permits issued by the State Road Commission allowed gross loads of 122,000 pounds to be hauled.

Potash.—The production of potassium salts increased twofold in quantity and value. The start of production operations at the Cane Creek potash mine of TGS on January 13 and an increase in production by Bonneville Division, Kaiser Aluminum & Chemical Corp., at Wendover contributed to the large increase in production of potassium salts. TGS did not achieve the initial goal of 4,000 tons of ore per day. Long distances and grade factors negotiated by shuttle cars limited daily production to 2,500 tons. Mining techniques were shifted to the contour method, and enough mining faces were developed for production of 4,000 tons per day once additional equipment was installed to facilitate moving the ore from the mine face to the shaft.

In a joint venture, LCA and Salzdefurth, A.G., of Hanover, West Germany, covered the development and exploitation of LCA rights to potash and other salts in Great Salt Lake. According to LCA, scientists connected with the University of Utah estimated that Great Salt Lake contained approximately 150 million tons of potash and over 1 billion tons of other salts.

Pumice.—Production of pumice increased 50 percent. Melvin Bradshaw, the principal producer, mined pumice near Milford in Beaver County; Thompson Block Co. mined volcanic cinders at the Thompson mine near Cedar City in Iron County. The pumice produced was used as an aggregate in concrete.

Salt.—Solar evaporation of Great Salt Lake brine accounted for the bulk of the total quantity of salt produced in the State; rock salt from mines north of Redmond in Sanpete and Sevier Counties accounted for the rest. Principal uses of evaporated salt were in manufacturing chlorine and other chemicals; for use on highways; as livestock feed; for water softening; and by meat packers, tanners, and casing manufacturers. Most of the rock salt was used as livestock feed. Seventeen percent of the evaporated salt was used in Utah. Salt was shipped to 15 other States, principally Colorado, Montana, Oregon, and Washington, and to Canada.

Sand and Gravel.—Sand and gravel was produced from 153 pits in 26 of the 29 counties. In order of output, Salt Lake, Box Elder, Summit, Cache, Weber, and Beaver Counties were the leading producers, comprising 73 percent of the State total. The largest use of sand and gravel

Table 14.—Sand and gravel production in 1965, by counties

(Thousand short tons and thousand dollars)

County	Quantity	Value
Beaver	514	$476
Box Elder	807	708
Cache	652	764
Carbon	33	31
Daggett	37	39
Davis	441	430
Emery	W	W
Garfield	W	W
Grand	W	W
Iron	396	371
Kane	47	23
Millard	63	51
Morgan	115	134
Rich	57	70
Salt Lake	4,139	4,400
San Juan	53	53
Sanpete	79	79
Sevier	85	97
Summit	725	749
Tooele	W	W
Uintah	467	461
Utah	377	460
Wasatch	120	131
Washington	78	82
Wayne	22	27
Weber	528	612
Undistributed	197	216
Total	10,032	10,464

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

Table 15.—Sand and gravel sold or used by producers, by classes of operations and uses
(Thousand short tons and thousand dollars)

Class of operation and use	1964		1965	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Construction:				
Building	1,265	$1,428	1,101	$1,234
Paving	488	529	407	414
Fill	91	49	68	43
Other	15	23	1	2
Industrial:				
Molding	4	12	3	7
Blast	(1)	1	1	4
Fire or furnace	(2)	(2)	(2)	(2)
Engine	6	14	7	18
Other	[2] 25	[2] 43	[2] 25	[2] 36
Total	1,894	2,099	1,613	1,758
Gravel:				
Construction:				
Building	1,574	1,859	1,205	1,275
Paving	1,637	1,740	2,304	2,661
Railroad ballast	23	7	2	1
Fill	378	146	84	68
Other	16	16	------	------
Miscellaneous	377	471	375	469
Total	4,005	4,239	3,970	4,474
Total sand and gravel	5,899	6,338	5,583	6,232
Government-and-contractor operations:				
Sand:				
Building	9	10	3	3
Paving	191	142	215	233
Fill	84	42	------	------
Total	284	194	218	236
Gravel:				
Building	67	57	459	318
Paving	3,792	3,724	3,485	3,489
Fill	176	92	287	189
Total	4,035	3,873	4,231	3,996
Total sand and gravel	4,319	4,067	4,449	4,232
All operations:				
Sand	2,178	2,293	1,831	1,994
Gravel	8,040	8,112	8,201	8,470
Total	10,218	10,405	10,032	10,464

[1] Less than ½ unit.
[2] Fire or furnace sand combined with "Other (industrial)" sand to avoid disclosing individual company confidential data.

was in the paving business: 5.8 million tons of gravel and 622,000 tons of sand were consumed. Building construction consumed 2.8 million tons of sand and gravel. Additional uses were for fill, railroad ballast, and industrial applications.

Government - and - contractor operations (Federal, State, county, and municipal) produced 44 percent of the sand and gravel. More gravel (82 percent) than sand was produced; 94 percent of the sand and gravel produced was washed, sized, or otherwise processed. Virtually all of the commercially produced sand and gravel was transported by truck.

Stone.—Although stone was produced from seven more operations in 1965 than in 1964, output decreased about one-third. Utah County was the leading producer of stone, followed in order of output by Morgan, Tooele, and Cache Counties. Commercial operations accounted for 83 percent of the tonnage and 84 percent of the value of

Table 16.—Stone production in 1965, by counties

County	Short tons	Value
Beaver	148	$296
Box Elder	2,463	99,195
Cache	220,443	585,064
Daggett	20,000	40,000
Davis	W	W
Emery	41,900	83,800
Iron	375	3,976
Juab	43,411	138,166
Morgan	W	W
Salt Lake	52,293	64,749
Sanpete	130	10,250
Summit	9,968	19,936
Tooele	278,789	935,336
Uintah	67,930	106,060
Utah	W	W
Wasatch	3,083	19,833
Washington	9	2,015
Weber	64,461	128,922
Undistributed	1,352,245	2,314,633
Total	2,157,648	4,552,231

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

stone produced. Crushed limestone was the principal stone produced (86 percent of the total); 201,000 tons of crushed sandstone and 100,000 tons of crushed miscellaneous stones were produced.

Crushed and broken limestone, produced commercially in six counties, was used in agriculture; as exposed aggregate, flux, plaster sand, poultry grit, riprap, and refractory material; and for uranium processing. It was also used as raw material in manufacturing cement, in controlling coal dust in coal mines, and in road construction.

Dimension limestone was used as building stone; crushed marble was used in cast-stone products and terrazzo.

Crushed sandstone was used as an aggregate in concrete and cast-stone products and as road-building material, refractory stone, and roofing granules.

Sulfur Ore.—Sulfur was recovered from sulfur ore mined from the open pit operation of Sulphur Dale Chemical Co. near Sulphurdale in Beaver County.

Sulfuric acid was manufactured at the Garfield plant of Kennecott Copper Corp. from the sulfur dioxide produced during the smelting of metal sulfides. The sulfur dioxide produced was converted to SO_3 and then to sulfuric acid.

Vermiculite.—The Salt Lake City plant of Vermiculite Intermountain, Inc., produced exfoliated vermiculite from ore shipped from Montana. The exfoliated vermiculite was used as an aggregate and in insulation and acoustical material.

Table 17.—Stone sold or used by producers, by uses

Use	1964		1965	
	Quantity	Value	Quantity	Value
Dimension stone:				
Rough construction, short tons	168	$2,250	W	W
Rubble, do	28	125	W	W
Rough architectural, cubic feet	22,642	187,375	W	W
Sawed stone, do	5,346	34,482	16,771	$73,230
Dressed stone, do	3,526	5,800	1,550	5,550
Flagging, do	6,474	12,425	12,931	26,445
Total (approximate), short tons	3,200	242,457	3,400	131,422
Crushed and broken stone:				
Riprap, do	1,093,623	2,730,943	134,235	268,870
Metallurgical, do	810,592	1,244,774	930,378	1,673,066
Concrete and roadstone, do	165,240	312,052	260,753	512,786
Lime, do	246,765	657,713	258,272	729,140
Other, do	[1] 785,566	[1] 1,742,064	[2] 570,626	[2] 1,236,947
Total, do	3,101,786	6,687,546	2,154,264	4,420,809
Total stone (approximate), do	3,105,000	6,930,003	2,157,700	4,552,231

W Withheld to avoid disclosing individual company confidential data; included in "Totals."
[1] Includes stone used in asphalt filler, cast-stone products, cement, coal dust, concrete aggregates, filter, foundry, landscaping, poultry grit, railroad ballast, roofing granules, and terrazzo.
[2] Includes stone used in agriculture, cast-stone products, cement, coal dust, exposed aggregates, foundry, plaster sand, poultry grit, and terrazzo.

Table 18.—Stone sold or used by producers, by kinds

Year	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
	Basalt and related rocks (traprock)		Granite		Limestone		Marble	
1961	-------	-------	-------	-------	1,621,128	$2,815,852	639	$3,703
1962	-------	-------	159,724	$336,207	[1] 1,608,466	[1] 2,862,366	W	W
1963	-------	-------	15,704	253,225	[1] 1,716,450	[1] 3,219,167	W	W
1964	-------	-------	800	160,000	[1] 2,003,925	[1] 3,860,409	626	17,255
1965	200	$800	W	W	[1] 1,852,365	[1] 3,733,580	461	11,145
	Sandstone		Slate		Other stone		Total	
1961	126,470	329,405	-------	-------	59,681	69,774	1,807,918	3,218,734
1962	335,539	624,927	-------	-------	14,639	41,028	2,118,368	3,864,528
1963	611,628	524,713	-------	-------	2,106	43,200	2,345,888	4,040,305
1964	967,781	2,549,006	-------	-------	131,899	343,333	3,105,031	6,930,003
1965	202,141	499,364	1,660	82,360	100,821	224,982	2,157,648	4,552,231

W Withheld to aovid disclosing individual company confidential data; included with "Other stone."
[1] Excludes dimension limestone; included with "Other stone."

REVIEW BY COUNTIES

Carbon, Iron, Salt Lake, San Juan, and Uintah Counties each had mineral production valued at more than $10 million and collectively produced 87 percent of the total mineral value in the State. Salt Lake County alone produced 56 percent of the total value, and also listed the largest variety of minerals and mineral products, 12 in all.

Beaver.—Mineral production value decreased 14 percent as a result of smaller outputs of gold, silver, copper, iron, perlite, and uranium. Sand and gravel output value increased twelvefold over that of 1964, chiefly because of the use of sand and gravel in road construction near Milford and Minersville. Copper output continued to lead in mineral production value; the decrease in the output of this commodity, however, was significant in the overall decrease in mineral output value. The Bawana mine of American Mining Co., west of Milford, again was the major source of gold, silver, and copper. Most of the lead and zinc and some gold, silver, and copper were produced from the Horn Silver mine by Bellevue Mines and Horn Silver Mines, Inc. No iron ore was produced. All of the perlite and most of the pumice mined in the State was from this county. Production of uranium ore was from two operations, one less than in 1964. Stone and sulfur ore were produced at one operation each, whereas no production of either was recorded in 1964.

Box Elder.—A 90-percent decrease in the value of stone produced and a decrease of 44 cents per short ton in the weighted average price for sand and gravel resulted in an overall decrease in value of mineral production in the county. All mineral production came from nonmetals. No clay production was recorded in 1965; increases were recorded for lime and salt. Salt was used for ice manufacturing, in cold storage, as a water softener, and on highways. Lime produced by Utah-Idaho Sugar Co. was used entirely for processing sugar beets.

The county had its first oil production when the Charles E. King No. 1 Rozel-State well, sec 8, T 8 N, R 7 W, was completed in January, pumping 5 barrels per day of 9° API oil from a depth of 149 to 177 feet; total production was 391 barrels. The well was on the north end of Great Salt Lake. During the year, four more wells were drilled.

Cache.—Mineral production value was 34 percent less than in 1964. Sand and gravel and stone output comprised the bulk of the total mineral production value in the county. Sand and gravel was used mostly in building and road construction. The Amalgamated Sugar Co. increased by 82 percent its production of lime for use in sugar refining.

Carbon.—Carbon County, with a total output value of $26.5 million—98 percent derived from the production of bituminous

Table 19.—Value of mineral production in Utah, by counties

County	1964	1965	Minerals produced in 1965 in order of value
Beaver	$2,421,769	$2,073,217	Copper, sand and gravel, silver, pumice, lead, uranium ore, gold, perlite, zinc, sulfur ore, stone.
Box Elder	1,938,430	W	Sand and gravel, lime, salt, stone.
Cache	W	W	Sand and gravel, stone, lime.
Carbon	r 29,252,619	26,380,296	Coal, natural gas, sand and gravel, carbon dioxide, petroleum.
Daggett	r 466,500	361,000	Natural gas, stone, sand and gravel, natural gasoline, petroleum.
Davis	704,715	W	Sand and gravel, stone.
Duchesne	W	W	Petroleum, gilsonite, natural gas.
Emery	r 5,648,399	6,055,845	Coal, uranium ore, stone, natural gas, petroleum, vanadium, sand and gravel.
Garfield	W	420,902	Petroleum, uranium ore, vanadium, sand and gravel.
Grand	r 2,950,023	4,742,534	Potassium salts, natural gas, uranium ore, petroleum, vanadium, sand and gravel.
Iron	14,900,549	14,775,734	Iron ore, sand and gravel, coal, pumice, stone, silver, copper, gold.
Juab	1,135,630	1,512,491	Clays, stone, fluorspar, uranium ore, silver, gold, copper, zinc, lead.
Kane	51,047	32,737	Sand and gravel, coal.
Millard	345,178	53,644	Sand and gravel, zinc, lead, silver.
Morgan	W	W	Cement, stone, sand and gravel.
Piute	506,341	558,776	Zinc, lead, uranium ore, silver, gold, clays, copper.
Rich	W	W	Phosphate rock, sand and gravel.
Salt Lake	177,714,520	242,641,518	Copper, molybdenum, gold, lead, silver, sand and gravel, zinc, cement, salt, lime, stone, clays.
San Juan	r 87,530,925	59,497,254	Petroleum, uranium ore, natural gas, LP gases, vanadium, natural gasoline, copper, sand and gravel, silver.
Sanpete	130,400	173,952	Sand and gravel, salt, natural gas, stone, clays, zinc, lead, silver.
Sevier	1,222,888	1,287,799	Gypsum, coal, clays, sand and gravel, salt.
Summit	3,890,340	5,476,719	Zinc, lead, silver, sand and gravel, copper, clays, gold, coal, stone.
Tooele	8,192,701	8,467,887	Lime, potassium salts, salt, stone, lead, zinc, silver, sand and gravel, copper, clays, gold.
Uintah	r 29,967,141	30,742,751	Petroleum, gilsonite, natural gas, phosphate rock, sand and gravel, stone, LP gases, natural gasoline.
Utah	2,775,745	3,953,085	Stone, lead, sand and gravel, silver, zinc, lime, clays, copper, gold.
Wasatch	4,911,907	5,295,472	Gold, lead, zinc, silver, copper, sand and gravel, stone.
Washington	644,387	84,015	Sand and gravel, stone.
Wayne	2,000	27,000	Sand and gravel.
Weber	299,544	W	Sand and gravel, stone, clays.
Undistributed [1]	r 13,825,808	16,763,737	
Total	391,430,000	431,378,000	

r Revised. W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W.

coal—continued to rank fourth in mineral production value. The value of coal production decreased 7 percent despite an increase in production of more than 26,000 short tons. The county accounted for 81 percent of the State total coal output value. Coal was produced from 18 underground mines (2 less than in 1964); Kaiser Steel Corp. was the largest producer, followed by USS, Independent Coal & Coke Co., and Spring Canyon Coal Co. Coal was cleaned at the Carbon Fuel Co. mine, the Castle Gate washery, the Kaiser Steel preparation plant, the Knight Ideal plant, the Kingmine plant, and the Wellington cleaning plant. Most of the coal was shipped by The Denver & Rio Grande Western Railroad Co.

Production of crude oil was the same as in 1964; natural gas output was valued at about $421,000. Only one well, an unsuccessful wildcat, was drilled in the county. No development work was done by Pacific Natural Gas Exploration Co. following the 1964 gas discovery, the No. 1 North Springs-Federal well.

Daggett.—Although the value of stone production contributed $40,000, the total mineral value of the county decreased 5 percent because of a decrease in sand and gravel output value. Crude oil production and value at the Clay Basin field increased during the year. Natural gas output declined slightly, as did production of natural gasoline. Three successful development wells were drilled at Clay Basin.

Davis.—Sand and gravel production, the largest mineral output of the county, de-

creased 53 percent in quantity and 38 percent in value. Paving and fill uses consumed 68 percent of the sand and gravel produced; the rest was used in building construction. The output of stone, the only other mineral commodity produced, was greater than that of 1964.

Duchesne.—Value of mineral production increased 47 percent, chiefly because of a 100-percent increase in petroleum output. The county was ranked fourth in crude oil production with 166,442 barrels valued at $435,000. Natural gas production increased because of the wet gas accompanying the increased oil production.

Exploratory activity along the trend southwestward from Red Wash field remained the same as in 1964—10 wells—but there were 5 successful wells, compared with 1 in 1964. Eight development wells were drilled; seven were successful.

Gilsonite, produced from the underground Castle Peak mine of Ziegler Chemical & Mineral Corp., accounted for 45 percent of the mineral value in the county.

Emery.—Mineral output value continued to increase (8 percent), largely because of an increase in bituminous coal production of 30 percent in quantity and 14 percent in value. Coal produced from seven underground mines accounted for 88 percent of the county mineral production value. Principal producers in order of output value were United States Fuel Co. (a subsidiary of USSR&M Co.), USS, and Heiner Coal Co. Production of natural gas, petroleum, sand and gravel, and stone also increased. Quantity and value of uranium and vanadium production decreased.

The single oil well completion in the Ferron unit, pumping 23 barrels of oil and 23 barrels of water per day, was the second Kaibab (Permian) well in the field.

Garfield.—Value of mineral production increased considerably because of increased petroleum production. Tenneco Oil Co. completed the third producer in the Upper Valley unit; this well, No. 4 Upper Valley Unit, was completed for 210 barrels of oil per day. Production from the field more than doubled, to an annual output of 126,000 barrels. Three unsuccessful exploratory wells were drilled.

Sand and gravel production decreased. The quantity of uranium ore produced increased slightly, as did that of vanadium; the value of uranium ore production, however, decreased 21 percent.

Grand.—The mine and mill operations at the Cane Creek potash property of TGS chiefly accounted for a 75-percent increase in overall mineral output value. Production and value of potassium salts were ranked first in the county.

Increases in the quantity and value of uranium ore and vanadium production resulted from processing additional ores formerly treated by Vitro Chemical Co. in Salt Lake City. Uranium ore production from 27 operations (3 less than in 1964) increased 36 percent in quantity and 78 percent in value. The county was ranked third in uranium production in the State.

Sand and gravel production declined considerably.

Although petroleum and natural gas production declined, the county was ranked third in the State for both commodities. Natural gas, mainly from the San Arroyo field, was the second most valuable mineral commodity at $1.4 million. Ten successful development wells and one successful wildcat well were drilled.

Iron.—Iron ore accounted for 96 percent of the mineral value. Coal and stone production decreased, whereas sand and gravel production increased. Additional increases in value came from the production of gold, silver, copper, and pumice; none of these commodities was produced in 1964.

Iron ore from five of the six operations was in the form of magnetite; the ore from the Desert Mound mine of USS (the principal producer) was hematite mixed with minor amounts of magnetite. All production of iron ore, mostly direct-shipping ore, came from open pit mines.

Coal produced from three underground mines was shipped by truck.

All of the sand and gravel produced from five operations was used in paving. Two operators produced dimension sandstone used as building stone. Small amounts of basalt used as riprap, limestone, used as exposed aggregate also were produced.

Juab.—An increase in quantity and value of production of clay (halloysite) by Filtrol Corp. accounted for an overall 33-percent increase in value of mineral output. In terms of value clay continued as the leading commodity in the county. Output

value of fluorspar and uranium increased; output of gold, silver, copper, and stone decreased. Sand and gravel was not produced in 1965. Small amounts of lead and zinc, not produced in 1964, were produced in 1965.

Three companies, Chesley & Black, George Spor & Sons, and Willden Brothers, produced all of the fluorspar for the county and State. Most of the silver and all of the gold and copper came from the Godiva mine, operated by Stanley Ryan in the Tintic district. Uranium ore was produced from the Yellow Chief underground mine of Black Rock Mining Co. in the Spor Mountain district. Crushed limestone from two operations was used for flux and in manufacturing lime. One operation produced crushed sandstone, used as a refractory.

Morgan.—Substantial increases in the yield of cement and sand and gravel, more than offsetting a decrease in stone output, produced a 3-percent net increase in the value of minerals. Ideal Cement Co. at Devil's Slide increased cement production, mostly portland, by more than 85,000 barrels. The company also produced crushed limestone for use in manufacturing the cement. Miscellaneous stone was used by contractors for the State highway department as riprap. More gravel than sand was produced and was used principally for paving.

Piute.—Value of mineral output gained 10 percent. Increased production of gold, silver, lead, and zinc at the Deer Trail mine of Deer Trail Mines & Arundel Mining Co. accounted for the overall increase in mineral output value. Uranium ore production from four operations of VCA decreased 43 percent in quantity and 64 percent in value. Clay produced from the White Horse mine of Empico Alunite Co. was used in fertilizers.

Rich.—Phosphate rock was produced from the Cherokee and Benjamin mines by San Francisco Chemical Co. and from the Jeffs mine by FMC Corp. Sand and gravel production, used for highway paving, increased thirteenfold. The principal supplier was LeGrand Johnson Construction Co., Inc.

Salt Lake.—The county, ranked first in value of mineral production, reported an increase in value of 37 percent. Copper production amounted to 74 percent of the value in the county, and represented an increase of 31 percent in quantity and 43 percent in value; the product was significant in the overall increase in value of mineral production. The recovery of gold, silver, and molybdenum, associated with the copper ores in Bingham Canyon, also increased substantially in quantity and value. The quantity of selenium also recovered as a byproduct increased substantially. Copper was also produced from eight other operations, principally the U.S. and Lark mine of USSR&M Co. Lead and zinc production decreased in 1965. The leading producer of lead and zinc was USSR&M Co. from the U.S. and Lark mine. Lead and zinc were also recovered from the Murray slag dump by IS&R, the Cardiff and Wasatch mines by Cardiff Industries, Inc., the Lavinia mine by Page Blakemore, and the Butterfield mine by USSR&M Co. In addition to lead and zinc, each of these operations produced small amounts of gold, silver, and copper.

Construction of 26 precipitation cones and other facilities in the Utah Copper new precipitate plant were started during the year. Each cone was to handle 2,000 gallons per minute of solution, containing 15 pounds of copper per 1,000 gallons of solution, obtained from leaching low-grade, copper-bearing dumps. Solution flow rates were to be increased from 8,000–10,000 gallons per minute to 35,000 gallons per minute; daily production of 150,000 pounds of copper precipitate was to be increased to 400,000 pounds.

Output of lime and salt increased in quantity and value. Decreases in quantity and value of production were reported for cement, clays, sand and gravel, and stone. Despite a 9-percent decrease in the value of output, sand and gravel, from 36 operations, continued to be one of the leading nonmetal commodities in the county. Output of commercially produced sand and gravel, 73 percent of the total, was used principally for building construction (46 percent), paving (39 percent), and fill, railroad ballast, and other miscellaneous uses (15 percent). Government-and-contractor production was used in highway construction, 89 percent for paving and the rest as fill. Portland cement production by the Salt Lake City plant of Portland Cement Company of Utah declined 2 percent. Crushed limestone produced by Utah Copper was used as a flux. A small quantity of granite was quarried

by Wilford H. Hansen Stone Quarries, Inc., for use as architectural building stone; Aggregate Supply, Inc., produced crushed sandstone for use as aggregate in manufacturing cast-stone products. Contractors for the State highway department produced a small amount of limestone for riprap. Utah Copper produced quicklime for use in copper ore concentrating; Utah-Idaho Sugar Co. manufactured quicklime for use in sugar refining. Salt produced by Morton Salt Co. at Saltair increased 8 percent in quantity and 6 percent in value.

San Juan.—Decreases in value of output of all commodities, except vanadium, which increased 17 percent, resulted in an overall $27 million decrease. Value of output of uranium decreased 69 percent ($17.2 million) because of the reduction in output caused by the stretchout program.

The number of operations that produced uranium ore decreased from 118 in 1964 to 97 in 1965. A small tonnage of copper was produced from oxide ores at the Alpha Lucille mine of Micro Copper Corp. in the La Sal mining district in Lisbon Valley. No stone was produced in 1965. Sand and gravel produced by crews of the county and State highway departments was used in paving.

The county was ranked first in petroleum production and second in natural gas. Petroleum production declined 17 percent; natural gas output dropped 16 percent. This decline in production was largely attributed to the steady decline in exploratory drilling since 1961. Although exploratory drilling in the county was 35 percent below that of 1964, the success ratio was considerably better—27 percent compared with 9 percent.

Sanpete.—Value of mineral production increased 36 percent. Production of sand and gravel and salt increased; clay production decreased. Three commodities, stone, zinc, and natural gas, produced in 1965 but not in 1964, added to the overall increase of mineral value. Rock salt was produced by Albert Poulson Salt Co. and Redmond Clay & Salt Co.; the latter company also produced bentonite for reservoir lining. Azome Utah Mining Co. mined miscellaneous clay for use in fertilizers. Sand and gravel produced by Hales Sand & Gravel and crews of the county highway department was used principally for paving.

In July, the county had its first natural gas production since 1961: The Joes Valley field, which had been shut in, yielded 83 million cubic feet of gas during the remainder of the year.

Sevier.—Total value of mineral output increased 5 percent, despite a 13-percent decrease in value of production of gypsum mined by Bestwall Gypsum and United States Gypsum. Coal production, mined underground, increased in quantity and in value.

Production of clays increased 82 percent. Western Clay & Metals Co. mined bentonite from the Redmond mine for use as a refractory in foundries, in filters, and in rotary-drilling muds. The company also mined fuller's earth from the Aurora mine for use in filtering mineral oils and for export. Miscellaneous clays, used in manufacturing building bricks, were mined by International Pipe and Ceramics Corp. (Interpace) and Interstate Brick Co. Increased sand and gravel production was from two operations of Hales Sand & Gravel and from one operation each of Herring Sand & Gravel Co., the State highway department, and the county highway department. Most of the sand and gravel was used in paving and building construction. No stone was produced in 1965.

Summit.—An increase in value of output in seven of the nine mineral commodities in the county effected an overall 41-percent increase. Metals, again the chief source of value, comprised 83 percent of the total. Sand and gravel had the largest individual gain in value; production increased 722,000 short tons. The leaders among the metals in value of production were zinc and lead, followed by silver, copper, and gold. The United Park City mines of United Park City Mines Co. (the major producer in the county) produced each of the metal commodities. The second largest output of gold, silver, and copper was obtained from the Ontario dump by McFarland & Hullinger. Keystone Mining Co. (in a joint venture with United Park City Mines Co.) produced from the Keystone mine the second largest amount of zinc and lead; gold, silver, and copper also were produced.

Nonmetals increased in quantity and value of production. The large increase in sand and gravel was due to the increased use for paving material in the construction of the Interstate 80 highway. Principal

operators were Morrison Knudsen Co., Inc., and contractors for the State highway department. The Utelite Corp. near Peoa produced most of the shale in the county for use as a raw material in manufacturing lightweight aggregates. Coal was mined at the underground Chappell mine of Chappell Coal Co.

This county was the site of the very significant deep Dakota oil discovery by Phillips Petroleum Co.

Tooele.—Increases in the production value of gold, lead, zinc, lime, and potassium salts—not entirely offset by decreases in silver, copper, clays, salt, sand and gravel, and stone—resulted in a 3-percent increase in total value of mineral production. The major portion of the value of the five metals produced came from the underground Ophir mine of USSR&M Co. (McFarland & Hullinger, lessee). IS&R recovered appreciable quantities of copper, lead, and zinc from the Tooele cold slag dump. The company also recovered all five metals from the IS&R mill cleanup.

Lime, continuing as the major mineral commodity, increased 11 percent in value. It was produced by Utah Marblehead Lime Co. for use as refractory lime and by U.S. Lime Division, The Flintkote Co., for use in construction, chemical, and other industries. Potassium salts, ranked second in production value, were produced entirely by Bonneville Division at Wendover. Solar evaporated salt was produced by Hardy Salt Co., Leslie Salt Co. (purchased by Hardy Salt Co. in October), Solar Salt Co., and Utah Salt Co.

Limestone, marble, and sandstone were produced. The principal use for the limestone was as a refractory (dolomite). Some marble was used in cast-stone products and for terrazzo; sandstone was used for caststone aggregate.

Uintah.—The county was ranked first in natural gas and second in crude oil production. Natural gas production, valued at $3.4 million, was 38 percent of the value of the State output. Production of crude petroleum, up slightly, was valued at $20.1 million. Overall drilling, with the completion of 20 development wells, increased 36 percent. Although the number of exploratory wells was the same as in 1964, three oil and two gas wells were discovered, compared with five oil and one gas well in 1964. One of the oil discoveries appeared very promising: Phillips Petroleum Co. No. 1 River Junction Unit well was completed, pumping 284 barrels of oil per day from the Green River formation (Tertiary).

Value of production of phosphate rock increased 48 percent. Increased mining and expansion of plant facilities by San Francisco Chemical Co. near Vernal stimulated an increase in production. Production of gilsonite decreased 14 percent in quantity and 13 percent in value. Sand and gravel was produced chiefly by contractors and crews for the State highway department and by crews of the county highway department for use in paving. A contractor used sandstone as riprap and road metal for the National Park Service, and miscellaneous other stones as riprap for the Federal Bureau of Public Roads.

Utah.—Output of stone constituted the largest percentage of the mineral production value. The 42-percent overall increase in value, however, was primarily the result of increased production of lead, zinc, and associated gold and silver from the Burgin Shaft mine of Kennecott Copper Corp. Value of lime production increased 42 percent. Output of copper, clays, and sand and gravel decreased in quantity and value.

Most of the stone (crushed limestone) was produced by USS for use as a flux in manufacturing steel. The company also produced crushed limestone for use in concrete and at foundries. Crushed limestone produced by Lakeside Lime & Stone Co. was used for coal-dust control and in manufacturing lime. Limestone was also produced for the State highway department. Sand and gravel from 11 operations was used chiefly for building construction.

Kennecott Copper Corp. produced lead-zinc and lead ores from the 1,050-foot level of Burgin Shaft mine. Some tonnage was obtained from development work on the 1,200-foot level. The main ore zone consisted of mixtures of sulfides and oxides. The main haulage crosscut extended 550 feet from the Burgin No. 2 production shaft and was to be extended another 50 feet. The water table was lowered by pumping below the upper level of the ore body. Approximately 3,000 gallons per minute were pumped by stainless steel pumps through polyvinyl chloride-lined pipes because the water was a scalding 140° F and contained

abundant iron and soluble sulfates which made it unusually corrosive. Underground rock temperatures were approximately 130° F which created a ventilation problem in working places. Major ore production was shipped to the Kellogg, Idaho, mill and smelter of The Bunker Hill Co.

Lime was produced by Lakeside Lime & Stone Co. for agricultural and chemical and other industrial uses. Clay, from six operations, was used principally in manufacturing building brick.

Wasatch.—Value of mineral production in the county (metals comprised 97 percent) increased 8 percent. The largest production of gold, silver, copper, lead, and zinc came from the Mayflower mine of Hecla Mining Co. The only other metals production came from the United Park City mines of United Park City Mines Co.

Sand and gravel produced from three operations was used for paving. Miscellaneous stone was produced by a contractor for the Federal Bureau of Public Roads for use as riprap and roadstone.

Washington.—Value of mineral production declined 87 percent. Silver, copper, and zinc produced in 1964, were not produced in 1965. Sand and gravel and stone output decreased 88 and 95 percent in quantity, respectively. Sand and gravel was used in paving and building construction.

Weber.—Value of stone production increased ninefold; the value of sand and gravel production doubled. Sand and gravel from six operations was used principally in paving; 155,000 tons was used in building construction. Crushed and broken limestone and sandstone were produced by contractors for the Federal Bureau of Reclamation for use as riprap and roadstone, and miscellaneous other stones by contractors for the State department of highways for use as riprap. Clay was produced by Interpace for use in manufacturing building bricks.

The Mineral Industry of Vermont

By H. F. York [1]

The value of the minerals produced in Vermont reached a record high of $27.4 million in 1965. Stone accounted for 79 percent of the total value. Marble and granite, cut for monuments and architectural work, were the leading kinds of stone in value. Crushed limestone, crushed miscellaneous stone, and dimension slate were also important stone commodities. Other minerals produced in order of value were asbestos, sand and gravel, talc, lime, clay, peat, and gem stones. All mineral commodities increased in the value of output, except peat.

[1] Geologist, Bureau of Mines, Pittsburgh, Pa.

Table 1.—Mineral production in Vermont [1]

Mineral	1964		1965	
	Short tons	Value (thousands)	Short tons	Value (thousands)
Peat	286	$4	780	$3
Sand and gravel	1,764,000	1,494	2,084,000	1,670
Stone	2,069,704	20,652	2,591,178	21,564
Value of items that cannot be disclosed: Asbestos, clays, gem stones, lime, and talc	XX	3,977	XX	4,155
Total	XX	26,127	XX	27,392

XX Not applicable.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Value of mineral production in constant 1957–59 dollars
(Thousands)

Year	Value	Year	Value
1956	$22,069	1961	24,096
1957	22,065	1962	24,917
1958	21,583	1963	24,341
1959	22,886	1964	r 26,064
1960	22,656	1965	27,303

r Revised.

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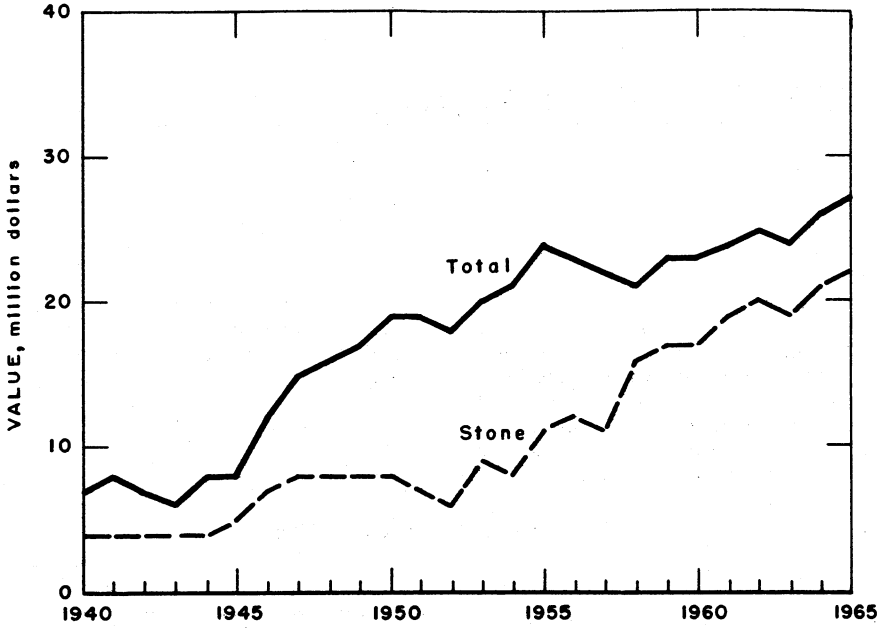

Figure 1.—Value of stone and total value of mineral production in Vermont.

Table 3.—Employment and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1964:								
Nonmetal and peat	308	273	84	678	------	17	25.06	228
Sand and gravel	205	185	38	312	1	3	12.81	19,475
Stone	1,962	260	510	4,127	1	154	37.56	2,411
Total	2,475	255	632	5,117	2	174	34.40	3,164
1965: p								
Nonmetal and peat	303	281	85	684	------	17	24.85	9,273
Sand and gravel	175	188	33	268	------	3	11.19	933
Stone	2,210	246	544	4,391	1	137	31.43	2,687
Total	2,688	246	662	5,343	1	157	29.57	3,442

p Preliminary.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Asbestos. Compared with 1964, the 1965 production of asbestos declined 6 percent in tonnage, but increased 4 percent in value because of increased sales of higher quality material. Twenty-four grades of asbestos were produced. The sales price per ton ranged from $21.00 to $370.26 compared with a range of $30.75 to $376.08 in 1964. However, average weighted price per short ton in 1965 was $89.72, compared with $81.60 in 1964 and $77.32 in 1963.

Clays.—The value of clay production

was 16 percent greater in 1965 than it was in 1964, and reached a record high for the State. The tonnage output of clays increased 3 percent. Kaolin was produced in Addison County for use in floor and wall tile, refractories, and for filler purposes. Some kaolin was exported. Clay for brickmaking was produced in Chittenden County.

Gem Stones.—Specimens of jasper, graphite, talc, magnetite, pyrite, and other minerals were collected at various sites throughout the State.

Lime.—The production of lime was unchanged from 1964. Quicklime for chemical uses was produced in Chittenden County and accounted for about three-fourths of the total lime output. Hydrated lime for construction and chemical uses was produced in Addison County.

Mica, Reconstituted.—The Samica Corp. (Subsidiary of Minnesota Mining & Manufacturing Co.) fabricated reconstituted mica from specially delaminated mica scrap, using a papermaking technique. This manufactured sheet material continued to supplant built-up mica for certain insulating applications. The plant was at Rutland.

Peat.—Two operators produced peat in Windsor County. Most of the production was of the reed-sedge type and was sold both packaged and in bulk for the purpose of general soil improvement. Humus peat was likewise sold in package and bulk for general soil improvement and in bulk for potting soil. In Chittenden County, the Kleen Moss Co., Inc., prepared to produce peat in 1964 but reported no production in 1965.

Sand and Gravel.—The value of the production of sand and gravel was 12 percent more than that of 1964 and at $1.67 million, was the highest on record. Total production of sand and gravel was 2.1 million tons and sold for an average price of $0.80 per ton, down $0.05 per ton from 1964. Government-and-contractor production was 0.7 million tons, 20 percent greater than in 1964 because of an increased demand for highway construction. The average price per short ton ranged from $0.35 for sand and gravel for fill purposes to $1.37 for gravel for building construction. Forty-five percent of the total output was processed by washing and screening. The average price per ton of processed material was $1.38; unprocessed sand and gravel sold for an average price of $0.32 per ton. Bennington County led in production.

Fifty-seven percent of the sand output was used for paving, 20 percent for building, 11 percent for fill, and the remainder for other purposes, including ice control. Seventy-five percent of the gravel was used for paving, 18 percent for building, 6 percent for fill, and the balance was used for miscellaneous uses.

Table 4.—Sand and gravel production by Government-and-contractor operations, by counties

(Thousand short tons)

County	1964	1965
Addison	224	44
Bennington	--	4
Caledonia	--	--
Chittenden	1	95
Essex	7	--
Franklin	5	166
Grand Isle	--	--
Lamoille	51	--
Orange	--	9
Orleans	43	50
Rutland	50	28
Washington	62	28
Windham	25	37
Windsor	86	206
Total	554	667

Stone.—The production of stone during 1965 accounted for 79 percent of the value of the State's mineral output for the year. Tonnage produced was 2.6 million short tons, 25 percent more than in 1964. Rutland County led in the output of stone and contributed 53 percent of the State total stone value. Other counties with large stone production were Washington, Windsor, Orange, and Chittenden, each with marketed production in excess of $1.0 million. Dimension marble and dimension granite led in value, followed by crushed limestone and dimension slate. No commercial sales of crushed granite were reported during the year.

Sales of dimension granite increased less than 1 percent over those of 1964. Washington County marketed most of the production for use as rough architectural and monumental stone. Additional dimension granite was used for rough construction work, curbing, flagging, dressed monumental stone, and for rubble. Government-and-contractor operations produced

137,312 tons of granite for use in concrete and as roadstone. The value of crushed limestone was 3 percent more than that of 1964. Crushed limestone was used for riprap, concrete and roadstone, railroad ballast, and agricultural lime. Additional uses include paint and rubber filler and other industrial applications. The output of dimension marble decreased 8 percent in tonnage and 6 percent in value, compared with 1964. Rutland County was the principal producer of dimension marble followed by Windsor, Grand Isle, and Bennington Counties. Dimension marble was produced for rough and dressed building stone and dressed monumental stone. Crushed marble also declined in value when compared with the 1964 value. The production was used for chips, flagging, and miscellaneous purposes. While sales of dimension slate declined 3 percent in value, sales of crushed slate increased 17 percent. Rutland County was the only slate producing county. Principal uses were for structural and sanitary purposes, roofing, flagging, tile, and architectural slate. Crushed slate was expanded for use as a lightweight aggregate. Some crushed slate was sold for fill. Crushed miscellaneous stone increased in value by 1 percent when compared with the 1964 value. The production was for use in concrete and as roadstone. Government-and-contractor production of miscellaneous stone totaled 800,000 tons, valued at $1.5 million.

Talc.—The value of talc production was 10 percent greater than in 1964, and the highest since 1952. Lamoille and Windsor were the principal producing counties, followed by Windham. Talc was produced from three mines for grinding and for use in roofing, paper, rubber, toilet preparations, paint, insecticides, and other purposes. The demand for talc was firm during the year. Some operators reported a shortage of skilled labor.

REVIEW BY COUNTIES

Addison.—The production of sand and gravel declined 37 percent in value from that of 1964. Government-and-contractor operations accounted for 27 percent of the output of 165,000 tons. Construction sand and gravel was produced for building, paving, and fill. Twenty percent of the commercial production was processed by washing and screening. The Champlain Construction Co. and J. P. Carrara & Sons, Inc., both in Middlebury, produced sand and gravel for building, paving, and fill. Roy P. Shackett at Leicester produced gravel for paving and fill.

The Vermont Kaolin Corp., Bristol, produced clay from its Electra pit for use in floor and wall tile, boiler liners, and as filler in rubber and feed pellets.

The production of lime in Addison County was unchanged from 1964. The Vermont Associated Lime Industries, Inc., produced hydrated lime at its plant in New Haven. The lime produced at this plant was used in construction, paper filler, sewage treatment, and water purification.

Bennington.—The value of sand and gravel production was slightly greater in 1965 than in 1964. Burgess Brothers, Bennington, and William E. Dailey, Inc., North Bennington, produced sand and gravel for building and paving. The G & H Sand & Gravel Co., Inc., Manchester, produced sand for building purposes and bank-run gravel for building and fill use. Transportation was by truck.

Caledonia.—Comparing 1965 with 1964, the value of sand and gravel production increased 9 percent, while that of stone production increased 55 percent. The Caledonia Sand & Gravel Co. at St. Johnsbury produced sand and gravel for paving purposes. Lawrence Sangravco, Inc., also at St. Johnsbury, produced sand and gravel for building and paving use. All transportation was by truck.

From its Waterford quarry, the Caledonia Sand & Gravel Co. produced crushed miscellaneous stone for use as concrete aggregate and road stone. The State of Vermont Highway Department used 27,343 tons of crushed granite for road building purposes.

Chittenden.—The value of all minerals produced in Chittenden County declined about 3 percent during 1965, chiefly owing to a decline in the production of stone. The output of clay and lime was the same as in 1964. Sand and Gravel production was 58 percent greater than in 1964. The

Table 5.—Value of mineral production in Vermont, by counties

County	1964	1965	Minerals produced in 1965 in order of value
Addison	$171,778	$132,437	Sand and gravel, clay, lime.
Bennington	W	W	Sand and gravel, stone.
Caledonia	W	W	Do.
Chittenden	1,329,790	1,294,618	Stone, sand and gravel, lime, clay.
Essex	4,000	----------	
Franklin	W	W	Stone, sand and gravel.
Grand Isle	W	W	Stone.
Lamoille	W	W	Talc, sand and gravel.
Orange	W	W	Stone, sand and gravel.
Orleans	W	W	Asbestos, sand and gravel, stone.
Rutland	12,096,732	11,404,577	Stone, sand and gravel.
Washington	W	W	Do.
Windham	272,500	146,000	Sand and gravel, talc.
Windsor	571,164	2,084,203	Stone, talc, sand and gravel, peat.
Undistributed	11,680,361	12,330,397	
Total	26,127,000	27,392,000	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

principal mineral commodity produced was crushed limestone. Government-and-contractor operations utilized 277,000 tons of this material for highway construction. The L. A. Demers Crushed Rock Co., Colchester, produced crushed limestone for riprap, concrete aggregate, roadstone, and railroad ballast. The Vermont Associated Lime Industry, Inc., quarried limestone at its Winooski operation for agricultural use and for the manufacture of lime in its own plant.

Twenty-two percent of the sand and gravel production was processed by washing and screening. At its pit in Williston, the Campbell Construction, Inc., produced bank-run sand and gravel for building and fill purposes. The Hinesburg Sand & Gravel Co., Hinesburg, produced sand and gravel for paving. Sand and gravel for building and paving was produced by W. C. Kirby, contractor, at Burlington. All transportation was by truck.

The Vermont Associated Lime Industries, Inc., produced quicklime at its Winooski plant, principally for use in the manufacture of paper. At Essex Junction, the Densmore Brick Co. produced clay for manufacture of common building brick. The Kleen-Moss Co., Inc., did not produce any commercial peat from its bog near Williston.

Franklin.—The production of stone was nearly 52 percent more than in 1964. The Swanton Lime Works, Inc., produced crushed limestone at its Swanton quarry for use in concrete and roadstone, agricultural purposes, chemical uses, and riprap. The State of Vermont Highway Department quarried crushed limestone for concrete and roadstone. Commercial and Government-and-contractor output of sand and gravel totaled 301,000 tons, valued at $139,000. A. G. Anderson Co., Inc., Swanton, produced processed and bank-run sand for building, paving and fill purposes. Ray Debois, also of Swanton, produced bank-run sand and gravel for paving.

Grand Isle.—The production of marble declined during 1965. The Vermont Marble Co., at its Isle La Motte quarry, produced dimension marble and crushed marble for chips, flagging, and other uses. A wildcat well was drilled for American Petrofina near Alburg, by Falcon Seaboard Drilling Co. Planned for 6,500 feet depth, the test was abandoned as a dry hole at 5,120 feet.

Lamoille.—The value of the output of both talc and sand and gravel increased, resulting in a 5-percent rise in the value of minerals produced in the county during 1965. At Johnson, Eastern Magnesia Talc Co., Inc., mined talc from its underground No. 4 Johnson mine. Most of the production was ground at the company mill and sold for use as fillers in roofing, paper, rubber, toilet preparations, paint, and other miscellaneous products.

Kenneth Farr produced bank-run gravel at Morrisville. Albert S. Nadeau, Johnson, washed and screened sand and gravel for building and paving. Transportation was by truck.

Orange.—The value of the mineral production in Orange County increased 8 percent over that of 1964. The gain in value of stone production more than offset the loss in sand and gravel.

The Rock of Ages Corp. (Pirie Division) quarried dressed monumental stone at its quarry near Williamstown. Crushed granite for concrete and roadstone was produced in Government-and-contractor operations.

The Caledonia Sand & Gravel Co., Inc. processed gravel for paving purposes at its pit near Ryegate. Levi Lemieux at Williamstown produced bank-run sand and gravel for fill. Willard B. Martin produced bank-run gravel for paving from a pit at East Corinth. The entire output was transported by truck.

Orleans.—Asbestos was the main mineral commodity produced in the county, followed by sand and gravel and stone. The value of the 1965 production of each of the three commodities increased over that of 1964, with a gain of 4 percent for the combined production.

The Vermont Asbestos Mines, Division of the Ruberoid Co., produced and processed chrysotile asbestos at its mine and mill at Lowell. Twenty-four grades of asbestos were marketed during the year at prices ranging from $21.00 to $370.26 per ton. The company also produced crushed miscellaneous stone for concrete and roadstone.

At Newport, Irio Bianchi recovered dimension granite for construction purposes. Howard G. Calkins processed sand and gravel at Danville for paving purposes. A small amount of bank-run material was also produced. Production of sand and gravel by the Vermont State Highway Department was used for paving and fill.

Rutland.—Value of mineral production in Rutland County during 1965 declined 6 percent from that of 1964, but still accounted for 42 percent of the State total. Stone was the principal commodity produced. The value of sand and gravel output was less than 1 percent of the county total.

Dimension marble, dimension slate, crushed limestone, crushed marble, and crushed slate were the important stone classifications, in that order, and were valued at a total of $11.3 million. The Vermont Marble Co. of Proctor operated five quarries, three mills, and two finishing plants for the recovery and processing of dimension marble. Dressed marble, consisting of cut stone and sawed slabs for interior and exterior building stone and cut stone for monuments, were important uses. The Green Mountain Marble Division of Georgia Marble Co. recovered marble from its underground quarry for processing in the company's finishing plant at West Rutland. The production was used chiefly for cut and dressed monu mental stone and interior and exterior building stone. The company's Meadow quarry, also at West Rutland, experienced only exploration and development work during 1965.

The Vermont Marble Co. produced some crushed marble for miscellaneous uses. Rutland was the only county with slate production in 1965. Dimension slate was valued at 3 percent less than in 1964. Crushed and broken slate increased 17 percent in value during 1965. Considering value, slate for structural and sanitary purposes were the most significant uses. Other uses included flagging, roofing, tile, and architectural. Sixteen operators produced dimension slate, valued at $2.76 million. Some of the larger producers of slate included Vermont Structural Slate Co., Hilltop Slate Co., Fair Haven Slate Co., and John G. Hadeka.

At Castleton, the Vermont Light Aggregate Corp. produced expanded slate for lightweight aggregate. Some waste was used for fill. The Kehoe quarry at West Pawlet was idle.

The White Pigment Corp., at its South Wallingford quarry, produced crushed limestone for whiting, much of which was used as paint and rubber filler. Other uses included filler in flooring, plastics, and caulking. At Florence, the Vermarco Lime Co., subsidiary of the Vermont Marble Co., produced crushed limestone for concrete aggregate, roadstone, and for agricultural purposes.

J. P. Carrara & Sons, Inc., at Rutland, processed sand and gravel for building and paving and sand for fill purposes.

Washington.—The value of mineral production during 1965 declined 2 percent from that of 1964. The value of sand and gravel production increased as did that of crushed miscellaneous stone, but not enough to offset the decrease in value of the output of granite.

Garand-Teed Quarries, Inc., quarried rough dimension granite for use in monuments, mausoleums, and in construction. The open quarry is located at Adamant. The Rock of Ages Corp. produced dimension granite from three quarries for use mainly as monumental stone. Some rough blocks for architectural work were produced, as well as some material for use as rubble and curbing. The Rock of Ages quarries and E. L. Smith quarry are located at Graniteville. The Wetmore and Morse quarry is at Websterville. The Wells-Lamson Quarry Co., at its Websterville quarry, produced dimension granite for monuments and mausoleums. Woodbury Quarries, Inc., removed granite from its Woodbury quarry for processing at the Concord, N. H., plant of the John Swenson Granite Co. Government-and-contractor operations used crushed granite for concrete and roadstone.

The Celedonia Sand & Gravel Co., Inc., quarried miscellaneous stone at its Plainfield quarry for use in concrete and for roadstone. The company also produced processed and bank-run sand and gravel for paving. A. King's pit at South Barre produced sand and gravel for building and paving. Le Page gravel pit, Barre, produced bank-run sand and gravel for paving. Ralph Lowe's operation at Montpelier was idle during 1965.

Windham.—Sand and gravel was the most important mineral commodity produced in 1965. There was no production of stone during the year. The value of the output of talc was less than in 1964. For all minerals in 1965, the value declined 46 percent, when compared with the 1964 value.

Brattleboro Sand & Gravel, Inc., produced processed and bank-run sand and gravel for building and paving. Additional sand and gravel was produced by Government-and-contractor operations for road building.

The Vermont Talc Co. at Windham produced talc for grinding in the company mill at Chester. The ground material was for use in rubber, paper, insecticides, plastics, and other products.

Windsor.—Mineral production in Windsor County was valued at $2.1 million in 1965, almost a fourfold gain over 1964, chiefly because of a high demand for crushed stone for highway use. The value of sand and gravel and talc production was improved. Dimension granite increased. Both dimension and crushed marble output declined.

The Vermont Marble Co. quarried dimension marble at its Rochester quarry. Some crushed stone was also produced. The Rock of Ages Corp. produced rough granite blocks for architectural purposes and rubble from its quarry at Bethel. Eastern Magnesia Talc Co., Inc., mined crude talc at its Hammondsville No. 3 mine at Reading. Ground talc was used in the manufacture of roofing, paper, rubber, toilet preparations, paint, and other products. Hume Pipe of N. E. Inc., processed sand for the manufacture of cement pipe. Unprocessed gravel was also produced for aggregate. The pit is located near Windsor. Sharon Sand & Gravel, Inc., at Sharon, produced sand and gravel for building, paving, and other purposes. Government-and-contractor road paving projects utilized 201,000 tons of sand and gravel and 800,000 tons of crushed miscellaneous stone.

Located at Barnard, Kirk's Green Mountain Peat produced reed-sedge peat. King's Pine Peat (Jack Comstock) at Hartland, marketed bulk and packaged humus peat and bulk potting soil.

The Mineral Industry of Virginia

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U. S. Department of the Interior, and the Virginia Division of Mineral Resources for collecting information on all minerals except fuels.

By David J. Kusler,[1] James L. Calver,[2] and Harold F. York [3]

Paced by recordbreaking outputs of coal and construction aggregates, the value of mineral output in Virginia in 1965 rose to a new high of $268 million, 13 percent greater than in 1964. Almost three-fifths of the mineral commodities produced gained in output; over four-fifths gained in value. Production and value of lime, sand and gravel, and stone reached new highs. An increased level of highway and other construction in 1965 was of prime influence in the increased output of sand and gravel and stone. Fifty-two percent of the total value of mineral production in Virginia was contributed by fuels, 45 percent by nonmetals, and 3 percent by metals; the same proportions as in 1964.

Trends and Developments.—New electricity facilities in a four-State area (100,000 square miles) in North and South Carolina, Virginia, and West Virginia were planned by four power companies. Construction was planned of 44 million kilowatts of new electric generating capacity (about five times the group's existing capacity) and more than 3,100 miles of

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Table 1.—Mineral production in Virginia [1]

Mineral	1964 Quantity	1964 Value (thousands)	1965 Quantity	1965 Value (thousands)
Clays—thousand short tons	1,440	$1,614	1,415	$1,657
Coal (bituminous)—do	31,654	123,123	34,053	139,291
Gem stones	NA	6	NA	7
Lead (recoverable content of ores, etc.)—short tons	3,857	1,010	3,651	1,139
Lime—thousand short tons	780	9,781	847	10,584
Natural gas—million cubic feet	1,600	479	3,152	942
Petroleum (crude)—thousand-42 gallon barrels	6	W	4	W
Sand and gravel—thousand short tons	10,588	13,722	15,322	18,019
Soapstone—short tons	3,775	9	3,549	9
Stone—thousand short tons	30,407	52,153	36,350	59,397
Zinc (recoverable content of ores, etc.)[2]—short tons	21,004	5,700	20,491	5,942
Value of items that cannot be disclosed: Aplite, portland cement, masonry cement, feldspar, gypsum, iron ore (pigment material), kyanite, salt, titanium concentrate (ilmenite and rutile), and values indicated by symbol W	XX	29,818	XX	30,990
Total	XX	237,415	XX	267,977

NA Not available. W Withheld to avoid disclosing individual company confidential data.
XX Not applicable.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Recoverable zinc valued at the yearly average price of prime western slab zinc, East St. Louis market. Value established after transportation, smelting, and manufacturing charges have been added to the value of ore at the mine.

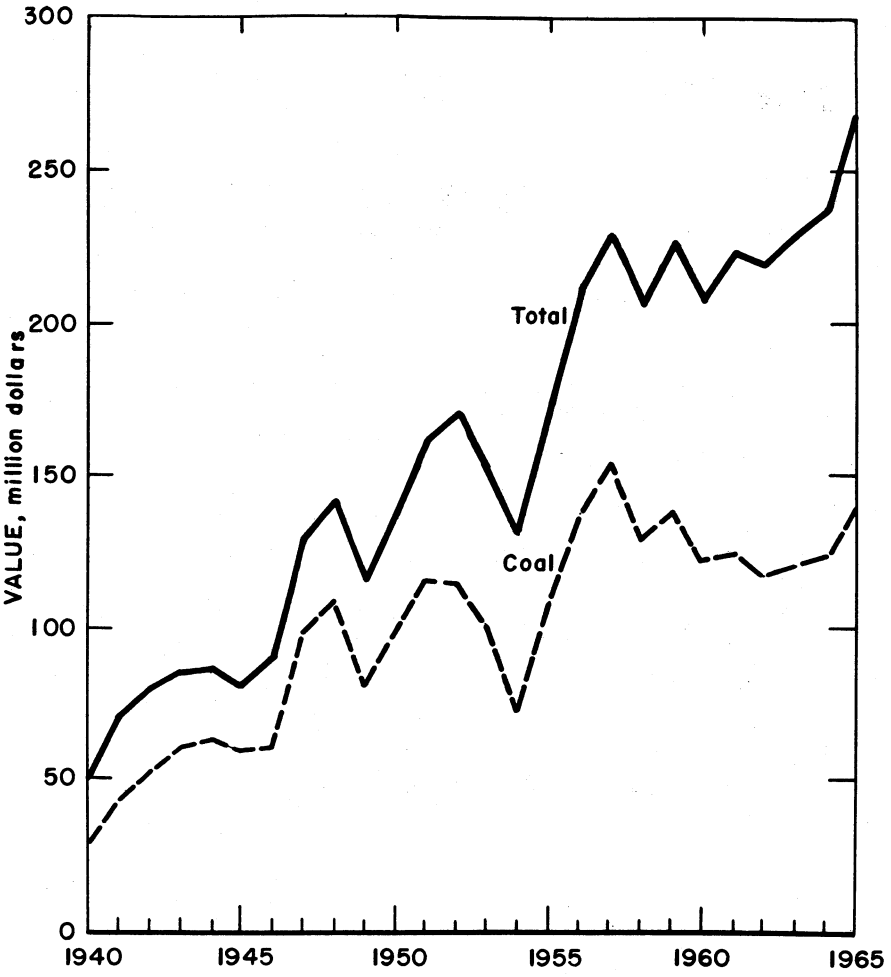

Figure 1.—Value of coal and total value of mineral production in Virginia.

Table 2.—Value of mineral production in constant 1957–59 dollars
(Millions)

Year	Value
1956	$210
1957	223
1958	205
1959	231
1960	214
1961	234
1962	234
1963	244
1964	r 250
1965	282

r Revised.

new high voltage transmission lines, of which more that 1,400 miles will be at 500,000 volts.

A significant development in the State's port program is occurring in the Pinners Point section of Portsmouth. Up to $12 million was scheduled to be spent in restoration of the terminal area. The creation of 40 acres of waterfront land at Pinners Point from mud and clay dredged for the second Norfolk-Portsmouth tunnel was a contribution to the development of this area. The land so created is expected to provide ample space for a major mar-

Table 3.—Employment and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1964:								
Coal	11,437	210	2,407	19,189	23	1,009	53.78	9,834
Metal	301	259	78	622	----	28	45.04	1,108
Nonmetal	701	261	183	1,454	----	45	30.95	1,077
Sand and gravel	806	247	199	1,768	----	34	19.23	2,418
Stone	3,837	264	1,014	8,418	3	201	24.23	3,548
Total	17,082	227	3,881	31,451	26	1,317	42.70	7,158
1965:[p]								
Coal	11,650	212	2,465	20,196	25	905	46.05	9,668
Metal	300	263	79	629	----	35	55.64	1,448
Nonmetal	705	281	198	1,564	----	45	28.77	850
Sand and gravel	615	217	133	1,181	----	30	25.40	508
Stone	3,955	265	1,047	8,715	2	217	25.13	2,144
Total	17,225	228	3,922	32,285	27	1,232	39.00	6,714

[p] Preliminary.

ginal pier to handle bulk commodities.

Virginia's fuel capability was increased by the opening of a new coal mine near Big Stone Gap, Wise County, by Stonega Division of Westmoreland Coal Co. The mine will have an expected annual output of 1.8 million tons at full capacity. Another coal development was Island Creek Coal Co.'s plans to develop a second mine in Buchanan County. The mine, scheduled to start late in 1967, is expected to produce 2 million tons of metallurgical coal annually and will be opened in the company's 500-million-ton reserve area of the Pocahontas No. 3 seam.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Coal (Bituminous).—Spurred by a substantial gain in output in Dickenson County, coal production rose to 34 million short tons—8 percent more than in 1964, the previous record year. Production data includes coal produced from deposits within Virginia, whether the mine opening is or is not inside the State boundary and excludes operations producing less than 1,000 tons per year. Consequently, production data in this volume published by the Federal Bureau of Mines may differ somewhat from data published by the State. The value of the output increased 13 percent over that of 1964, partly because of a 5-percent rise in average value per ton ($4.09) in 1965 over the $3.89 in 1964. The total value was 10 percent below the 154 million reported in the peak value year, 1957.

Both high- and low-volatile bituminous coals were produced for domestic and industrial purposes and for export. A small quantity of semianthracite coal was mined in Montgomery County. Forty-five percent of Virginia's coal tonnage was produced in one county, Buchanan; 63 percent of the State's coal mines were in Buchanan County. Four of the eight southwestern counties in which coal was mined—Buchanan, Dickenson, Wise, and Russell—accounted for 97 percent of the total output compared with 98 percent in 1964. Underground production comprised 86 percent of the total output (88.7 percent in 1964); strip mine output, 9 percent (7.7 percent in 1964); and auger mine production, 5 percent (3.6 percent in 1964).

In 1965 the number of mines in Virginia totaled 1,271, 9 percent fewer than in 1964. Underground mines declined 11 percent to 1,153, while the number of strip and auger mines rose to 56 and 62, respectively, compared with 44 and 56 in 1964. The tonnage of mechanically loaded coal was 57 percent of the total underground output, 12 percent higher than in 1964. This percentage reflects the continuing trend toward modernization and mechanization in underground mining in Vir-

Table 4.—Coal (bituminous) production and value, by counties
(Thousand short tons and thousand dollars)

County	1964		1965	
	Quantity	Value [1]	Quantity	Value [1]
Buchanan	14,503	$57,379	15,291	$59,989
Dickenson	7,728	28,510	8,835	37,604
Lee	471	1,826	499	2,157
Montgomery	8	29	W	W
Russell	1,899	7,317	1,737	9,045
Scott	4	17	W	W
Tazewell	237	787	401	1,237
Wise	6,804	27,258	7,280	29,211
Undistributed [2]	-------	--------	10	48
Total	31,654	123,123	34,053	139,291

W Withheld to avoid disclosing individual company confidential data.
[1] Value received or charged for coal, f.o.b. mine, including selling cost. (Includes 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).
[2] Includes data indicated by symbol W.

ginia. Sixty-four percent of the mechanically loaded tonnage was by 177 mobile loading machines (50 more than in 1964); 35 percent was by 56 continuous mining machines (25 more than in 1964); and the remaining 1 percent by hand-loaded face conveyors. Of the total coal mined, 50 percent was mechanically cleaned in 33 cleaning plants (5 more than in 1964). Wet washing other than with jigs was the principal method of cleaning, accounting for 76 percent of the cleaned coal. Thirty-five percent of the cleaned coal was thermally dried. Thirty-five percent of the total coal mined was crushed. Nine percent of the total coal produced was treated with dust-allaying and antifreezing preparations, of which oil predominated (96 percent).

Coke.—Beehive coke was produced in six plants (five companies), five in Wise County and one in Buchanan County. There were 759 beehive ovens operational, 118 less than in 1964, of which 390 were rectangular- or horizontal-bed internal-combustion ovens. Machine-drawn ovens numbered 641, and the number of hand-drawn ovens was 118. There were no slot ovens operated and no byproduct recovery was made. Production of coke was about 6 percent greater than in 1964, and the average value per ton increased $0.28 to $15.28.

Petroleum and Natural Gas. — Natural gas production data in table 1 are reported to the Bureau of Mines by pipeline companies and are comparable with other State chapter data, although not necessarily with data reported by State agencies. The production data recorded by the Virginia State Department of Labor and Industry, Division of Mines and Quarries, was 1,882 million cubic feet in 1964 and 4,210 million cubic feet in 1965. Tazewell County led in output, producing 58 percent of the production reported by the State; Buchanan and Dickenson produced 28 and 14 percent, respectively. The output from Buchanan and Tazewell Counties was delivered to the pipelines of Hope Natural Gas Co. and the Atlantic Seaboard Line; production from Dickenson County was delivered to the lines of the Kentucky-West Virginia Gas Co. There were no natural gas processing plants operating in Virginia as of January 1, 1965. Natural gas reserves were estimated by the American Gas Association to total 32,467 million cubic feet, an increase of 296 million cubic feet or almost 1 percent more than the estimated reserve at the end of 1964. As of December 31, 1965, according to the Virginia Division of Mines and Quarries, there were 99 producing gas wells in Virginia compared with 103 in 1964. Of significance was the completion of the first full year of gas delivery from Tazewell County from 12 wells completed in 1961, 1964, and 1965. There was only one well started in Buchanan County in 1965, and there were no new well completions; there was no drilling in Dickenson County in 1965. In Rockingham County, the Shell Oil Co. and others

drilled an unsuccessful test well to a depth of 14,176 feet in the Bergton gasfield, exceeding the previous depth record in Virginia by 4,836 feet.

Oil production in Lee County (Rose Hill and Ben Hur fields) decreased from 5,828 barrels in 1964 to 3,617 barrels in 1965. Ultimate recovery for the Rose Hill field has been estimated at 210,000 barrels; remaining reserves at 29,400 barrels. Two dry holes were drilled in Lee County in 1965.

Washington Gas Light Co. operated LP gas storage facilities in Fairfax County. Storage capacity in a mined cavity (granite) for propane was rated at 300,000 barrels as of January 1, 1966. The American Oil Co. operated a skimming, cracking, and coking plant at Goodwin Neck, York County. The plant had a crude oil capacity of 38,000 barrels, a catalytic-cracking capacity of 22,800 barrels, and a catalytic-reforming capacity of 6,800 barrels, all per calendar day. The total gasoline output capacity was 14,100 barrels per calendar day.

NONMETALS

Aplite.—Output and value of aplite for glass manufacture increased. Production was from Hanover and Nelson Counties.

Cement.—Shipments and total value of portland cement decreased slightly in 1965; unit value was slightly higher. Masonry cement shipments increased 3 percent and total value rose 5 percent. The greater gain in total value was due to a 2-percent increase in unit value in 1965. Portland cement plant capacity remained virtually unchanged during the year. The wet process of manufacturing portland cement was used by one plant, and two plants used the dry process. Four plants manufactured cement; three plants made both portland and masonry cement, and one plant produced only masonry cement. The cement was produced in Augusta, Botetourt, and Warren Counties and the City of Chesapeake.

The cement producers mined limestone, shale, clay, and calcareous marl for their own use. Materials purchased for use in cement manufacture included sand, gypsum, oystershells, mill scale, various air-entraining compounds, and a variety of grinding aids.

Types I-II (general-use and moderate-heat cements) comprised the bulk of portland cement produced and marketed; both air-entrained and non-air-entrained types were produced. High-early-strength cement was also produced and shipped. Most of the shipments were in bulk and made by railroad, but sizable bulk shipments were also made by truck. Shipments of cement in containers (paper bags) were also sizable and were made by railroad and truck.

The distribution of portland cement for various consumer uses was as follows: 66 percent to ready-mixed concrete companies (59 percent in 1964); 17 percent to concrete products manufacturers (19 percent in 1964); 11 percent to contractors, including highway contractors (15 percent in 1964); 6 percent to other users, including building material dealers, Federal, State, and local government agencies and miscellaneous customers (7 percent in 1964).

Marketing areas for portland cement were chiefly Virginia, North Carolina, West Virginia, Maryland, and Alabama. The bulk of masonry cement was shipped to Virginia, North Carolina, the District of Columbia, Maryland, and West Virginia.

Clays.—Production of clay was 2 percent lower than in 1964, but a new record was set for value, which exceeded that of 1964, the previous record year, by 3 percent. Nearly two-thirds of the clay and shale output was consumed in brick manufacture, compared with a little over one-half in 1964. The principal uses for the balance were lightweight aggregate and the manufacture of portland cement; some was consumed in the making of vitrified sewer pipe, flue linings, pottery, clay dummies, and other heavy clay products. Clay production was reported from 21 operations in 16 counties. The chief clay-producing counties in order of tonnage mined were Botetourt, Russell, Nansemond, Chesterfield, and Orange; in order of output value they were Botetourt, Orange, Prince

Table 5.—Clays sold or used by producers

Year	Short tons	Value
1956–60 (average)	1,147,981	$1,190,645
1961	1,406,201	1,332,165
1962	1,464,417	1,443,927
1963	1,410,098	1,558,327
1964	1,440,385	1,613,523
1965	1,415,397	1,657,229

William, Nansemond, and Chesterfield.

Feldspar.—Production was by one company in one county (Bedford). The combined output from several mines increased 13 percent compared with that of 1964, while the average value per ton remained the same. Mixed and potash feldspar were mined. Feldspar, processed and ground at the company mill in Bedford, was marketed chiefly in Maryland, Ohio, New Jersey, New York, and Pennsylvania, principally for pottery and enamel manufacture, although smaller quantities were used in the manufacture of welding rod coatings, soaps and abrasives, and other uses.

Gem Stones. — Agate, amazonite, blue corundum, lepidolite, olivine, staurolite, and unakite were among the gems and mineral specimens gathered by mineral collectors and hobbyists.

Gypsum. — Production of gypsum increased moderately. The crude material, mined at Plasterco, Washington County, and near Chatham Hill, Smyth County, was calcined and manufactured into plasterboard and other gypsum products by United States Gypsum Co. at their Plasterco plant. The company also processed imported gypsum at a plant near Norfolk. Imported gypsum was ground by several firms in the Norfolk area for use as a land dressing.

Kyanite.—Production of crude kyanite ore increased substantially. Sales of the refined material to manufacturers of refractories and other ceramic products also increased substantially. Two mines and three processing plants were operated by the Kyanite Mining Corp. in Buckingham and Prince Edward Counties, and the company also operated a grinding and bagging plant in the latter county.

Lime.—Alltime highs in production and value of lime were set in 1965; lime output and value were 9 and 8 percent greater, respectively, than in 1964, the previous record year. The gains were attributed chiefly to the continually increasing demand for lime in chemical and other industrial uses. Sales of building lime increased, while sales of agricultural lime declined, compared with 1964. All but 5 percent of the lime sold or used, including both quicklime and hydrated lime, was consumed in chemical and industrial uses. Quicklime comprised 92 percent of the total production and hydrated lime accounted for the balance. Lime production was reported by nine companies in seven counties; Giles, Smyth, and Shenandoah Counties were the chief lime-producing areas. Processing equipment used in lime manufacturing included pot, shaft, and rotary kilns and batch and continuous hydrators. Fuel used in calcining included natural gas, bituminous coal, and coke. Uses for quicklime included the manufacture of calcium carbide, paper, and alkalies, flux in steel manufacture, and agricultural lime. Hydrated lime was marketed principally for use in the purification and treatment of water, leather tanning, sewage and trade-wastes treatment, construction, and agriculture. Principal marketing areas included the District of Columbia, Florida, Georgia, Kentucky, Maryland, Michigan, North and South Carolina, Ohio, Pennsylvania, Virginia, and West Virginia.

Mica.—No sales of crude mica were reported. Domestic and foreign scrap mica were ground by Richmond Mica Corp., Newport News, for use in paint, rubber, wallpaper, plastics, and other products. This company was dissolved in June 1965, and operations were continued at the site

Table 6.—Lime sold or used by producers, by uses

Year	Agricultural		Building		Chemical and other industrial		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1956–60 (average)	W	W	W	W	W	$6,334,476	594,031	$6,736,858
1961	28,760	$375,489	4,932	$72,584	623,075	6,926,661	656,767	7,374,734
1962	31,104	426,476	2,816	40,629	580,593	7,201,198	614,513	7,668,303
1963	W	W	W	W	603,325	7,572,738	638,800	8,058,415
1964	W	W	W	W	742,065	9,251,156	780,290	9,780,920
1965	W	W	W	W	808,751	10,079,996	847,196	10,583,984

W Withheld to avoid discloisng individual company confidential data; included in total.

by two surviving and associated companies, Asheville Mica Co. and Mica Co. of Canada (N.Y.), Inc.

Nitrogen Compounds.—Allied Chemical Corp., Nitrogen Division, Hopewell, Prince George County, produced nitrogen compounds for use chiefly as fertilizer ingredients.

Perlite.—Virginia Perlite Corp., Hopewell, Prince George County, expanded out-of-State perlite (and vermiculite) chiefly for use as a lightweight concrete aggregate and building plaster.

Salt.—Olin Mathieson Chemical Corp., Saltville, Smyth County, produced chlorine, caustic soda, soda ash, and other chemicals from brine recovered from nearby captive salt wells. Production of salt was comparable to the output in 1964.

Sand and Gravel. — New record highs were established for output and value of sand and gravel in 1965. Output exceeded that of 1964, the previous year of record production, by 45 percent, while value was 2 percent greater than the former peak year of 1963 and 31 percent greater than in 1964. Demand for sand and gravel used in building and road construction was largely responsible for the increase in output; production of commercial sand and gravel used in paving was substantially higher than in 1964.

Paving and building uses comprised 78 percent of the commercial production (53 percent paving, 25 percent building). Other sand and gravel uses included glass sand, engine sand, filtration sand, railroad ballast, fill material, and sand and gravel for miscellaneous uses. Commercial output comprised 99.9 percent of the total production and virtually all of the value. The small remainder of the total output (0.1 percent) was State and local government production (2 percent in 1964). Sand comprised 59 percent of the total commercial sand and gravel output and 46 percent of the commercial value. Sixty-nine percent of the total commercial sand and gravel output was washed, screened, or otherwise prepared, compared with 84 percent in 1964. Seventy-three percent of the commercial tonnage was shipped by truck, and most of the remainder by waterway or railroad; a small quantity was used at the producing plant or transported by unspecified methods.

Sand and gravel production was reported from 31 counties and 2 independent cities. In order of decreasing output, the principal sand and gravel producing areas were Fairfax, City of Virginia Beach, Chesterfield, Henrico, and Prince George. Over four-fifths of both the total output and value was contributed by these five producing areas. Of the 51 commercial sand and gravel operations reported during 1965, 4 had an output range of 1,000,000 tons or over and accounted for 53 percent of the output; 4 had an output range of from 500,000 to 1,000,000 tons and accounted for 19 percent; 13 had an output range of from 100,000 to 500,000 tons and accounted for 20 percent; 12 had an output range of from 50,000 to 100,000 tons and accounted for 6 percent; and 18 had an output range of up to 50,000 tons and accounted for 2 percent of production.

Soapstone.—Crushed and ground soapstone was produced by one firm in Franklin County. The principal uses of the product were insecticides and foundry facings. Soapstone used as a dimension stone is included with miscellaneous stone in the stone section of this chapter.

Stone.—Continuing its increasing trend, Virginia's stone production in 1965 broke all records in both quantity and value for the eighth consecutive year. In 1965 stone, the second most important mineral commodity produced in Virginia, surpassed coal (traditionally the leading mineral in both tonnage and value) in output but not in value. Production totaled 36.4 million tons valued at $59.4 million, a gain of 20 percent in output and 14 percent in value over 1964. Contributing most to the gain in output were increases in the production of limestone (14 percent over that of 1964) and granite (24 percent over that of 1964). Limestone and granite, the leading stone types, accounted for more than five-sixths of the total stone tonnage and more than three-quarters of the value. The substantially greater demand for concrete aggregate and roadstone was the major reason for the rise in output of both limestone and granite, reflecting a higher rate of building and local and interstate highway construction than in 1964. The crushed or broken material was chiefly produced, only a limited amount of dimension limestone and no dimension granite production was reported in Virginia in 1965. Basalt (including traprock and

Table 7.—Sand and gravel sold or used by producers, by classes of operations and uses
(Thousand short tons and thousand dollars)

Class of operation and use	1964		1965	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	2,002	$2,608	2,046	$2,518
Paving	1,975	2,036	4,476	4,009
Engine	79	128	W	W
Fill	927	533	2,129	788
Other [1]	387	889	420	1,004
Total	5,370	6,194	9,071	8,319
Gravel:				
Building	1,667	2,718	1,738	3,285
Paving	3,183	4,440	3,647	5,929
Fill	W	W	744	375
Other [2]	114	115	101	105
Total	4,964	7,273	6,230	9,694
Total sand and gravel	10,334	13,467	15,301	18,013
Government-and-contractor operations:				
Sand:				
Paving	104	36	--------	---------
Other	29	12	--------	---------
Total	133	48	--------	---------
Gravel:				
Paving	121	207	6	2
Fill	-------	--------	15	4
Total	121	207	21	6
Total sand and gravel	254	255	21	6
All operations:				
Sand	5,503	6,242	9,071	8,319
Gravel	5,085	7,480	6,251	9,700
Grand total	10,588	13,722	15,322	18,019

W Withheld to avoid disclosing individual company confidential data.
[1] Includes engine sand (1965), railroad ballast, glass, filtration, ground sand, and sand for other construction and industrial uses.
[2] Includes fill (1964) and gravel for miscellaneous and other uses.

diabase), the third leading stone produced in Virginia, and sandstone both increased substantially in output and value mainly because of the strong demand for the crushed material as construction aggregates; limited amounts of dimension basalt and sandstone were also produced. Production and value of miscellaneous dimension stone, including soapstone and Virginia greenstone, decreased; no production of the crushed material was reported in 1965. Crushed slate production and value declined moderately, while output and value of the dimensioned product increased substantially, primarily because of the increased demand for wall facing and flooring material, both for domestic and foreign markets.

Many types of stone were mined or quarried in Virginia including limestone, granite, basalt (including traprock and diabase), sandstone, slate, calcareous marl, miscellaneous stone, and marble, in order of decreasing output. Seventy-four percent of the total stone output was used as concrete aggregate and roadstone (71 percent in 1964); 11 percent was used in the manufacture of cement and lime; 3 percent was used as metallurgical fluxstone; and the remaining 12 percent was used as stone sand, railroad ballast, riprap, and agricultural dressings. Limestone, either as such or as lime, had additional application in the chemical, glass, and paper industries. Marine shell, substantial tonnage of which was dredged from the Chesapeake Bay area, together with a limited quantity obtained as a product of

Table 8.—Stone sold or used by producers, by kinds and uses

Kind and use	1964		1965	
	Short tons	Value	Short tons	Value
Dimension stone:				
Sandstone: All uses	1,551	$20,029	1,035	$15,453
Undistributed [1]	58,789	4,965,029	74,792	4,535,423
Total	60,340	4,985,058	75,827	4,550,876
Crushed and broken stone:				
Basalt: Concrete and roadstone [2]	2,554,958	4,405,082	3,161,265	5,334,785
Granite:				
Concrete and roadstone	6,833,728	11,097,722	8,730,527	14,067,536
Riprap	123,995	196,742	90,291	190,740
Railroad ballast	275,097	396,710	130,770	174,488
Limestone:				
Fluxing stone	1,265,548	2,034,365	1,018,109	1,588,002
Concrete and roadstone	11,803,660	16,463,698	14,065,792	18,124,010
Railroad ballast	165,982	194,735	265,498	349,388
Agricultural	1,038,857	1,959,948	1,295,064	2,319,572
Miscellaneous [2]	4,974,505	8,333,293	5,230,764	9,560,465
Sandstone: All uses	431,945	688,071	899,408	1,297,872
Undistributed [3]	878,591	1,397,491	1,386,956	1,839,617
Total	30,346,866	47,167,857	36,274,444	54,846,475
Grand total	30,407,206	52,152,915	36,350,271	59,397,351

W Withheld to avoid disclosing individual company confidential data.
[1] Includes basalt (1965), granite (1964), limestone (1965), slate, and miscellaneous stone.
[2] Includes riprap.
[3] Includes miscellaneous stone (1964), calcareous marl, marble, shell, and slate.

oyster and other mollusk processing, was used mainly as an aggregate in road construction, in the manufacture of cement and lime, and as an agricultural liming material. Roofing granules were produced from crushed slate by a firm in Buckingham County. Output of limestone, granite, and basalt, the three leading stone types produced, accounted for over nine-tenths of the total stone production. Crushed or broken material comprised virtually all (99.8 percent) of the total stone output and 92 percent of the total value. In terms of production, dimension stone accounted for 0.2 percent and in terms of value accounted for 8 percent.

The principal stone-producing counties, in terms of tonnage, were Shenandoah, Frederick, Botetourt, Loudoun, and Augusta (Frederick, Botetourt, Loudoun, Wythe, and Roanoke Counties in 1964). In terms of product value, the most important counties were Frederick, Giles, Shenandoah, Loudoun, and Botetourt (Frederick, Botetourt, Nelson, Loudoun, and Giles in 1964). Fifteen counties produced more than 1 million tons of output, compared with 10 in 1964 and 8 in 1963, and there were 25 counties with production valued at more than $1 million each (22 in 1964, 18 in 1963). Commercial stone was reported in 53 counties, compared with 48 in 1964, and Government-and-contractor stone was produced in 7 counties, (9 in 1964).

METALS

Ferroalloys.—Ferromanganese was produced by blast furnace reduction of imported ore by E. J. Lavino and Co., Furnace Division, near Lynchburg.

Iron Ore (Pigment Material).—Crude brown and yellow iron oxide pigments were produced by one firm near Hiwassee, Pulaski County. This firm also produced brown, red, and yellow natural iron oxide pigments, and a variety of finished natural and manufactured pigments at operations near Hiwassee and Pulaski. The materials used for pigment manufacture included manufactured oxides, imported oxides, and iron oxides from local deposits. Iron oxide pigments were also produced from imported hematite by another firm near Henry, Franklin County. Total marketed output of iron oxide pigments increased substantially.

Lead and Zinc.—Production of lead and zinc ore was limited to two mines in Wythe County. The tonnage of both lead

Table 9.—Mine production of recoverable lead and zinc

Year	Lead		Zinc	
	Short tons	Value	Short tons	Value [1]
1956-60 (average)	2,807	$735,822	20,193	$4,814,002
1961	3,733	768,998	29,163	6,726,462
1962	4,059	746,856	26,479	6,140,705
1963	3,500	756,000	23,988	5,724,628
1964	3,857	1,010,534	21,004	5,699,645
1965	3,651	1,139,112	20,491	5,942,390

[1] Recoverable zinc valued at the yearly average price of prime western-slab zinc, East St. Louis market. Value established after transportation, smelting, and manufacturing charges have been added to the value of ore at the mine.

and zinc recovered was less than in 1964, but the value of both commodities increased. Lead and zinc output declined 5 percent and 2 percent, respectively; however, the value rose 13 percent and 4 percent, respectively, because of higher unit prices prevailing in 1965.

Titanium Concentrates.—Continuing an increasing trend, marketed production of titanium concentrates (ilmenite and rutile) gained substantially in both output and value. Shipments of both ilmenite and rutile increased substantially. Ilmenite was produced by American Cyanamid Co., Pigments Division, in Amherst County, and both ilmenite and rutile were produced by M & T Chemicals, Inc., in Hanover County.

REVIEW BY COUNTIES

Producers reported mineral production from 76 counties and 3 independent cities.

Production of unprocessed construction gravel (paving and fill) by Government-and-contractor operations by the Virginia Department of Highways was reported in Alleghany, Bath, Highland, and Page Counties.

Crushed limestone for use in road building and maintenance was produced in Clarke and Highland Counties by the Virginia Department of Highways. Crushed granite for construction uses was produced by the Public Works Department of the cities of Danville and Martinsville in Pittsylvania and Henry Counties, respectively.

Accomack.—Output and value of commercial sand and gravel increased, mainly because of a sharp rise in production of construction sand. Charles F. Matthews, Oak Hall, dredged and processed construction sand and gravel near New Church; unprocessed construction sand was produced by Lance J. Eller, Inc., Keller, from a pit near Mappsville.

Albemarle. — Crushed granite for concrete aggregate, roadstone, and railroad ballast was produced by Superior Stone Co., Division of Martin Marietta Corp., at its Red Hill quarry near North Garden. Charlottesville Stone Corp. crushed basalt, quarried near Shadwell, for concrete aggregate and roadstone. Production of both granite and basalt increased. Vein quartz was produced by Stone & Mineral Corp. of Warrenton, and Economy Cast Stone Co. of Richmond, from quarries near Boyd Tavern and Earlysville, respectively. The crushed material was used as exposed aggregate.

Alberene Stone Division of the Georgia Marble Co. quarried soapstone near Alberene, Schuyler, and Old Dominion for preparation as dimension stone at its processing plant at Schuyler, Nelson County.

Construction sand was mined by several operators; S. L. Williamson Co., Inc., Charlottesville, was the leading producer.

Alleghany.—Limestone, primarily for use as concrete aggregate and roadstone, was quarried and crushed by Lambert Brothers Division, Vulcan Materials Co., near Richpatch, and Liberty Limestone Corp., near Callaghan. Production increased substantially.

West Virginia Pulp and Paper Co., Covington, produced lime from purchased limestone and also regenerated lime in a natural-gas-fired rotary kiln for use in its paper manufacturing.

Unprocessed construction gravel was produced by the Virginia Department of Highways.

Table 10.—Value of mineral production in Virginia, by counties [1]

County	1964	1965	Minerals produced in 1965 in order of value
Accomack	$30,000	$193,000	Sand and gravel.
Albemarle	W	W	Stone, sand and gravel.
Alexandria (city)	W	----	
Alleghany	W	W	Stone, sand and gravel.
Amherst	W	W	Titanium concentrate, sand and gravel.
Appomattox	98,537	101,447	Stone.
Augusta	W	W	Cement, stone, clays, sand and gravel.
Bath	----	2,000	Sand and gravel.
Bedford	W	W	Stone, feldspar.
Bland	14,986	18,772	Stone.
Botetourt	W	W	Cement, stone, clays.
Brunswick	W	W	Stone, clays.
Buchanan [2]	r 57,378,626	59,989,326	Coal, natural gas.
Buckingham	3,348,818	4,074,376	Stone, kyanite.
Campbell	2,586,018	1,616,359	Stone.
Caroline	W	W	Sand and gravel.
Charles City	----	W	Sand and gravel.
Chesapeake (city)	W	W	Cement, stone, lime, sand and gravel.
Chesterfield	W	W	Sand and gravel, stone, clays.
Clarke	W	W	Stone.
Craig	W	W	Sand and gravel.
Culpeper	W	W	Stone.
Dickenson [2]	r 28,513,094	37,605,420	Coal, natural gas, sand and gravel, clays.
Dinwiddie	W	W	Stone, clays.
Fairfax	7,183,821	7,514,392	Sand and gravel, stone.
Fauquier	W	518,295	Stone.
Floyd	----	19,700	Do.
Fluvanna	W	W	Do.
Franklin	9,438	8,872	Soapstone.
Frederick	4,871,654	4,833,783	Stone, lime, sand and gravel, clays.
Giles	W	W	Lime, stone.
Gloucester	----	W	Sand and gravel.
Goochland	W	W	Stone.
Grayson	90,908	152,148	Stone, sand and gravel.
Greensville	W	W	Stone.
Halifax	W	W	Do.
Hanover	W	W	Stone, aplite, titanium concentrate.
Henrico	W	W	Sand and gravel.
Henry	W	W	Stone.
Highland	31,127	21,052	Stone, sand and gravel.
Isle of Wight	W	W	Lime, sand and gravel, stone.
King William	60,000	W	Sand and gravel.
Lee [3]	1,826,593	2,156,804	Coal, stone, petroleum.
Loudoun	2,709,639	2,889,809	Stone.
Louisa	W	W	Stone.
Mecklenburg	W	W	Stone, sand and gravel.
Montgomery	W	W	Stone, clays, coal.
Nansemond	W	W	Stone, clays.
Nelson	W	W	Stone, aplite.
New Kent	96,000	W	Sand and gravel.
Northampton	W	W	Do.
Northumberland	26,000	----	
Nottoway	W	W	Stone.
Orange	W	W	Clays.
Page	----	2,000	Sand and gravel.
Patrick	----	W	Do.
Pittsylvania	772,839	455,759	Stone, sand and gravel.
Powhatan	W	W	Stone.
Prince Edward	W	W	Kyanite, stone.
Prince George	W	W	Sand and gravel.
Prince William	W	W	Stone, clays.
Pulaski	W	W	Stone, iron ore (pigment material).
Rappahannock	----	W	Stone.
Roanoke	W	W	Stone, clays.
Rockbridge	1,004,216	1,311,756	Stone, sand and gravel, clays.
Rockingham	1,391,204	1,988,448	Stone, sand and gravel.
Russell	r 7,316,815	10,146,670	Coal, stone, clays.
Scott	944,095	1,116,398	Stone, coal.
Shenandoah	W	4,968,257	Stone, lime.
Smyth	W	W	Lime, salt, stone, gypsum, sand and gravel, clays.
Spotsylvania	W	W	Sand and gravel, stone.
Stafford	W	W	Sand and gravel.
Sussex	49,000	58,000	Do.
Tazewell [5]	r 901,288	1,333,334	Stone, coal, natural gas, lime, clays.
Virginia Beach (city)	938,000	W	Sand and gravel.
Warren	W	W	Cement, stone, sand and gravel.
Washington	2,115,098	1,840,052	Stone, gypsum.
Westmoreland	W	W	Sand and gravel.
Wise	27,413,732	29,383,306	Coal, stone.

See footnotes at end of table.

Table 10.—Value of mineral production in Virginia, by counties [1]—Continued

County	1964	1965	Minerals produced in 1965 in order of value
Wythe	$8,347,488	$8,359,077	Zinc, stone, lead, sand and gravel.
York	W	W	Sand and gravel.
Undistributed [6]	r 77,346,184	85,298,132	
Total	237,415,000	267,977,000	

r Revised. W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] The following counties are not listed because no production was reported: Amelia, Arlington, Carroll, Charlotte, Cumberland, Essex, Greene, James City, King and Queen, King George, Lancaster, Lunenberg, Madison, Mathews, Middlesex, Richmond, Southampton, and Surry.

[2] Excludes natural gas; included with "Undistributed."

[3] Excludes stone and petroleum; included with "Undistributed."

[4] Excludes stone and clays; included with "Undistributed."

[5] Excludes stone and natural gas; included with "Undistributed."

[6] Includes gem stones, natural gas, and values indicated by symbol W.

Amherst.—American Cyanamid Co., Pigments Division, mined ilmenite (iron titanium dioxide) near Lowesville for use in its titanium pigment plant at Piney River, Nelson County.

Smiley Sand Co., Lynchburg, processed construction sand dredged from the James River.

Appomattox.—Limestone for agricultural purposes was quarried and crushed by the Commonwealth of Virginia at its No. 2 Lime Grinding Plant near Oakville.

Augusta.—Limestone and shale for use in the manufacture of cement were produced by Lehigh Portland Cement Co. at Fordwick. Both general-use and high-early-strength portland cement were produced by the dry process in six kilns of varying dimensions. A sizable quantity of masonry cement was also produced. Electric power was both generated and purchased.

Crushed limestone for concrete aggregate and roadstone was produced by Augusta Stone Corp., Belmont Trap Rock Co., Inc., and Valley Stone Corp., all near Staunton, and Greenville Stone Corp., near Greenville, and W. E. Graham and Sons Division, Vulcan Materials Co., near Spottswood. The Commonwealth of Virginia quarried and ground limestone for use as agstone at its No. 1 Lime Grinding Plant near Staunton. Commercial production of limestone increased moderately.

North Mountain Brick of Virginia quarried shale near Buffalo Gap for use in its brick manufacturing plant near the quarry site.

Construction sand, mostly processed, was mined by D. M. Conner Sand Co., Inc., at its stationary plant at Stuarts Draft. Unprocessed construction gravel was produced by the Virginia Department of Highways. Southwest Materials, Inc., produced and crushed stream gravel near Steels Tavern for road construction, and Valley Sand Co. produced sand and gravel near Waynesboro.

Bath.—Unprocessed construction gravel was produced by the Virginia Department of Highways.

Bedford.—Blue Ridge Stone Corp., of Roanoke, quarried and crushed limestone for concrete aggregate and roadstone, railroad ballast, stone sand, and agstone at its Blue Ridge plant.

Clinchfield Sand & Feldspar Corp. mined potash feldspar and mixed feldspar (soda and potash) at its Coles, Mitchell, Overacre, Peakesville, and Skinnel mines, all in Bedford County. The feldspar, ground at the company mill, near Bedford, was marketed chiefly for pottery and enamel manufacture. Production increased, while the unit value was unchanged.

Bland.—The Commonwealth of Virginia Bland Correctional Farm produced agstone and riprap from limestone quarried near Point Pleasant; the crushed material was also marketed for local use.

Botetourt. — Lone Star Cement Corp., near Haymakertown, captively quarried limestone for use in the manufacture of cement. Both general-use and high-early-strength cement were manufactured by the dry process in four 9- by 340-foot rotary kilns; electric power was purchased. Both air-entrained and non-air-entrained portland cement, however, comprised the bulk of both production and shipments; masonry cement was also prepared and marketed.

Production of limestone declined moderately and Botetourt County dropped from second to third in output among the limestone-producing counties. Limestone marketed for use as concrete aggregate, roadstone, fluxstone, agstone, railroad ballast, and as raw material for chemical use was produced by Liberty Limestone Corp., at quarries near Buchanan and Rocky Point, and James River Hydrate and Supply Co., Inc., near Buchanan.

The county continued to rank first among the clay-producing counties in the State; production was comparable with that of 1964. Clay and shale for building brick and lightweight aggregate, respectively, were produced by Webster Brick Co., Inc., and Weblite Corp., both with plants near Webster.

Brunswick.—Granite for concrete aggregate and roadstone was quarried and crushed by Southern Materials Co., Inc., at its quarry near Rawlings.

Clay and schist were mined by Brick and Tile Corp. of Lawrenceville, for use in the manufacture of brick.

Buchanan.—As in previous years, Buchanan County led in coal production, accounting for 15.3 million tons or 45 percent of the State total. Production rose 5 percent, although there were 48 fewer active mines than in 1964. Of the 807 mines reporting production, 762 were underground mines, 14 were strip mines and 31 were auger mines. As in 1964, 92 percent of the output was from underground mines. The larger producers in the county included Harmon Mining Corp., Island Creek Coal Co., and Jewell Ridge Coal Corp. The chief producing seams included Red Ash, Jewell, and Splashdam.

Beehive coke was produced by Jewell Smokeless Coal Corp. at a plant near Vansant.

Natural gas, totaling 1,176 million cubic feet was produced and delivered to the pipelines of Atlantic Seaboard Co. and Hope Natural Gas Co.

Buckingham.—Slate was quarried and processed for roofing slate, structural and sanitary slate, flagging, and wall facing and flooring material by Arvonia-Buckingham Slate Co., Inc., and LeSueur-Richmond Slate Corp., both near Arvonia. Crushed slate was also produced and marketed as roadstone by Arvonia-Buckingham Slate Co., Inc. Blue Ridge Slate Corp. produced roofing granules from crushed slate at its plant near New Canton. Expanded slate for lightweight aggregate was produced by Solite Corp. of Richmond at a plant near New Canton.

Kyanite Mining Corp. mined and beneficiated raw kyanite at its mine near Sprouses Corner and processing plants near Dillwyn and Sprouses Corner. The refined material was marketed to manufacturers of refractories and other ceramic products. Dixon Sand Co. marketed construction and industrial sand produced in the beneficiation of the raw kyanite.

Campbell.—Limestone was quarried and crushed for concrete aggregate and roadstone by Blue Ridge Stone Corp. and Rockydale Stone Service Corp., both near Lynchburg; a limited quantity was also produced as agstone. Rough and dressed dimension building stone, dimension and dressed refractory stone (bakery oven hearth stones), and sawed and rough stone for flagging were prepared from rock quarried near Lynchburg by Virginia Greenstone Co., Inc. A limited quantity of waste or mill scrap was marketed for various uses. Lynlite Materials Co. produced lightweight aggregate from schist (phyllite) mined near Lynchburg.

Caroline. — Mattaponi Sand & Gravel Co., Inc. and Torrence & Wright produced sand and gravel near Point Eastern and Milford, respectively. Most of the output was processed for use in building and paving; a limited quantity of bankrun material was produced for construction use. Production increased compared with that of 1964. Caroline Sand and Gravel Co., Inc., began operations at the former pit of Dillard's Sand and Gravel near Guinea in 1965.

Carroll.—Pyrrhotite was mined intermittently near Galax, and in limited quantity, for use in the Pulaski plant of Allied Chemical Corp., General Chemical Division. Production from this operation was not reported and is not included in the statistical tables.

Charles City.—Sand and gravel was produced near Hopewell by Southern Materials Co., Inc.

Chesapeake (City). — Portland cement was produced by Lone Star Cement Corp. in Chesapeake. Calcareous marl and clay, captively produced near Chuckatuck in

Nansemond County, were used in the product manufacture, which was by the wet process. Non-air-entrained portland cement was the chief product. Three 7- by 219-foot kilns and one 10- by 340-foot kiln were used.

Radcliff Materials, Inc., dredged buried shell deposits (reef shell) in the Hampton Roads area. The shells were marketed for road aggregate, base for oyster seeding grounds, poultry grit, and for use in manufacturing cement.

Reliance Fertilizer and Lime Corp., Norfolk, produced hydrated lime for agricultural purposes at a plant near West Chesapeake. A mixture of half dolomitic limestone and half oystershell was calcinated in four coal-fired pot kilns.

Imported gypsum was processed at a plant near Norfolk by United States Gypsum Co. for plaster and other products. F. S. Royster Guano Co. and Chas. W. Priddy and Co., Inc., both near Chesapeake, ground imported gypsum for use as a land dressing.

Chesterfield.—Output and value of sand and gravel rose sharply, reflecting increased activity in highway construction; the county continued to rank third in production among the sand-and-gravel-producing areas. Sand and gravel, recovered by dredging along the James River, was processed for road construction by Southern Materials Co., Inc., at its Kingsland Reach plant near Chester.

Crushed granite for use mainly as concrete aggregate and roadstone was produced by Southern Materials Co., Inc., at the company's Dale quarry, near Chester, and by Tidewater Crushed Stone and Asphalt Co., in Richmond. A limited quantity of the output was also used as riprap.

Redford Brick Co., Inc., and General Shale Products Corp., Southside Division, mined clay near Richmond for use in building brick manufacture at their plants in Richmond. Southern Pottery at Richmond produced flowerpots from purchased clay. Clay was also produced and used by Daniels Brick & Tile Co., Inc., for the manufacture of vitrified sewer pipe and flue linings at its Richmond plant.

Clarke.—Stuart M. Perry, Inc., quarried and crushed limestone near Berryville for use as concrete aggregate, roadstone, and agstone. J. C. Digges & Sons, White Post, produced calcareous marl near Old Chapel for agricultural use. The Virginia Department of Highways produced crushed limestone for use in road building and maintenance.

Craig.—Sand for building and industrial use was produced and processed by Castle Sands Co. at operations near New Castle.

Culpeper.—Sandstone was quarried and crushed by Culpeper Stone Co., Inc., at its stationary plant near Stevensburg. The entire output was used as concrete aggregate and roadstone. Diabase was quarried for use as monumental and architectural stone by Buena Black Granite Corp. and Virginia Granite Corp. at plants near Buena. Production of both crushed and dimension stone increased.

Dickenson.—The second ranking of the eight coal-producing counties, Dickenson County, led in the degree of production gain, increasing its output over 1964 production by 14 percent. Included among the 135 active mines—19 less than in 1964—were 112 underground mines (132 in 1964), 13 strip mines (11 in 1964) and 10 auger mines (11 in 1964). Ninety percent of the county output was underground mine production.

Leading in coal production were Betty B. Corp., Clinchfield Coal Co., Contracting Enterprises, Inc., and Kilgore Creek Coal Co. Principal producing coal seams included Upper and Lower Banner, Splashdam, and Clintwood seams.

Clinchfield Coal Co. produced natural gas from numerous wells in the county, and 592 million cubic feet was delivered to Kentucky-West Virginia Gas Co. pipelines.

A limited quantity of industrial sand was dredged and processed by Honaker Sand Co. at Birchleaf. Clay for use in the manufacture of clay dummies was produced near Georges Fork by Combs Dummie Co.

Dinwiddie. — Southern Materials Co., Inc., quarried and crushed granite at its Jacks quarry near Petersburg for concrete aggregate and roadstone. Production continued at an increasing trend.

Daniels Brick & Tile Co., Inc., mined schist at its Hardy shale pit for use in manufacturing vitrified sewer pipe and flue linings at its plant in Richmond.

Fairfax.—Fairfax County continued to be the leading sand-and-gravel-producing area in both output and value; production

totaled 4 million tons valued at $5.1 million, a gain of 17 percent in output and 6 percent in value over that of 1964. This production and value constituted 26 and 28 percent, respectively, of the State total, compared with 32 and 35 percent, respectively, in 1964. Seventy-eight percent of the output was wet or dry screened, washed, or otherwise processed. Most of the tonnage produced was used for building and road construction. Leading producers of processed sand and gravel included Virginia Sand and Gravel Co., Inc., L. S. Sorber and Co., Hilltop Sand and Gravel Co., Inc., and Newton Asphalt Co., Inc., (formerly Mount Vernon Gravel Co., Inc.). Prepared and unprocessed gravel was produced by George F. Dodd Gravel Corp., near Franconia, and Edsall Corp., near Garfield.

Crushed granite for use as concrete aggregate, roadstone, riprap, and railroad ballast was produced by W. E. Graham & Sons Division, Vulcan Materials Co., near Occoquan. Fairfax Quarries, Inc., quarried and crushed diabase near Centreville for concrete aggregate and roadstone. Total stone production was greater than that of 1964. Purchased oystershell was crushed and ground as an agricultural liming material and poultry grit by Herbert Bryant, Inc., Alexandria.

Fauquier.—Sanders Quarry, Inc., quarried and crushed diabase at its stationary plant near Warrenton for concrete aggregate and roadstone. Riverton Lime and Stone Co. (formerly Chadbourn Gotham, Inc.) produced crushed basalt at its Fauquier quarry near Markham for concrete aggregate and roadstone; the company reported closing of this operation after mid-year 1965. Irregularly shaped sandstone rubble and flagging were produced and marketed by John Costello and Lofton Lambert, both with operations near The Plains. Two operations, Will Miller, Broad Run and Stone & Mineral Corp., Horner quarry, near Flint Hill, active in 1964, were idle during 1965.

Additional crushing facilities installed at the Sanders Quarry, Inc., plant near Warrenton, enabling the company to manufacture fine aggregate (sand) from their quarry stone, is reported, and the installation details are described in a recent publication.[4]

Floyd.—Basalt (amphibolite) was quarried and crushed for concrete aggregate and roadstone by Newman Brothers Quarry, Inc., near Floyd. Stream gravel was produced near Kings Store by Shanks Construction Co. and crushed for use in roads and driveways.

Fluvanna.—Stone & Mineral Corp. produced crushed quartz for architectural facing material at its Davis and Nahor quarries near Scottsville and Nahor, respectively.

Franklin.—Blue Ridge Talc Co., Inc., produced ground soapstone at its mine and plant near Henry chiefly for use in insecticides and foundry facings. The company also processed out-of-State hematite to produce a variety of finished natural and manufactured iron oxide pigments.

Frederick.—While it continued to lead in value of limestone produced, Frederick County was second in limestone output in 1965 (first in 1964) and was surpassed in tonnage by Shenandoah County. Output totaled 2.5 million tons valued at $3.5 million, a decrease of 9 percent in output and 7 percent in value. Limestone, used as concrete aggregate and roadstone, was quarried and crushed by Salem Stone Corp. at two portable operations near Middletown and Clearbrook, respectively. Stuart M. Perry, Inc., produced crushed limestone at a stationary operation near Winchester mainly for concrete aggregate and roadstone; a limited quantity was marketed as agstone, stone sand, and asphalt filler. W. S. Frey Co. mined and quarried limestone near Clearbrook chiefly for use as fluxstone for blast and open-hearth furnaces, concrete aggregate, roadstone, and for use in lime manufacture; a limited amount was also marketed as agstone, railroad ballast, and for use in cement making. M. J. Grove Lime Co., Division of the Flintkote Co., recovered and crushed limestone at its Middletown quarry and also at its surface and underground operations near Stephens City. The output was used mainly as fluxstone for iron and steelmaking, in the manufacture of lime, glass, and cement, and as concrete aggregate, roadstone, and agstone.

Hydrated lime and quicklime were produced at the Stephens City plant of M. J. Grove Lime Co., Division of the Flintkote

[4] Rock Products. Fine-Material Crusher Updates Virginia Quarry. V. 68, No. 2, February 1965, pp. 59–61.

Co. The products were marketed for chemical and other industrial uses, for agricultural uses, and for construction uses (soil stablization and mason's lime). The process equipment included seven natural gas-fired shaft kilns, one batch and one continuous hydrator, one Azbe Slip vertical and two Corson vibrating kilns.

Sand, used mainly in glass manufacture, was produced and processed by Virginia Glass Sand Corp. at its stationary plant near Gore; a limited quantity of building sand was also produced. Shenandoah Silica Co., Inc., Gore, operated a processing plant utilizing sand quarried by Virginia Glass Sand Corp.; the output was marketed for ceramic purposes.

Shale mined near Winchester was used by Shenandoah Brick and Tile Corp., Winchester, for the manufacture of brick.

Giles.—Foote Mineral Co. and National Gypsum Co. quarried and crushed limestone near Kimballton chiefly for use in the production of quicklime at the companies' plants, also near Kimballton; hydrated lime was also produced by the latter company. The products were marketed chiefly for chemical and other industrial uses; limited quantities of mason's lime and agricultural lime were also sold. A limited output of limestone was sold for metallurgical and other uses. Out-of-State magnetite was processed for use in coal preparation at a grinding plant operated by Foote Mineral Co. Limestone was also quarried and crushed for use as concrete aggregate, railroad ballast, and agstone by Ripplemead Limestone Co. and Virginian Limestone Corp., both near Ripplemead.

Gloucester.—Clyde R. Royals produced sand for use in asphalt at a pit near Gloucester.

Goochland.—Granite for concrete aggregate and roadstone was quarried and crushed by Boscobel Granite Corp. and W. E. Graham & Sons, Division Vulcan Materials Co., near Manakin and Hylas, respectively. A limited quantity was also marketed as riprap.

Grayson. — Grayson Stone Corp., near Fries, quarried and crushed granite for concrete aggregate and roadstone. Sand was produced for concrete and other uses by Riverside Sand near Fries.

Greensville.—Trego Stone Corp. quarried and crushed granite at its stationary plant near Skippers for use as concrete aggregate, roadstone, railroad ballast, and riprap.

Halifax.—W. E. Graham & Sons, Division of Vulcan Materials Co., quarried and crushed granite at their stationary plant near South Boston. Most of the output was used as concrete aggregate and roadstone; a limited amount was marketed as railroad ballast. Sand was produced on an intermittent basis by Kendall Sand Works near South Boston.

Hanover.—The General Crushed Stone Co. produced crushed granite at its stationary plant near Verdon for concrete aggregate and roadstone. M & T Chemicals, Inc., produced aplite (for glass manufacture) and ilmenite and rutile at its operations near Montpelier.

Henrico.—Output and value of commercial sand and gravel was comparable to 1964. The output was marketed mainly for building and highway construction; limited quantities were used for fill and septic tank drain fields. Most of the output (96 percent) was processed. Dredge No. 12, owned by Southern Materials Co., Inc., continued operations along the James River. Among producers operating stationary plants were Carter Sand & Gravel Co., Inc., Commonwealth Sand and Gravel Corp., and West Sand & Gravel Co., Inc., all near Richmond. Sadler Materials Corp. recovered sand and gravel from a pit near Varina. The blending system used by West Sand & Gravel Co., Inc., is described in a recent publication.[5]

Henry.—Granite was quarried and crushed for concrete aggregate and roadstone by Martinsville Stone Corp., near Martinsville; Wilson Qarries, Horse Pasture; and Snyder Stone Co., near Figsboro. Crushed granite for construction use was produced by the Public Works Department of the city of Martinsville.

Highland.—Limestone was produced and crushed for use in highway construction and maintenance by the Virginia Department of Highways; a limited quantity of unprocessed construction gravel was also produced by this State agency.

Isle of Wight.—Battery Park Fish & Oyster Co., Battery Park, produced lime by calcining oystershell; the lime was hy-

[5] Rock Products. In Virginia—Blending System is Simple and Foolproof. V. 68, No. 9, pp. 82–83.

drated and marketed for agricultural purposes.

Construction sand was produced by Benns Church Sand Co., Inc. Most of the output was processed. Bowden Brothers Gulf Service (formerly Zuni Sand Co., Inc.) recovered sand for masonry use from a pit near Zuni.

King William.—Sand and gravel for construction use was mined and processed by Fox Co. at their pit and stationary plant near Aylett.

Lee.—Output of coal increased 6 percent, although the number of active mines was 2 percent less than in 1964. Of the 68 mines active in 1965, 64 were underground, 3 were strip mines, and 1 was an auger mine. Underground mining accounted for most of the tonnage produced. Black Mountain Mining Co., Laurel Branch Coal Co., and Wright Mining Co. were among the leading producers. Output was largely from Darby No. 5, Marker, and Mason seams.

Limestone for use as concrete aggregate, roadstone, stone sand, agstone, railroad ballast, coal mine dust, and riprap was quarried and crushed by Kentucky-Virginia Stone Co. at its stationary plant (Wheeler quarry) near Gibson Station. Limestone for concrete aggregate, roadstone, and agstone was produced by Woodway Stone Co. at its stationary plant near Woodway.

Lee County (Ben Hur and Rose Hill fields) was the only oil-producing area in the State. Output was 3,617 barrels in 1965, compared with 5,828 barrels in 1964. Six wells were productive at yearend, compared with eight wells at yearend in 1964.

Loudoun.—Production and value of diabase (basalt) increased by 13 percent and 7 percent, respectively. Loudoun County ranked fourth in tonnage and value among all stone-producing counties. Diabase was the only stone type produced in the county. All the production was crushed for use as concrete aggregate and roadstone, and the stone was quarried by Arlington Stone Co., near Leesburg; Bull Run Stone Co., Inc., near Manassas; Chantilly Crushed Stone Co., Inc., near Arcola; Loudoun Quarries, Inc., near Herndon; and Virginia Trap Rock, Inc., near Leesburg.

Louisa.—Limestone for concrete aggregate and roadstone was quarried and crushed by Superior Stone Co., Division of Martin Marietta Corp., at its quarry near Gordonsville. A. H. Smith Stone Co. produced crushed stone from a granite quarry near Mineral.

Mecklenburg.—W. E. Graham & Sons, Division of Vulcan Materials Co., quarried and crushed granite for concrete aggregate, roadstone, railroad ballast, and riprap at the firm's Buggs Island quarry near Boydton. Southern Materials Co., Inc., quarried and crushed granite near Bracey for concrete aggregate and roadstone. Production increased substantially, compared with that in 1964. Sand for use in road construction was produced by Southern Materials Co., Inc., near Bracey.

Montgomery.—Limestone output declined slightly. Montgomery Limestone Corp., at its Shawsville and Ellett quarries, and Lambert Brothers Division, Vulcan Materials Co., at its portable plant near Radford, produced crushed limestone for use mainly as concrete aggregate and roadstone; a limited quantity was also produced for agstone. Sandstone was quarried and crushed for concrete aggregate and roadstone by Ironto Sand Co., Division of Montgomery Limestone Corp., near Ironto.

Old Virginia Brick Co., Inc., mined shale near Elliston for use in manufacturing building brick at its plant near Salem.

Semianthracite coal in limited quantity was mined from the Brushy Mountain seam.

Nansemond.—Lone Star Cement Corp. mined calcareous marl near Chuckatuck and also dredged clay from the Nansemond River, near Oakland; these captive materials were used in the manufacture of cement at the company's South Norfolk plant in the city of Chesapeake.

Webster Brick Co., Inc., manufactured brick from clay mined near Suffolk.

Nelson.—Dimension soapstone was produced by Alberene Stone Division of the Georgia Marble Co. at Schuyler. The material was quarried near Alberene and Old Dominion in Albermarle County and near Schuyler; the output from the quarries was processed at Schuyler. Laboratory and architectural stone and flagging were the principal products.

Aplite, mostly for use in glass manufacture, was mined and processed by International Minerals & Chemical Corp., Industrial Minerals Division, near Piney River. Shipments of ground aplite were made to glassmakers in Midwestern, Southern, and Eastern States. Dominion Stone Plant Co., Inc., also near Piney River, produced crushed material (aplite) for use in road construction.

New Kent.—J. R. Parker and Co., Inc., produced and processed construction sand and gravel at their stationary plant near Providence Forge.

Northampton.—Southern Materials Co., Inc., washed and screened paving sand at its Eastern Shore operation near Seaview. Clyde R. Royals, Inc., produced sand for use in asphalt at a pit near Nassawadox.

Nottoway.—Crushed granite was produced for concrete aggregate and roadstone by Burkeville Stone Corp., at its stationary plant near Burkeville. Granite was also quarried and crushed by the 1st United States Army, Camp Pickett, near Blackstone. Output, from operations wholly owned by the United States Army, was used for tank trails throughout the military reservation.

Orange.—Triassic mudstone for use in brick manufacture was mined by Webster Brick Co., Inc., near Somerset.

Page.—A limited quantity of unprocessed construction gravel was produced by Virginia Department of Highways. Shenandoah Sand and Gravel, Inc., produced sand and gravel near Shenandoah; and Dry Run Sand and Stone quarry produced weathered sandstone near Luray on an intermittent basis.

Patrick.—Sand and gravel was produced near Patrick Springs by Wilson Quarries.

Pittsylvania.—Crushed granite and sandstone chiefly for concrete aggregate and roadstone was produced by Superior Stone Co., Division of Martin Marietta Corp. and W. E. Graham and Sons Division, Vulcan Materials Co., at quarries near Danville and Dry Fork, respectively. Crushed granite was produced for use in construction by the Public Works Department, City of Danville.

Sand was dredged by portable draglines and processed for use mainly in building and paving applications. Principal producers included Kendall Sand Works and Marshall's Sand and Gravel Co., both near Danville.

Shale mined in North Carolina (near the North Carolina-Virginia border) was used in the manufacture of lightweight aggregate by Virginia Solite Corp. at its plant near Leakesville Junction.

Powhatan.—W. E. Graham and Sons Division, Vulcan Materials Co., quarried and crushed granite at the company's portable plant near Genito, mainly for concrete aggregate and roadstone; a limited quantity of riprap was also produced.

Prince Edward.—Kyanite was mined and beneficiated near Darlington Heights by Kyanite Mining Corp. The refined material, including output from the company's processing plants in Buckingham County, was ground and bagged at Pamplin City grinding and bagging plant. Chief users were the ceramic and refractory industries. Sand, prepared from quartzite separated during the beneficiation of the kyanite ore, was marketed for industrial and construction use by Dixon Sand Co.

Prince George.—Sand and gravel, most of which was processed, was produced for road construction, building, and as fill material by Friend and Co., Inc., and Southern Materials Co., Inc., both near Petersburg, and by Hitch Gravel Corp., near Garysville.

Prince William.—Diabase (traprock) for concrete aggregate and roadstone was quarried and crushed by W. E. Graham and Sons Division, Vulcan Materials Co., at quarries near Gainesville and Manassas, and McCanless Construction Co., near Aldie, (Loudoun County). Shale for the manufacture of building brick was mined by Woodbridge Clay Products Co. near Manassas.

Pulaski.—Radford Stone Corp., at quarries near Radford and Newbern, and Acme Stone, Inc., at its Newbern quarry, quarried and crushed limestone principally for use in building and road construction; other uses were agstone and railroad ballast. Crushed limestone for local use was produced by Robert P. Whitman, near Pulaski.

Hercules Powder Co., Inc., Imperial Color and Chemical Department, Pulaski, mined crude iron oxide near Hiwassee to produce natural iron oxide pigments at its Hiwassee plant; imported iron oxide was also utilized. The company also pro-

duced manufactured or synthetic iron oxide pigments at its Hiwassee and Pulaski plants.

Rappahannock. — Culpeper Stone Co., Inc., produced crushed granite near Flint Hill for concrete aggregate and roadstone.

Roanoke.—Rockydale Quarries Corp., at its Rockydale quarry near Roanoke, and Blue Ridge Stone Corp., at its portable plant also near Roanoke, quarried and crushed limestone for concrete aggregate, roadstone, and agstone. The modernization, especially the installation of improved crushing facilities, by the Rockydale Quarries Corp.'s Roanoke quarry is described in a recent publication.[6]

Shale for use in the manufacture of brick was produced by Old Virginia Brick Co., Inc., near Salem.

Rockbridge.—Output and value of stone increased, chiefly because of increased demand for materials required in highway construction. Charles W. Barger and Son, Inc., quarried and crushed limestone for concrete aggregate and roadstone at its quarry near Lexington. Lone Jack Limestone Co., Inc., produced crushed limestone and quartzite near Glasgow for concrete aggregate and roadstone. Lambert Brothers Division, Vulcan Materials Co., produced metallurgical quartzite at a quarry near Greenlee.

Sand, marketed primarily for use in glass manufacture, was produced from sandstone quarried near Goshen by Locher Silica Corp.

Clay was recovered near Glasgow by Locher Brick Co., Inc., for use in making brick.

Rockingham. — Stone production and value increased substantially. Elkton Limestone Co., Elkton; The Frazier Quarry, Inc., near Harrisonburg; W. E. Graham and Sons Division, Vulcan Materials Co., near New Market and Mount Crawford; Fred K. Betts, III, Quarry, Inc., near Harrisonburg; and C. S. Mundy Quarries, Inc., near Singers Glen, quarried and crushed limestone primarily for use in building and road construction. Other uses were agstone, railroad ballast, and cement and lime manufacture. Nielson Construction Co., Inc., Harrisonburg, produced dimension limestone. The output was chiefly irregularly shaped building stone. Jamison Black Marble Co., Harrisonburg, crushed marble for use as terrazzo.

Grottoes Sand & Gravel Co., Inc., produced and processed sand and gravel mainly for building and road construction and sanitary drain fields at its stationary plant near Grottoes.

Russell. — Output of coal in Russell County was 9 percent less than in 1964, but the value was 24 percent higher, because of a substantial increase in the unit value in 1965. Virtually all the tonnage was accounted for by underground production. Forty-two mines were active, 2 mines more than in 1964. Principal producers were Clinchfield Coal Co., Flat Rock Coal Co., and Griffith Banner Coal Co. Coal seams chiefly mined were Upper and Lower Banner, Red Ash, Kennedy, and Tiller seams.

Clinch River Quarries, near St. Paul, and R. G. Pope Construction Co., near Dickensonville, quarried and crushed limestone for concrete aggregate and roadstone. James River Hydrate and Supply Co., Inc., near Gardner, produced crushed limestone for aggregate, agstone, mine safety dust, and miscellaneous uses. White Excavating Co. quarried and crushed limestone near Castlewood.

Shale used in the manufacture of lightweight aggregate by the Clinchfield Coal Co., Lightweight Aggregate Division, was obtained from the coal preparation plant of the Moss No. 2 mine of Clinchfield Coal Co., near Cleveland, and processed at a plant near South Clinchfield.

Scott.—Output and value of limestone increased moderately. Natural Tunnel Stone Co. and Tri-State Lime, Inc., produced crushed limestone near Glenita and Bruno, respectively. The output was marketed as concrete aggregate, roadstone, railroad ballast, and agstone. Foote Mineral Co. captively mined and crushed limestone at Sunbright for use in manufacturing lithium hydroxide at its spodumene-processing plant also at Sunbright. Penn-Dixie Cement Corp. mined and crushed limestone near Speers Ferry for captive use at its Kingsport, Tenn., cement plant. A small output of coal was produced in the county by underground operations.

[6] Puckett, J. Eugene. Pinched for Production, Rockydale Quarries Modernizes. Rock Products, v. 68, No. 2, February, 1965, pp. 73–74.

Shenandoah.—Output and value of limestone, the only stone type produced, increased sharply, and in 1965 Shenandoah County ranked first in production and third in value among the stone-producing counties. The production gain was attributed mainly to increased demand for aggregates used in building and highway construction. Limestone was quarried and crushed chiefly for construction aggregate by Salem Stone Corp., with portable operations near Mount Jackson and Woodstock; Interstate Stone Corp. at its portable plant near New Market; C. S. Mundy Quarries, Inc., at its stationary plant near Timberville; and Toms Brook Lime and Stone Co., Inc., at a stationary plant near Toms Brook; a limited quantity of agstone was also produced. Chemstone Corp., a subsidiary of Minerals and Chemicals Philipp Corp., produced crushed limestone at its Dominion quarries near Strasburg, primarily for use in the company's lime-making operations, and as fluxstone in blast and open-hearth furnaces. Other uses were in road construction and miscellaneous applications. Shenandoah Valley Lime and Stone Corp. produced crushed limestone at its stationary plant near Strasburg for concrete aggregate, roadstone, fluxstone, lime manufacture, and railroad ballast. Kipps Magnesium Limestone quarry produced crushed limestone near Forestville for agstone.

Chemstone Corp., subsidiary of Minerals and Chemicals Philipp Corp., produced quicklime and hydrated lime from captive limestone quarried near Strasburg. The limestone was calcined in four gas-fired shaft kilns; a continuous hydrator was used to produce hydrated lime. The products were marketed chiefly as flux for steelmaking and for use in paper manufacture. Water purification and softening and sewage and trades-waste treatment were other uses. Pennsylvania, Maryland, Ohio, and Virginia were the principal marketing areas.

Smyth.—Lime was produced by Olin Mathieson Chemical Corp., Saltville, from captive limestone mined nearby; a limited quantity of the crushed stone was marketed as construction aggregate. The limestone was conveyed to the lime kilns by aerial tramway. Calcining equipment included 3 rotary and 14 vertical kilns that were coal- and coke-fired. The output was captively consumed in the production of alkalies (soda ash and caustic soda), together with salt brine from the company's nearby salt wells. Chlorine and caustic soda were other principal products manufactured from the captive brine. Crushed limestone was produced chiefly for concrete aggregate and roadstone by Holston River quarry, Inc., near Marion; a limited quantity of agstone was also produced.

The United States Gypsum Co. recovered gypsum from its Locust Cove mine near Chatham Hill; the material was trucked to the company's processing plants at Plasterco in Washington County.

Sayers Sand Co. and C. R. Snider and Sons Sand Co., both near Marion produced crushed sandstone and sand. The total output of fine and coarse aggregates was used in building and road construction.

General Shale Products Corp., Appalachian Shale Division, mined shale for use in the manufacture of brick at a plant near Groseclose.

Spotsylvania. — Sand and gravel was mined from several pits in the Fredericksburg area by Massaponax Sand & Gravel Corp. and procesesd at its stationary plant near Fredericksburg. Output was used in building and road construction.

Crushed granite for concrete aggregate and roadstone was produced near Fredericksburg by Fredericksburg Stone Co., Inc.

Stafford.—Fredericksburg Sand & Gravel Co., Inc., Jobe Newton, and P. C. Goodloe and Son, all near Fredericksburg, produced construction sand and gravel, most of which was processed.

Sussex.—Adams Construction Co. mined and processed sand and gravel for road construction at a plant near Stony Creek. Production increased, compared with that of 1964.

Tazewell. — Crushed limestone, largely for concrete aggregate and roadstone, was produced by Pounding Mill Quarry Corp. at quarries near Bluefield and Pounding Mill. Other uses included railroad ballast, stone sand, mine safety dust, agstone, and fluxstone. Mine safety dust was manufactured by Limestone Dust Corp. at its grinding plant near Bluefield from purchased limestone. Limestone quarried by

Peery Lime Co. at North Tazewell and Blue Grass Lime Co., near Maxwell, was consumed in the companies' lime kilns in the manufacture of hydrated lime. Coal-fired pot kilns were used. The lime was marketed as mason's lime, agricultural lime, and for use in water purification and softening, chiefly in Virginia and neighboring States. A limited quantity of crushed limestone was also marketed for local use by Peery Lime Co.

Even though the number of active mines was two less than in 1964, the output of coal mined in Tazewell County increased by more than two-thirds in 1965. Of the 16 active mines, 11 were underground mines, 3 were auger mines, and 2 were strip mines. Leading producers were Alfredton Coal Co., Myner Coal Co., Inc., Rebecca Coal Co., and Rodger Brothers Construction Co., Inc. The Upper Seaboard, Red Ash, and Jawbone seams were chiefly mined.

Production of natural gas totaled 2,443 million cubic feet in 1965 compared with 12 million cubic feet in 1964. The increase was due mainly to new gas wells completed during 1965. Deliveries were to the pipeline of the Atlantic Seaboard Line.

General Shale Products Corp. mined shale from a pit near Richlands for use in brick manufacture. Clay, for use in the manufacture of clay dummies, was produced near Tazewell by Tazewell Clay Products Co.

Virginia Beach (City).—Output of sand increased sharply, and in 1965 the city ranked second in output among sand-and-gravel-producing areas but continued to rank fourth in value. The output, 88 percent of which was unprocessed, was used principally for building and road construction and fill. A limited quantity was marketed for industrial use. As in 1964, no gravel production was reported. Leading in the recovery of sand from pits near Virginia Beach were E. V. Williams Co., Inc., E. C. Womack, Inc., R. H. Baillio, Tidewater Sand Co., and J. C. Jones Sand Co., Inc.

Warren. — Argillaceous limestone was quarried by Riverton Lime & Cement Co., Inc., near Riverton, for use in the manufacture of masonry cement; a sizable tonnage was also produced for construction aggregate, agstone, and railroad ballast.

A limited quantity of crushed quartzite was produced by J. B. Earle, Front Royal, for use as aggregate in road construction.

Washington. — Reversing a declining trend, limestone production and value increased slightly. Crushed limestone for concrete aggregate, roadstone, agstone, and railroad ballast was produced by Acme Stone, Inc., near Abingdon; Lambert Bros. Division, Vulcan Materials Co., near Bristol; Meadowview Lime & Stone Corp., near Meadowview; and Washington County Stone Co., near Glade Spring.

The United States Gypsum Co. mined and processed gypsum at Plasterco. Gypsum, mined at the company's Locust Cove mine near Chatham Hill, Smyth County, was also processed at Plasterco. Materials marketed included plasterboard and other gypsum products for distribution chiefly to construction industries.

Westmoreland.—Construction Materials, Inc., (formerly Potomac Sand & Gravel Co.) produced and processed sand at its stationary plant at Coles Point, mainly for use in building and road construction.

Wise.—Continuing an increasing trend, coal production in 1965 was 7.3 million tons, 7 percent greater than in 1964, even though the number of active mines decreased. The county produced 21 percent of the coal mined in Virginia and led in the production of strip mined coal. Of the 200 mines active in 1965 (257 in 1964), 160 were underground mines, 23 were strip mines, and 17 were auger mines. Sixty-eight percent of the county output was from underground mines (75 percent in 1964); strip mines accounted for 26 percent (19 percent in 1964). Leading coal producers included Coal Processing Corp., Stallard-Womack Mining Corp., Stamach Mining Corp., Sunrise Mining Corp., and Westmoreland Coal Co., Stonega Division. Important producing seams were the Blair, Clintwood, Kelly, Taggart, and Upper Banner. Coke producers (beehive) in 1965 were Christie Coal and Coke, Inc., and Norton Coal Co., Inc., both with plants near Norton; Westmoreland Coal Co., Stonega Division; and Wise Coal and Coke Co., with plants near Roaring Fork and Dorchester, respectively.

Southwest Quarries, Inc., quarried and crushed limestone for construction aggregate and railroad ballast at its stationary plant near Big Stone Gap.

Wythe. — The New Jersey Zinc Co. treated zinc and lead ores from both the Austinville and Ivanhoe mines at its mill at Austinville; ore from the Ivanhoe mine was conveyed to the mill through an underground tunnel. Zinc concentrate was treated at the Palmerton, Pa., smelter of The New Jersey Zinc Co. and the East Chicago, Ind., roaster of Grasselli Chemicals Dept., E. I. du Pont de Nemours and Co., Inc.; the roasted product was further treated at the Depue, Ill., smelter of The New Jersey Zinc Co. Lead concentrate was shipped to Schuylkill Products Co., Baton Rouge, La.

Newman Bros. Quarry, Inc., produced crushed sandstone near Patterson for concrete aggregate and roadstone. Locher Silica Corp. (formerly Silica Products Co.) produced and prepared construction sand (crushed sandstone) at its stationary plant near Fort Chiswell. Production of limestone was less than in 1964. Crushed limestone for concrete aggregate and roadstone was produced by H. D. Crowder and Sons at a quarry near Poplar Camp; Pendleton Construction Corp., near Wytheville; and Holston River Quarry, Inc., near Rural Retreat. Limestone recovered from lead and zinc ore concentration at The New Jersey Zinc Co. operations at Austinville was marketed chiefly as agstone, although some material was produced for road construction and fertilizer filler.

York.—Sand for building and road construction was dredged and processed by Southern Materials Co., Inc., Yorktown, at its Grafton plant.

The Mineral Industry of Washington

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the Washington Division of Mines and Geology for collecting information on all minerals except fuels.

By Ronald P. Collins [1] and William N. Hale [2]

Washington's mineral production was valued at $86 million in 1965, an increase of 6 percent as compared with the 1964 total. Increased values of sand and gravel and stone production, mainly due to dam and highway construction were largely responsible for the gain. Highway contracts awarded in 1965 were valued at $103 million. Sand and gravel and stone amounted to $45 million (52 percent) of the total value of mineral production. The tonnage of sand and gravel production declined somewhat; nevertheless, the commodities accounted for about 75 percent of the $5 million increase in total value over that of 1964.

Other principal commodities were zinc, lead, gold, and cement. Zinc output and value declined, but the value of lead increased, owing to higher prices and increased production. Olivine and fire clays

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Table 1.—Mineral production in Washington [1]

Mineral	1964		1965	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Barite—short tons	--------	--------	(2)	$1
Carbon dioxide—thousand cubic feet	W	W	11,848	3
Cement:				
Portland—thousand 376-pound barrels	W	W	6,258	22,351
Masonry—thousand 280-pound barrels	W	W	62	201
Clays [3]—thousand short tons	128	$119	162	211
Coal (bituminous)—do	68	575	55	497
Copper (recoverable content of ores, etc.)—short tons	35	23	30	21
Lead (recoverable content of ores, etc.)—do	5,731	1,502	6,328	1,974
Peat—do	35,609	170	29,729	131
Sand and gravel—thousand short tons	31,920	25,971	31,301	27,234
Stone—do	r 10,498	r 15,204	12,461	17,446
Talc and soapstone—short tons	2,680	18	2,861	17
Uranium ore—do	147,005	3,601	73,495	1,871
Zinc (recoverable content of ores, etc.)—do	24,296	6,609	22,230	6,491
Value of items that cannot be disclosed: Diatomite, fire clay, bentonite, gem stones, gold, lime, magnesite, mercury (1965), olivine, pumice, silver, tungsten (1965), and values indicated by symbol W	XX	27,518	XX	7,723
Total	XX	r 81,310	XX	86,172

r Revised. W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed." XX Not applicable.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Less than ½ unit.
[3] Excludes bentonite and fire clay; included with "Value of items that cannot be disclosed."

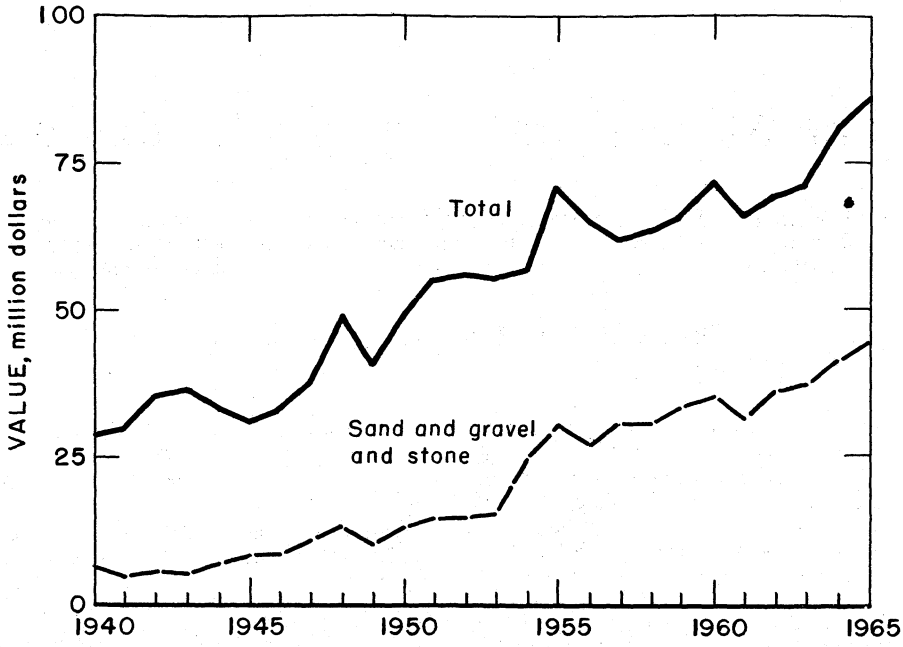

Figure 1.—Value of sand and gravel and stone, and total value of mineral production in Washington.

showed substantial production increases.

Portland cement output was over 6 million barrels. Three firms announced that additional facilities for producing cement were to be constructed in the Puget Sound region of western Washington.

For the second consecutive year, aluminum production exceeded the published primary capacity. The value of the 1965 aluminum output was $263 million. The 76,000-ton primary aluminum reduction complex under construction by Intalco Aluminum Corp. at Bellingham was to be operational by May 1966, and a second 76,000-ton-per-year potline was planned for completion early in 1967.

Another major development in the aluminum industry was the initiation of waterborne delivery of alumina to nearly completed facilities at Aluminum Company of America's Vancouver reduction works. A similar venture was planned for Tacoma (Kaiser Aluminum & Chemical Corp.) and Bellingham (Intalco Aluminum Corp.). The alumina was to be imported from South America and Australia.

Sales of electric energy by the Bonneville Power Administration (BPA) to aluminum reduction and rolling plants in Washington increased over 9 percent; total revenue generated by these sales amounted to nearly $17 million.

A 267-mile pipeline, designed to carry 135,000 barrels of petroleum products daily, was completed from the Ferndale-Anacortes area to Portland, Oreg. It featured 40 miles of lateral connections to intermediate marketing areas.

Battelle Northwest, a research and development firm based at Columbus, Ohio, suggested that studies be made of the feasibility of erecting plants to fabricate lead, zinc, and other metals produced in State mining districts which could be developed from research conducted at its Pacific Northwest laboratory. Besides the $80 million laboratories it took over at the Richland works of the Hanford project, Battelle planned to spend $20 million on new facilities adaptable to problems of the minerals and mining industry.

Consumption, Trade, and Markets.—Important gains were recorded in construction activity. Building permits rose 10

percent in value, but of special significance to long-term growth were new housing starts, which reached 17,100 units, substantially above the 1964 figure. Washington expanded in heavy construction and nonresidential building because of aerospace and dam activity in addition to highway construction in King County. Significant projects included a $20 million space center in Seattle for the Boeing Company, and $30 million in other aerospace construction projects. Contracts were awarded in early 1965 for two large dam projects, $7.19 million for the Little Goose Dam on the Snake River and $42.5 million for the Mossyrock Dam and powerhouse on the Cowlitz River. Washington ranked first among the States in the magnitude of gross theoretical waterpower potential (almost 22 million kilowatts) and in actual installed capacity (about 9.3 million kilowatts as of December 31, 1964). When powersites under construction (6.1 million kilowatts) were included, approximately 70 percent of the gross theoretical waterpower in Washington would be developed or its development would be in progress.

Table 2.—Value of mineral production in constant 1957–59 dollars

(Thousands)

Year	Value
1956	$57,207
1957	60,608
1958	61,932
1959	64,565
1960	71,383
1961	66,381
1962	68,315
1963	r 71,383
1964	r 80,296
1965	84,906

r Revised.

Agricultural products registered a slight drop in receipts because a major freeze damaged fruits; this sharply curtailed output of the State's dependent canning industry.

The strength of business activity also was reflected in the growth of business loans as reported by the Federal Reserve Bank of San Francisco. Washington's $271 million increase in 1965 accounted for its largest loan expansion to date, as banks assisted local firms in financing the current boom in plant and equipment investment.

Employment.—Influence of the expansive industrial activities was most apparent in the employment sector of the State's economy, which recorded substantial gains in nonfarm employment in 1965 over the relatively weak 1963–64 performance. Fig-

Table 3.—Indicators of Washington business activity

		1964	1965 p	Change, percent
Personal income:				
Total	million dollars	8,032	8,564	+6.6
Per capita	dollars	2,707	2,864	+5.8
Construction activity:				
Building permits	million dollars	401.6	441.2	+9.9
Heavy engineering awards	do	314.9	408.7	+29.8
State highway commission:				
Value of contracts awarded	do	91.8	102.9	+12.1
Value of contract work performed	do	83.6	103.3	+23.6
Cement shipments to and within Washington	thousand 376-pound barrels	5,360.2	5,893.8	+10.0
Cash receipts from farm marketings	million dollars	610.0	603.9	−1.0
Factory payrolls	do	1,543.5	1,651.6	+7.0
Annual average labor force and employment:				
Total labor force	thousands	1,137.2	1,159.5	+2.0
Unemployment	do	69.8	58.3	−16.5
Employment:				
Construction	do	40.5	46.1	+13.8
Aerospace	do	52.6	57.0	+8.4
Lumber and wood products	do	46.7	46.2	−1.1
Food processing	do	25.8	26.0	+0.8
All manufacturing	do	219.3	225.6	+2.9
All industries	do	1,067.1	1,100.0	+3.1

p Preliminary.

Sources: Survey of Current Business, Construction Review, Pacific Builder and Engineer, Washington State Highway Commission, The Farm Income Situation, Washington Employment Security Department, and Bureau of Mines.

Table 4.—Annual employment and total wages in the mineral industries

Industry	1964		1965	
	Employment	Wages (thousands)	Employment	Wages (thousands)
Mining:				
Metal mining	579	$3,896	587	$4,135
Bituminous coal, crude petroleum, and natural gas	164	1,229	127	899
Nonmetallic mining and quarrying	983	6,956	1,098	8,421
Total	1,726	12,081	1,812	13,455
Stone, clay, and glass products:				
Cement, hydraulic	509	3,652	542	3,950
Structural clay products	238	1,421	276	1,666
Concrete, gypsum, and plaster products	3,551	24,930	3,710	27,278
Other	925	6,011	929	6,303
Total	5,223	36,014	5,457	39,197
Smelting, refining, and casting:				
Blast furnaces, steelworks, rolling and finishing mills	1,622	12,063	1,896	14,309
Iron and steel foundries	1,029	7,052	1,092	7,847
Smelting, refining, and casting of nonferrous metals, except aluminum	1,100	7,363	1,108	7,609
Smelting, rolling, drawing, and casting of aluminum	7,192	54,910	7,544	59,388
Miscellaneous	796	5,825	73	553
Total	11,739	87,213	11,713	89,706
Industrial chemicals [1]	9,229	81,763	6,781	59,914
Petroleum refining and related industries	1,314	9,977	1,230	9,923
Grand total	29,231	227,048	26,993	212,195

[1] The Hanford atomic plant is the largest in this classification.

Source: Washington Employment Security Department bulletins on industries covered by Washington State Employment Security Act. Industry groups may vary from those in the Bureau of Mines canvass.

ures published by the Washington Employment Service show that the jobless count had reached an 8-year low, 3.8 percent of the labor force. There was a significant recovery in aerospace activities in 1965, and an announcement by the Boeing Company suggested that the peak employment of 1962 might be surpassed within a few years. The announcement was based on commercial sales rather than Defense Department contracts and should provide a dependable framework for stable growth in the State's related manufacturing and metal-fabricating industries.

Annual employment in the lumber and wood products industries remained about the same as in 1964, apparently indicating that long-range downward trends were leveling off. Employment during 1964 and 1965 in these industries was higher than in 6 of the 7 preceding years. The only persistent downward trend was in the food and kindred products industries where a decline averaging 1.5 percent per year had been registered for the past decade.

Legislation and Government Programs.—The Washington Department of Natural Resources placed in effect new mineral leasing laws to stimulate prospecting and mineral production on the 3 million acres of State-owned land. The biggest change in the mining law was to increase from 80 to 640 acres the amount of land that can be held under a single lease for prospecting or mining. There is no limit to the number of leases that can be held by any lessee. The new law also removed any requirement for development work under the 2-year prospecting lease or for the first 4 years of a mining contract, but after that, evidence of efforts to go into production was necessary, or the contract was to be canceled. This gave companies more time and flexibility to arrange financing. A previous requirement for a royalty payment of at least 1 percent of proceeds from the mine had been eliminated because the Department was to determine the royalty. Another provision prevented any renewals of the 2-year prospecting

Table 5.—Employment and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1964:								
Coal	85	247	21	169	-------	4	23.64	402
Peat	45	156	7	58	-------	-------	-------	-------
Metal	447	246	110	884	1	46	53.19	7,984
Nonmetal	147	122	19	150	-------	1	6.67	7
Sand and gravel	1,879	183	343	2,825	2	48	17.70	4,676
Stone	1,207	198	238	1,912	-------	37	19.35	655
Total	3,810	194	738	5,998	3	136	23.17	3,599
1965: p								
Coal	80	275	22	178	-------	4	22.47	382
Peat	35	114	4	32	-------	1	30.79	123
Metal	425	282	120	958	1	76	80.38	8,160
Nonmetal	140	157	22	176	-------	2	11.36	318
Sand and gravel	2,085	193	402	3,311	-------	62	18.73	337
Stone	1,270	202	256	2,053	-------	31	15.10	128
Total	4,035	205	826	6,708	1	176	26.39	1,390

p Preliminary.

leases which discouraged attempts to obtain land for hunting, fishing, and other recreational uses.

L–D Mines of Wenatchee explored for gold on its property (Gold King mine) in Chelan County with financial assistance from the Office of Minerals Exploration (OME), U.S. Department of the Interior. The total cost of the work was estimated at $133,260, of which Government participation was $66,630.

The Federal Geological Survey and the Federal Bureau of Mines began a project to evaluate the minerals potential of the North Cascades Primitive Area of Whatcom and Okanogan Counties.

An important development affecting the industrial base of the Washington economy was approval by the Federal Power Commission of a 3-percent BPA power rate increase effective December 20, 1965. It was authorized to allow repayment of the Federal investment in presently authorized power facilities within the period expected by Congress. The rate increase was the first in BPA's 28-year history as the marketing agent for power generated at Pacific Northwest Federal dams.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Abrasive Materials.—Carborundum Co., Vancouver, continued manufacturing silicon carbide for abrasive, chemical, and refractory purposes. Abrasive-grade material was shipped to sizing and treatment plants in the Eastern States for subsequent processing into material used in bonded and coated abrasive products. Some went to the Western States for use in sandblasting. Chemical-grade silicon carbide was consumed by the steel industry as a furnace additive, and by the petroleum industry as a catalyst in refining crude oil. Refractory-grade crude silicon carbide was shipped to the company Perth Amboy, N.J., refractory plant.

Imperial Metals & Abrasives, Inc., announced plans to construct an electric furnace operation at Centralia to produce silicon metal. The company planned to revamp, and modify to suit its operation, a building constructed on an 8.8-acre site in the early 1940's. In addition to silicon metal, the firm announced that it expects to produce molded abrasive products, silicon carbide, and other abrasives. Electric power for the operation was expected to be supplied by BPA, and the Centralia city light system was to be an alternate source.

The artificial abrasives industry of the Pacific Northwest was described.[3]

Barite.—Output of barite, by W. A. Madsen from the Madsen quarry in Stevens County, was sold to Northwest Talc & Magnesium Co., Clear Lake, for grinding.

Cement.—Portland cement shipments, by four firms operating six plants, totaled 6,257,506 barrels.

Raw materials for manufacturing cement included 1.6 million tons of cement rock (argillaceous limestone) and limestone, 89,000 tons of sand or siliceous materials, 66,000 tons of clay, 50,000 tons of iron ore and iron-bearing slag, and 48,000 tons of gypsum. In addition, 143 million kilowatt-hours of electric energy was consumed in manufacturing the product.

Of the total portland cement shipped from the four dry- and two wet-process plants, 66 percent was transported by truck, 24 percent by rail, and 10 percent by boat. The ratio of bulk to paper bag shipments was about 9:1. About 74 percent of the portland cement produced was distributed to firms manufacturing commercial concrete products, such as ready-mixed concrete companies (57 percent), concrete product manufacturers (12 percent), and building material dealers (5 percent). The remaining 26 percent was sold to highway (11 percent) and other contractors (14 percent), and to Federal, State, and local government agencies (1 percent).

Commitments were made by three firms to construct additional cement-producing facilities in the Puget Sound region of western Washington. Peter Kiewit Sons' Co. was named general contractor for constructing Ideal Cement Company's proposed $20 million cement plant at Seattle. Foundation testing and other preliminary work were underway at the company 25-acre site on the Duwamish River Waterway, and completion of the plant was scheduled for late 1966. Kaiser Cement & Gypsum Corp. announced a settlement agreement with the Federal Trade Commission providing for divestment of its cement plant at Bellingham and two of the three aggregate and ready-mixed cement plants of its subsidiary, Glacier Sand & Gravel Co. The agreement provided that the cement plant be divested within 4 years and the two aggregate and ready-mixed concrete plants within 2 years. The aggregate and ready-mixed concrete plants of Glacier Sand & Gravel Co. to be divested were the Vancouver plant and the Albina Street plant in Portland, Oreg. Glacier Sand & Gravel Co. would retain the Curry Street plant in Portland and the aggregate deposits with related mining and transport equipment. To protect its market position in the area, Kaiser Cement & Gypsum Corp. signed a long-term lease with the Seattle Port Commission for a proposed 20-acre tidewater cement-plant site on the Duwamish River Waterway at Seattle. The company did not set a date for the proposed cement plant construction; however, terms of the lease require the company to make property improvements of at least $10 million within 4 years. Late in the year, Lone Star Cement Co. announced that it held options on several sites and was in the final stages of preparation for an additional cement-producing facility at Anacortes, Concrete, or Seattle.

The proposed construction of additional highly efficient cement plants, including automatic controls and equipment for their operation, may supplant some of the existing cement plants in the State. The present cement-producing facilities, with the year of initial plant output in parentheses after the location, included operations of Lone Star Cement Corp. at Concrete (1910) and Seattle (1929); Ideal Cement Co. at Irvin (1913) and Grotto (1928); Kaiser Cement & Gypsum Corp. at Bellingham (1913); and Lehigh Portland Cement Co. at Metaline Falls (1911).

Clays.—The tonnage of clays produced advanced 27 percent owing to increased output of miscellaneous clay for heavy clay products (building brick and draintile) and an increase of fire-clay output for use in refractory products.

Fire clay was mined in King and Spokane Counties. Miscellaneous clay for making heavy clay products came from 14 pits in 9 counties. Clay used in manufacturing cement was furnished from pits in King, Spokane, and Whatcom Counties. Bentonitic clay, used in lining irrigation canals, was dug in Yakima County.

Diatomite.—Production of diatomite declined 15 percent from the 1964 total.

[3] Petersen, N. S., and W. N. Hale. Trends and Outlook for Manufacture of Artificial Abrasives in the Pacific Northwest. Report for the Bonneville Power Administration, Portland, Oreg. Bureau of Mines Mineral Resource Office, Albany, Oreg., 1965, 37 pp.

Kenite Corp. continued to mine and process diatonite in Grant County. Prepared diatomite was marketed as a filtering aid, as a filler, and for insulation purposes.

Gypsum.—No gypsum was mined, but Agro Minerals, Inc., prepared and marketed gypsum for agricultural land plaster from stockpiles of material mined previously in Okanogan County.

Kaiser Gypsum Co., Inc., Seattle, made building products from gypsum mined in Baja California, Mexico. Some gypsum from the foreign source also was marketed by the company as a portland-cement retarder, for agricultural land plaster, and as a filler. Greenacres Gypsum Co., Spokane, sold gypsum imported from Canada for agricultural purposes.

Lime.—Production of lime increased 5 percent over the 1964 total. Primary open-market lime was manufactured by Pacific Lime, Inc., Tacoma; the material was marketed for a wide variety of chemical uses and for construction and agricultural purposes. Limestone for the operation was received by barge from company quarries at Texada Island, British Columbia, Canada. Captive lime output for interplant use was from burning limestone at sugar-refining operations in Grant and Yakima Counties, and from regenerating lime sludge in kilns at eight sulfate (Kraft) pulping operations. Lime recycled at Kraft pulping operations was not included in the State total.

Magnesian Minerals.—Lessened demand for refractory magnesia by the steel industry resulted in a 29-percent decrease in magnesite tonnage mined by Northwest Magnesite Co. Shipments of refractory-grade magnesia by the company declined 10 percent.

Olivine was mined from the massive Twin Sisters Mountain deposit by Northwest Olivine Co. and Scheel Stone Co. at operations in Skagit County, and by Olivine Corp. at an operation in Whatcom County. The crude material was processed at plants of Northwest Olivine Co., Hamilton, and Olivine Corp., Bellingham. Olivine Corp. operations at Bellingham were described.[4] Processed olivine tonnages, sold principally as a foundry sand to consumers in the Western and Midwestern States and Canada, increased 21 percent over the 1964 output. A pilot plant was operated at Bremerton to determine the feasibility of processing olivine for its magnesium content.

Pumice.—Production of pumice and pumiceous materials declined 19 percent from the 1964 total. Pumice for use as concrete aggregate was produced by Ewer Lumber Co. from a deposit in Chelan County.

Sand and Gravel.—Sand and gravel output, remaining substantially constant, declined only 2 percent from the 1964 total. Increased requirements for sand and gravel by the State highway department offset a large decline for these materials by the U.S. Army Corps of Engineers at dam construction projects.

Government-and-contractor operations, largely production (by Federal, State, and local government agencies) for road building and dam construction projects, continued to contribute large tonnages that comprised about 51 percent of the State sand and gravel output. Production was from 206 plants—17 stationary, 135 portable, and 54 semiportable. The remaining 49 percent came from commercial firms operating 131 plants—85 stationary, 28 portable, and 18 semiportable.

Sand and gravel was produced in 37 of the 39 counties. Output was valued at over $6 million in King County, $3 million in Pierce County, $2 million in Walla Walla County, and more than $1 million each in Clark, Snohomish, Spokane, Whitman, and Yakima Counties.

Distribution of total output by use was roadbuilding and maintenance, 43 percent; construction, 18 percent; fill (largely for railroad and dam embankment), 35 percent; railroad ballast, 1 percent; and miscellaneous, 3 percent. Included under miscellaneous were small but important tonnages of special industrial sands utilized for glass manufacturing, sandblasting, and foundry applications.

Stone.—Output of stone advanced 19 percent over the 1964 total, owing to greater requirements by the U.S. Army Corps of Engineers at dam construction projects. Stone was quarried in 35 counties. Columbia, King, Snohomish, and Whatcom Counties each had production valued at over $1 million. Output from Government-and-contractor operations, largely ba-

[4] Herod, Buren C. Olivine Corporation. Pit and Quarry, v. 58, No. 5, November 1965, pp. 125–126, 138.

Table 6.—Sand and gravel sold or used by producers, by classes of operation and uses
(Thousand short tons and thousand dollars)

Class of operation and use	1964		1965	
	Quantity	Value	Quantity	Value
Commercial operations:				
Building	5,496	$6,316	5,699	$6,235
Road material	5,524	5,801	6,047	6,015
Fill	2,714	1,821	2,724	1,899
Railroad ballast	376	271	190	142
Other [1]	527	806	739	1,030
Total	14,637	15,015	15,399	15,321
Government-and-contractor operations:				
Building	120	180	2	6
Road material	16,409	10,235	7,260	6,768
Fill	397	233	8,404	4,772
Other [1]	357	308	236	367
Total	17,283	10,956	15,902	11,913
All operations:				
Building	5,616	6,496	5,701	6,241
Road material	21,933	16,036	13,307	12,783
Fill	3,111	2,054	11,128	6,671
Railroad ballast	376	271	190	142
Other [1]	884	1,114	975	1,397
Grand total	31,920	25,971	31,301	27,234

[1] Includes special sands for construction and industrial uses and sand and gravel for miscellaneous unspecified purposes.

salt production for roads and as riprap, continued to be large and represented 66 percent of the State figure. The remaining 34 percent of total stone output came from operations by commercial firms.

Basalt, accounting for 87 percent, or 10.8 million tons, of the total stone output, came from operations in 31 counties; it was used for concrete aggregate, roadstone, riprap, and ballast.

Limestone production, totaling 1.4 million tons valued at $2.9 million, came from operations in Chelan, Pend Oreille, San Juan, Skagit, Snohomish, Stevens, and Whatcom Counties. About 1.3 million tons of the limestone output was used for manufacturing cement; the remainder was used by the paper and metallurgical industries and for agricultural purposes. A large tonnage of limestone was imported for manufacturing cement, lime, and paper.

Output of 100,040 tons of silica-bearing materials valued at $483,855 came from sandstone, quartz, and quartzite operations in Chelan, Pend Oreille, Pierce, Stevens, and Spokane Counties. The crushed and sized siliceous material was marketed for use in manufacturing abrasives, cement, ferrosilicon, glass, roofing granules, and sodium silicate, and for use as foundry sand. Large tonnages of silica-bearing material from sources outside the State continued to supplement the material mined. Dimension sandstone was produced in Chelan, Ferry, Kittitas, and Pierce Counties.

Small but important tonnages of granite and marble were produced. Dimension marble came from Stevens County. Crushed and sized marble from operations in King and Stevens Counties included products for marble whiting, terrazzo, roofing granules, and stucco. Granite from Ferry, King, and Okanogan Counties was used for riprap, roadstone, and poultry grit.

Talc and Soapstone.—Output of soapstone mined at operations near Marblemount, Skagit County, increased 7 percent over the 1964 total. Crude material from two operations was shipped to grinding plants of Northwest Talc & Magnesium Co. (Clear Lake), Miller Products Co., and Stauffer Chemical Co. (both in Portland, Oreg.). The processed material was used as a carrier in insecticides and as a filler for paint. A third producer sold crude material for sculpturing purposes.

Vermiculite.—Crude vermiculite from an operation in Montana was exfoliated at the Vermiculite Northwest, Inc., Spokane

Table 7.—Stone sold or used by producers, by uses
(Thousand short tons and thousand dollars)

Use	1964		1965	
	Quantity	Value	Quantity	Value
Dimension stone (building)	W	W	9	$269
Concrete and roadstone	7,709	$9,745	8,208	10,488
Riprap	1,080	1,365	2,326	2,359
Railroad ballast	227	278	W	W
Other [1]	r 1,482	r 3,817	1,917	4,330
Total [2]	r 10,498	r 15,204	12,461	17,446

r Revised. W Withheld to avoid disclosing individual company confidential data.
[1] Used at cement, paper, metallurgical, and chemical plants; sugar refineries; and for miscellaneous unspecified purposes, and items indicated by symbol W.
[2] Owing to rounding, individual items may not add to totals shown.

Table 8.—Primary aluminum plant capacity and production data

Year	Rated primary capacity, short tons	Primary production			Average U.S. ingot price per pound, cents
		Short tons	Percent of national total	Value (thousands)	
1956–60 (average)	482,600	384,614	22	$192,790	[1] 26.7
1961	483,000	331,264	17	168,921	25.5
1962	483,000	371,757	18	178,226	23.9
1963	483,000	439,144	19	202,327	22.6
1964	483,000	489,919	19	232,893	23.7
1965	524,000	534,680	19	262,702	24.5

[1] Price of pig now applied to ingot. The use of the term "pig" was discontinued in August 1960.

plant. Output of the expanded product, slightly greater than in 1964, was marketed for use in insulation, lightweight plaster, and concrete aggregates, and for agricultural purposes.

METALS

Aluminum.—Production was a record-breaking 534,680 short tons, exceeding the published industry capacity of 524,000 short tons. This marked the second consecutive year that production exceeded the published capacity figures.

Continued high market demand throughout the United States apparently contributed to the decision of Intalco Aluminum Corp. to enlarge the capacity of the reduction plant under construction near Bellingham. It was announced that the initial construction program would include a second potline with the same capacity (76,000 tons annually) as the first; therefore, 152,000 tons would be added to the rated primary capacity of the State. The first potline was expected to be completed by May 1966 and the second by January 1967. Excluding the construction force, the expansion raised the total labor requirements of the completed plant to more than 600 employees. Total investment by Intalco increased $40 million to a total of $100 million. BPA was to invest $4.3 million to provide necessary additional power of 105,000 kilowatts. American Metal Climax, a 50-percent owner of Intalco, signed an agreement with Western Aluminum, a subsidiary of Alcoa of Australia, Pty., Ltd., to supply alumina to the new plant.

Aluminum Company of America (Alcoa) began waterborne delivery of alumina by deep-draft freighter to docking and unloading facilities under construction adjacent to the Vancouver aluminum smelter. In addition to being a new Columbia River development for Alcoa in transportation, it was also the first alumina delivery from a refining plant of Surinam Aluminum Co., an Alcoa subsidiary in South America. When completed in early 1967, the facility was to include a discharging dock and extensive conveyor system designed to unload alumina directly

from oceangoing vessels into storage tanks. Since Alcoa's Vancouver smelter was built 25 years ago, alumina had been shipped exclusively by rail from company refining plants on the Gulf of Mexico, at Mobile, Ala., and Point Comfort, Tex.

Kaiser Aluminum & Chemical Corp. announced plans to import alumina from Queensland Alumina, Ltd., an affiliated company in Australia. Under the agreement, the Port of Tacoma would install and operate unloading and alumina storage facilities to be operational by 1967 which were to be leased by Kaiser Aluminum. The alumina was to be supplied to Kaiser reduction plants in Tacoma and Mead for conversion to aluminum.

The Trentwood works of Kaiser Aluminum & Chemical Corp. near Spokane installed a five-stand, cold-rolling mill to produce aluminum sheet for the building industry and canmaking companies.

Alcoa began a $1 million expansion of facilities at Wenatchee for making carbon anodes that will raise the quantity and quality of the plant's output of anodes.

A study of regional aluminum mill product trends was released in which the 1985 Western States market was projected to be 1.1 million tons.[5]

Gold.—A continuing decrease in gold production resulted in a 4-percent decline from the 1964 figure. However, production of gold from mines in Ferry (Knob Hill and Gold Dollar mines) and Chelan (Gold King mine) Counties contributed significantly to the mineral production of the State. Activity announced in the annual report to stockholders by Day Mines, Inc., indicated significant development and exploration at both sites. Excavations in the Gold Dollar ore body reached deeper levels where small but continuing improvement in the ore grade was indicated. The existing ore reserves were sufficient to sustain production at the 1965 rate from the Gold Dollar ore body for over 4 years. In the northern sector of the mine, work was performed on nine raises between the 9th and 12th levels to further develop the JO No. 3 vein.

Ore mined and milled, or direct smelted, from the Gold King mine in the previous 3 years, according to the Day Mines Inc., annual report, was as follows: 1963—88,728 dry tons containing 0.30 ounce of gold and 0.32 ounce of silver per ton; 1964—94,002 dry tons containing 0.22 ounce of gold and 0.70 ounce of silver per ton; 1965—88,321 dry tons containing 0.26 ounce of gold and 0.66 ounce of silver per ton.

Lead-Zinc.—The value and quantity of lead produced, primarily in Pend Oreille (Pend Oreille mine) and Stevens (Van Stone mine) Counties, were 31 and 10 percent higher, respectively, than the 1964 totals. Zinc output, primarily from the same sources as lead, totaled 22,230 short tons valued at $6.5 million, compared with 24,296 short tons valued at $6.6 million in 1964. Zinc exhibited a stable price pattern, holding steadily at 14½ cents, but the value of zinc output declined because of curtailed production due to closure of the Mineral Right and Grandview mines in Pend Oreille County late in 1964. Another factor in the decline of zinc production, and also limiting lead production, was the persistent shortage of workers in Pend Oreille mining operations because of alternative employment opportunities at nearby dam construction.

Approximately 63 percent of total lead and zinc ore milled was produced at the Pend Oreille mine in the Metaline Falls district of northeastern Washington. A total of 640,604 tons of ore was milled, averaging 0.72 percent lead and 2.32 percent zinc.

Development work was underway at the Lucky Joe Mining Co. lead-zinc property near Newport. Exploration by The Bunker Hill Co. was continuing in the Gladstone Mountain area of Stevens County with other work at the Grandview Mines holdings. American Zinc, Lead and Smelting Co. negotiated a $21 million loan and indicated some of the funds would be used to complete development at the Calhoun mine, 40 miles northeast of Colville. A concentrator was to be completed in 1966 with a capacity of 1,200 tons of lead-zinc ore per day.

Magnesium.—The Bonneville Power Administration published a survey of Pacific Northwest States magnesium production

[5] Fulkerson, Frank B., and Jerry J. Gray. Economic Trends in the Pacific Northwest Aluminum Mill Products Industry. BuMines Inf. Circ. 8267, 1965, 36 pp.

potential.[6] The report pointed up factors that could lead to production by 1970 and projected 1985 output at 100,000 tons, about 30 percent of the projected 1985 U.S. consumption. Several firms had discussed with BPA the electrical requirements and the availability of power for sites in Washington and Oregon, but no location had been selected for a magnesium plant.

Silver.—Production and value of silver decreased 5 percent below the 1964 levels. Gold- and silver-mining operations in Chelan (Gold King mine) and Ferry (Knob Hill and Gold Dollar mines) Counties accounted for 90 percent of the output. Lead-zinc operations were responsible for most of the remainder, with an average content of 1.5 ounces of recovered silver per ton of concentrate. Silver was recovered at an average rate of 3.9 ounces per ounce of recoverable gold.

L & S Mining Co. of Wenatchee was developing a gold-silver property in the Orient mining district of Stevens County. An open-pit mine with ore reserves of 100,000 tons near Northport was announced by Silver Crown Mining Co. of Spokane. The firm stockpiled several hundred tons of silver-lead-zinc ore and planned to operate a mill at the site.

Steel.—Pacific Northwest steel ingot production, approximately 70 to 75 percent of which was being produced at Seattle, was projected to double by 1985, according to a BPA report.[7]

Uranium.—Efforts to extend a sales contract between Dawn Mining Co. and the Atomic Energy Commission were unsuccessful. Sufficient uranium oxide was produced to fulfill the existing contract which called for regular deliveries until December 31, 1966; therefore, milling operations were suspended at midyear. Ore reserves of 550,000 tons remaining in the mine could be exploited should adequate markets develop in the future.

Zircon.—A report was published that evaluated zircon resources and potential marketability in the Pacific Northwest, Alaska, and California. A limited production potential was reported in Washington, primarily from beach sands.[8]

MINERAL FUELS

Carbon Dioxide.—Recovery of carbon dioxide from mineral waters continued in Klickitat County by Gas-Ice Corp. The company, converting the gas to dry ice, also maintained a plant at Finley, Benton County, where carbon dioxide was recovered from an ammonia-plant waste product.

Coal.—Output of coal from five coal mines in three western counties was 54,758 tons, a decline of 20 percent from the 1964 total. Coal-bearing material from underground mining operations in King and Thurston Counties was fed to mechanical cleaning equipment, and 32 percent of the raw material washed was refuse. A strip-mining operation in Lewis County marketed coal directly from the mine without processing. The unit value of coal sold in the open market was $9.07 per ton.

Peat.—Production of peat totaled 29,629 tons, of which 12,812 tons was unprepared and 16,817 tons was shredded before marketing. The average unit value of peat was $4.41 per ton. King County led in output, followed by Snohomish, Pierce, Thurston, Kitsap, Mason, and Skagit Counties. Peat reserves at active operations totaled 2.1 million tons.

Petroleum and Natural Gas.—Four drytest holes for oil and gas were drilled, two in Clallam County and one each in Grays Harbor and Pend Oreille Counties. There was no drilling on submerged lands leased in 1964 off the coast of Washington, but preparation was made to move offshore-drilling rigs into the area.

Olympic Pipeline Co. completed a 267-mile petroleum products pipeline from refineries in the Ferndale-Anacortes petroleum-refining complex to Portland, Oreg. The pipeline, 16 inches in diameter from Anacortes to Renton and 14 inches from Renton to Portland, was designed to carry 135,000 barrels of petroleum products daily. Petroleum products also were carried through 40 miles of lateral lines to

[6] Fulkerson, Frank B., and Jerry J. Gray. The Magnesium Industry and Its Relation to the Pacific Northwest. Report for the Bonneville Power Administration, Portland, Oreg. Bureau of Mines Mineral Resource Office, Area VII, Albany, Oreg., 1965, 59 pp.

[7] Kingston, Gary A. The Steel Industry of the Columbia Basin. Report for the Bonneville Power Administration, Portland, Oreg. Bureau of Mines Mineral Resource Office, Area VII, Albany, Oreg., 1965, 58 pp.

[8] Kauffman, A. J., Jr., and Dean C. Holt. Zircon: A Review, With Emphasis on West Coast Resources and Markets. BuMines Inf. Circ. 8268, 1965, 69 pp.

Table 9.—Test holes drilled for oil and gas in 1965

Company	Well	Total depth (feet)	County
Standard Oil Co. of California	Dungeness Spit No. 1	5,105	Clallam.
Texaco, Inc	R.D. Merrill No. 1	8,462	Clallam.
Brett Oils, Ltd	Brett-Cardinal P.R. Carlisle No. 1	3,972	Grays Harbor.
E.A. Holman Drilling Co	Records No. 1	863	Pend Oreille.

Source: Washington Division of Mines and Geology.

marketing facilities in Seattle, Tacoma, and Olympia. Gasoline, jet, diesel, and heating fuels were carried from the Shell Oil Co. and Texaco, Inc., refineries near Anacortes and from the Socony-Mobil refinery at Ferndale.

Washington Water Power Co. continued testing an underground natural-gas storage site near Chehalis. Six wells were drilled in Lewis County to allow injection of gas to the reservoir. Late in the year, gas escaped from the structure, necessitating evacuation of areas surrounding Lewis and Clark State Park.

REVIEW BY COUNTIES

Selected counties with significant metal and nonmetal developments are discussed in the following review. Mineral production was reported from all 39 counties. With certain important exceptions, output was principally from nonmetallic deposits.

Chelan.—Limestone, mined from the Soda Springs quarry near Leavenworth by Ideal Cement Co., was trucked 21 miles to the Merritt railway siding from where it was shipped by rail 35 miles to the company cement plant at Grotto, King County. Sandstone, quarried at a deposit near Wenatchee by L–D Mines, Inc., was sold for manufacturing cement in the Pacific Northwest. Pumice, produced from a pit near the southeastern tip of Chelan Lake by Ewer Lumber Co., was screened and sold to Pacific Northwest and Canadian consumers for use in manufacturing pumice blocks.

The Gold King mine (L–D Mines) operated during 1965 at full capacity on low-grade gold-silver ore. Exploration at the B–Reef, a near-surface ore deposit, was continued through a 50-percent participation OME contract. Total development and exploration during the year consisted of drifts and crosscuts, 6,208 feet; raises, 3,388 feet; and test drilling, 12,036 feet.

Blewett Mining Co. of Seattle started a diamond-drilling program at the Gold Bond property in the Blewett mining district. The firm also planned to operate a small gold recovery mill.

The Wenatchee plant of Alcoa produced throughout 1965 at a level near rated capacity.

Clark.—Clay produced by Hidden Brick Co., Vancouver, and Ridgefield Brick & Tile Co., Ridgefield, was used by the companies in making building brick and drain-tile.

Alcoa began waterborne delivery of imported alumina to its Vancouver reduction works. The firm operated at levels above rated capacity throughout the year.

Cowlitz.—Reynolds Metals Co. continued to operate its Longview aluminum reduction plant throughout the year at levels exceeding the published capacity.

Douglas.—Keokuk Electro-Metals Co. ferrosilicon and silicon metal plant at Wenatchee was operated throughout the year.

Ferry.—Part-time and professional prospectors were active in the Republic area of Ferry County. Silver and tellurium, the latter a semimetallic element used chiefly in vulcanizing rubber and in manufacturing iron castings and various metal alloys, were being sought in the Sheridan district, and silver and antimony in the Covada district southeast of Republic. Most of the older inactive mines in Republic's Eureka Gulch area were owned by Day Mines, Inc.; however, the firm's Gold Dollar mine was operated by Knob Hill Mines, Inc., along with the Knob Hill mine, from the Knob Hill shaft where ore

Table 10.—Value of mineral production in Washington, by counties
(Thousand dollars)

County	1964	1965	Minerals produced in 1965 in order of value
Adams	$65	$405	Stone, sand and gravel.
Asotin	62	8	Sand and gravel.
Benton	283	1,112	Stone, sand and gravel.
Chelan	1,445	W	Gold, stone, sand and gravel, silver, pumice, copper.
Clallam	231	87	Sand and gravel, stone, gold.
Clark	968	2,262	Sand and gravel, stone, clays.
Columbia	2,203	2,057	Stone, sand and gravel.
Cowlitz	447	397	Sand and gravel, stone, clays.
Douglas	178	112	Stone, sand and gravel, clays.
Ferry	W	W	Gold, silver, sand and gravel, stone, copper, lead.
Franklin	916	502	Sand and gravel, stone.
Garfield	71	192	Stone, sand and gravel.
Grant	1,786	2,132	Sand and gravel, diatomite, lime, stone.
Grays Harbor	634	796	Sand and gravel, stone.
Island	72	34	Sand and gravel.
Jefferson	W	551	Stone, sand and gravel.
King	12,826	14,154	Cement, sand and gravel, stone, coal, clays, peat.
Kitsap	372	296	Sand and gravel, peat.
Kittitas	255	142	Stone, sand and gravel, gold.
Klickitat	1,507	795	Stone, sand and gravel, carbon dioxide.
Lewis	649	483	Stone, sand and gravel, coal, clays, mercury.
Lincoln	230	244	Stone, sand and gravel.
Mason	234	173	Stone, sand and gravel, peat.
Okanogan	223	322	Sand and gravel, stone, zinc, lead, silver, copper.
Pacific	143	175	Stone.
Pend Oreille	W	8,241	Zinc, cement, lead, stone, sand and gravel, silver, copper.
Pierce	4,327	5,179	Sand and gravel, lime, stone, clays, peat.
San Juan	W	531	Sand and gravel, stone.
Skagit	r 4,441	6,550	Cement, stone, olivine, sand and gravel, soapstone, peat.
Skamania	169	186	Stone, sand and gravel.
Snohomish	3,358	2,672	Sand and gravel, stone, peat, clays.
Spokane	6,292	4,630	Cement, sand and gravel, stone, clays, uranium.
Stevens	5,294	6,744	Zinc, uranium, stone, magnesite, lead, sand and gravel, clays, silver, copper, barite.
Thurston	347	302	Sand and gravel, coal, peat.
Wahkiakum	12	2	Stone.
Walla Walla	4,038	2,530	Sand and gravel, stone.
Whatcom	W	W	Cement, stone, sand and gravel, olivine, clays.
Whitman	364	1,895	Sand and gravel, stone.
Yakima	1,356	1,610	Sand and gravel, lime, stone, clays.
Undistributed [1]	25,512	17,669	
Total	r 81,310	86,172	

r Revised. W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] Includes value of mineral production that cannot be assigned to specific counties and values indicated by symbol W.

was being extracted from the JO No. 3 vein. According to the Day Mines, Inc., annual report, joint operation development included 1,866 feet of drifting, 186 feet of crosscutting, and 1,234 feet of raising. At midyear, the 500-ton-per-day concentrator at the Knob Hill mine was operating on a three-shift basis, 7 days a week.

Bear Creek Mining Co. continued mapping work on its 20,000-acre lease on the Colville Indian Reservation, and some shallow drilling was done in the Keller district.

King.—The county was the principal nonmetal-producing area in the State, in terms of value of mineral commodities. Production of cement increased at both the Seattle plant of Lone Star Cement Corp. and the Grotto plant of Ideal Cement Co.

International Pipe & Ceramics Corp. produced clay from the Blum and Harris pits for use in making firebrick, and material from the Harris pit and Pit 55 was used in making building brick at the company Renton clay products complex. Builders Brick Co. mined clay at the Elk and Newcastle pits for building brick and draintile. Ideal Cement Co. dug clay at the Grotto pit for manufacturing cement.

Coal output was from the Rogers No. 2, No. 3, and Franklin No. 10 mines by Palmer Coking Coal Co., Inc. The county ranked first as a peat-producing area, and output was from eight bogs.

Sand and gravel output of 5.9 million tons valued at $6.1 million continued to be the highest for any county in the State. About 66 percent of the output was by

Table 11.—Mine production of gold, silver, copper, lead, and zinc in the Metaline district, Pend Oreille County, in terms of recoverable metals

Year	Mines producing, lode and placer	Material sold or treated [1] (thousand short tons)	Gold, lode and placer (troy ounces)	Silver, lode and placer (troy ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)	Total value (thousands)
1956–60 (average)	4	888	12	32,098	32	9,679	17,398	$6,723
1961	3	982	-------	43,729	38	8,032	20,215	6,367
1962	3	830	-------	29,233	35	5,901	21,430	6,068
1963	4	810	-------	30,274	35	5,373	22,270	6,343
1964	3	809	-------	28,766	31	4,755	19,597	6,634
1965	1	641	-------	23,689	22	4,411	13,201	5,277
1906–65	-------	15,997	307	642,584	473	178,062	400,808	133,086

[1] Does not include gravel washed.

commercial firms for building and road construction, and the county ranked second in commercial production.

Kittitas.—Gold Placers, Inc., operated at Liberty by dry-land dredging for gold in the Williams Creek stream bed.

Okanogan.—Silver and copper were produced as byproducts from two mines—the M & M zinc mine, owned by M & M Mining Co., Oroville, and the Andy O'Neil lead mine, owned by Sullivan Mining Co., Nespelem.

Tonasket Lime Products, Inc., began constructing a crushing plant near Tonasket for producing agricultural limestone and poultry grit.

Pend Oreille.—The principal nonmetal producer continued to be the Metaline Falls operation of Lehigh Portland Cement Co. Production of cement by the firm declined slightly, but shipments were 18 percent greater than the 1964 total.

Lucky Joe Mining Co. was installing a 100-ton-per-day mill at its property between Marshall and Bead Lakes, 9 miles north of Newport, where lead, silver, copper, and gold were to be extracted.

Pend Oreille Mines and Metals Co., as stated in its annual report to shareholders, milled 640,604 tons of ore, compared with 697,113 tons in 1964. Operating costs were $3.906 per ton and total costs $4.243 per ton compared with $3.353 and $3.652 per ton, respectively, the previous year. The concentrator was operated uninterruptedly throughout 1965 but at slightly less than 70 percent of rated capacity due to the continued critical shortage of skilled underground laborers, which seriously affected production and development work. Metal prices for lead and zinc remained stable throughout the year. Receipts from the sale of concentrates amounted to $3,258,486, compared with $3,265,874 in 1964. Underground exploration and development expenditures amounted to $462,939 and consisted of 6,100 feet of drifts and raises, 40,650 cubic feet of station work, and 72,511 feet of diamond and long-hole drilling.

The Federal Geological Survey[9] published a report that described the Metaline mining district as an important district because continued output of zinc and lead ore from this relatively young development seems assured for many years. The grade of ore was described as being low compared with many other zinc-lead districts, but the report stated that highly mechanized mining methods, relatively low mining costs, and firm ground partly offset this factor.

Pierce.—Primary open-market lime from the Tacoma operation of Pacific Lime, Inc., went to Pacific Northwest and Canadian consumers for agricultural, chemical, and construction purposes. Clay from the Clay City pit was used by Builders Brick Co. in brickmaking. Sand and gravel output totaled 4.6 million tons, valued at $3.4 million. About 88 percent of the output was by commercial firms for building purposes and road construction. The county ranked first in commercial output, and the largest commercial sand and gravel firms operating in the State included op-

[9] Dings, McClelland G., and Donald N. Whitebread. Geology and Ore Deposits of the Metaline Zinc-Lead District, Pend Oreille County, Washington. U.S. Geol. Survey Prof. Paper 489, 1965, 109 pp.

erations near Steilacoom of Pioneer Sand & Gravel Co. and Glacier Sand & Gravel Co.

Skagit.—The Lone Star Cement Corp. plant at Concrete continued supplying the largest value to the county mineral industry total. Cement rock was trammed from the Lang quarry to the Concrete plant.

Olivine mined by Northwest Olivine Co. at the Twin Sisters quarry was trucked 20 miles to the company grinding plant at Hamilton for processing. Scheel Stone Co. mined olivine from the Sisters Mountain quarry.

Soapstone mining continued near Marblemount by Herman Smith, Skagit Talc Products, and Scheel Stone Co.

Snohomish.—The county ranked second as a peat-producing area and fourth in commercial sand and gravel output. Limestone for agricultural purposes came from operations of Miller Lime Co. at the Haystack quarry and Western Lime Co. at the Bryant quarry. Lowell Brick & Tile Co. dug clay from a pit near Lowell for use in making building brick.

Spokane.—The Irvin plant of Ideal Cement Co. continued to be the principal nonmetallic industry in the county. Clay dug near the plant and limestone from the Stevens County Limerock quarry supplied raw materials for the operation.

International Pipe & Ceramics Corp. produced clay from the Adams, Mica, Pirello, and Sommer pits. Fire clay refractories and other clay products were made at the company Mica plant.

Sand and gravel output by commercial firms of 1.3 million tons ranked the county third in the State for commercial output, which was used in building and road construction.

Stevens.—Mining at the Red Marble and Keystone quarries of Northwest Magnesite Co. supplied the largest part of the county nonmetal mineral output value. Limestone, marble, and siliceous materials continued to be quarried.

Uranium mining operations at Ford (Dawn Mining Co.) were terminated in 1964, and the milling of the stockpiled ore was completed in July 1965. An accumulated stock of uranium oxide concentrate was to be shipped during the remaining term of the Atomic Energy Commission contract, which was scheduled to expire December 31, 1966.

American Smelting and Refining Company (Asarco) operated its Van Stone mine throughout the year; it was reopened in 1964 after being closed for 7 years. The mine produced 9,867 tons of zinc and a small amount of lead, according to the Asarco annual report to shareholders.

American Zinc, Lead and Smelting Co. was completing development at the Calhoun mine, 40 miles northwest of Colville, where a concentrator was to be completed in 1966.

Admiral Consolidated Mining Co., Spokane, announced a lease agreement with American Zinc, Lead and Smelting Co. on the Admiral zinc-lead property near Leadpoint. The agreement provided for American Zinc to explore and develop the property and to mine ore developed for 60 percent of net profits. The northeast part of Stevens County continued as in the last few years to be an area of major interest to large lead and zinc producers.

Whatcom.—The county again ranked second in value of nonmetallic minerals. The Kaiser Cement & Gypsum Corp. plant at Bellingham continued as the principal mineral industry in terms of value and supplied more cement than any other plant in the State. Clay for the operation was purchased, and limestone came from the company Kendall quarry near Maple Falls.

The Mineral Industry of West Virginia

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the West Virginia Geological and Economic Survey for collecting information on all minerals except fuels.

By Marlyn J. Ackerman [1]

The value of West Virginia's mineral production increased $36.9 million in 1965, a gain of 4 percent. Coal production accounted for about 84 percent of the value of the State's mineral output and increased $32.5 million in value primarily as a result of greater consumption in manufacturing and for electric power generation. Production of stone increased 1 million tons, reflecting expanded activity in construction.

[1] Mining engineer, Bureau of Mines, Pittsburgh, Pa.

Table 1.—Mineral production in West Virginia [1]

Mineral	1964 Quantity	1964 Value (thousands)	1965 Quantity	1965 Value (thousands)
Clays [2] ---thousand short tons--	261	$309	289	$328
Coal (bituminous) ---do---	141,409	693,572	149,191	726,096
Natural gas ---million cubic feet--	r 202,765	50,968	207,416	48,743
Petroleum (crude) ---thousand 42-gallon barrels--	3,370	12,975	3,530	13,591
Salt ---thousand short tons--	1,033	3,666	1,153	5,539
Sand and gravel ---do--	5,472	11,555	5,253	11,480
Stone [3] ---do--	7,481	13,105	8,482	14,587
Value of items that cannot be disclosed: Calcium-magnesium chloride, cement (portland and masonry), fire clay, gem stones, lime, natural gas liquids, and dimension sandstone ---	XX	36,541	XX	39,240
Total ---	XX	822,691	XX	859,604

r Revised. XX Not applicable.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Excludes fire clay; included with "Value of items that cannot be disclosed."
[3] Excludes certain stone; included with "Value of items that cannot be disclosed."

The leading counties in value of mineral production, in declining order, were McDowell, Wyoming, Logan, Marion, Raleigh, Kanawha, Monongalia, Boone, Nicholas, and Harrison. All were large coal-producing counties, and each had a mineral production value over $34 million.

Table 2.—Value of mineral production in constant 1957–59 dollars
(Millions)

Year	Value
1956 ---	$960
1957 ---	954
1958 ---	755
1959 ---	760
1960 ---	754
1961 ---	731
1962 ---	770
1963 ---	r 841
1964 ---	r 892
1965 ---	935

r Revised.

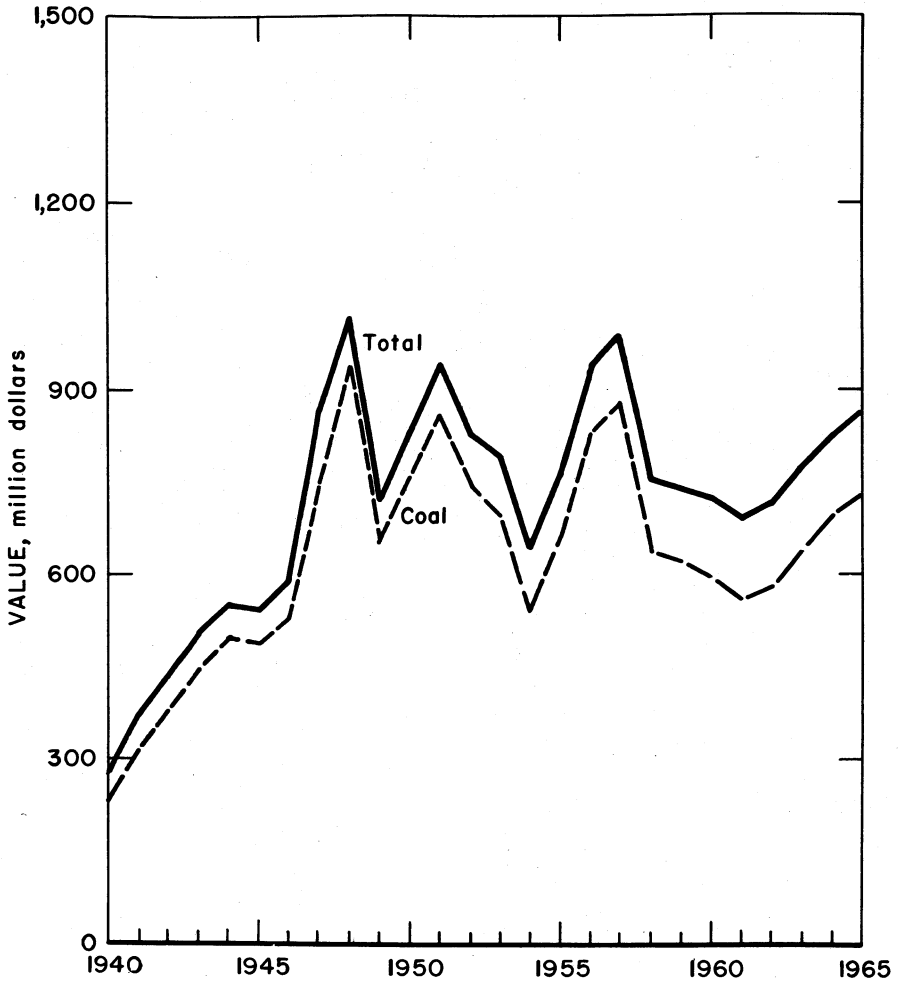

Figure 1.—Value of coal and total value of mineral production in West Virginia.

Table 3.—Employment and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1964:								
Coal	44,644	210	9,422	74,679	88	4,280	58.49	10,119
Nonmetal	957	297	284	2,268	---	36	15.87	208
Sand and gravel	411	224	92	780	1	12	16.68	8,150
Stone	888	262	233	1,865	1	21	11.80	3,739
Total	46,900	213	10,031	79,592	90	4,349	55.77	9,668
1965: [p]								
Coal	45,000	214	9,635	75,840	94	4,475	60.25	10,504
Nonmetal	985	307	302	2,410	---	17	7.05	433
Sand and gravel	450	210	95	806	---	16	19.85	953
Stone	975	272	265	2,132	1	29	14.07	3,058
Total	47,410	217	10,297	81,188	95	4,537	57.05	9,971

[p] Preliminary.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Coal (Bituminous).—West Virginia was the leading coal-producing State in the Nation. Coal production in 1965 was 149.2 million tons, a 6-percent increase over that of 1964. Increased coal consumption was due to continued high demand by industrial and metallurgical markets and additional use for electric power generation. The value of coal production amounted to $726.1 million, 5 percent more than in 1964. The average price per ton for coal sold was $4.87 which was $0.03 less than in 1964. Coal produced by commercial mines was 129.5 million tons, an increase of 6 percent over the 1964 tonnage. Captive mines production was 19.7 million tons, an increase of 3 percent.

The State's coal production was obtained from 1,660 mines, 83 less than in 1964. Of the total production 90 percent was produced at 1,383 underground operations, 69 less than in 1964, 7 percent at 191 strip mines, 3 more than in 1964, and 3 percent at 86 auger mines, 17 less than in 1964. Production of coal by strip mines increased 33 percent over that in 1964, underground mines increased 4 percent, and auger mines increased 6 percent.

Additional equipment used at underground mines included 1,473 cutting machines, 122 less than in 1964; 1,970 handheld or post-mounted drills, a decrease of 190; 209 mobile drills, an increase of 25; 800 rotary drills, an increase of 89; and 336 percussion drills, no change from 1964.

In the production of coal at strip mines, equipment included 292 power shovels, 29 draglines, 7 carryall scrapers, 278 bulldozers, and 58 horizontal and 77 vertical drills. Transportation of coal from strip pit to tipple, an average distance of 6 miles, was done by 537 trucks, each having an average capacity of 17 tons. Equipment at auger mines included 92 augers, 12 power shovels, 2 draglines, 82 bulldozers, and 1 horizontal and 4 vertical drills. Coal transportation from auger operation to tipple, an average distance of 5 miles, was done by 241 trucks, each with an average capacity of 19 tons.

In 1965, 158 cleaning plants, an increase of 5 more than in 1964, cleaned 79.5 percent of the total production compared with 76.4 percent in 1964. Of the total, 32 percent was cleaned by jigs, 60 percent by wet washing other than jigs, and 8 percent by pneumatic methods. Of the total output, 36 percent was crushed, and 12 percent was treated for dust control. Of the total treated, 92 percent was with oil, 0.4 percent with calcium chloride, 3 percent with calcium chloride and oil, and the balance by other methods.

Of the total underground production, coal loaded mechanically increased to 94 percent, 1 percent more than in 1964. Of the total mechanically loaded, 49 percent was by 780 mobile loading machines 31 less than in 1964. Of the total loading machines, 668 loaded into shuttle cars, 71 into mine cars, and 41 onto chain conveyors. Continuous mining machines produced 63.5 million tons, equal to approximately 50 percent of the coal mechanically loaded. Of the 506 continuous mining machines in use, 37 more than in 1964, 380 loaded into shuttle cars and 126 onto conveyors. To obtain greater production and prevent delays that occur at times in shuttle car transportation, mobile loading machines are sometimes used in conjunction with continuous miners. In this method, the continuous miner discharges the coal mined onto the bottom at discharge end of the miner. A mobile loading machine is used to pick up the coal and load it into shuttle cars. In 1965, an additional 144 mobile loaders were used with continuous miners. The remainder of the mechanically loaded tonnage was hand loaded into 160 face conveyors, 45 less than in 1964.

A total of 1.2 million tons was produced by longwall mining. Seven longwall units (included in continuous mining data) were in operation compared with four in 1964.

Of the total production, 96 percent was transported by rail or water, and the remainder by truck and other methods.

According to preliminary data 84 fatalities occurred underground and 10 on the surface. Of the surface fatalities eight were at surface facilities serving underground mines and two at open pit auger operations.

Causes of fatal accidents underground were falls of roof or face—52, mountain bump—1, haulage—10, mine machinery—5,

electricity—1, mine explosion—5, mine fires —9, and others—1.

One major disaster (five or more fatalities) occurred in 1965. A mine fire in the Mars No. 2 mine, Clinchfield Coal Co. near Clarksburg, Harrison County, killed seven men.

Unit trains (7,000 tons or more per trainload) were used for the most part to transport coal long distances to large industrial and utility markets. This method of delivery, whereby transportation costs were reduced as much as $1.50 per ton, increased materially in 1965.

Construction of a pilot plant to manufacture gasoline from coal was started at Cresap by the Consolidation Coal Co. in cooperation with the Office of Coal Research.

Installation of one of the two 500,000-kilowatt generating units at the 1-million-kilowatt power station being built by Virginia Electric and Power Co. near Mount Storm, Grant County, was completed, and the plant started operations in August 1965. Upon completion of the second unit, scheduled for 1966, coal consumption will be about 3 million tons annually. All the coal will be acquired from sources nearby.

Construction was started on a new 1-million-kilowatt electric-generating station near Morgantown. Allegheny Power System and Duquesne Light Co. will be owners of the new plant on a 50–50 basis. Anticipated annual coal requirements after completion are 3 million tons which will be acquired from coal companies operating in West Virginia.

A new mine, expected to provide employment for about 300, was under development at Herndon, Wyoming County, by the Eastern Associated Coal Corp.

Table 4.—Coal (bituminous) production

(Thousand short tons and thousand dollars)

Year	Quantity	Value
1956–60 (average)	134,167	$710,611
1961	113,070	558,525
1962	118,499	578,293
1963	132,568	634,794
1964	141,409	693,572
1965	149,191	726,096

Table 5.—Coal (bituminous) production by counties

(Thousand short tons and thousand dollars)

County	1964		1965	
	Quantity	Value	Quantity	Value
Barbour	2,328	$10,108	3,366	$14,328
Boone	8,593	38,454	8,597	38,330
Braxton	74	324	W	W
Brooke	1,030	3,422	1,020	3,353
Clay	73	301	65	258
Fayette	5,738	25,881	6,237	27,771
Grant	W	W	1,729	6,396
Greenbrier	945	4,069	972	4,679
Hancock	35	92	4	9
Harrison	8,287	34,351	8,158	34,053
Kanawha	11,002	49,180	10,938	46,087
Lewis	170	581	342	1,196
Lincoln	18	45	18	43
Logan	15,886	71,771	16,343	74,313
McDowell	17,310	106,715	17,102	107,761
Marion	11,768	60,942	14,093	72,030
Mason	458	1,537	423	1,447
Mercer	1,462	8,751	W	W
Mineral	73	293	W	W
Mingo	5,609	28,332	5,640	29,313
Monongalia	8,528	41,443	8,977	42,756
Nicholas	7,856	37,792	8,031	38,090
Pocahontas	W	W	91	322
Preston	3,534	13,087	3,857	13,954
Putnam	5	22	---	---
Raleigh	7,657	42,777	9,657	51,933
Randolph	1,051	3,874	1,027	3,704
Taylor	430	1,384	317	1,115
Tucker	245	843	460	1,317
Upshur	422	1,691	591	2,252
Wayne	30	139	W	W
Webster	825	3,501	667	3,097
Wyoming	13,480	72,811	14,099	75,991
Other counties [1]	6,487	29,059	6,370	30,198
Total	141,409	693,572	149,191	726,096

W Withheld to avoid disclosing individual company confidential data.

[1] Includes data for Gilmer, Marshall, and Ohio Counties, and counties indicated by symbol W.

Coke and Coal Chemicals.—Production of coke at 3 oven-coke plants having 668 ovens was slightly over 3.5 million tons compared with slightly less than 3.4 million tons in 1964. Total value of the oven-coke f.o.b. plant was $59.4 million; average value per ton was $16.88, an increase of $0.46 from that of 1964. Beehive coke was produced at 2 plants (1 more than in 1964) with 274 ovens (80 more than in 1964).

At the oven-coke plants 5.1 million tons of coal was carbonized with a coke-yield of 68.50 percent per ton. Total value of coal carbonized was $39.8 million with an average value per ton of $7.74. Coal requirements to produce 1 ton of coke was 1.46 tons with a value of $11.30. Of the total coal receipts, 3.6 million tons was from Pennsylvania, 1.4 million tons from West Virginia, and 0.1 million tons from Virginia. All of the coal was washed. Most of the coal was high-volatile (83.7 percent); the balance was low-volatile.

A total of 235,934 tons of coke breeze valued at $1.48 million was recovered at the coke plants. This amounted to 4.59 percent per ton of coal carbonized. Coal-chemical materials, exclusive of breeze, produced at oven coke plants included coke-oven tar (50.2 million gallons), coke-oven gas (57.6 billion cubic feet), ammonium sulfate (47,258 tons), and large quantities of crude light oil from which benzene, toluene, xylene, and solvent naphtha were recovered.

Natural Gas Liquids.—Production of natural gasoline in 1965 was 32.9 million gallons, an increase of 4 percent over that in 1964, and value correspondingly increased. Output of LP gases was 332 million gallons, a decrease of 3 percent; but because of a higher unit price the value of production increased 6 percent. According to the American Gas Association, reserves of all natural gas liquids at the end of 1965 were 75 million barrels, an increase of 7.5 percent. Types of natural gas liquids recovered included propane, butane, other LP gases, and natural gasoline. According to the Oil and Gas Journal, the total number of natural gas processing plants in operation in 1965 was 34. Compression facilities were at 29 plants, absorption facilities at 5 plants, and refrigeration-absorption facilities at 1 plant. The processing plants were operated by Consolidated Gas Supply Corp. (formerly Hope Natural Gas Co.), Owens, Libbey-Owens Gas Department, Union Oil of California, (formerly Pure Oil Co.), Pennzoil Co. (formerly South Penn Oil Co.), (26 plants), Union Carbide Corp. (3 plants), and United Fuel Gas Co. (2 plants). No production was reported by Manufacturers Light & Heat Co. from their Porter Falls plant.

Petroleum and Natural Gas.—Production of crude oil in 1965 was 3.5 million barrels, a 5-percent increase over 1964 production. Value increased correspondingly. The well-head price was $3.85 per barrel, the same as in 1964. Natural gas production of 207,400 million cubic feet was slightly higher than that of 1964. At the end of 1965 production was obtained from 13,225 oil wells and 20,187 gas wells.

During the year, the State issued 1,406 permits to drill or deepen wells. A total of 1,166 wells, including wells started in 1964, were drilled to completion, of which, 125 were oil wells, 660 gas wells, 207 oil and gas wells, 33 for storage and other uses, and 141 were dry holes. The number of incomplete drilling operations at end of the year was 399.

Total footage drilled was 3,253,172 feet, an increase of 101,000 feet over that of 1964. The average depth of the 1,166 wells drilled during 1965 was 2,792 feet, 142 feet greater than that in 1964. The deepest well, a wildcat drilled in Grant County to test various formations in the Ordovician and Cambrian Formations, was 13,000 feet. Most of the drilling was done in the north-central counties. The largest number of well completions, 134, and the greatest drilling footage was done in Gilmer County.

Approximately 95 percent of the wells were completed in shallow horizons above the Lower Devonian Oriskany Sandstone. Of the completions, 53 percent were in 6 counties, Gilmer (134), Doddridge (118), Roane (107), Calhoun (95), Ritchie (92), and Lewis (73). These six counties accounted for 79 percent of the oil and 37 percent of the gas, most of which was produced from the Big Injun Sand (Mississippian). Almost as much gas was produced from the Riley-Benson Sands (Upper Devonian) as from the Big Injun Sand. Most of the gas from the Riley-Benson Sands was produced in Barbour, Upshur, Lewis, and Harrison Counties. In Mason County

12 wells were completed in the newly discovered oil field; there was an average initial flow of 15 barrels per day per well from the Berea Sandstone.

Eighty-four deep wells were drilled to the Oriskany Sandstone or deeper. These wells accounted for about 15 percent of the new gas production. No oil was reported from any of the deep wells, and approximately one-fifth of them were dry. Six of the dry holes were deep wildcats to test the Tuscarora Sandstone (Lower Silurian).

Exploratory drilling resulted in the development of a gasfield in the Newburg Sand (Upper Silurian Williamsport Sandstone) in Kanawha County.

Approximately 90 percent of the producing wells were fractured in 1965. The initial production after fracturing usually is several times the natural production; this accounts for most of the State's increase in oil and gas since 1957. The production rate from most fractured wells declines rapidly. Studies on production decline after hydraulic fracturing were conducted by the West Virginia University Engineering Experiment Station.[3]

Underground gas storage facilities in the State increased to 384.5 billion cubic feet ultimate capacity, an increase of 4 percent over the 1964 capacity. There were 34 operating storage facilities in 20 counties. Natural gas in storage at the end of 1965 was 354.6 billion cubic feet, a 4.4-billion-cubic-foot increase over that of 1964. Companies with storage facilities were Atlantic Seaboard Corp., Cabot Corp., Consolidated Gas Supply Corp., Equitable Gas Co., Manufacturers Light & Heat Co., and United Fuel Gas Co.

Two petroleum refineries were in operation in 1965. These refineries produced gasoline, kerosine, fuel oil, motor oils, and lubricants.

Reserves of crude oil at yearend were 55.2 million barrels less than in 1964. Natural gas reserves at the end of 1965 were 2,494 billion cubic feet, an increase of 146.1 billion cubic feet over that of 1964.[4]

NONMETALS

Clays.—Combined production of fire clay and miscellaneous clay was about 4,000 tons more than in 1964. Miscellaneous clay output rose 28,000 tons offsetting a decline in fire clay output. Miscellaneous clays were chiefly used in the manufacture of building brick and in cement manufacture. Fire clay was used mostly for producing firebrick and block (including ladle brick). A total of 10 clay mines were in operation, 7 of which were open pit and 3 were underground mines. Clay was produced in seven counties, the highest production of miscellaneous clay was from Berkeley County, and greatest output of fire clay was from Hancock County.

Cement.—Shipments of portland cement increased 10 percent and masonry cement 5 percent over 1964 shipments. The market was highly competitive, and the average value per barrel remained about the same. The sole producer was at Martinsburg, Berkeley County. The plant used the wet process with five to seven kilns in operation. A modernization program includes the installation of a new kiln to replace five obsolete kilns, and upon completion in 1966, it will increase the capacity and operating efficiency. The company operates an underground mine for high-calcium limestone and open pit mines for cement rock and shale requirements. Most of the cement produced was non-air-entrained for general use and moderate heat. Coal was used to fire the kilns. Leading uses were

[3] Bulletin of American Association of Petroleum Geologists. V. 50, No. 6, June 1966, p. 1152.
[4] American Gas Association, Inc., and American Petroleum Institute. Proved Reserves of Crude Oil, Natural Gas Liquids, and Natural Gas. V. 20, Dec. 31, 1965.

Table 6.—Clays sold or used by producers

Year	Fire clay		Miscellaneous clay		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1956-60 (average)	353,913	$2,171,568	287,728	$274,620	641,641	$2,446,188
1961	259,340	1,964,265	215,497	228,531	474,837	2,192,796
1962	242,913	W	203,954	W	446,867	2,085,597
1963	236,695	W	177,624	W	414,319	2,044,390
1964	W	W	261,498	308,522	W	W
1965	W	W	289,395	327,576	W	W

W Withheld to avoid disclosing individual company confidential data.

for ready-mixed concrete, concrete products, and building and highway construction. Shipments were mainly to Maryland, District of Columbia, Virginia, western Pennsylvania, North Carolina, and West Virginia with delivery about evenly divided between truck and railroad haulage.

Gem Stones.—Miscellaneous mineral specimens were collected at scattered locations in the State by amateur lapidarists and hobbyists. Specimens of aragonite, cave onyx, fossils, and stilbite have been collected in recent years.

Lime.—Production of lime increased 26 percent over that of 1964. The chief uses were for refractory lime, steel production (open hearth furnaces, basic oxygen converters), and pulp and paper manufacture. Sales of agricultural lime were relatively minor. Four companies operated plants—two in Berkeley County, one in Jefferson County, and one in Pendleton County.

Sand and Gravel.—Production of sand and gravel decreased 4 percent from that of 1964; total value decreased less than 1 percent. The average price per ton in 1965 increased 8 cents to $2.19. Building sand and paving gravel showed small increases, while paving sand and building gravel decreased. Sand used for glassmaking, an important market, declined slightly. Of the total output, 60 percent was sand and 40 percent was gravel. About 55 percent of the output was shipped by barge, with the balance, about 50 percent for each, by railroad and truck. The major portion of the production outside Morgan County was recovered by dredge operations on the State's rivers.

Production was reported from operations in 13 counties. Of the leading producing counties, Hancock was first, followed in descending order by Morgan, Tyler, Ohio, and Wood.

Natural Salines.—Calcium-magnesium chloride was produced as a byproduct from natural well brines at an operation near South Charleston. Production was considerably less than that of 1964. It was chiefly used for coal preparation and chemical manufacturing.

Salt.—Production of salt from brines increased 12 percent over that of 1964. Nearly all of the production was used by the producers in manufacturing chlorine and caustic soda. Production of brine was reported from four counties—Kanawha, Marshall, Pleasants, and Tyler. Brine in Kanawha County was obtained from a naturally occurring brine. Production in the other counties was from brines produced by deep well operations dissolving solid salt deposits.

Slag (Iron-Blast-Furnace).—Production of crushed air-cooled blast furnace slag at a Weirton plant was sold for aggregate use.

Stone.—Total production of stone (limestone and sandstone) was 8,481,685 tons, an increase of 13 percent over that of 1964. Most of the increased sales of limestone were reported for concrete aggregate, highway construction, and flux for steel production. Limestone consumption for agricultural purposes, railroad ballast, and refractory use decreased slightly.

Sandstone production used for concrete aggregate, highway construction, and refractory materials showed a 38-percent in-

Table 7.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1964		1965	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	1,446	$1,807	1,505	$1,947
Paving	601	931	444	772
Fire or furnace	61	70	W	W
Railroad ballast	11	17	---	---
Fill	W	W	31	41
Gravel:				
Building	1,340	1,642	1,209	1,515
Paving	748	1,242	858	1,452
Fill	W	W	21	26
Undistributed [1]	1,265	5,846	1,185	5,727
Total sand and gravel	5,472	11,555	5,253	11,480

W Withheld to avoid disclosing individual company confidential data.
[1] Includes glass, molding, blast, engine, filtration (1965), other industrial and ground sands, railroad ballast and other gravel, and items indicated by symbol W.

Table 8.—Stone sold or used by producers, by uses

Use	1964		1965	
	Short tons	Value	Short tons	Value
Crushed and broken stone:				
Concrete and roadstone	2,725,191	$4,303,718	3,120,037	$4,817,789
Railroad ballast	663,994	847,182	636,051	797,883
Agriculture	131,012	317,033	125,444	299,506
Other uses[1]	3,960,600	7,636,846	4,600,153	8,672,094
Total	7,480,797	13,104,779	8,481,685	14,587,272

[1] Includes limestone for glass, asphalt filler, coal dust, poultry grit, stone sand, cement, lime, riprap, flux, refractory material, and miscellaneous uses, and sandstone for glass and engine sand (1965), and refractory use.

crease. The major part of the increase was used in construction.

Leading limestone-producing counties were Berkeley, Jefferson, Monongalia, and Greenbrier. The leading counties in sandstone production were Tucker, Raleigh, Harrison, and Monongalia.

METALS

Aluminum.—Aluminum production by Kaiser Aluminum & Chemical Corp. at its plant in Ravenswood decreased slightly, but, because of higher selling prices, value increased a small amount over that of 1964.

Ferroalloys.—New facilities completed during the year at the Graham plant will triple the capacity for the production of ductile iron alloys.

Iron and Steel.—New facilities were being installed at the Weirton plant of National Steel Corp. They included two basic oxygen furnaces, a large degassing unit, and a casting machine to produce steel slabs in a continuous operation. Wheeling Steel was continuing its $145 million expansion program at its Wheeling plant.

Construction of a multimillion-dollar industrial gas facility was underway at Weirton, principally to supply oxygen requirements for the basic oxygen steel making facility being built by Weirton Steel Division of National Steel Corp.

Nickel.—The world's reputed largest rolling mill devoted exclusively to the production of high-nickel base alloys was operated at Huntington by the International Nickel Co., Inc. Production and shipment of products in 1965 were about 90 million tons. Alloys produced fall into four families—nickels (95 percent or more nickel), Monel (nickel-copper alloy), and Inconel and Incoloy (nickel, chromium, and iron). In addition, the company was a major producer of high-nickel welding wire and rods. The nickel was obtained from Canada, but many of the other basic materials were obtained in West Virginia or adjoining States. Modernization of all facilities continued. A program costing about $75 million during a 5- to 6-year period was about 70 percent complete.

Zinc.—A vertical-retort zinc smelter was operated by Matthiessen & Hegeler Zinc Co. at Meadowbrook.

REVIEW BY COUNTIES

Barbour.—Production of coal increased 45 percent over that of 1964. Most of the output was produced at 32 underground mines with a reported increase of 18 percent in 1965 and 15 strip mines, where production more than doubled. Auger production decreased 21 percent, with only one mine in operation. Of the underground production, 92 percent was loaded mechanically compared with 88 percent in 1964. Of the total loaded mechanically, 51 percent was by 11 continuous miners, 4 more than in 1964, and 49 percent by 20 mobile loading machines, 7 more than in 1964. Of the total production, 34 percent was cleaned at two preparation plants; 92 percent was crushed, and 6 percent was treated. The leading underground producers were Badger Coal Co., Inc., and Bethlehem Mines Corp. The county ranked first in strip mine production in 1965. The large increase in strip mine production was due primarily to increased output at both Grafton Coal Co.'s Pepper No. 2 mine and

Table 9.—Value of mineral production in West Virginia, by counties [1]

County	1964	1965	Mineral production in 1965 in order of value
Barbour	$10,107,739	$14,328,035	Coal.
Berkeley	17,579,928	18,951,730	Cement, stone, lime, clays.
Boone	38,453,749	38,329,519	Coal.
Braxton	W	W	Stone, coal.
Brooke	3,836,906	W	Coal, sand and gravel.
Cabell	W	W	Sand and gravel, clays.
Clay	300,856	257,764	Coal.
Doddridge	155	8,212	Stone.
Fayette	25,881,332	27,771,017	Coal.
Gilmer	W	W	Coal, stone.
Grant	W	W	Do.
Greenbrier	W	6,755,949	Do.
Hancock	W	W	Clays, sand and gravel, coal.
Hardy	W	40,886	Stone.
Harrison	34,742,424	W	Coal, stone.
Jefferson	4,208,251	4,986,004	Stone, lime.
Kanawha	50,103,809	46,892,306	Coal, salt, clays, stone, calcium-magnesium chloride.
Lewis	W	W	Coal, stone, clays.
Lincoln	W	W	Coal, sand and gravel.
Logan	71,770,931	74,313,414	Coal.
McDowell	106,715,453	107,807,209	Coal, stone.
Marion	60,942,148	72,030,408	Coal.
Marshall	15,487,799	14,137,037	Coal, salt.
Mason	1,596,272	1,490,919	Coal, sand and gravel.
Mercer	W	8,217,633	Coal, stone, clays.
Mineral	W	725,336	Coal, stone.
Mingo	28,331,698	29,312,840	Coal.
Monongalia	43,583,022	W	Coal, stone.
Morgan	W	W	Sand and gravel.
Nicholas	37,801,132	38,133,070	Coal, stone.
Ohio	W	W	Coal, sand and gravel.
Pendleton	569,243	964,951	Stone, lime.
Pleasants	W	W	Sand and gravel, salt.
Pocahontas	749,394	514,070	Coal, stone.
Preston	W	W	Do.
Putnam	22,253	—	
Raleigh	W	W	Coal, stone, sand and gravel.
Randolph	W	W	Coal, stone.
Taylor	W	W	Coal, clays.
Tucker	1,040,983	W	Coal, stone.
Tyler	W	W	Sand and gravel, salt.
Upshur	W	W	Coal, stone.
Wayne	138,574	W	Coal.
Webster	3,501,090	3,096,846	Do.
Wetzel	W	W	Sand and gravel.
Wood	1,582,000	W	Do.
Wyoming	72,820,851	76,039,395	Coal, stone, sand and gravel.
Undistributed [2]	190,822,836	274,499,315	
Total	822,691,000	859,604,000	

W Withheld to avoid disclosing individual company confidential data.
[1] Calhoun, Hampshire, Jackson, Monroe, Ritchie, Roane, Summers, and Wirt Counties are not listed because no production was reported.
[2] Includes gem stones, natural gas, natural gas liquids, petroleum, some stone (1964) and salt (1965) that cannot be assigned to specific counties, and values indicated by symbol W.

Queen Bros. Coal Co., Inc. These companies were the leading producers. Equipment used at strip mines included 28 power shovels, 3 draglines, 1 carryall scraper, and 28 bulldozers.

Berkeley.—Cement manufacturing was the leading mineral industry. Both portland and masonry cement were produced by Capitol Cement Co., Division of Martin Marietta Corp. The company produced limestone and shale, raw materials needed in cement production, from its own mines. Cement production increased 10 percent in 1965. Output was used mostly for highway construction, ready-mixed concrete material, and manufacture of concrete products.

The county continued to be the leading limestone producer. Over 50 percent of the output was used by the cement industry. Other uses were for concrete aggregate, roadstone, blast-and-hearth flux, lime manufacture, and railroad ballast. Producers were Capitol Cement Co. and Appalachian Stone, both divisions of Martin Marietta Corp., Blair Limestone Division, Jones & Laughlin Steel Corp., and Inwood Quarry, Inc.

Blair Limestone Division and Capitol Cement Co. also produced lime. Most of the output was produced by the former company and used for open-hearth flux; output of the latter company was for masonry mortar and water treatment. The Martinsburg mine of Capitol Cement Co. received a Certificate of Achievement in Safety for operating 1 year without a disabling accident.

Clay production increased 12 percent over that in 1964, and the county ranked first in clay output. Clay for building brick was produced by Continental Clay Products Co., Martinsburg, the leading producer, and The United Clay Products Co., North Mountain.

Boone.—Output of coal remained about the same despite closure of 6 of the 83 operations active in 1964. The county dropped from sixth to eighth place in coal production. Of the total production, 62 underground mines produced 73 percent of the output, 7 strip mines 12 percent, and 8 auger mines 15 percent. The county ranked first in auger production and fourth in strip mine production. Of the underground production, 93 percent was mechanically loaded by 46 mobile loaders, 2 less than in 1964, 10 continuous miners, 4 more than in 1964, and 1 hand-loaded face conveyor. Equipment at strip mines included 12 power shovels and 16 bulldozers. At auger mines coal was produced by 11 augers, 2 power shovels, and 11 bulldozers. Of the county coal production, 66 percent was cleaned at seven cleaning plants. Thermal drying was done at four of the plants with about 27 percent of the cleaned coal dried. Approximately 41 percent of the output was crushed and 12 percent was oil treated.

The leading underground producers were Westmoreland Coal Co. (two mines), Eastern Associated Coal Corp. (two mines), and Armco Steel Corp. The leading producer of both strip and auger production was Ranger Fuel Corp. Three new underground mines, each employing about 20 persons, were opened during the year—The Wharton No. 4, Eastern Associated Coal Corp.; No. 12 mine, the Spruce River Coal Co.; and No. 1 mine, S. and I. Coal Corp., Inc.

Braxton.—Coal production decreased materially as only one small underground mine was active in 1965 compared with four in 1964. Meadows Stone & Paving, Inc., the only stone producer in the county, produced small quantities of sandstone aggregate in 1964.

Brooke.—Coal was produced at four underground, seven strip, and two auger operations. The leading underground mine producer was Windsor Power House Coal Co. This company's production was cleaned at its own preparation plant. Output was captive coal used for power generation. Weirton Ice and Coal Supply Co. also operated a cleaning plant for coal from mines in West Virginia and Ohio. None of the county coal production was treated, but most of it was crushed. The leading strip mining company was Huberta Coal Co.

Production of sand and gravel increased over that in 1964. The larger producer, Duquesne Sand Co., recovered materials by dredge from the Ohio River. The product was used for construction aggregate. The Brilliant Materials Co. produced sand and gravel at a stationary plant near Follansbee. Sand was used for fire or furnace and building; gravel was used for aggregate.

Cabell.—Production of sand and gravel decreased moderately from that of 1964. Material was produced by dredges on the Ohio River by both Tri-State Materials Corp. and Ohio River Dredging Co., Inc., of Huntington, and used for construction aggregate.

Production of red shale by Barboursville Clay Manufacturing Co., Barboursville, for manufacture of building brick increased over that of 1964.

Clay.—There were seven coal mines in operation, one more than in 1964, six underground and one auger. Of the total underground production, 83 percent was hand-loaded onto face conveyors. None of the coal was mechanically cleaned, crushed, or treated for dust control.

Doddridge.—The Feather Construction Corp. quarry was idle and abandoned in 1965. Some sandstone from stock was used for concrete aggregate and roadstone.

Fayette.—Output increased 9 percent in 1965 and the county ranked 11th in coal production. Of the total, 87 percent was produced at 125 underground mines, 23 less than in 1964, 7 percent from 11 strip mines, 3 more than in 1964, and 6 percent from 5 auger mines, 1 more than in 1964. Of the underground production, 86 percent

was mechanically loaded. Of this total, 67 percent was loaded by 57 mobile loading machines, 2 less than in 1964; 32 percent by 19 continuous miners, 2 less than in 1964; and 1 percent by hand-loading into 12 conveyors. Of the total production, 62 percent was cleaned at nine preparation plants, 28 percent was crushed, and 6 percent was oil treated. Thermal drying was done at two of the cleaning plants. The leading underground producers were Allied Chemical Corp., The New River Co. (three mines), Riverton Coal Co., and Clifftop Smokeless Coal Co. (two mines). Eagle Coal & Dock Co. was the largest strip producer. The county ranked fifth in the State in auger production because of a 34-percent increase in coal produced at auger mines. The increased tonnage was produced by Eagle Coal & Dock Co., the leading producer, and C. C. Conley & Sons, the second largest producer.

The New River Co. closed its Oakwood mine and reactivated the Garden Grove preparation plant in 1965. The Beards Fork Coal Mining Corp. purchased the underground mines of Ranger Fuel Corp. At the end of 1964 the strip and auger mines of Ranger Fuel Corp. had been closed.

Gilmer.—Coal production in the county decreased sharply due to lower production by Rochester & Pittsburgh Coal Co., the leading producer, and no output by Compton Mining Co., which had been the second largest producer in 1964. All of the coal was produced at seven underground mines, five less than in 1964. A strip mine that had been operated by Eleanor Coal Co. in 1964 also was inactive. A preparation plant, with jig cleaning facilities, was operated by Rochester & Pittsburgh Coal Co. Thermal drying facilities were at the plant also. Of the county output, 42 percent was crushed and 5 percent treated. Most of the coal was loaded mechanically by continuous miners and mobile loaders.

Sandstone was produced by Basil R. Heavner for road construction.

Grant.—Coal production increased substantially over that of 1964. Most of the increased output resulted from higher production at North Branch Coal Co.'s No. 1 underground mine, a new auger and strip mine operation by Allegheny Corp., a new strip mine operated by Buffalo Coal Co., Inc., and greater production at Grant County Coal Corp.'s strip operation. About 98 percent of the underground production was mechanically loaded by 13 continuous miners and 1 mobile loader. The leading underground producers were Alpine Coal Co. and North Branch Coal Co.

Two cleaning plants, one with thermal drying facilities, were operated. Of the county output, 90 percent was crushed but none was treated.

A new electric generating station built by Virginia Electric & Power Co. started operating during the year and consumed a large quantity of coal, which was a major factor in the increased coal production.

Production of limestone increased 68 percent over that of 1964. Material was used for agricultural stone, concrete aggregate, and roadstone. Producers were Keplinger Lime Co., Inc., Maysville, Bean's Lime and Stone, Inc., Petersburg, and Garbart Trucking Co., Aurora.

Greenbrier.—Coal production increased 3 percent over that of 1964, although the number of mines decreased from 86 to 68. Of the total output, 99 percent was produced at 66 underground mines and the balance at 2 strip mines. The leading underground producers were Gauley Coal & Coke Co. and Leekie Smokeless Coal Co. Of the underground production, 60 percent was mechanically produced by five mobile loaders, eight continuous miners and six hand-loaded conveyors, a marked increase over the 19 percent in 1964. There were no cleaning or drying facilities in operation. About 33 percent of the county output was crushed, and less than 1 percent was treated.

Production of crushed limestone increased over that of 1964 and the county was the fourth largest stone producer. Material was used for railroad ballast, concrete aggregate, roadstone, rock dust for coal mines, stone sand, and agricultural stone. Producers were The H. Frazier Co., Inc., and Acme Limestone Co., both of Fort Spring, Savannah Lane Quarries, Frankford, and Central Asphalt Paving Co., Lewisburg. The latter was a new producer in 1965.

Hancock.—Coal was produced at a small strip mine.

Clay production decreased from that of 1964, and the county dropped from first to second place in State output. The main cause of the decrease was a strike closing

the Crescent Brick Co., Inc., New Cumberland, starting in September 1964 and extending through 1965. The Globe Brick Co., the county's only producer in 1965, mined fire clay for manufacture of firebrick for ladle use at steel plants. The company was enlarging its manufacturing facilities.

Production of sand and gravel decreased 25 percent from that of the previous year, but the county continued to be the leading producer in 1965. Two dredges were operated on the Ohio River near New Cumberland by Dravo Corp. to produce sand and gravel for building purposes. Volino Brothers Blocks, Arroyo, also produced material for building at a stationary plant.

Hardy.—Production of crushed limestone decreased 24 percent from that of 1964. State Soil Conservation Service, Potomac Valley Soil Conservation District, operated the Baker lime plant near Baker and produced limestone for concrete aggregate and agricultural purposes.

Harrison.—Coal production in the county decreased 2 percent from that of 1964 with 76 operating mines, 15 fewer than in 1964. Of the total output, 43 underground mines produced 82 percent, 24 strip mines 16 percent, and 9 auger mines 2 percent. The county ranked ninth in total production and second in coal produced by strip mining. Of the underground output, 97 percent was produced mechanically with 85 percent by 28 continuous miners, 3 more than in 1964, and 15 percent by 25 mobile loading machines. About 60 percent of the county output was cleaned at six preparation plants, all of which had thermal drying facilities. Of the total, 49 percent was crushed, and 5 percent was treated. The leading underground coal producers were Clinchfield Coal Co. (three mines) and Mountaineer Coal Co. (two mines). Equipment used at strip mines included 33 power shovels, 16 less than in 1964, 5 draglines, and 30 bulldozers, 10 less than in 1964. The leading strip mine operators were Wesgin Mining Co., Inc., Mountaineer Coal Co. (two mines), Fresa Construction Co., United Coals, Inc., Panora Company, Inc., and Thompson Coal and Construction Co. The Panora Company, Inc., opened two new strip mines and one auger mine during the year.

Production of crushed limestone by Paul Harrold at a quarry near Wolf Summit for concrete aggregate and roadstone increased substantially over that of 1964. Total crushed sandstone production decreased 17 percent. Producers of sandstone materials used for aggregate and roadstone were North View Stone Co., Clarksburg, and Salerno Bros., Inc., Shinnston.

Jefferson.—Production of limestone increased 24 percent over that of 1964, and county ranked second in output. The limestone material was used primarily for blast furnace flux and manufacture of dead-burned dolomite; lesser amounts went for refractory use, aggregate, railroad ballast, and agricultural purposes. Producers were Blair Limestone Division, Jones & Laughlin Steel Corp., Millville; United States Steel Corp., Millville; and Standard Lime & Refractories Co., Division of Martin Marietta Corp., Millville. The latter company also produced quicklime used mainly for refractory purposes in steel plants. Production of quicklime increased over that of 1964.

Kanawha.—Coal production decreased slightly from that in 1964 with 22 fewer mines operating. The county ranked fifth in coal mined. Of the total output, 90 percent was produced at 85 underground mines, 1 percent at 7 strip mines and 9 percent at 12 auger mines. Of the underground production, 96 percent was mechanically produced with 14 continuous miners, 2 less than in 1964, accounting for 18 percent, 73 mobile loaders, 8 less than in 1964, accounting for 81 percent, and the balance by 5 hand-loaded face conveyors. Of the total county output, 81 percent was cleaned at 10 preparation plants, 2 more than in 1964, with thermal drying at 1 of the plants. About 35 percent of the coal was crushed, and 9 percent was treated with oil. Equipment at auger mines included 13 augers, 3 power shovels, and 12 bulldozers. The leading underground producers with 92 percent of the output were the Carbon Fuel Co. (four mines), Union Carbide Corp. (three mines), Valley Camp Coal Co. (five mines of which one was new), Cannelton Coal & Coke Co. (three mines), Oglebay Norton Co. (five mines), Imperial Colliery Co. (five mines of which one was new), and Central Appalachian Coal Co. (two mines). The county ranked second in the State in auger production. The leading producers by auger mining were Carbon Fuel Co., Robbin Coal Co., and Kelley's Creek Fuel Co.

The Morris Fork No. 6 mine of Union Carbide Corp. received a Certificate of Achievement in Safety for operating without a disabling work injury in 1965.

Salt in brine was produced by Inorganic Chemical Division, FMC Corp., and was used by the company in the manufacture of chlorine and caustic soda at its South Charleston plant. Production decreased slightly from that of 1964. The company also recovered calcium-magnesium chloride.

Fire clay was produced by both Charleston Clay Products Co. and West Virginia Brick Co. of Charleston for manufacturing building brick. Output increased slightly over that of 1964. Tony Pacifico Stone Quarry, Inc., near Charleston produced dimension and crushed sandstone. Crushed sandstone for aggregate uses was produced by Mazella Quarries, Inc., South Charleston.

Lewis.—Coal production more than doubled over that of 1964 although the number of mines decreased from 10 to 8; the output was produced at 2 underground and 6 strip operations. Most of the increased tonnage was from the strip mine operated by Bitner Fuel Co. None of the underground output was loaded mechanically or cleaned, but about 75 percent was crushed. A new strip mine was opened by Panora Company, Inc.

Crushed sandstone used for State highway construction was produced by Meadows Stone & Paving, Inc. A small amount also was produced by Andersons' Black Rock, Inc., Charleston, but the plant was sold during the year and was dismantled by the new owner.

Miscellaneous clay was produced by Gum Bros., Weston, for use by Weston-Jane Lew Brick & Tile Co. in the manufacture of building brick.

Lincoln.—Three companies, one less than in 1964, dredged coal from the Guyandot River.

A small quantity of engine sand also was dredged from the river by Dial Coal Co., Branchland.

Logan.—The county ranked second in coal production and third in auger production. Production from 71 mines increased 3 percent over that of 1964. Of the total output, 95 percent was from 62 underground mines; the balance was from 2 strip and 7 auger mines. Virtually all of the underground production was mechanically loaded by 129 mobile loading machines, 6 less than in 1964, and 24 continuous miners, 6 more than in 1964. The leading underground coal producers, accounting for 74 percent of the tonnage mined, were Island Creek Coal Co. (eight mines), Amherst Coal Co. (five mines), Omar Mining Co. (five mines), Boone County Coal Corp. (two mines), and Princess Coals, Inc. (six mines). Of the total county production, 90 percent was cleaned at 21 preparation plants, 1 more than in 1964. Thermal drying was done at four of the plants. About 23 percent of the coal was crushed and 15 percent was treated. New mines were opened by Crystal Block Coal & Coke Co. (two mines), MYNU Coals, Inc. (three underground, one strip, and one auger mine), Omar Mining Co. (one new, one reactivated), Princess Coals, Inc. (two mines), Raleigh Eagle Coal Co. (three mines) and Spruce River Coal Co. (one mine). Underground mines abandoned in 1965 included the No. 22 mine of Island Creek Coal Co. which had employed 109 men and No. 1, No. 2, and Rex No. 2 mines of Raleigh Eagle Coal Co.

McDowell.—The county continued to be the leading coal-producing county in the State. The total number of mines in operation increased from 243 to 258 with 95 percent of the output mined at 244 underground mines. The balance was produced at five strip mines and nine auger mines. Of the underground production, 89 percent was loaded mechanically with 81 continuous miners, 2 more than in 1964, producing 77 percent of this tonnage. Of the balance, 45 mobile loaders, 16 less than in 1964, loaded 22 percent and 1 percent by 13 hand-loaded conveyors and 4 duckbills. The county ranked fifth in strip mine production. Equipment used at strip mines included 12 power shovels, 4 bulldozers, and 29 trucks. Of the total output, 96 percent was cleaned at 22 preparation plants, 2 more than in 1964, of which 6 had thermal drying facilities. About 40 percent of the coal was crushed and 45 percent treated with oil for dust allaying. The leading underground producers accounting for 77 percent of the tonnage were United States Steel Corp. (six mines), Eastern Associated Coal Corp., Bishop Coal Co., Olga Coal Co., Pocahontas Fuel Co. (four mines), and Island Creek Coal Co. (two mines).

The leading strip and auger mines were operated by United States Steel Corp., who reopened the No. 9 mine which had been closed since 1962. Certificates of Achievement in Safety for operating a full year without a disabling work injury were awarded to three mines of United States Steel Corp., No. 1 mine, No. 17 mine, and the Gary Contour No. 15 mine.

Island Creek Coal Co. sold its Algoma mine to United Pocahontas Coal Co. in 1965.

Sandstone was produced by the State Road Commission of West Virginia for highway construction.

Marion.—The county ranked fourth in coal production. The total output increased 20 percent over that of 1964 and was produced at 11 mines, 10 underground and 1 strip mine. Most of the production was from the underground mines, and nearly all was produced by mechanical means. A total of 65 continuous miners, 3 more than in 1964, mined 93 percent of the tonnage produced; the balance was loaded by 11 mobile loading machines, 1 less than in 1964. Mobile loaders were also used to load the coal mined by 53 of the 65 continuous miners. Almost all of the county output was cleaned at eight preparation plants, six of which had thermal drying facilities. About 52 percent of the coal was crushed, but less than 1 percent was treated for dust allaying. Leading producers were Mountaineer Coal Co. (three mines), Bethlehem Mines Corp. (two mines), Eastern Associated Coal Corp., Rochester & Pittsburgh Coal Co., and Joanne Coal Co.

Marshall.—Coal production decreased slightly from that of 1964 with all of the output coming from three underground mines. Mines were operated by Hanna Coal Co., the Valley Camp Coal Co., and State of West Virginia Board of Control with most of the tonnage mined by the first two companies. Of the mechanically loaded coal, 96 percent was produced by 18 continuous miners, 1 less than in 1964. The balance was loaded by one mobile loading machine. Of the total output, 89 percent was cleaned at two cleaning plants. About 34 percent of output was crushed. None of the coal was thermal dried or treated for dust allayment.

Salt production increased over that of 1964, and the county continued to be the leading producer in the State. Brine operations were conducted by Pittsburgh Plate Glass Co., New Martinsville, and Solvay Process Div., Allied Chemical Corp., Moundsville. Output was used for the manufacture of chlorine and caustic soda.

Mason.—Coal production decreased 8 percent from that of 1964; the number of mines decreased from 14 to 11, 9 underground, 1 strip, and 1 auger. Of the underground production, which was most of the total, 95 percent was mechanically loaded by 7 mobile loading machines and 11 hand-loaded face conveyors. About 64 percent was crushed, and 2 percent was oil treated. Lieving Coal Co. was the leading underground producer.

Production of sand and gravel decreased 25 percent from that of the previous year. Producers were Letart Sand & Gravel Co., Letart, and Mason Aggregates, Inc., West Columbia. Output was used mostly for building and paving.

Mercer.—Coal production decreased slightly from that of 1964. The output was produced at 39 mines, 1 less than in 1964, of which 31 were underground, 4 strip, and 4 auger mines. Of the total underground production, 92 percent was mechanically loaded by 13 mobile loading machines, 1 continuous miner, and 6 hand-loaded face conveyors.

Coal from mines in the county and from some mines located in adjacent counties was cleaned at four plants. None of the coal was thermal dried; only a small amount was crushed, and about 23 percent was treated with oil. The leading producer of both underground and strip mined coal was Pocahontas Fuel Co.

Crushed sandstone was produced by Oakvale Stone Co. at a portable plant near Princeton for concrete aggregate and roadstone. Shale production by Virginian Brick & Tile Co., Princeton, for manufacture of building brick and other heavy-clay products increased 30 percent over that of 1964.

Mineral.—Coal production from five mines, one more than in 1964, increased substantially over that of 1964. Only about 6 percent of the underground tonnage was mechanically loaded, compared with 31 percent in 1964, because the only mine at which mechanical loading was done closed during the year. About 92 percent of the total output was cleaned at one cleaning plant that was new in 1965. Nearly 50 per-

cent of the coal was crushed, and 6 percent was oil treated.

Production of crushed limestone increased over that of 1964. Output was used mostly for concrete aggregate and road construction. Producers were Aurora Stone Co., Short Gap, and Earl L. Spencer, Keyser.

Mingo.—Coal production was virtually the same as that of 1964, although the number of mines increased from 80 to 83. The county ranked 12th in coal output. Of the total production 95 percent was mined at 77 underground mines and the balance at 1 strip and 5 auger mines. Of the underground production, 95 percent was mechanically loaded of which 85 percent was loaded by 60 mobile loaders, 4 less than in 1964, and 15 percent by 6 continuous miners, 1 less than in 1964. A minor amount was produced by hand-loaded conveyors. Seven cleaning plants, five of which had thermal drying, were used in cleaning 85 percent of the total output. Of the total, 28 percent was crushed and 12 percent treated with oil. The leading underground producers were Island Creek Coal Co. and National Coal Mining Co.

Monongalia.—Coal production increased 5 percent over that of 1964, and the number of mines increased from 51 to 57. The county ranked seventh in coal output. Of the total coal produced 98 percent was mined at 45 underground mines and the balance at 11 strip and 1 auger mine. Of the underground production, 98 was mechanically loaded with 96 percent of this coal mined by 39 continuous miners, 5 more than in 1964, and 4 percent loaded by 12 mobile loading machines, 2 less than in 1964. Of the county total, 66 percent was cleaned at three preparation plants, one of which had thermal drying facilities; 18 percent was crushed and 2 percent was treated. Christopher Coal Co. with four mines operating was the leading producer.

Production of crushed limestone was nearly the same as in 1964, and county ranked third in output. Producers were Green Bag Cement Co., Division of Marquette Cement Manufacturing Co. and Greer Limestone Co. Output of the former company was used chiefly in cement manufacture and of the latter company for concrete aggregate and roadstone. Other limestone uses included agricultural stone, railroad ballast, and riprap. Deckers Creek mine of Marquette Cement Manufacturing Co. received a Certificate of Achievement in Safety for operating in 1965 without a disabling work injury.

Sandstone was produced at a plant operated by both Deckers Creek Sand Co. and Greer Limestone Co. The latter company purchased the plant in June 1965 and operated it for the remainder of the year. Material was used for engine sand and glass and concrete products.

Morgan.—The county continued to rank second in sand and gravel production and first in value. Production by Pennsylvania Glass Sand Corp., Hancock, was about the same as in 1964. Output was mostly used for glass, abrasives, pottery, and engine sand.

Nicholas.—Coal was produced at 91 mines, 17 less than in 1964. Of the total production, 96 percent was mined at 85 underground mines and the balance at 4 strip and 2 auger mines. Of the underground production, 97 percent was mechanically loaded. Of this total, 57 percent was produced by 51 continuous miners, 12 less than in 1964, 38 percent loaded by 49 mobile loading machines, 13 more than in 1964, and the balance by 42 hand-loaded face conveyors. Of the total output, 85 percent was cleaned at eight preparation plants, six of which had thermal drying facilities; 52 percent was crushed and 12 percent was treated. The leading underground producers were Gauley Coal & Coke Co. (four mines), Sewell Coal Co. (two mines), Summersville Coal Co. (two mines), Johnstown Coal & Coke Co., Imperial Smokeless Coal Co. (three mines), and Peerless Eagle Coal Co. Strip mine producers were Summersville Coal Co., Janutolo Construction Co., and Imperial Coal & Construction Co. The latter company's Leivasy mine received a Certificate of Achievement in Safety for operating in 1965 without a disabling injury. The Sterling Sewell mine of Sewell Coal Co., idle in 1964, was reopened during the year.

Crushed sandstone was produced by Nettie Sand Co., Nettie, for use as concrete sand. The State Road Commission of West Virginia produced sandstone material for concrete aggregate and roadstone.

Ohio.—Coal production in the county was produced at two underground mines operated by The Valley Camp Coal Co. Output declined slightly from that of the

previous year. All of the coal was loaded by eight mobile loading machines and one continuous miner. The company operated a preparation plant where 96 percent of the coal was cleaned. The plant also had thermal drying facilities. Twenty-nine percent of the coal was crushed, and 48 percent was treated. The company opened the new Souttell Run mine during the year.

Production of sand and gravel increased 17 percent over that of 1964, and the county ranked fourth in output. Output was dredged from the Ohio River near Wheeling by Delta Concrete Co. and was used for building.

Pendleton.—Production of limestone increased 17 percent over that of 1964. The material was used for concrete aggregate, agricultural purposes, rock dust in coal mines, glass and lime manufacture, and metallurgical purposes. Producers were Germany Valley Limestone Co., Division of Greer Limestone Co., and North Fork Lime Producers Cooperative, Inc., both at Riverton, Ruddle Lime Co., Franklin, and the State Road Commission of West Virginia.

Quicklime was produced by Germany Valley Limestone Co., Division of Greer Limestone Co., a new lime operation in 1965, and was used for paper and pulp manufacture, refractory purposes, and tanning.

Pleasants.—Salt production from Pleasants and Tyler counties by Inorganic Chemical Division, FMC Corp., Bens Run, increased over that produced in 1964. Salt brine was produced by deep well solution mining of underground salt deposits and shipped by barge to South Charleston, where it was used in manufacturing chlorine and caustic soda.

Sand and gravel was produced by Ohio River Sand & Gravel, Division of McDonough Co., a dredge operation on the river at Broadhead Island near St. Marys. Output was used primarily for building and paving with a part used for fill.

Pocahontas.—Coal production decreased sharply from that of 1964. Output was produced from four underground mines, the same as in 1964. Of the total, 97 percent was produced by four continuous miners. None of the coal production was mechanically cleaned, dried, crushed, or treated.

Limestone was produced for concrete aggregate and road construction. Producers were Terra Alta Limestone Co. near Marlinton and the State Road Commissioner of West Virginia.

Preston.—Although 16 less mines were in operation, coal production increased 9 percent over that of 1964. Output was produced at 80 underground, 28 strip, and 2 auger mines. The county ranked third in strip-mined production, a drop from second place in 1964, although strip output increased 22 percent. Auger production increased 27 percent because two auger mines were operating, one more than in 1964. Of the underground production, 61 percent was mechanically loaded. Of this total, 17 mobile loaders, 4 less than in 1964, loaded 60 percent, 7 continuous miners, 5 more than in 1964, loaded 37 percent, and 8 hand-loaded face conveyors loaded the balance. Equipment used at strip mines included 42 power shovels, 11 draglines, and 42 bulldozers. Of the total output, 50 percent was processed at four cleaning plants. One of the plants had thermal drying facilities. Of the total, 61 percent was crushed but none was treated. The leading underground producers were Chapel Coal Co. and Sand Creek Fuel Corp. (four mines). Sandy Creek Fuel Corp. closed its No. 10 underground mine idling 61 men, and the Walsh-McCartney Coal Co. closed its mine idling 44 men.

Crushed limestone was produced by Preston Limestone Co., Inc., Kingwood, for concrete aggregate, roadstone, and agricultural stone. A small quantity of dimension sandstone was produced by Rhine Creek Stone Co. at a quarry near Brookside.

Raleigh.—Coal production increased 26 percent over that of 1964, and the county moved from 10th to 6th place in the State in output. Of the total production by 130 mines, 8 more than in 1964, 107 underground mines produced 90 percent, 12 strip mines 6 percent, and 11 auger mines 4 percent. Of the underground production, 94 percent was mechanically loaded. Of this total, 80 percent was loaded by 67 mobile loading machines, 2 less than in 1964, 19 percent by 28 continuous miners, 2 more than in 1964, and the balance by 8 hand-loaded face conveyors. The county was the fourth leading producer by auger mining. Equipment used at auger mines included 11 augers, 2 power shovels, 2 draglines, and 15 bulldozers.

Of the total output, 77 percent was cleaned at 17 preparation plants, 1 of which had thermal drying equipment. Of the total 25 percent was crushed and 4 percent was treated.

The leading underground producers were Winding Gulf Coals, Inc. (seven mines), Armco Steel Corp. (two mines), Slab Fork Coal Co., Eastern Associated Coal Corp., and Ranger Fuel Corp. The leading producer of both strip- and auger-mined coal was Ranger Fuel Corp. Winding Gulf Coals, Inc., purchased the Eccles Nos. 5 and 6 mines from Eastern Associated Coal Corp.

The county ranked first in value of sandstone production. Producers were Raleigh Stone Co. with a plant near Glen Morgan and Table Rock Sand Plant near Beckley. Output was used for concrete aggregate and roadstone.

Grandview Sand Co., a subsidiary of Beaver Block Co., produced a small quantity of sand for building purposes at a plant near Beaver. The company's production decreased 20 percent from that in 1964.

Randolph.—Coal production decreased 2 percent with seven fewer mines in operation than in 1964. Of the total output, 88 percent was mined at 23 underground mines and the balance at 5 strip mines. In the production of underground coal, 85 percent was mechanically loaded with 16 continuous miners, 1 more than in 1964, producing 72 percent and 7 mobile loaders, 3 more than in 1964, loading 18 percent. One cleaning plant processed 18 percent of the total output. None of the coal was thermally dried; 61 percent was crushed and 3 percent treated. A. C. & H. Coal Co. with three mines operating was the leading underground producer. The company's Golden Ridge No. 6 mine was closed during 1965, idling 98 men.

Limestone production increased significantly over that of 1964. Output was mainly used for concrete aggregate and roadstone and a small quantity for railroad ballast. Producers were Elkins Limestone Co. and Sam G. Polino & Co. with stationary plants near Elkins and Bowden, respectively. A small quantity was produced also by Basil R. Heavner.

Taylor.—Coal production decreased 26 percent from that of 1964 with one less mine operating. Of the total output, 57 percent was produced from 7 strip mines and 43 percent from 19 underground mines. Equipment at strip mines included 11 power shovels and 12 bulldozers. All of the underground mines were small hand-loading operations. None of the coal was mechanically loaded, cleaned, dried, or treated; 74 percent was crushed. The leading strip mine producer was La Rosa Fuel Co., Inc.

A small quantity of shale was produced by Grafton Brick Co. near Thornton for the manufacture of building brick. Output was substantially below that of 1964.

Tucker.—Coal production from one underground mine and six strip operations, one more than in 1964, increased 88 percent over that of 1964. The increased tonnage was produced by Douglas Coal Co. with four mines operating. Three hand-loading face conveyors were used in the production of coal at the underground mine. There was no preparation, crushing, or treatment of the coal production.

Sandstone production almost doubled over that of 1964. Output was produced by Fairfax Sand & Crushed Stone Co. near Thomas and Feather Construction Co. at Tucker "G" quarry near Davis. The material was used for concrete aggregate and roadstone. There was no production of limestone or sand and gravel in 1965.

Tyler.—Production of sand and gravel more than doubled over that of 1964, and the county ranked third in the State in output. Material was produced by Ohio River Sand & Gravel, Division of McDonough Co., by dredge operations on the Ohio River. Output was used primarily for building and paving with some gravel used for railroad ballast and fill.

Inorganic Chemical Division, FMC Corp., produced salt brines by deep well operations at Bens Run for chlorine manufacture at the company's plant at South Charleston. (See Pleasants County.)

Upshur.—Coal production increased 40 percent over that of 1964. Output from underground mines increased 14 percent and that from strip mines 2.67 percent. Of the total, 73 percent was mined at 17 underground mines, 2 less than in 1964, and 27 percent at 5 strip mines, 3 more than in 1964. Of the underground production, 80 percent was mechanically loaded by one mobile loader, five less than in 1964, and

four continuous miners, two more than in 1964. Strip mine production increased substantially because three more strip mines were in operation and output was increased by R. & V. Contracting Co.

Of the total output, 58 percent was cleaned at two preparation plants. None of the output was thermally dried; 36 percent was crushed and 2 percent was oil treated. The leading underground producers were Pecks Run Coal Co. and Upshur Coals, Ltd. The latter company's operation was new in 1965 and employed 55 men.

Crushed sandstone was produced by Basil R. Heavner at a portable plant near Buckhannon, but output decreased materially from that in 1964. Sandstone was used for concrete aggregate and roadstone.

Wayne.—Coal production from six small underground mines, one more than in 1964, increased substantially over the output of 1964. Of the total, 58 percent was mechanically loaded by three mobile loading machines.

Webster.—Although the same number of mines were in operation, coal production decreased 19 percent from that of 1964. Output was produced at 35 mines, 31 underground, 3 strip, and 1 auger. Of the underground production, 92 percent was loaded mechanically by 16 mobile loaders, 4 more than in 1964, 8 continuous miners, and 4 hand-loaded face conveyors, 13 less than in 1964. Of the total output, 88 percent was processed at four cleaning plants, one more than in 1964. One plant had thermal drying facilities. Forty percent of coal was crushed and 16 percent treated for dust allayment. The largest underground producers were Johnstown Coal & Coke Co., Bergoo Corp. (three mines), and Sugar Creek Corp. (six mines).

Wetzel.—Production of sand and gravel by Ohio Valley Sand Co. by a dredge operation on the Ohio River near New Martinsville increased significantly over that of 1964. Output was used for building and paving.

Wood.—Production of sand and gravel decreased sharply from that of 1964, and the county dropped from third to fifth place in output. The decrease resulted chiefly from no production in 1965 by Ohio River Sand & Gravel, which was active in 1964. Output was produced by Kanawha Sand Co. and Pfaff & Smith Builders Supply Co. and used mostly for building and paving.

Wyoming.—Coal production increased 5 percent over that of 1964, and the county ranked third in State output. The number of operating mines increased by 5 to 96. Underground production increased 2 percent, strip 87 percent, and auger 169 percent. Of the total production, 95 percent was produced from 84 underground mines; the balance came from 8 strip and 4 auger mines. Of the underground production, 95 percent was mechanically loaded. Of this, 64 percent was loaded by 100 mobile loading machines, 5 more than in 1964, 35 percent by 49 continuous miners, 5 more than in 1964, and 1 percent by 9 hand-loaded conveyors. The leading underground producers, who produced 74 percent of the underground tonnage, were the Eastern Associated Coal Corp. (three mines), Itmann Coal Co., Island Creek Coal Co. (two mines), Allied Chemical Co., and Pocahontas Fuel Co. (two mines). Of the total output, 91 percent was cleaned at 13 preparation plants, 5 of which had thermal drying facilities. Thirteen percent was crushed, and 13 percent was treated. A large increase in strip coal output resulted from increased production at Lafayette Springs Coal Co., the county's leading strip producer, and from a new mine of Buffalo Mining Co., the county's second leading producer. Greater output by the two leading producers accounted for the significant increase in auger production. Eastern Associated Coal Corp. started operating Premier Pocahontas Co. at the beginning of the year. Robinson Phillips Coal Co. purchased the No. 1 branch mne from Wyoming Pocahontas Coal Co. at the end of 1965.

Tolers Sand Co., Clear Fork, continued to produce a small quantity of sand for use as traction sand for mine locomotives.

Crushed sandstone was produced by the State Road Commission of West Virginia for use as concrete aggregate and roadstone.

The Mineral Industry of Wisconsin

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the Geological Survey of Wisconsin for collecting information on all minerals except fuels.

By Keith S. Olson[1]

Desite the termination of iron mining in Wisconsin during 1965, the value of mineral production was the second highest on record, exceeded only by that of 1960. Mineral production was valued at $73.0 million, an increase of 4 percent over that of 1964. Of the total value, nonmentals comprised nearly 87 percent, metals 13 percent, and mineral fuels (peat) less than 1 percent. A 20-percent decrease in the value of metal production was more than offset by a $5.5 million increase in the output of nonmetallic minerals.

Higher prices for lead and zinc were principally responsible for a combined increase of $800,000 in the production of these metals. This increase was more than offset by a 73-percent reduction in the value of iron ore shipments resulting in a net decrease of 20 percent in the value of metal production. Greater demand for construction materials, primarily in road building, was evidenced by increased sales of sand and gravel and crushed and broken stone.

[1] Industry economist, Bureau of Mines, Minneapolis, Minn.

Table 1.—Mineral production in Wisconsin [1]

Mineral	1964		1965	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays---thousand short tons	119	$147	119	$147
Iron ore (usable) thousand long tons, gross weight	524	W	141	W
Lead (recoverable content of ores, etc.)---short tons	1,742	456	1,645	513
Lime---thousand short tons	W	W	197	3,076
Peat---short tons	3,261	136	3,090	122
Sand and gravel---thousand short tons	34,348	24,695	38,751	27,707
Stone---do	13,901	20,232	15,344	21,924
Zinc (recoverable content of ores, etc.)---short tons	26,278	7,148	26,993	7,882
Value of items that cannot be disclosed: Abrasive stones (tube-mill liners 1964 and grinding pebbles), cement, gem stones, and values indicated by symbol W	XX	17,193	XX	11,628
Total	XX	70,007	XX	72,999

W Withheld to avoid disclosing individual company confidential data, included with "Value of items that cannot be disclosed." XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

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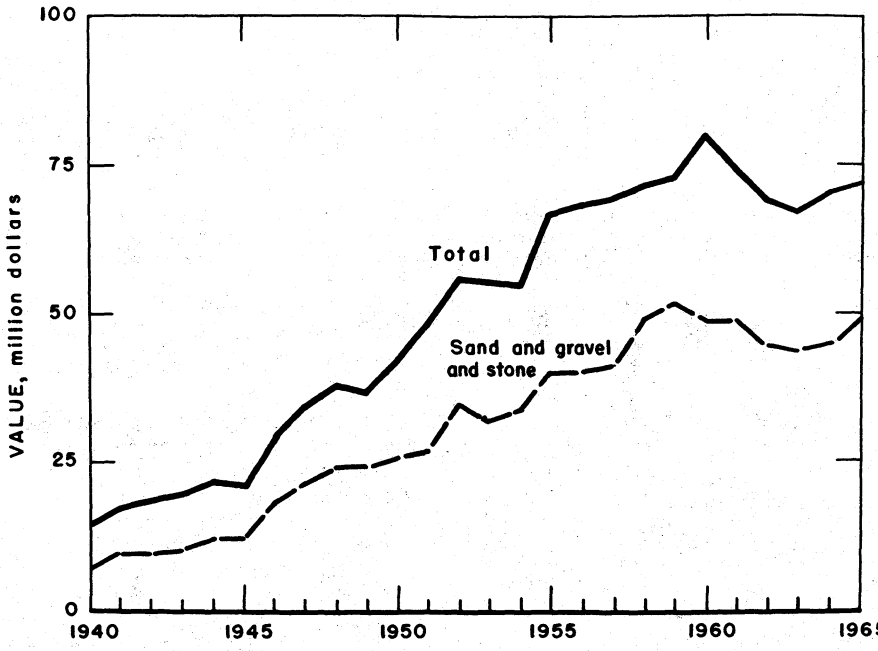

Figure 1.—Value of sand and gravel and stone, and total value of mineral production in Wisconsin.

Table 2.—Value of mineral production in constant 1957-59 dollars

(Thousands)

Year	Value	Year	Value
1956	$64,560	1961	$73,148
1957	70,250	1962	68,246
1958	73,056	1963	67,190
1959	71,276	1964	r 69,773
1960	77,575	1965	p 72,523

r Revised. p Preliminary.

Table 3.—Employment and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1964:								
Peat	15	200	3	23	-------	2	86.08	215
Metal	347	268	93	745	3	36	52.36	26,475
Nonmetal	104	125	13	107	-------	2	18.70	103
Sand and gravel	2,323	186	432	3,597	-------	73	20.30	688
Stone	2,567	202	518	4,254	1	93	22.10	1,817
Total	5,356	198	1,059	8,726	4	206	24.07	3,431
1965: p								
Peat	14	71	1	9	-------	1	113.37	5,668
Metal	330	200	66	527	-------	35	66.41	2,683
Nonmetal	15	67	1	5	-------	-------	-------	-------
Sand and gravel	2,435	193	469	3,899	-------	65	16.67	1,199
Stone	2,720	201	547	4,484	2	154	34.79	3,995
Total	5,514	197	1,084	8,924	2	255	28.80	2,695

p Preliminary.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Abrasive Stones. — Baraboo Quartzite Co., Inc., operated a quartzite deposit in Sauk County, producing grinding pebbles for grinding silica flour and deburring purposes. Production decreased in quantity but increased in value from that of 1964.

Cement.—Shipments of portland cement increased 7 percent in quantity and 5 percent in value, but production declined 2 percent. Shipments and production of masonry cement decreased in quantity and value from those of the preceeding year.

Production consisted of types I and II (general-use and moderate-heat) and type III (high-early-strength) portland cements, and masonry cement. Thirty-one percent of the types I and II portland cement was air-entrained. Average mill value per 376-pound barrel of portland cement was $3.42, a decrease of 6 cents from 1964 value. Shipments of portland and masonry cements were primarily to points within the State, however, some shipments went to the adjoining States of Illinois, Iowa, Michigan, and Minnesota.

The breakdown of portland cement shipments by form and type of transportation was as follows: Bulk shipments by truck, 75 percent; bulk shipments by rail, 15 percent; bag shipments by truck, 9 percent; and bag shipments by rail, 1 percent. Rail shipments decreased 44 percent, whereas truck shipments increased 32 percent from that of 1964. Shipments of portland cement to building material dealers and ready-mixed concrete companies increased, but shipments to concrete product manufacturers and highway contractors decreased. Small quantities were also shipped to other contractors, government agencies, and miscellaneous customers.

In addition to the cement produced and used in Wisconsin, 5.6 million barrels of portland cement and 424,000 barrels of masonary cement were shipped into the State from plants in the four adjacent States and Indiana.

The Manitowoc Portland Cement Co., a subsidiary of Medusa Portland Cement Co., produced types I and II portland cement by the wet process with limestone from Michigan and local clay from their pit. At Milwaukee, the Marquette Cement Manufacturing Co. produced types I, II, and III portland cement and masonry cement.

Clays.—Miscellaneous clay or shale was produced in Dunn, Fond du Lac, Manitowoc, Pierce, Portage, and Racine Counties. Quantity and value of production was virtually unchanged from that of 1964. Products manufactured, in decreasing order of material used, were cement, building brick, vitrified sewer pipe, and other heavy clay products.

Lime. — Wisconsin lime production in-

creased for the fourth consecutive year. Quantity and value increases were noted in the production of quicklime, which constituted about two-thirds of the total output, and in the production of hydrated lime, which comprised the remainder. Approximately 61 percent of the lime shipments went to users in 15 other States and Canada, the remainder to consumers within the State. Lime was shipped into Wisconsin from the four adjoining States, the bulk from Illinois and Michigan and the remainder from Iowa and Minnesota. Quicklime shipments into the State increased 14 percent, while incoming shipments of hydrated lime remained approximately the same as in 1964.

Four companies operated six plants in the State. The Western Lime & Cement Co. operated three plants producing both hydrated lime and quicklime at its Green Bay and Eden plants and only hydrated lime at the Knowles plant. At Superior, the Cutler-La Liberte-McDougall Corp. produced quicklime. Mayville White Lime Works produced quicklime at Mayville for its own use in the manufacture of insecticides. Rockwell Lime Co. produced quicklime and hydrated lime at Rockwood. About 73 percent of the output was for chemical and industrial uses, 26 percent for construction use, and 1 percent for agricultural purposes.

Major uses of chemical and industrial lime, in descending order of quantities used, were paper manufacture, water purification, metallurgy, insecticides, sewage disposal, metal polishing, tanning, plastics, food and food products, brick, petroleum refining, and other miscellaneous purposes.

Perlite and Vermiculite.—Crude perlite mined outside the State was expanded by Midwest Perlite Co. at its plant in Appleton and by Western Mineral Products Co. at Milwaukee. The latter company also produced exfoliated vermiculite. Sales of both commodities were up from the 1964 level. Perlite increased about 45 percent in quantity and value, and vermiculite increased 9 percent in quantity and value. Perlite was used for building plaster, concrete aggregate, loose fill insulation, and soil conditioning. Perlite used for concrete aggregate increased nearly 80 percent in quantity and value whereas material used for building plaster decreased more than 20 percent in quantity and value. Uses of exfoliated vermiculite were as loose fill insulation, concrete aggregate, and plaster aggregate.

Sand and Gravel.—Production of sand and gravel, comprising 38 percent of the State total mineral value, increased 13 percent in quantity and 12 percent in value from the 1964 levels. Quantity and value increases were recorded in nearly every use pattern. Road building materials showed the largest gain. Of the total sand and gravel output, about 68 percent was used for paving, 18 percent for building, 10 percent for fill, and about 4 percent for other purposes. Wisconsin supplied more than 4 percent of the National sand and gravel production, ranking 5th in quantity and 11th in value. Commercial operations accounted for 66 percent of the total volume and 74 percent of the total value, virtually the same as in 1964. Average value of total sand and gravel produced in the State was $0.72 per ton; sand, $0.81 per ton; and gravel, $0.67 per ton, practically the same as in 1964. Ninety-two percent of all commercial shipments were by truck, the remainder by rail and water.

Sand and gravel production was recorded in 70 out of the 71 counties, although some producers did not indicate county origin of their material. Counties with sand and gravel production exceeding 1 million tons were Columbia, Dane, Rock, Washington, and Waukesha. Collectively, these five southeastern counties comprised 32 percent of the State total. Leading producers of sand and gravel in the State, in terms of quantity follow in alphabetical order: Consumers Co., Division of Vulcan Materials Co.; Hillview Sand & Gravel Co.; Janesville Sand & Gravel Co.; Edward Kraemer & Sons, Inc.; C. C. Linck, Inc.; Manley Sand Division (Martin Marietta Corp.); Rein, Schultz & Dahl, Inc.; State Sand & Gravel Co.; Valley Sand & Gravel Co.; and Wissota Sand & Gravel Co.

Stone.—Combined production of basalt, granite, limestone, marble, marl, quartzite, and sandstone increased 10 and 8 percent, respectively, in quantity and value from the 1964 production. Stone accounted for 30 percent of the total value of mineral production in the State. Crushed and broken stone constituted 99 percent of the

Table 4.—Sand and gravel sold or used by producers, by classes of operations and uses
(Thousand short tons and thousand dollars)

Class of operation and use	1964		1965	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	3,481	$2,783	3,495	$2,842
Paving	1,689	1,214	2,424	2,031
Blast	23	85	15	44
Engine	25	21	W	W
Fill	1,115	572	1,325	623
Molding	833	2,125	879	2,251
Oil (hydrafrac)	14	69	3	15
Other [1]	118	258	169	229
Total	7,298	7,127	8,310	8,035
Gravel:				
Building	3,270	2,769	3,507	2,986
Paving	10,579	7,663	11,824	8,588
Railroad ballast	215	138	196	111
Fill	927	406	1,690	721
Other	89	71	142	111
Total	15,080	11,047	17,359	12,517
Total sand and gravel	22,378	18,174	25,669	20,552
Government-and-contractor operations:				
Sand:				
Paving	2,903	1,485	3,459	1,777
Fill	564	186	491	152
Other	174	73	182	72
Total	3,641	1,744	4,132	2,001
Gravel:				
Building	112	62	--------	--------
Paving	7,889	4,633	8,678	5,069
Fill	280	73	267	83
Other	48	9	5	2
Total	8,329	4,777	8,950	5,154
Total sand and gravel	11,970	6,521	13,082	7,155
All operations:				
Sand	10,939	8,871	12,442	10,036
Gravel	23,409	15,824	26,309	17,671
Grand total	34,348	24,695	38,751	27,707

W Withheld to avoid disclosing individual company confidential data; included with "Other."
[1] Includes other industrial sands (1964), filtration, glass, railroad ballast, other construction sands, and items indicated by symbol W.

total stone output and accounted for 83 percent of the total value. Commercial operations accounted for 95 percent of the total quantity of crushed and broken stone produced. Eighty-six percent of the commercial crushed and broken stone was trucked, the remainder was shipped by rail. Crushed and broken stone output increased 10 percent in quantity and 12 percent in value, and averaged $1.20 per ton. Crushed and broken limestone, which comprised 85 percent in quantity and 75 percent in value of all crushed and broken stone produced in the State, was produced in 36 counties; however, some producers did not indicate the county origin of their production. Concrete aggregate and roadstone accounted for 90 percent of the total output. Production of agricultural limestone declined in quantity and value for the second consecutive year. Other uses of crushed and broken limestone, in descending order of production, were lime manufacture, riprap, asphalt, flux, railroad ballast, fill, and filter beds.

Crushed and broken granite production was used entirely for road material. The Ruberoid Co. produced crushed and broken stone for the manufacture of roofing granules from an andesite quarry near

Table 5.—Limestone sold or used by producers, by uses

Use		1964		1965	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Dimension:					
Rough construction	thousand short tons	8	$70	8	$77
Rubble	do	34	211	26	201
Rough architectural	thousand cubic feet	62	100	22	21
Sawed	do	46	155	45	149
House stone veneer	do	450	1,063	467	1,058
Cut	do	58	180	52	131
Flagging	do	94	93	87	88
Total	approximate thousand short tons [1]	98	[2] 1,873	88	[2] 1,724
Crushed and broken:					
Riprap	thousand short tons	101	139	67	62
Concrete aggregate and roadstone	do	10,189	10,353	11,623	11,798
Agriculture	do	1,310	1,741	1,116	1,485
Other [3]	do	193	439	136	321
Total	do	11,793	12,672	12,942	[2] 13,667
Grand total	do	11,891	14,545	13,030	15,391

[1] Average weight of 160 pounds per cubic foot used to convert cubic feet to short tons.
[2] Data do not add to total shown because of rounding.
[3] Includes limestone for fertilizer (1964), asphalt, filter beds, flux, lime, and other uses (1964–65), and railroad ballast (1965).

Pembine. Near Grandview, the Wisconsin Aggregate Co. produced terrazzo chips from a marble deposit. Crushed and broken sandstone and quartzite were produced in Marathon and Sauk Counties for use in railroad ballast, roofing granules, concrete aggregate and roadstone, silica (refractory) brick, abrasives, terrazzo, filler, filter material, riprap, and other purposes, in descending order of quantity produced. Calcareous marl was produced in Portage County for agricultural purposes.

Combined production of all types of dimension stone decreased in value, and all but granite declined in volume, with an overall decrease of 3 percent in quantity and 7 percent in value from that of 1964.

Limestone constituted 80 percent of the volume and 47 percent of the value of total dimension stone. House stone veneer accounted for 69 percent of the total dimension limestone production, excluding rubble and irregular-shaped stone. Other uses for dimension limestone, in descending order of quantity, were rubble, rough construction, flagging, cut stone, sawed stone, and rough architectural stone. Dimension limestone was produced in 5 counties by 30 companies with 93 percent of the total value being recorded in Fond du Lac and Waukesha Counties.

Dimension granite valued at $1.9 million was produced by eight companies in Ashland, Marathon, Marinette, Marquette, and Waushara Counties. Rough and dressed granite for monument use constituted 83 percent of the quantity and 86 percent of the value of the total dimension granite production, excluding rubble and irregular-shaped stone. Dressed monumental granite continued to have the highest average unit stone value at $25 per cubic foot, an increase of $1.81 over the 1964 value. Other uses for dimension granite, in descending order of volume, were rubble, rough architectural, rough construction, and dressed architectural stone.

Dimension sandstone was produced in Marathon, Sauk, Waushara, and Wood Counties. Uses for dimension sandstone, in decreasing order of value, were cut stone, rough construction, flagging, and rubble. Production of this commodity was valued at $58,000, a 32-percent decrease from the 1964 production.

METALS

Iron Ore.—Shipments of iron ore in 1965 totaled 140,746 long tons of direct-shipping-grade ore, a decrease of 73 percent from 1964. Shipments from the port of Ashland began May 3 and ended October

Table 6.—Iron ore production and shipments

Year	Number of mines	Production (thousand long tons)	Shipments (thousand long tons)	Iron content of shipments natural (percent)
1961	2	1,129	1,122	53.61
1962	2	1,081	1,045	54.24
1963	2	413	938	54.31
1964	1	376	524	W
1965	1	56	141	W

W Withheld to avoid disclosing individual company confidential data.

Table 7.—Usable iron ore produced, by ranges

(Thousand long tons)

Year	Gogebic range (Wisconsin part)	Menominee range (Wisconsin part)	Mayville District	Baraboo District	Pierce County	Total [1]
Prior to 1910	13,612	10,716	[2] 755	304	[3] 41	25,428
1910–1919	7,356	1,640	1,057	339	1	10,393
1920–1929	8,428	308	765	----------	----------	9,501
1930–1939	8,134	67	2	----------	----------	8,203
1940–1949	13,921	4	1	----------	----------	13,926
1950–1959	14,709	348	----------	----------	----------	15,057
1960	1,484	----------	----------	----------	----------	1,484
1961	1,129	----------	----------	----------	----------	1,129
1962	1,081	----------	----------	----------	----------	1,081
1963	413	----------	----------	----------	----------	413
1964	376	----------	----------	----------	----------	376
1965	56	----------	----------	----------	----------	56
Total [1]	70,696	13,082	2,580	643	41	87,043

[1] Data may not add to some totals shown because of rounding.
[2] Partly estimated.
[3] Incomplete total; excludes data which were not available prior to 1906.

30. Opening and closing dates for the port of Escanaba, Mich., were April 7 and December 19, respectively. Lake Erie base prices for iron ore remained unchanged from those of 1964.

Iron mining in Wisconsin ceased on January 28 when Pickands Mather & Co. closed the Cary mine, near Hurley, on the Gogebic Range. Chief reason for the closing was competition from pellets and high-grade ore from other sources. The Cary was opened in 1886, the third year of mining on the Gogebic Range, and produced every year except the depression year of 1932. More than 18 million tons of ore was shipped from the mine during its lifetime.

Cessation of iron mining marks the end of an era which began about 1849 with the opening of the Iron Ridge mine in the Mayville District. Last reported shipments from this district were in 1940 (including ore sold for manufacturing paint). Mining on the Wisconsin portions of the Menominee and Gogebic Ranges began in 1880 and 1885, respectively. Shipments from the Menominee Range (Wisconsin portion) were last made in 1959. Shipments from the Baraboo District in Sauk County began in 1904 and continued through 1925. Iron mining has also been recorded in Pierce County; the last reported shipments from the county were in 1910.

Table 7 shows historical production data for the State iron-ore producing districts. With the termination of iron mining in the State, interest has turned principally to various taconite prospects. Inland Steel Co. is conducting drilling operations near Upson on the western Gogebic Range and near Black River Falls in Jackson County.

Lead and Zinc.—Lead and zinc production, as well as exploration and develop-

Table 8.—Mine production of lead and zinc, in terms of recoverable metals

Year	Mines producing		Material treated		Lead		Zinc		Total value
	Lode	Tailings	Ore (short tons)	Tailings (short tons)	Short tons	Value	Short tons	Value	
1956–60 (average)	9	2	631,730	31,481	1,438	$397,062	17,530	$4,290,730	$4,687,792
1961	9	1	465,407	99	680	140,080	13,865	3,188,950	3,329,030
1962	9	----	411,820	------	1,394	256,496	13,292	3,057,160	3,313,656
1963	8	----	445,742	------	1,116	241,056	15,114	3,476,220	3,717,276
1964	13	----	849,943	------	1,742	456,404	26,278	7,147,616	7,604,020
1965	[1] 16	----	967,083	------	1,645	513,240	26,993	7,881,956	8,395,196

[1] Includes 2 boulder piles.

ment activity in southwestern Wisconsin, continued to be stimulated by higher prices for these metals.

Average yearly weighted prices used to calculate values of lead and zinc in table 1 were 15.6 cents per pound for lead and 14.6 cents per pound for zinc, as compared with 13.1 cents for lead and 13.6 cents for zinc in 1964.

American Zinc, Lead & Smelting Co. operated the Blackstone-Hancock-Winskell, Champion, Teasdale, Temperly-Thompson, and Tennyson Nos. 1 and 2 mines. Ore from the Tennyson mines (formerly Piquette Nos. 1 and 2) was processed at the Tennyson mill. The remainder was processed at its Shullsburg mill. In May, the Ivey Construction Co. began operations in its new mill at Mineral Point treating ores from the nearby Graysville mine. The Eagle-Picher Co. operated the Kennedy, Birkett-Bastian-Andrews, Booty-Thompson, and Shullsburg mines. Ores from these mines were treated at its mills near Shullsburg, Wis., and Galena, Ill. The company continued exploration drilling in the area and also began sinking a new incline on the Stevens property near Linden.

Table 9.—Mine production of lead and zinc in 1965, by months, in terms of recoverable metals

(Short tons)

Month	Lead	Zinc
January	195	2,210
February	200	2,205
March	165	2,270
April	130	2,395
May	115	2,175
June	105	2,325
July	135	2,220
August	140	2,470
September	120	2,260
October	130	2,110
November	110	2,180
December	100	2,173
Total	1,645	26,993

In November the Grimes Mining Co. closed the Burnham mine, which had been in operation since reopening in late 1963. Near Rewey, the Mifflin Mining Co. operated the Coker No. 1 mine and mill until November, when the mill was closed for repairs. Mine production continued with shipments of custom ore to Ivey Construction Co. at Mineral Point.

The New Jersey Zinc Co. announced plans to reopen its mine and construct an 800-ton-per-day flotation mill near Elmo. Developmental operations in the underground workings are to be concurrent with mill construction. Both mine and mill are to be in operation by the end of 1966. This project was halted several years ago owing to a low price for zinc.

A Canadian concern, the C. C. Huston Exploration Co., examined by a geochemical method of sampling spring water approximately 125 square miles in the Block House Range and in the area between Platteville and Tennyson. The company has secured leases on approximately 10,000 acres and plans to begin drilling test holes in 1966, using an induced potential survey to check the results of geochemical work.

MINERAL FUELS

Peat.—Peat sales decreased 5 percent in quantity and 11 percent in total value from the 1964 figures, chiefly because of unfavorable weather conditions. Three companies were active in 1965, one produced only humus peat, another only moss peat, and the other company produced both

types. Over half the total production, nearly all of which was sold in bulk, was used for general soil improvement. The remainder was sold primarily in packaged form for seed inoculant and as an ingredient for potting soils.

REVIEW BY COUNTIES

Mineral production was reported from every county in the State. Value of mineral production in 18 counties exceeded $1 million. The five counties with the greatest value of mineral production, in descending order of value, were Lafayette, Waukesha, Manitowoc, Milwaukee, and Marathon. Production of sand and gravel was reported from 70 counties and stone production from 45 counties, although some companies did not indicate the county source of their production. Iron ore was mined in one county and lead and zinc ore in three counties. Minerals produced in each county are shown in table 10, although all counties are not discussed in the text.

Ashland.—Iron ore shipments from the Soo Line Railroad Co. dock at the port of Ashland totaled 298,000 tons. Shipping dates extended from May 3 to the early closing on October 30. Because iron mining on the Gogebic Range ceased, the Soo Line dock was not expected to reopen for the 1966 shipping season. Since 1885, more than 295 million tons of Wisconsin and Michigan iron ores were shipped from Ashland to lower Lake ports.

Cold Spring Granite Co. produced dimension granite near Mellen for architectural and monumental use. The Primax Corp., also near Mellen, produced rough granite blocks and rubble. About 56,000 tons of paving gravel was produced by the county highway department.

Bayfield. — Mineral production value more than doubled as a result of a substantial increase in value of marble production. Wisconsin Aggregate Co. near Grandview, the only marble producer in the State, produced material for roadstone, agricultural purposes, and terrazzo chips. The county highway department produced 41,000 tons of paving sand and gravel.

Brown.—Crushed and broken limestone was produced by Daanen & Janssen from four quarries near Duck Creek, Glenmore, Greenleaf, and West De Pere. Scray Quarries produced dimension limestone near De Pere for use in house stone veneer and rough architectural blocks. Five companies produced a total of 293,000 tons of sand and gravel for building, paving, and fill. The Western Lime & Cement Co., using limestone from Michigan, produced both quicklime and hydrated lime for construction, chemical, and other industrial purposes.

Buffalo.—Mon-Arc Quarries, Inc., Tiffany Construction, Inc., and J. Allen Wiles, using portable plants, produced crushed and broken limestone from 13 quarries. Production, down slightly from that of 1964, was used for concrete aggregate, roadstone, riprap, and agricultural limestone (aglime). Paving gravel was produced near Fountain City by C. C. Linck, Inc. The county highway department produced 61,000 tons of sand for paving, fill, and other uses.

Clark.—Sand and gravel production increased 19 percent in quantity and 36 percent in value. Principal uses were for building and road construction. Hatfield Sand & Gravel and Carl Opelt Sand & Gravel operated stationary plants near Merrillan and Neillsville, respectively. A portable plant was operated near Willard by Plautz Bros., Inc. The county highway department produced and contracted for paving sand and gravel. Ellis Quarries, Inc., dimension sandstone operation near Dorchester, was idle throughout the year.

Columbia.—Total mineral value in the county increased 15 percent from the 1964 value. Manley Sand Division (Martin Marietta Corp.) operated a stationary plant near Portage producing sand for paving, glass making, and molding. Wisconsin Dells Sand & Gravel produced fill sand and paving gravel near Wisconsin Dells. Columbia Ready-Mix Co. operated a stationary plant near Pardeeville and produced sand and gravel for building, road construction, and fill. Paving gravel was produced by Linck-Henes Construction Co., Inc., and C. C. Linck, Inc., operating portable plants near Rio and Columbus, respectively. James Sand & Gravel operated a portable plant near Doylestown and produced molding sand. The county

Table 10.—Value of mineral production in Wisconsin, by counties

County	1964	1965	Minerals produced in 1965 in order of value
Adams	W	W	Sand and gravel.
Ashland	W	$243,343	Stone, sand and gravel.
Barron	W	424,000	Sand and gravel.
Bayfield	$58,000	118,000	Stone, sand and gravel.
Brown	847,149	891,866	Lime, stone, sand and gravel.
Buffalo	268,837	293,052	Stone, sand and gravel.
Burnett	65,000	66,195	Sand and gravel, stone.
Calumet	W	235,160	Do.
Chippewa	W	131,000	Sand and gravel.
Clark	W	W	Do.
Columbia	W	W	Sand and gravel, stone.
Crawford	210,367	167,155	Stone, sand and gravel.
Dane	2,040,410	2,301,642	Sand and gravel, stone.
Dodge	1,228,118	1,273,231	Lime, sand and gravel, stone.
Door	211,493	257,516	Sand and gravel, stone.
Douglas	W	W	Lime, sand and gravel.
Dunn	166,810	166,821	Sand and gravel, stone, clays.
Eau Claire	W	W	Sand and gravel.
Florence	25,000	36,000	Do.
Fond du Lac	1,556,435	1,493,855	Stone, sand and gravel, lime, clays.
Forest	74,000	56,000	Sand and gravel.
Grant	1,128,584	1,635,688	Zinc, stone, sand and gravel, lead.
Green	638,859	596,706	Stone, sand and gravel.
Green Lake	383,000	513,000	Sand and gravel.
Iowa	682,094	796,049	Zinc, stone, lead.
Iron	W	W	Iron ore, sand and gravel.
Jackson	177,000	173,000	Sand and gravel.
Jefferson	198,000	506,017	Sand and gravel, stone.
Juneau	W	W	Stone, sand and gravel.
Kenosha	253,000	315,000	Sand and gravel.
Kewaunee	W	353,000	Do.
La Crosse	W	387,000	Stone, sand and gravel.
Lafayette	W	W	Zinc, lead, stone, sand and gravel.
Langlade	150,000	211,000	Sand and gravel.
Lincoln	152,200	230,500	Sand and gravel, peat.
Manitowoc	W	W	Cement, sand and gravel, lime, stone, clays.
Marathon	2,859,946	3,069,379	Stone, sand and gravel.
Marinette	W	W	Do.
Marquette	W	W	Do.
Milwaukee	W	W	Cement, stone, sand and gravel.
Monroe	274,725	366,500	Stone, sand and gravel.
Oconto	420,276	431,511	Sand and gravel, stone.
Oneida	209,000	214,000	Sand and gravel.
Outagamie	759,258	716,319	Stone, sand and gravel.
Ozaukee	327,000	428,000	Sand and gravel.
Pepin	19,000	29,241	Stone, sand and gravel.
Pierce	387,520	338,168	Stone, sand and gravel, clays.
Polk	629,208	677,882	Stone, sand and gravel.
Portage	352,570	457,215	Sand and gravel, stone, clays.
Price	101,000	84,000	Sand and gravel.
Racine	1,339,200	1,466,160	Stone, sand and gravel, clays.
Richland	46,000	50,000	Sand and gravel.
Rock	1,763,202	1,822,035	Sand and gravel, stone.
Rusk	74,000	101,000	Sand and gravel.
St. Croix	259,162	454,287	Stone, sand and gravel.
Sauk	1,185,286	1,159,803	Stone, sand and gravel, abrasives.
Sawyer	51,000	72,000	Sand and gravel.
Shawano	244,781	308,353	Sand and gravel, stone.
Sheboygan	446,000	499,560	Do.
Taylor	276,000	378,000	Sand and gravel.
Trempealeau	W	W	Stone, sand and gravel.
Vernon	146,542	139,120	Do.
Vilas	79,000	64,000	Sand and gravel.
Walworth	411,000	577,000	Do.
Washburn	W	W	Do.
Washington	893,000	1,078,000	Do.
Waukesha	5,729,966	6,619,956	Sand and gravel, stone, peat.
Waupaca	306,557	W	Sand and gravel, stone.
Waushara	W	W	Do.
Winnebago	1,562,217	1,774,882	Stone, sand and gravel.
Wood	W	W	Sand and gravel, stone.
Undistributed [1]	38,340,228	35,750,833	
Total	70,007,000	72,999,000	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] Includes some sand and gravel and stone that cannot be assigned to specific counties and values indicated by symbol W.

highway department produced 300,000 tons of paving gravel.

Limestone was produced for roadstone and aglime by Dann & Wendt, Inc., operating a stationary plant at a quarry near Rio.

Crawford.—Value of mineral production decreased 21 percent owing to decreased demand for limestone used for roadstone and aglime. Loren J. Slaght operated four quarries near Gays Mills, Ferryville, and Eastman, and Turner Stone Corp. operated three quarries near Gays Mills, Seneca, and Steuben. Both companies operated portable plants, producing limestone chiefly for use as roadstone. Sand and gravel for building, road construction, and fill was produced near Prairie du Chien by Lakeside Sand & Gravel and Prairie Sand & Gravel, Inc. The county highway department produced sand for ice-control purposes.

Dane.—Value increases in limestone and sand and gravel production resulted in a 13-percent increase in value of county mineral production from that of 1964. A total of 786,000 tons of limestone was produced by 13 companies for use in concrete aggregate and roadstone, aglime, and riprap. Leading producers, in alphabetical order, were Hammersley Stone Co., Inc., near Fitchburg; Madison Stone Co., Inc., near Madison; and Wingra Stone Co. near Fitchburg. Thirteen commercial companies and the county highway department produced a total of 1.5 million tons of sand and gravel for building, paving, fill, and molding. Major producers of sand and gravel, both in quantity and value, in alphabetical order, were Hartland-Verona Gravel Co. near Verona; Madison Sand & Gravel Co. near Madison; Rein, Schultz & Dahl, Inc., at various locations; Wingra Stone Co. near Fitchburg and Madison; and Yahara Materials, Inc. near Waunakee.

Dodge.—Quicklime was produced intermittently by Mayville White Lime Works at Mayville, for its own use. The Western Lime & Cement Co. produced hydrated lime for construction purposes. Both companies produced limestone for lime manufacture and road construction. The former company also sold crushed limestone for aglime and metallurgical purposes. Other limestone producers were Linck-Henes Construction Co., Inc., and the county highway department. Sand and gravel production totaled 589,000 tons. The entire output was produced with portable plants for road construction and maintenance. Commercial producers were Martin Kaddatz Gravel Co. near Watertown; Linck-Henes Construction Co., Inc., who operated five pits near Horicon, LeRoy, and Rubicon; C. C. Linck, Inc., who operated five pits at Burnett, Fox Lake, Horicon, Randolph, and Reeseville; and Rein, Schultz & Dahl, Inc. The county highway department produced sand and gravel for its own use.

Door.—Mineral value increased substantially due to greater output of sand and gravel, which totaled 278,000 tons. Hubert Charles, near Rosiere, and Vernon E. Olson Excavating Co., near Sturgeon Bay, operated stationary plants producing sand and gravel for building, paving, and fill. Koepke Sand & Gravel Co. operated a portable plant and produced paving gravel from a pit near Sturgeon Bay. The county highway department produced limestone and sand and gravel for road material. Dimension limestone for use as house veneer and sawed stone was produced by Adamski-Fisher Quarry, near Sturgeon Bay.

Douglas.—The Great Northern Railway Co. purchased a 15-acre site in Superior, near the company's Allouez iron ore docks, for winter storage of taconite pellets produced in Minnesota. Estimated capacity of this facility was expected to exceed 2 million tons. Cutler-La Liberte-McDougall Corp., the largest lime producer in the State, produced quicklime for metallurgical purposes, paper manufacture, and other industrial uses, with limestone from Michigan. The city of Superior and the county highway department accounted for the entire sand and gravel output of 89,000 tons, used principally for road construction and maintenance.

Dunn.—The Barron County Agricultural Department produced aglime from the Boyceville quarry. Clay was produced by Menomonie Brick Co. for its own use in manufacturing building brick. The county highway department produced 225,000 tons of sand and gravel for paving use and fill.

Fond du Lac.—Mineral production decreased 4 percent in value from that of 1964. Limestone production was valued at $1.2 million, of which 60 percent was

dimension stone. Types of dimension limestone produced, in descending order of value, were house stone veneer, irregular-shaped stone, rubble, flagging, cut stone, sawed stone, and rough architectural blocks. Producers of dimension limestone were El Dais Stone Co., Eden Stone Co., Fond du Lac Stone Co., Inc., Hamilton Stone Co., Oak Stone Co., and Rademann Stone Co. Crushed and broken limestone was produced by seven companies for aglime, concrete aggregate and roadstone, lime manufacture, and metallurgical purposes. Near Eden, The Western Lime & Cement Co. produced quicklime and hydrated lime for construction, agricultural, chemical, and other industrial uses. Oakfield Shale Brick & Tile Co. produced building brick near Oakfield, using clay from its own pit. About 420,000 tons of sand and gravel was produced for building, paving, and fill purposes. Producers included Lake View Sand & Gravel Co., C. C. Linck, Inc., Cyril H. Simon, and the county highway department.

Grant.—Mineral production was valued at $1.6 million, the largest of any year since 1957. The 44-percent increase in value of mineral production was primarily due to increased production and higher prices of lead and zinc. The American Zinc, Lead & Smelting Co. became sole owner of the Piquette Mining Co. on July 1. The operation is now called the Tennyson Division of the parent company. Both mines, Tennyson No. 1 and No. 2 (formerly Piquette No. 1 and No. 2), and the mill were operated throughout the year. Grimes Mining Co., Inc., operated the Burnham zinc mine near Platteville, until closing down in November. Eight companies operated portable plants, producing crushed limestone for concrete aggregate, roadstone, and aglime. American Zinc, Lead & Smelting Co. sold jig tailings from its Tennyson mill for road material. About 100,000 tons of sand and gravel was produced, primarily for building and road construction. Stationary plants were operated by Becker & Tuckwood near Lancaster, and by Dubuque Sand & Gravel Co. near Kieler. The county highway department produced pit-run gravel and contracted for paving sand.

Green.—Total value of county mineral production decreased 7 percent, chiefly because of a substantial drop in value of limestone production. Crushed limestone was produced for concrete aggregate, roadstone, and aglime, by Bergen Rock & Lime Co., near Brooklyn; Glen J. Lingard, near Blanchardville; Rees Construction Co., operating 10 quarries near Monroe; P. W. Ryan Sons, Inc., operating 12 quarries near Albany, Belleville, Blanchardville, Brooklyn, Monroe, Monticello, and New Glarus; and Ted Stauffacher near Monroe. All companies operated portable plants. Sand and gravel production increased substantially from the 1964 output. John W. Dieckman produced pit-run sand near Monroe, Wm. J. Kennedy & Son produced sand and gravel near Brodhead for building and paving use, and Lyle T. Manley Co., Inc., produced ground silica sand near Browntown for foundry purposes. The county highway department produced and contracted for sand and gravel for paving and other purposes.

Green Lake.—Molding sand, comprising 54 percent of the total county mineral value, was produced by Chier St. Marie Sand Co., C. A. Chier Sand Co., F. B. Dubberstein & Sons, Inc., and Wilbur W. Wick, all of whom operated stationary plants near Berlin. Koepke Sand & Gravel Co. and C. C. Linck, Inc., operated portable plants near Markesan and produced paving gravel. The county highway department also produced paving gravel. Kopplin & Kinas Co., Inc., operating a portable plant near Green Lake, and Paul Polenska & Son, operating a stationary plant near Manchester, produced sand and gravel for building and fill.

Iowa.—The 17-percent increase in value of mineral production was the result of increased production of limestone, as zinc production declined slightly both in quantity and value. A small quantity of lead was produced in 1965; none was produced in 1964. Limestone was produced for concrete aggregate and roadstone by Davis & Richardson, operating three quarries near Muscoda, Spring Green, and Arena; G. A. Watson, operating three quarries near Clyde, Barneveld, and Highland; and George Wendtlandt, operating seven quarries near Dodgeville, Edmund, Mineral Point, and Ridgeway. The latter company also produced aglime. The Eagle-Picher Co. sold jig tailings for railroad ballast and roadstone. The county highway department produced 86,000 tons of lime-

stone from various quarries throughout the county.

In May, the Ivey Construction Co. began operating its new mill near the site of the old Mineral Point zinc works, using ores from its nearby Graysville mine. The Eagle-Picher Co. began an incline into the Stevens property near Linden and constructed a road from the incline to its nearby mill. The company also conducted exploration drilling. Mifflin Mining Co. operated the Coker No. 1 mine and its mill near Rewey until November, when the mill was closed down for repairs.

Iron.—The last producing iron ore mine in the State, the Cary underground mine near Hurley, on the Gogebic Range, was closed in January by Pickands Mather & Co. Shipments of 141,000 tons from the Cary were completed later in the year. Competition with pelletized ores and high-grade ores from other sources forced the company to cease operation. Approximately 18 million tons of ore was shipped from the mine since it was opened in 1886. Because of the late development of the mine, approximately half of the total production occurred in the last 20 years. Near Upson, the Jackson County Iron Co., as subsidiary of Inland Steel Co., conducted drilling operations for taconite on land owned by the La Pointe Iron Co. The county highway department contracted for 19,000 tons of paving gravel.

Jackson. — Taconite exploration continued as the Jackson County Iron Co., a subsidiary of Inland Steel Co., conducted drilling operations near Black River Falls. About 301,000 tons of sand and gravel, used mainly for building and road construction, was produced. Commercial operators were Laurence Murphy, operating a portable plant near Black River Falls, and H. T. Smith Sand & Gravel, who operated a stationary plant near Hixton. Paving sand and gravel was produced by the county highway department.

Jefferson.—A substantial gain in value of mineral production resulted from an increase in production of sand and gravel. Approximately 516,000 tons of sand and gravel was produced, for building, paving, and fill. Producers were Hausz Bros., Inc., Rein, Schultz & Dahl, Inc., Rude Sand & Gravel, Wolf Construction Co., and the county highway department. Hausz Bros., Inc., also produced crushed limestone for road use.

Juneau.—Arthur Overgaard Co., operating a stationary plant near Elroy, produced crushed and broken limestone for riprap, roadstone, and aglime. The county highway department produced 127,000 tons of sand and gravel for paving and other purposes.

Kewaunee. — Production of sand and gravel remained approximately the same as in 1964. Schuster Construction Co. operated a fixed plant near Casco and produced 265,000 tons of sand and gravel for building and other uses. The county highway department produced 195,000 tons of paving gravel.

La Crosse. — Arthur Overgaard, Inc., produced crushed limestone principally for roadstone and aglime from a quarry near La Crosse. Also near La Crosse, stationary sand and gravel plants were operated by Kammel-Smith Sand & Gravel Co., Inc., and La Crosse Sand & Gravel, Inc., producing building and paving material. The county highway departement produced paving sand.

Lafayette.—Primarily as the result of higher lead and zinc prices, mineral production exceeded the 1964 record value by 6 percent. For the second consecutive year, the county has ranked first in value of mineral production. Zinc production was down from that of 1964 by 2 percent in quantity but increased 5 percent in value. Production of lead decreased slightly, but as a result of the 2.5-cent price rise, value increased by 1 percent. Early in the year, American Zinc, Lead & Smelting Co. began production from its newly reopened Champion mine near New Diggings. The company also continued to operate the Blackstone - Hancock - Winskell, Teasdale, and Temperly-Thompson mines and a mill near Shullsburg. Exploration work included diamond drilling in the floors of their mines in the Shullsburg area and the operation of two churn drills on the surface during most of the year. The number of churn drills was increased to five in December.

The Eagle-Picher Co. transported lead-zinc ore by highway trucks from its Birkett-Bastian-Andrews and Kennedy mines to the company's mill at Galena, Ill. Ores from the company's Booty-Thomson and Shullsburg mines were beneficiated at the

Shullsburg mill. The company operated one drill for exploration purposes during the year.

Near Shullsburg, the New Doyle Mine Partners operated the Doyle mine, sending a small shipment of custom lead-zinc ore to the American Zinc, Lead & Smelting Co.'s Shullsburg mill. Early in October, the New Jersey Zinc Co. announced plans to reopen their mine near Elmo and to construct an 800-ton-per-day flotation mill nearby. Underground development operations began late in the year. Mill construction was to begin in May 1966; both operations are expected to be in production by the end of 1966.

Seven companies produced a total of 195,000 tons of crushed limestone for use as roadstone and aglime. Limestone production was up 19 percent in quantity and 10 percent in value from that of the 1964 levels. Paving gravel was produced by Oscar Zwalanek near Gratiot.

Lincoln.—About 279,000 tons of sand and gravel was produced. Merrill Gravel & Construction Co. and Tomahawk Sand & Gravel Co., Inc., operated stationary plants near Merrill and Tomahawk, respectively, and produced sand and gravel for building, road construction, and fill. Rein, Schultz & Dahl, Inc., operated a portable plant and produced paving sand and gravel. The county highway department produced sand and gravel for paving and other uses. Superior Brand Peats produced humus and moss peat, sold in packaged form for general soil improvement.

Manitowoc.—Value of mineral production in the county increased 6 percent from the 1964 value, although the county dropped from second rank to third in the State. The largest producer of cement in the State, Manitowoc Portland Cement Co., operated four kilns and produced types I and II (general-use and moderate-heat) portland cement. Raw materials included limestone from Michigan and local clay, piped in the form of a slurry, from the company's pit about 1.5 miles from the plant. Shipments of cement increased in quantity and value. The parent company, Medusa Portland Cement Co., plans to close this plant late in 1967 or early 1968, at which time their new plant at Charlevoix, Mich. will be in production and supply their Wisconsin markets. Near Rockwood, the Rockwell Lime Co., a Division of the Brisch Brick Co., produced and sold quicklime for chemical and other industrial uses and hydrated lime for construction purposes. In addition, the company also operated a limestone quarry, producing crushed limestone for aglime and for use in its lime plant. Valders Lime & Stone Co., near Valders, produced nearly 19,000 cubic feet of dimension limestone, mainly for architectural use, as well as crushed and broken limestone for roadstone and riprap. A small quantity of crushed limestone was produced by the city of Manitowoc.

Sand and gravel production totaled 859,000 tons, a substantial increase from 1964 production. Five companies produced sand and gravel for building, paving, and fill. The city of Manitowoc and the county highway department produced sand and gravel for paving and fill.

Marathon. — Production of dimension granite decreased slightly in quantity and value from 1964 production. Near Wausau, Anderson Bros. & Johnson Co., Lake Wausau Granite Co., Prehn Granite Quarries, Inc., and Wisconsin Quarries, Inc., produced rough and dressed granite for monumental use. Cold Spring Granite Co. also produced granite near Wausau, for architectural and monumental purposes. Decomposed granite, primarily for roadstone, was quarried by Harold Bolike, Ray Fitzgerald Granite Pit, Gottschalk Bros., Inc., Knauf Bros., and Tony Schilling Granite Pit. Dimension sandstone was produced by Ernest F. Liebe near Wausau and Nemke's Stone Quarry near Hatley. Output was used as cut stone and flagging. Minnesota Mining & Manufacturing Co. operated the Greystone argillite quarry and Rib Mountain quartzite quarry near Wausau. Material produced from the Greystone quarry was used chiefly for roofing granules; output from the Rib Mountain quarry was used mainly for abrasive materials. In addition, material was produced from both quarries for road use, terrazzo, and other purposes.

A total of 408,000 tons of sand and gravel was produced, a substantial decrease from 1964 production. Output was used for building, road construction, and other purposes. Stationary sand and gravel plants were operated by Edmund Gesicki, Sr., near Athens; Heiser Ready-Mix Co., Lotz Sand & Gravel Co., and Riverside

Gravel Co., near Wausau; and Sonnentag Concrete & Gravel near Marathon. Frank Drewek and Joseph Zoromaski produced pit-run material near Athens and Hatley, respectively. The county highway department produced and contracted for paving sand and gravel.

Marinette.—Mineral value in the county increased substantially from that of 1964. Basalt (andesite) was quarried by The Ruberoid Co., about 10 miles east of Pembine, for the manufacture of roofing granules. Anderson Bros. & Johnson Co. produced monumental granite near Amberg. About 419,000 tons of sand and gravel was produced, for building, paving, and railroad ballast. Plants were operated by John Bartkouski, near Crivitz; Koepke Sand & Gravel Co., near Pembine; Mason Sand & Trucking, near Marinette; and the Soo Line Railroad Co., near Kremlin. The county highway department also produced sand and gravel for paving.

Marquette.—Montello Granite Co. produced dressed monumental granite near Montello. The county highway department produced 30,000 tons of paving gravel.

Milwaukee.—The county ranked fourth in mineral production value, compared with third in 1964, although the value of mineral production in the county increased 14 percent from 1964. At Milwaukee, the Marquette Cement Manufacturing Co. produced types I and II (general-use and moderate-heat) and type III (high-early-strength) portland cement and masonry cement. One kiln was operated. Raw materials used at the Milwaukee plant included shale from Illinois and limestone from Michigan. Limestone used mainly for road material was produced by Consumers Co. (Division of Vulcan Materials Co.) near Hales Corners and Franklin Stone Products, Inc., near Franklin. Both companies operated stationary plants. Sand and gravel production increased substantially from that of 1964. Companies operating portable sand and gravel plants, producing building, paving, or fill material, were Ray Anderson & Son Sand & Gravel, Inc., near Franklin; Fink Sand & Gravel, near South Milwaukee; and Koepke Sand & Gravel Co., near Milwaukee. Gravel, Inc., operated a stationary plant near Franklin and produced paving sand and gravel. Western Mineral Products Co. of Milwaukee expanded crude perlite and vermiculite produced outside the State. The expanded products were used for concrete and plaster aggregate and loose fill insulation.

Monroe.—Because of a 228,000-ton increase in sand and gravel production by the county highway department, mineral production value increased one-third from the 1964 value. Crushed limestone, used chiefly for roadstone and aglime, was produced by Otto Meyer & Son, Schendel Bros., and Schultz Quarry Co., operating portable plants near Tomah, Norwalk, and Wilton, respectively.

Oconto.—A total of 524,000 tons of sand and gravel was produced, an increase of 12 percent from that of 1964. Foster Construction Co., Inc., produced crushed limestone for aglime from the Gillett quarry near Gillett and roadstone from the Montevedio quarry near Abrams. The company also produced paving gravel from a pit near Little Suamico. Paving gravel was produced with portable plants by John Jaworski and M. R. K. Construction Co., Inc., both near Pulaski, and by the county highway department. Gillett Cement Products, Inc., produced building and paving gravel from a stationary plant near Gillett.

Outagamie.—About 323,000 tons of sand and gravel was produced for building, paving, and fill. Portable plants were operated by Carl W. Krause and Landwehr, Inc., near Appleton and by M. R. K. Construction Co., Inc., near Seymour. Murphy Construction Co., operated a stationary plant near Black Creek. County highway department crews produced paving sand. Limestone used for road material was produced by the M. R. K. Construction Co., Inc., and by Landwehr, Inc. The Black Creek Limestone Co. produced aglime and roadstone with a stationary plant near Black Creek. At its Appleton plant, Midwest Perlite Co. expanded crude perlite produced outside the State for building plaster, concrete aggregate, loose fill insulation, and soil conditioning.

Pierce.—Bay City Sand Co. produced sand for molding, blast, and engine uses from its underground operation near Bay City. In June, the operation of Pepin Shore Silica Sand Co., Inc., near Maiden Rock, was acquired by Delbert Gore of Maiden Rock. This underground opera-

tion produced sand for blast and oil (hydrafrac) purposes. River Falls Sand & Gravel Co. operated a fixed plant near River Falls and produced sand and gravel for building. The county highway department produced paving sand and gravel. Red Wing Sewer Pipe Corp. produced clay from its pit near Elmwood for manufacturing vitrified sewer pipe at its Red Wing, Minn., plant. Crushed and broken limestone, used for roadstone, aglime, and riprap, was produced by Tiffany Construction, Inc., and the county highway department.

Polk.—Total mineral value in the county increased 8 percent from the 1964 value. Bryan Dresser Trap Rock, Inc., produced basalt near Dresser for railroad ballast and road material. The county agricultural agency produced about 52,000 tons of limestone for aglime and roadstone. Atlas Gravel Co. produced sand and gravel near Luck for paving use and fill. Bohn Sand & Gravel operated a fixed plant near West Sweden and produced sand and gravel for building, road construction, and fill. Jorgenson Construction Co. and Osterman Sand & Gravel, Inc., operated portable plants near Luck and Turtle Lakes, respectively, and produced paving gravel. The county highway department produced 405,000 tons of paving sand and gravel.

Portage.—Mineral production increased 30 percent in value primarily because of a 112,000-ton increase in sand and gravel production. About 506,000 tons of sand and gravel was produced, principally near Custer and Stevens Point. Output was used for building, road construction, railroad ballast, and fill. Producers included Nick Charneski, F. F. Mengel Co., Wimme Sand & Gravel, the country highway department, and the city of Stevens Point.

Clay was mined by Graff Brick Co. of Waupaca, Inc., near Stevens Point, for the manufacture of building brick at the company's Waupaca plant. Caldwell's Dredging Co. produced calcareous marl near Almond for agricultural purposes.

Racine.—Consumers Co. (Division of Vulcan Materials Co.) produced crushed limestone near Racine for concrete aggregate and roadstone. About 883,000 tons of sand and gravel, used mainly for building and paving, was produced. Plants were operated by Burlington Sand & Gravel Corp., Morrow & Reesman, and J.W. Peters & Sons, Inc., near Burlington; Hillside Sand Co., Inc., near Caledonia; Root River Sand & Gravel Co., Inc., near Franksville; and the county highway department. Union Grove Drain Tile Co. produced clay near Union Grove for use in manufacturing draintile.

Rock.—Nearly 2 million tons of sand and gravel was produced, of which 70 percent was for building, 17 percent for paving, and 13 percent for other purposes, including railroad ballast, molding sand, and fill. Value of sand and gravel production increased 8 percent over the 1964 value and comprised 83 percent of the total county mineral production value. Major producers in terms of value, and listed in alphabetical order, were Edgerton Sand & Gravel Co., near Edgerton; Janesville Sand & Gravel Co., near Janesville; Wm. J. Kennedy & Son, also near Janesville; and Lyle T. Manley Co., Inc., near Hanover. Ten companies and the country highway department produced a total of 396,000 tons of crushed and broken limestone. Production declined 8 percent in quantity and 14 percent in value. The material was used for roadstone, aglime, and riprap. All but two companies operated portable plants, one operated a stationary plant, and one shipped from stockpiles.

St. Croix.—The county highway department produced 391,000 tons of paving sand and gravel and 51,000 tons of limestone for roadstone and riprap. Other producers of sand and gravel were Casey Gravel Works, who operated a stationary plant near New Richmond, and Leary Construction Co., Inc., who produced building gravel from a pit near River Falls. The latter company and the Wilson Rock & Limestone Co. produced crushed and broken limestone, with portable plants, for use as roadstone, aglime, railroad ballast, and riprap.

Sauk.—Decreases in value of limestone, quartzite, and sandstone were chiefly responsible for the 2-percent drop in value of mineral production. Sandstone and quartzite comprised 69 percent of the mineral production value, slightly less than in 1964. Crushed quartzite was produced by the Foley Bros., Inc., near Rock Springs, for railroad ballast. The company has a large quarry with a 90-foot face, approximately 300 feet wide. This material has

qualities which are ideal for railroad ballast. Crushed quartzite used in the manufacture of silica brick was produced near Baraboo by Harbison-Walker Refractories Co. and General Refractories Co. Baraboo Quartzite Co., Inc., produced grinding pebbles and roadstone from a quartzite deposit near Baraboo. Dimension sandstone was produced by Bloss Stone Co. and Alfred Boyles Flagstone Quarry near Rock Springs, and by Hildebrandt Stone Co. near Sauk City. The material was used for cut stone, irregular-shaped stone, flagging, and rubble. Sand and gravel was produced by Baraboo Concrete Co., Inc., W. R. Du Bois & Son, Inc., and the city of Baraboo for building, paving, and fill. Crushed limestone was produced for aglime and roadstone by Frederic Bindl, Davis & Richardson, and Holtz & Schulenburg Lime Works.

Shawano.—Increased production of sand and gravel resulted in a 26-percent gain in mineral production value over the 1964 value. A total of 495,000 tons of sand and gravel was produced. Seven commercial companies produced sand and gravel for building, paving, and fill. Plants were operated near Angelica, Bonduel, Caroline, Cecil, Embarrass, Shawano, and Wittenberg. The county highway department produced sand and gravel for paving and other purposes. The county agricultural department produced 16,000 tons of crushed limestone for aglime and roadstone.

Sheboygan.—Value of mineral production increased 12 percent from the 1964 value. Five companies and the county highway department produced a total of 833,000 tons of sand and gravel, chiefly near Cascade, Elkhart Lake, Greenbush, Kiel, and Plymouth. The material was used for building, road construction, and other purposes. The county agricultural department produced nearly 5,000 tons of crushed limestone for aglime.

Walworth.—Mineral production in the county consisted entirely of 865,000 tons of sand and gravel valued at $577,000 representing an increase of more than 40 percent both in quantity and value from the 1964 figures. Output was used for building, paving, and fill. Plants were operated by B. R. Amon & Sons near Elkhorn; Community Sand & Gravel near Delavan; Mann Bros. Sand & Gravel, Inc., at 10 locations throughout the county; R. W. Miller & Sons, Inc., near Lake Geneva; Ernest Nobis near Fontana; Thorpe & Madison near Delavan; and Lake Geneva Sand & Gravel Co. near Fontana. The latter company operated a stationary plant, the remaining companies operated portable plants except for R. W. Miller & Sons, Inc., who operated both types.

Washington.—Production of sand and gravel, the only mineral produced in the county in 1965, increased 33 percent in quantity and 21 percent in value. The largest increase was in the production of paving material, 38 percent in quantity and 28 percent in value. Other uses for sand and gravel were building, fill, and miscellaneous purposes. Sand and gravel was produced by 10 companies and the county highway department, chiefly in the vicinities of Barton, Colgate, Germantown, Newburg, Richfield, and West Bend. Major producers, listed alphabetically, were R. M. Hinze, Inc.; Milwaukee Gravel Products; Reiske Sand & Gravel Corp.; and Wissota Sand & Gravel Co.

Waukesha.—This county ranked first in the production of sand and gravel, comprising 16 percent in quantity and 14 percent in value of the State total. A substantial increase in the production of sand and gravel advanced the county from fourth to second in value of mineral production. More than 6.1 million tons of sand and gravel was produced, of which 31 percent was for building, 50 percent for paving, 17 percent for fill, and 2 percent for other purposes. Twenty-eight companies and the county highway department produced sand and gravel. Leading producers, in alphabetical order, were Consumers Co. (Division of Vulcan Materials Co.) near Dousman; Hartland Sand & Gravel Co. near Hartland; Hillview Sand & Gravel Co. near New Berlin; T. Johnson & Sons and C. C. Linck, Inc., both near Pewaukee; Palmer Crushing Co. near Colgate; Richardson Sand & Gravel near Brookfield; State Sand & Gravel Co. near Big Bend and Merton; Turner Sand & Gravel near Sussex; and Valley Sand & Gravel Co. near New Berlin.

Dimension limestone was produced by 21 companies. Nearly the entire production was from the Sussex-Lannon area. Uses of the material, in descending order

of production, were house veneer, rubble, flagging, sawed stone, cut stone, rough construction, and rough architectural. Major producers were Milwaukee Lannon Stone Co., Halquist Lannon Stone Co., and Consumers Co. The last two companies also produced crushed limestone for roadstone and aglime. Waukesha Lime & Stone Co., near Waukesha, produced crushed limestone for aglime, road material, metallurgical purposes, asphalt filler, and filter beds. Demilco, Inc., produced humus peat near Delafield and sold the material in packaged form for seed inoculant and in bulk for general soil improvement and potting soils. Moss peat was produced near New Berlin by H. Geipel's Custom Soil, Inc., and sold for general soil improvement in bulk form.

Waupaca.—About 348,000 tons of sand and gravel was produced for building, paving, and fill. Plants were operated by Mantin Bros. and Stilen's Sand & Gravel near Clintonville, C. H. Peters near Readfield, and the county highway department. C. H. Peters also produced crushed limestone for roadstone and aglime, and the county highway department produced 40,000 tons of limestone for road use.

Winnebago.—Value of mineral production increased 13 percent from the 1964 value. Sand and gravel was produced principally for building and highway purposes. Output increased 18 percent in quantity and 25 percent in value. Plants were operated by Courtney & Plummer, Inc., and Schulz Sand & Gravel, Inc., near Neenah; Friedrich, Loots & Below, Inc., near Omro; and the county highway department. Limestone production increased 2 percent in quantity and 8 percent in value. Quarries were operated by Badger Highways Co., Inc., near Menasha; Consumers Co. (Division of Vulcan Materials Co.) near Oshkosh; and Courtney & Plummer, Inc., near Neenah. Uses for limestone were road material, aglime, asphalt filler, and riprap.

Wood.—Ellis Quarries, Inc., Klesmith Stone Co., and Tony Schmick produced dimension sandstone near Rudolph for rough construction, flagging, and architectural purposes. The county highway department produced 40,000 tons of crushed granite and 296,000 tons of sand and gravel for road use.

The Mineral Industry of Wyoming

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the Geological Survey of Wyoming for collecting information on all minerals except fuels.

By H. C. Meeves [1] and William C. Henkes [2]

For the first time since 1949, Wyoming had a decrease in the value of mineral production. The slight decrease was caused principally by reduced uranium production because of the Atomic Energy Commission (AEC) stretchout program, and also by the reduced output of petroleum. Mineral fuels, comprising 80 percent, again dominated the mineral industry value, followed by nonmetals, 11 percent, and metals, 9 percent.

[1] Geologist, Bureau of Mines, Denver, Colo.
[2] Petroleum engineer, Bureau of Mines, Denver, Colo.

Table 1.—Mineral production in Wyoming [1]

Mineral	1964 Quantity	1964 Value (thousands)	1965 Quantity	1965 Value (thousands)
Clays---thousand short tons	1,271	$12,816	1,352	$13,633
Coal (bituminous) ---do	3,101	9,774	3,260	10,150
Copper (recoverable content of ores, etc.) short tons	5	3	6	4
Gem stones	NA	120	NA	120
Gold (recoverable content of ores, etc.) troy ounces	6	(2)	3	(2)
Iron ore (usable)---thousand long tons, gross weight	2,056	24,543	2,087	25,198
Natural gas (marketed) ---million cubic feet	r 231,613	29,808	235,849	31,840
Natural gas liquids:				
LP gases---thousand gallons	152,982	6,433	143,331	6,020
Natural gasoline and cycle products---do	86,803	5,607	95,093	6,195
Petroleum (crude)---thousand 42-gallon barrels	138,752	351,043	138,314	345,785
Sand and gravel---thousand short tons	5,632	5,936	7,996	8,373
Silver (recoverable content of ores, etc.) thousand troy ounces	(2)	(2)	(2)	(2)
Stone---thousand short tons	2,154	3,671	1,594	2,791
Uranium ore---short tons	[3] 1,183,754	[3] 23,321	1,048,176	17,758
Vanadium ---do	W	359	W	444
Value of items that cannot be disclosed: Beryllium concentrate, cement, feldspar (1965), gypsum, lime, phosphate rock, pumice (1964), sodium carbonate, sodium sulfate, and values indicated by symbol W	XX	26,822	XX	30,241
Total	XX	r 500,256	XX	498,552

r Revised. NA Not available. W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed." XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Less than ½ unit.

[3] Final figure, supersedes figure given in commodity chapter, Volume I.

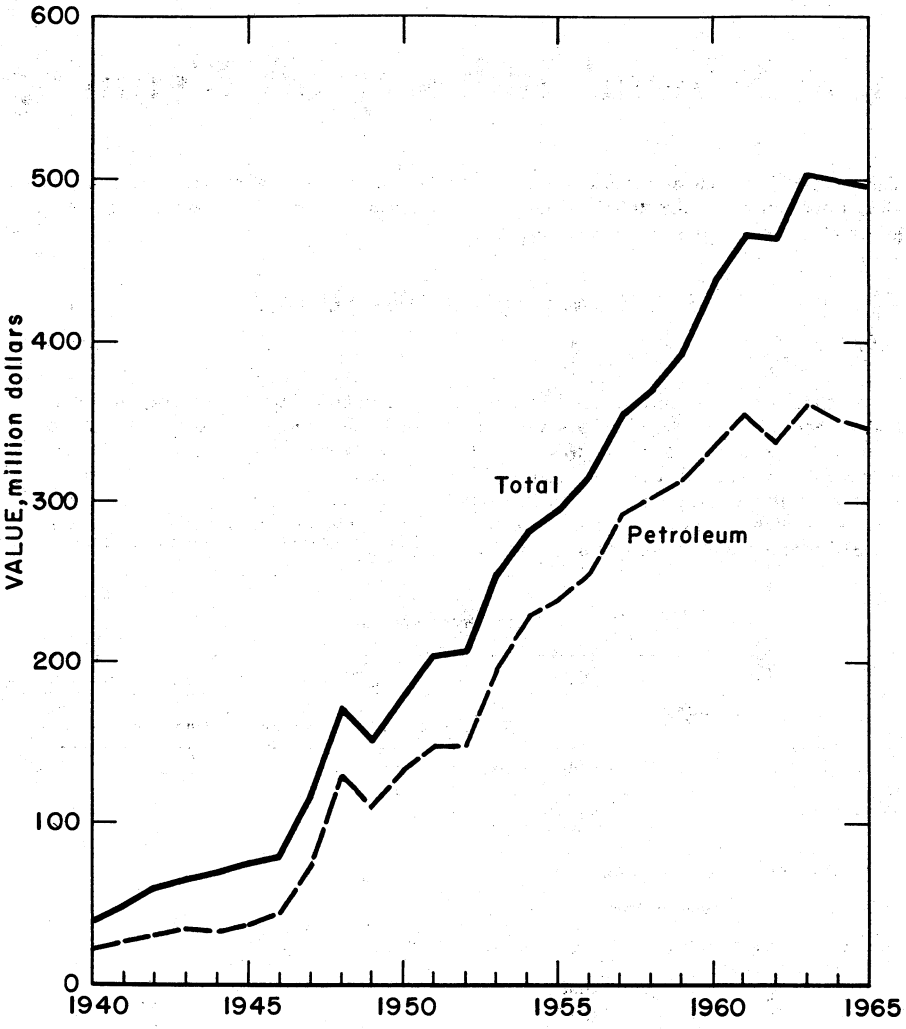

Figure 1.—Value of petroleum, and total value of mineral production in Wyoming.

Table 2.—Value of mineral production in constant 1957–59 dollars

(Millions)

Year	Value
1956	$342
1957	349
1958	370
1959	399
1960	440
1961	462
1962	452
1963	r 487
1964	r 484
1965	480

r Revised.

Employment and Injuries.—Statistics of employment and injuries for 1964 and preliminary data for 1965 in the mineral industries, excluding mineral fuels except coal, are given in table 3.

Government Programs.—The Laramie Petroleum Research Center of the Federal Bureau of Mines research programs included the following: Study of samples of bituminous rhyolite from Yellowstone National Park; examination and assaying of cuttings from two drillholes in oil shale from the eastern part of Wyoming Washakie basin and from one drillhole on the northwest-

Table 3.—Employment and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1964:								
Coal	415	195	81	635	------	18	28.36	2,034
Metal	1,715	250	429	3,614	1	102	28.50	3,027
Nonmetal	1,152	237	273	2,204	------	37	16.79	470
Sand and gravel	965	181	175	1,394	------	30	21.52	3,768
Stone	644	253	163	1,317	------	18	13.67	255
Total	4,891	229	1,121	9,164	1	205	22.48	2,058
1965:[p]								
Coal	395	213	84	667	------	19	28.49	2,051
Metal	1,675	248	416	3,384	1	85	25.41	3,725
Nonmetal	1,025	314	322	2,587	1	42	16.62	3,882
Sand and gravel	845	181	153	1,221	------	26	21.29	614
Stone	475	303	144	1,172	------	24	20.48	166
Total	4,415	253	1,119	9,031	2	196	21.92	2,764

[p] Preliminary.

ern part of Wyoming Green River basin; study of nitrogen in the North Tisdale field; field testing electrofracturing shale in situ in a tunnel near Green River; drilling of Wyoming Corehole No. 1 in oil shale near Rock Springs; and study of in situ retorting after nuclear explosion, and drilling a series of shallow holes for continuing the electrofracturing studies.

Several reports on the mineral resources of Wyoming were published.[3]

According to the Federal Bureau of Land Management, Wyoming received—for bonuses, royalties, and rentals from leasing on Federal lands—$8.1 million during the first 6 months of 1965, compared with $8 million for the same period in 1964. The total received for 1964 was $14.8 million.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Coal (Bituminous).—Coal was produced from 14 mines in 7 counties, collectively (2 mines producing less than 1,000 tons were not included). Coal production increased 5 percent in quantity and 4 percent in value.

Utah Power and Light Co. (UP&L) announced the planned second-phase addition to its 165-megawatt mine-mouth thermal-electric Naughton plant, a 220-megawatt generating unit costing $25.5 million. An additional $5 million was to be spent on transmission facilities for power delivery to the UP&L backbone system near Ogden, Utah. Completion of the newest and largest of UP&L generating units—capable of supplying the electrical needs of a city of 300,000 people—was scheduled for late 1968. Operated at higher steam pressures, the new addition, with advanced equipment, was to be even more efficient and highly automated than the first unit. The 165-megawatt initial phase of development was completed in 1963. Located vir-

Table 4.—Coal (bituminous) production, by counties

(Excludes mines producing less than 1,000 short tons)

County	1964	1965
	Short tons	Short tons
Campbell	488,846	490,527
Carbon	446,509	419,310
Converse	1,003,855	1,250,074
Hot Springs	11,788	11,711
Lincoln	621,484	626,706
Sheridan	431,521	349,338
Sweetwater	97,311	112,127
Total	3,101,314	3,259,793

[3] Hyden, H. J., H. McAndrews, and R. H. Tschudy. The Foote Creek and Dutton Creek Formations, Two New Formations in the North Part of the Laramie Basin, Wyo. U.S. Geol. Survey Bull. 1194-K, 1965, p. K1–K12.

Keefer, W. R. Stratigraphy and Geologic History of the Uppermost Cretaceous, Paleocene, and Lower Eocene Rocks in the Wind River Basin, Wyo. Geol. Survey Prof. Paper 495-A, 1965, 77 pp.

Morgan, T. A., W. G. Fischer, and W. J. Sturgis. Distribution of Stress in the Westvaco Trona Mine, Westvaco, Wyo. BuMines Rept. of Inv. 6675, 1965, 58 pp.

Smith, J. W., and K. E. Stanfield. Oil Shales of the Green River Formation in Wyo. Wyoming Geol. Assoc. Guidebook, 1965, pp. 167–170.

tually atop their fuel source, both units were to be fed coal from an adjacent strip mine on an automatically controlled ½-mile conveyor belt from the mine to the plant. The Kemmerer site was chosen originally because of the availability of low-cost strip-mined coal and ample water. The Kemmerer Coal Co. supplied fuel for the plant, which was to have a capacity of 700 megawatts. The new unit, with a 33 percent greater capacity than the existing unit, was to burn approximately 2,600 tons of coal per day.

The city of Thermopolis was experimenting with a coal-gravel slow-cure asphalt mixture for paving. If successful, the process would be a boon to the coal mines in the immediate area.

Kerr-McGee Corp. successfully bid $15 per acre for 880 acres of Federal Bureau of Land Management coal lands in Campbell County.

Natural Gas.—The quantity of marketed natural gas increased 4.2 billion cubic feet, 2 percent; most of the increase occurred in Fremont County. Fremont, Sublette, Sweetwater, and Washakie Counties were the leading gas producers. At yearend, there were 701 active gas wells and 337 shut-in gas wells; 745, 72 percent, of these were on Indian or Federal land.

The leading gas-producing fields were Greater LaBarge, 20.8 billion cubic feet, Beaver Creek, 16.6 billion cubic feet, and Worland Dome, 16.1 billion cubic feet.

Completion of a 26-mile, 12-inch pipeline by Western Transmission Corp. in February marked the first market outlets for several shut-in gasfields in the Washakie basin in southwestern Wyoming. Initial tie-in was between the Cow Creek field and the trunkline of Colorado Interstate Gas Co. (CIG) west of Rawlins. The line had a gas capacity of 77.5 million cubic feet per day. Other fields affected by this line and proposed extensions were West Side Canal, Robbers Gulch, South Baggs, and Deep Creek; Deep Creek field had been shut in since its discovery in 1950.

At midyear, Mountain Fuel Supply Co. announced the awarding of contracts for construction of 44 miles of 20-inch pipeline in southwestern Wyoming. One section of the project was 27 miles of line between Green River and an existing 20-inch line to the west near Little America; the other segment, 17 miles long, extended from the Eakin compressor station, 47 miles west of Green River, westward to Bigelow Bench where it joined an existing line.

The Wyoming Public Service Commission authorized McCulloch Gas Transmission Co. and Petrolane-Wyoming Gas Service Co. to build 52 miles of 4½-inch gasline from facilities in Crook County southeastward to Moorcroft, Upton, and Newcastle. The installation, costing about $750,000, also was to serve bentonite plants and the Sioux Oil Co. refinery near Newcastle.

Montana-Dakota Utilities Co. (MDU) added two gasfields to its central Wyoming facilities. The company built approximately 7 miles of 4-inch line to the Poison Creek field and 4 miles of 6-inch line to the East Riverton field; in addition to the lines, metering and dehydration facilities were built at both fields. The lines were tied to the MDU 12-inch main line at Riverton. In September, MDU announced plans to build 240 miles of 12-inch gasline from the Wind River basin to its trunkline at Belle Fourche, S.Dak.

Late in the year, Kansas-Nebraska Petroleum Co. built a $2.2 million natural gas processing plant near Casper. The plant, designed to remove sulfur compounds and propane from the gas, was powered by gas turbine engines; daily initial gas capacity was to be 80 million cubic feet.

Ralston Processing Associates, Inc., affiliated with Planet Engineers, Inc., commenced operating a new gas-sweetening plant near Powell in February. The plant was to extract sulfur (30 tons per day) and natural gas liquids from sour gas from the Ralston, Silvertip, and Northwest Elk Basin fields.

Natural Gas Liquids.—Although production of natural gas liquids declined slightly, value increased slightly. LP gases declined 6 percent in production and value. Production of natural gasoline, however, increased 10 percent in quantity and value.

Operations at the GGG Corp. plant in the Cheyenne River field, Weston County, were discontinued; reportedly, the plant was to be sold for salvage.

In March, Pan American Petroleum Corp. began operating its new gas processing plant at Beaver Creek field. The plant was designed to remove hydrogen sulfide gas and natural gas liquids from the gas produced from the Phosphoria Formation

(Permian). The hydrogen sulfide was further treated to extract elemental sulfur; the Phosphoria gas contained 10 percent hydrogen sulfide.

At yearend, CIG was nearing completion of a 220-million-cubic-feet-per-day liquids extradition plant at Rawlins. With a refrigeration-absorption process, the plant was to have daily product capacities of 65,000 gallons of propane, 30,000 gallons of butane, and 12,000 gallons of natural gasoline. Design and construction were by Dresser Engineering Co., Tulsa, Okla. In conjunction with the extraction plant, CIG also began constructing an underground gas liquids storage cavern with a 180,000-barrel capacity. The cavern, designed by Fenix & Scisson, Inc., Tulsa, Okla., was to consist of 960,000 cubic feet of 15- by 20-foot interconnected tunnels and support pillars. Combined costs of the two projects were estimated at $4.9 million, of which $3.9 million was for the plant.

Oil Shale.—Interest continued in research for an economic method of extracting oil from the Green River oil shale (Tertiary).

The Federal Bureau of Mines awarded a $15,160 contract to Materi Exploration Co., Upton, for drilling the 1,300-foot Wyoming Corehole No. 1 in the Green River oil shale in Sweetwater County, about 30 miles north-northwest of the town of Green River.

Table 5.—Drilling for petroleum in 1965, by counties

County	Oil	Gas	Dry	Total	Footage
Exploratory completions:					
Big Horn	1	--	6	7	22,239
Campbell	10	--	51	61	527,374
Carbon	2	2	19	23	93,983
Converse	--	--	7	7	26,548
Crook	5	--	44	49	227,572
Fremont	1	4	17	22	96,073
Goshen	--	--	3	3	19,535
Hot Springs	--	--	11	11	48,076
Johnson	1	--	7	8	63,078
Laramie	--	--	1	1	9,425
Natrona	1	--	25	26	106,964
Niobrara	2	--	13	15	84,080
Park	--	1	9	10	45,785
Sublette	--	--	16	16	98,919
Sweetwater	1	1	14	16	91,363
Uinta	--	--	3	3	20,237
Washakie	--	--	3	3	7,758
Weston	1	--	30	31	185,829
Total	25	8	279	312	1,774,838
Development completions:					
Albany	--	--	1	1	2,230
Big Horn	8	--	9	17	63,741
Campbell	41	1	37	79	676.519
Carbon	2	10	7	19	117,804
Converse	11	--	16	27	120,305
Crook	30	1	36	67	242,556
Fremont	12	3	11	[1]33	129,780
Hot Springs	10	--	3	[2]14	44,682
Johnson	9	1	4	14	94,670
Laramie	7	--	6	13	99,042
Lincoln	--	1	1	2	9,733
Natrona	129	5	21	[3]159	392,058
Niobrara	4	3	12	19	55,140
Park	34	--	11	45	239,066
Sheridan	1	--	--	1	4,750
Sublette	36	8	18	[2]63	216,846
Sweetwater	13	17	6	36	185,161
Washakie	5	--	2	[2]8	14,458
Weston	21	--	12	[2]34	151,013
Total	373	50	213	[4]651	2,859,554
Total all drilling	398	58	492	[4]963	4,634,392

[1] Includes 7 service wells.
[2] Includes 1 service well.
[3] Includes 4 service wells.
[4] Includes 15 service wells.

Source: Oil and Gas Journal.

Table 6.—Crude petroleum production, by counties

(Thousand 42-gallon barrels)

County	1964	1965	Principal fields in 1965 in order of production
Albany	600	555	Quealy.
Big Horn	9,409	8,231	Garland, Byron, Sage Creek, Bonanza.
Campbell	6,840	8,349	Raven Creek, Timber Creek.
Carbon	3,564	3,325	Wertz, Rock River,
Converse	4,544	4,538	Glenrock South, Big Muddy.
Crook	6,755	7,994	Moorcroft West, Coyote Creek, Donkey Creek.
Fremont	12,195	10,849	Beaver Creek, Winkleman, Steamboat Butte, Big Sand Draw.
Goshen	------	8	Torrington.
Hot Springs	21,779	18,488	Hamilton Dome, Grass Creek, Little Buffalo Basin, Murphy Dome.
Johnson	7,364	7,690	Sussex, Meadow Creek, North Fork.
Laramie	399	513	Horse Creek, Golden Prairie.
Lincoln	3	4	Stead Canyon.
Natrona	15,635	16,964	Salt Creek, Grieve Unit, Cole Creek.
Niobrara	975	1,020	Lance Creek, Little Buck Creek.
Park	30,404	32,490	Elk Basin, Oregon Basin, Frannie, Pitchfork.
Sheridan	511	464	Ash Creek South, Ash Creek.
Sublette	4,531	4,518	Green River Bend, McDonald Draw, Birch Creek.
Sweetwater	7,634	7,236	Lost Soldier, Patrick Draw, Arch Unit.
Uinta	2	------	
Washakie	1,974	1,451	Cottonwood Creek, Hidden Dome, Worland, Slick Creek.
Weston	3,634	3,627	Fiddler Creek, Osage, Clareton.
Total	138,752	138,314	

Source: Wyoming Ad Valorem Tax Division, State Board of Equalization.

W. D. Thomas, Rock Springs drilling contractor, was awarded a $6,500 contract for drilling five shallow coreholes which were part of the Federal Bureau of Mines experiment to extract oil from the shale. The five coreholes, each 125 feet deep, were to be spaced 25 to 125 feet apart; passing electric currents (electrofracturing) between the holes was believed to be a means of attaining permeability in the shale and possibly retorting the oil in place. Drilling was to commence in January 1966.

Petroleum.—Production and value of crude petroleum declined slightly. At year-end, the State had 8,093 oil wells active and 1,968 shut in; of these 5,876, 58 percent, were on Federal or Indian land.

As in the past, the Big Horn basin led in oil production with an output of 60.7 million barrels; the Powder River basin was ranked second with production of nearly 48 million barrels. Two counties, Park and Hot Springs, were ranked first and second, respectively, in oil production. As in 1964, 28 fields had an annual production of 1 million or more barrels of oil. Fields leading in production were Elk Basin, Park County, 18.5 million barrels; Salt Creek, Natrona County, 12 million; Oregon Basin, Park County, 7.9 million; Hamilton Dome, Hot Springs County, 7.8 million; Grass Creek, Hot Springs County, 5.4 million; and Sussex, Johnson County, 4.2 million.

Refineries in the State processed 41.5 million barrels of crude oil; 39.6 million barrels was from Wyoming. Refinery runs were about 2 percent higher than those of 1964. About 108 million barrels of crude oil was shipped to refineries in other States, including Indiana, 34.7 million barrels, Montana, 17.1 million, Michigan, 12 million, and Illinois, 11.2 million.

The pattern of drilling activity was similar to that established in recent years. The Powder River basin had 52 percent of all drilling in the State, with 59 percent of exploratory drilling and 49 percent of development drilling. The Green River basin was second, with 18 percent of both total and development drilling and 19 percent of wildcat wells. The Wind River and Big Horn basins followed in order of drilling activity.

The overall success ratio in exploratory drilling was 10.6 percent. Campbell County had the most successful wells for a success ratio of 16.4 percent; Fremont County, with 5 discoveries out of 22 wildcat wells, had the highest success ratio.

Probably the most significant oil discovery in the Rocky Mountain area in recent years was made by Shell Oil Co. on its Reno unit in Johnson County. The discovery well, Shell No. 41X-24 Government, sec

Table 7.—Oil and gas discoveries in 1965

County and field	Well	Operator	Location			Producing formation	Gross producing interval (feet)	Total depth (feet)	Initial production		Date of completion	Remarks
			Section	Township	Range				Barrels of oil per day	Thousand cubic feet of gas per day		
Campbell County:												
Basin	No. 1–21 Goodstein-Government	Fred Goodstein	21	47 N	70 W	Minnelusa	9,972–9,995	10,183	127	-----	Apr. 10	Flowed. New field.
Basin, Northwest	No. 2 Government-Bishop Land	Union Texas Petroleum Corp.	9	47 N	60 W	----do	9,900–9,930	10,095	656	-----	June 9	Pumped. New field.
Kitty	No. 16–1 State	Shell Oil Co.	16	50 N	73 W	Muddy	9,089–9,110	10,925	203	-----	Aug. 23	Flowed. New field.
Kuehne Ranch	No. 1 Kuehne	Vaughn Petroleum, Inc.	18	51 N	69 W	Minnelusa	7,968–8,014	8,103	340	-----	May 24	Pumped. New field.
Little	No. 1 USA-Brown	Union Texas Petroleum Corp.	18	55 N	70 W	----do	7,304–7,314	7,492	80	-----	Apr. 29	Do.
Olsen	No. 1 Pure-Olson	Champlin Petroleum Co. & Texas Pacific Oil Co.	10	49 N	71 W	----do	9,588–9,595	9,620	368	-----	May 3	Do.
Pickrel Ranch	No. 1 Pickrel	Colorado Oil Co. & Frank Gower	18	48 N	69 W	----do	9,006–9,012	9,156	360	-----	May 14	Do.
Rozet, South	No. 3 Fortin	Davis Oil Co. & Colorado Oil Co.	25	50 N	70 W	----do	8,544–8,559	8,634	533	-----	July 25	Do.
Stewart	No. 1 Stewart	U.S. Smelting Refining and Mining Co.	3	50 N	69 W	----do	8,024–8,036	8,279	360	-----	Nov. 25	Do.
Unnamed	No. 1 Irvin Pickrel	Champlin Petroleum Co.	15	49 N	71 W	Muddy	8,097–8,115	9,924	120	-----	Feb. 24	Pumped. Combined with North Rainbow Ranch field.
Carbon County:												
Baggs, South	No. 11 Unit	Development Services Corp., Calvert Drilling & Producing Co.	9	12 N	92 W	Mesaverde Lewis	6,158–6,170 4,827–4,831	6,700	---- ----	1,470 909	Jan. 26	Flowed. New pay.
Barrel Springs	No. 1 Federal–J–Wyoming	Ambassador Oil Corp. & National Cooperative Refinery Association	14	16 N	93 W	Mesaverde	10,701–10,710	11,203	455	4,950	May 26	Flowed. New field.
Espy	No. 2 Bence-Federal	McCulloch Oil Corp. of California	22	19 N	89 W	Niobrara	4,018–4,023	4,023	1,089	-----	[1]	Pumped. New field.
Do	No. 3 Bence-Federal	----------do----------	26	19 N	89 W	Second Frontier	4,850–4,904	5,630	----	2,605	July 8	Flowed. New pay.

Table 7.—Oil and gas discoveries in 1965—Continued

County and field	Well	Operator	Location			Producing formation	Gross producing interval (feet)	Total depth (feet)	Initial production		Date of completion	Remarks
			Section	Township	Range				Barrels of oil per day	Thousand cubic feet of gas per day		
Crook County:												
Ammo	No. 1 Government-Amax-Mobil	Anschutz Oil Co., Inc., Cooperative Refinery Association	17	52 N	68 W	Muddy	5,483–5,487	7,408	221	-----	Aug. 23	Pumped. New field.
Little Mo	No. 2 Allen	Davis Oil Co.	26	53 N	68 W	Minnelusa	6,648–6,651	6,755	224	-----	Sept. 22	Do.
Oshoto	No. 1 Gregg-Federal	do	29	53 N	68 W	Muddy	5,532–5,544	6,027	99	-----	Jan. 5	Do.
Semlek, West	No. 1 Semlek-C	Texaco Inc.	28	52 N	68 W	Lakota-Butler	5,845–5,862	7,400	65	-----	Jan. 26	Pumped. New pay.
Unnamed	No. 1 Freda Donaldson	Midroc Oil Corp.	8	57 N	68 W	Muddy	3,871–3,877	4,383	75	-----	Dec. 28	Pumped. New field.
Fremont County:												
Alkali Butte, North	No. 2 Tribal-M	Pan American Petroleum Corp.	32	1 S	6 E	do	6,510–6,566	6,922	----	3,315	Apr. 2	Flowed. New field.
Indian Butte	No. F33–6–I-Government-Tribal	Mobil Oil Co. & Pan American Petroleum Corp.	6	1 N	6 E	Ft. Union Mesaverde	6,420–6,426 8,424–8,435	9,001	136 ----	5,700 3,100	Apr. 1	Do.
Kirk	No. 1 Government-Padon	Applewood Exploration, Petan Co. & Bobby M. Burns	6	28 N	92 W	Cloverly	2,568–3,061	3,086	----	3,000	June 1	Flowed. New pay.
Mexican Draw	No. 1 Tribal	C. E. Brehm	18	4 N	1 W	Phosphoria	7,182–7,192	7,573	15	-----	July 31	Flowed. New field.
Riverton, East	No. 1 Tribal	Continental Oil Co.	1	1 S	5 E	Frontier Muddy Lakota	9,770–10,263 10,922–10,932 11,218–11,258	11,346	---- ---- ----	15,300 6,300 1,370	Mar. 7	Flowed. New field.
Johnson County:												
Reno	No. 41X–24 Government	Shell Oil Co.	24	45 N	80 W	Minnelusa	14,942–15,063	15,211	797	-----	Feb. 15	Do.
Natrona County:												
River Bend	No. 44–10 Federal	Wind River Drilling Co.	10	30 N	82 W	Phosphoria	3,335–3,339	3,880	196	-----	July 6	Pumped. New field.
Niobrara County:												
Leimser	No. 1 Leimser	Tenneco Oil Co.	5	36 N	63 W	Fall River	4,447–4,452	4,737	138	-----	June 10	Do.

Park County:												
Silver Tip	No. 74–A–33 NP–J	Texaco Inc.	33	58 N	100 W	Lance	1,473–1,504	1,793		2,738	July 26	Flowed. New pay.
Sweetwater County:												
Black Butte Creek Unit	No. 14–30 Unit	U.S. Natural Gas Corp.	30	19 N	102 W	Dakota	3,897–3,907	4,216		4,042	Aug. 25	Do.
Pioneer Unit	No. 7 Pioneer Unit	Mountain Fuel Supply Co.	5	13 N	99 W	Wasatch	2,324–2,522	6,374		2,930	July 4	Do.
Weston County:												
Finn	No. 1 Finn	Eugene F. Arnold	9	42 N	64 W	Wall Creek	4,922–4,935	6,228	38		Jan. 10	Pumped. New field.
Do	No. 1 Chastain	do	34	43 N	64 W	Newcastle	5,801–5,807	5,876	250		June 11	Pumped. New pay.

[1] Date of completion Dec. 17, 1964, reported in 1965.

Source: Petroleum Information Corp., 1965 Résumé, Oil and Gas Operations in the Rocky Mountain Region.

24, T 45 N, R 80 W, was completed February 15, flowing 797 barrels of oil per day from the interval 14,942 to 15,063 feet in the Minnelusa formation (Pennsylvanian). The well was later reworked (recompleted) for 3,295 barrels per day. By yearend, Shell had completed three producers in the field; the second was completed for 2,004 barrels per day and the third for 1,416 barrels per day. Estimates based on the first two wells gave the field reserves of more than 25 million barrels. Shell and Service Pipe Line Co. jointly built a 32-mile, 10-inch pipeline from the Reno to the Salt Creek field.

The Reno discovery generated great interest in the deeper parts of the Powder River basin. Leasing activity involving about a million acres covered the area; leases were bought for $2.50 to $3.00 per acre with some going as high as $25 per acre.[4]

Frontier Refining Co. awarded contracts in September for construction of a 2,000-barrel-per-day propane deasphalting unit at its Cheyenne refinery. The unit, to cost approximately $750,000, was to have been completed by April 1966. The new process was expected to increase the per-barrel yield of gas-oil cracking stocks and, consequently, reduce the production of heavy residual fuel oils.

Early in the year, Mobil Oil Co. announced that it would close its 13,000-barrel-per-day, 42-year-old refinery at Casper. Closing was to be phased over 2 years to permit relocation, retraining, early retirement, and termination allowances for the 139 employees and to ease the impact on the community.

NONMETALS

A 12-percent increase, from $49.4 million in 1964 to $55.2 million, in nonmetal production, representing 11 percent of the total value, was recorded for 1965. Clays (bentonite, fire clay, and miscellaneous clay), feldspar, gypsum, sand and gravel, and sodium carbonate (trona) had increased outputs.

Cement.—Cement production declined 10 percent in quantity and value. Monolith Portland Midwest Co., the only producer in the State, mined sandstone, coal, and limestone; Wyoming Construction Co., a subsidiary, mined cement rock and gypsum for making cement.

Clays.—A 6-percent increase in quantity and value was recorded for bentonite, fire clay, and miscellaneous clay. Bentonite output increased 10 percent, from 1.2 million tons valued at $12.6 million in 1964 to 1.3 million tons valued at $13.5 million. Fire clay output increased 38 percent, whereas miscellaneous clay output decreased 51 percent. Bentonite for pelletizing taconite iron concentrates continued to lead the list of uses with 31 percent, followed by the foundry industry 30 percent, rotary drilling 27 percent, miscellaneous uses 7 percent, and exports 5 percent.

Producing companies, in order of bentonite output, were Magnet Cove Barium Corp. with a plant in Big Horn County, American Colloid Co. with plants in Crook and Weston Counties, Archer Daniels Midland Co. (ADM) with plants in Crook and Weston Counties, Baroid Division, National Lead Co., with plants in Crook and Weston Counties, Wyo-Ben Products Co. with a plant in Big Horn County, International Minerals & Chemical Corp. (IMC) with a mine in Crook County and a plant in South Dakota, Black Hills Bentonite Co. with a plant in Johnson County, and Benton Clay Co., Inc., with a plant in Natrona County.

In January Black Hills Bentonite Co. put its new 600-ton-per-day mill on stream and closed the Moorcroft operations. The new plant—a modern, efficient, dust-free plant controlled from a central panel—required two men per shift, three shifts per day. Remote television cameras were used for control of the feed into and discharge from the ore bin. The company bentonite deposits west of Kaycee were stripped to remove 20 feet of shale overburden to reach the bentonite beds averaging 4 feet in thickness. Trucking contractors hauled approximately 25-ton loads in bottom-dump trailers the 80 miles between the mine and the new plant.

American Colloid Co. built foundations for a new mill 3.5 miles east of Lovell. Steel erection for the new mill was begun in November; completion of the mill was scheduled for February 1966.

Benton Clay Co. affiliated with Georgia Kaolin Co. of New Jersey in February.

Other types of clay were produced for building brick by Interstate Brick Co. and

[4] Oil and Gas Journal. V. 63, No. 8, Feb. 22, 1965, p. 165.

International Pipe and Ceramics Corp. (Interpace) in Uinta County; for building brick, vitrified sewer pipe, and other products by Lovell Clay Products Co. in Big Horn County; and for building brick by Sheridan Block, Brick & Tile Co. in Sheridan County.

Feldspar.—A small amount of feldspar was produced, the first since 1958.

Gypsum.—Gypsum output increased 17 percent in quantity and 4 percent in value. The new $3.1 million plant of Gypsum Products of America was to be completed by late January 1966. The plant was to produce 75.4 million board feet of both 48- and 54-inch by ½-inch wallboard and pulverized gypsum for agricultural use. The plant was to be the first in the United States to produce 54-inch-wide wallboard for large-area ceilings; walls more than 8-feet high will result from the greater width. Cody Sulphur Products Co. milled and shipped from a stockpile created by Wyoming Gulf Sulfur Co. in 1955.

Lime.—Quicklime was manufactured at three sugar refineries, The Great Western Sugar Co. at Lovell and Holly Sugar Co. at Torrington and Worland. The valuation of quicklime was $34,000 less than in 1964.

Phosphate Rock.—Phosphate rock output declined 9 percent. San Francisco Chemical Co., the only producer, operated an upgrading plant at Sage in Lincoln County and processed ores from Utah and Wyoming. In July the company completed a newly augmented three-reactor Fluosolids plant for producing calcines. Most of the processed rock was shipped to out-of-State purchasers for manufacturing superphosphate fertilizers and phosphoric acid.

Susquehanna-Western, Inc., announced plans of a $17 million to $28 million (150,000 to 250,000 tons per year of finished product) mining and processing program for phosphate rock in the South Pass (Lander-Riverton) area. The company completed exploration and water well drilling and mined 160 tons of ore for process testing.

The Federal Bureau of Mines announced a new process to recover phosphate from western Wyoming low-grade shales now considered waste material. The process was to recover 75 percent of contained phosphate (up to 19 percent P_2O_5). The shale ore is crushed, roasted, attrition ground, and screened to recover a 32.5 percent concentrate. Desliming and flotation recover an additional 28 percent of the contained phosphate in a comparable concentrate.

Sand and Gravel.—A 42-percent increase in output of sand and gravel, from 5.6 million tons in 1964 to 8 million tons, was recorded; the average value was the same as in 1964, $1.05 per short ton. The increased output was attributed mainly to the 1965 Wyoming highway program.[5] Under the program for 1965, road construction contracts awarded totaled $34.6 million: $22.1 million for Interstate Highway System, $7 million for roads in the Federal-aid primary and secondary (ABC) program, and $5.5 million for roads financed by the State. Expenditures for road construction planned for 1966 totaled $51.6 million: $33.5 million for the interstate program, $12 million with ABC funds, and $6.1 million by the State. Under the interestate program for 1965[6], 63 miles of road was opened to traffic, bringing the total to 504.8 miles of road opened since the program was begun on July 1, 1956. Total designated mileage for the State was adjusted to 911.9 miles.

Producers reported 66 commercial operations and 74 Government-and-contractor operations representing all counties. According to reports, 93 percent of the sand and gravel was prepared for use by washing, crushing, or screening; the remainder was used as pit run. Production distribution was 88 percent for paving, 9 percent for building, 2 percent for railroad ballast, and 1 percent for fill and miscellaneous uses. Companies reporting the largest output of sand and gravel were Rissler & McMurry Co., Inc., in Fremont, Natrona, and Sheridan Counties; Asbell, Inc., in Natrona County; Woodward Construction Co. in Albany, Sublette, and Sweetwater Counties; Casper Concrete Co. in Natrona County; and Teton Construction Co. in Laramie County.

Sodium Carbonate and Sulfate.—Sodium carbonate (trona) output increased 21 percent in quantity and 19 percent in value because of full production from the ex-

[5] Engineering News-Record. State Highway Contracting Plans: 1966 Will Be a Record Breaker. V. 176, No. 14, Apr. 7, 1966, pp. 74–76.
[6] Bureau of Public Roads. Quarterly Report on The Federal-Aid Highway Program, Dec. 31, 1965. Press Release BPR 66–5, Feb. 9, 1966.

Table 8.—Sand and gravel production in 1965, by counties

(Thousand short tons and thousand dollars)

County	Quantity	Value
Albany	838	$916
Big Horn	86	96
Campbell	4	4
Carbon	569	579
Converse	96	98
Crook	53	66
Fremont	745	813
Goshen	W	W
Hot Springs	70	57
Johnson	156	161
Laramie	708	761
Lincoln	164	168
Natrona	1,191	1,349
Niobrara	W	W
Park	451	442
Platte	24	30
Sheridan	416	502
Sublette	156	170
Sweetwater	1,096	1,112
Teton	164	158
Uinta	132	137
Washakie	606	535
Weston	38	47
Undistributed	233	172
Total	7,996	8,373

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

panded facilities at the Inorganic Chemicals Division of FMC Corp. and Stauffer Chemical Company of Wyoming plants which were put on full-production schedules in mid-1965.

FMC announced plans to increase production to 900,000 tons by mid-1966 and to increase further to 1.2 million tons by late 1967. The completed expansion in 1967 was to make FMC the world's largest trona producer. Stauffer Chemical announced multimillion-dollar expansion plans to increase present output by 20 percent, from 400,000 tons to 500,000 tons, from 875,000 tons of mined ore. A third refinery unit, steam and power generation, and pumping facilities were to be added by fall 1967.

Solvay Process Division, Allied Chemical Co., completed its production shaft to 1,626 feet. Development of the trona deposit at 1,560 feet was begun. The process facilities were under construction; output from the complex was scheduled for fall 1966.

Phillips Petroleum Co. submitted a successful bid of $97.59 per acre for 2,516

Table 9.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1964		1965	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Construction:				
Building	202	$266	294	$336
Paving	141	184	368	434
Fill	4	4	[1]10	[1]13
Other	7	4	([1])	([1])
Total	354	458	672	783
Gravel:				
Construction:				
Building	207	286	413	496
Paving	1,473	1,661	2,131	2,483
Railroad ballast and fill	[2]151	[2]80	[2]191	[2]187
Miscellaneous	----	----	41	29
Total	1,831	2,027	2,776	3,195
Total sand and gravel	2,185	2,485	3,448	3,978
Government-and-contractor operations:				
Sand:				
Paving	17	17	1,882	1,878
Fill	6	3	----	----
Total	23	20	1,882	1,878
Gravel:				
Building	11	5	2	2
Paving	3,375	3,392	2,662	2,514
Fill	38	34	2	1
Total	3,424	3,431	2,666	2,517
Total sand and gravel	3,447	3,451	4,548	4,395
All operations:				
Sand	377	478	2,554	2,661
Gravel	5,255	5,458	5,442	5,712
Total	5,632	5,936	7,996	8,373

[1] Fill sand and "Other" sand combined to avoid disclosing individual company confidential data.
[2] Railroad ballast and fill gravel combined to avoid disclosing individual company confidential data.

acres of sodium lease land 14 miles northwest of Green River. The company was conducting exploration operations on the lease.

Duval Corp. conducted exploration drilling operations on land leased from Kern County Land Co. on ground near Stauffer Chemical and Solvay Process.

Church & Dwight Co. announced plans to construct a processing plant at Green River for manufacturing bicarbonate of soda and other products.

Texas Gulf Sulphur Co. (TGS) opened an exploration office in Green River to direct exploration operations on its 7,634-acre lease west of FMC leases.

Natural sodium sulphate output from saline lake deposits in Natrona County declined.

Stone.—Stone produced was crushed and broken, except for a small amount of dimension limestone and sandstone used for constructing and decorating buildings. Crushed and broken limestone accounted for 48 percent of the output, granite 45 percent, miscellaneous stone 4 percent, basalt 2 percent, and dimension sandstone and limestone and crushed marble 1 percent. Limestone was used for road construction, aggregate, railroad ballast, manufacturing cement and lime, riprap, mineral food, and flux; granite was used for railroad ballast, riprap, and roadstone; miscellaneous stone was used for riprap, railroad ballast, roadstone, and manufacturing fertilizer; sandstone was used for manufacturing cement, roadstone, and rough construction; and marble was used for roofing granules, landscaping, and rough construction.

The University of Wyoming reopened its sandstone quarry 9 miles east of Laramie and mined over 700 tons of a planned 5,000-ton program. The sandstone was to be used in a new $18 million building program on the campus; new dormitories, the science center, a food service complex, and classroom structures were to be faced with the product.

Sulfur.—Elemental byproduct sulfur was recovered by the modified Claus process at plants operated by Pan American Petroleum Corp. in Fremont and Park Counties, Ralston Processing Associates, Inc., and Kern County Land Co. in Park, and TGS in Washakie. Atlantic Refining Co. operated its refrigeration plant in Fremont County. The quantity recovered at the six plants was 68,176 tons. Shipments were 57,000 tons valued at $806,000, an increase of 40 percent in quantity and 48 percent in value over that of 1964.

Table 10.—Stone production in 1965, by counties

County	Short tons	Value
Albany	306,115	$525,036
Big Horn	31,500	56,125
Carbon	3,025	3,569
Converse	267	1,161
Crook	3,769	4,938
Fremont	10,117	20,234
Goshen	170	3,925
Laramie	856,307	1,435,968
Niobrara	W	W
Park	22,538	49,584
Platte	207,257	324,699
Sheridan	53,997	75,928
Sublette	1,135	4,870
Teton	W	W
Yellowstone National Park	13,558	28,610
Undistributed	84,641	246,641
Total	1,594,396	2,791,288

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

METALS

The combined value of the metal production—beryllium concentrate, copper, gold, iron ore, silver, uranium ore, and vanadium—decreased 10 percent. The decrease was mainly accounted for by a decline in production of uranium ore because of the AEC stretchout program. Increases were recorded for copper, iron ore, and vanadium.

Bear Creek Mining Co., a subsidiary of Kennecott Copper Corp., conducted exploratory drilling on a copper-molybdenum prospect near the junction of the South Fork of the Shoshone River and Needle Creek in the South Absaroka Wilderness area. American Metal Climax, Inc., conducted exploratory drilling for copper-molybdenum in the Kerwin area.

Beryllium.—A single operation in Fremont County produced a small quantity of hand-cobbed beryl.

Gold, Silver, and Copper.—Less than 5 ounces of gold was produced from a small placer operation in Teton County. Manson Mines, Ltd., Los Angeles, Calif., and Uraninite Corp., Encampment, shipped 238 tons

of ore containing gold, silver, and copper from the Encampment area.

Iron Ore.—Iron ore output increased 2 percent over that of 1964. The increase was mainly attributed to a combination of United States Steel Corp. (USS) which shipped the 3-millionth ton of agglomerates in February, surpassing the rated capacity of 1.3 million tons of agglomerates a year ahead of schedule and The Colorado Fuel and Iron Corp. (CF&I) which operated its new Sunrise mill at full capacity. USS received the Award of Honor from the National Safety Council for working 2 million man-hours without a lost-time accident between October 1962 and November 1964, at Atlantic City Ore Operations. From Albany County, Plicoflex, Inc., and Peterson, Anderson & Knisely shipped titaniferous magnetite ore for use as heavy aggregate.

Uranium Ore.—The 11-percent decrease in quantity and 24 percent in value of uranium ore output was accounted for by the AEC stretchout program. Uranium ore, produced from 66 operations in 7 counties, collectively was processed at 6 mills in Wyoming, 2 in Colorado, and 1 in South Dakota. The quantity of recoverable uranium oxide was 4.3 million pounds valued at $34.7 million, ranking Wyoming second in production.

Federal-Gas Hills Partners became the seventh company, the fourth in Wyoming, to sign a stretchout contract with AEC. The contract extended from December 1966 to December 1970. The firm installed an automatic acid control in the leach circuit, using electrodeless torrid-type recording-controlling units for the acid residue in its Fremont County mill. The efficient Eluex circuit uses a sulfuric acid eluate to strip the uranium oxide from the resins, feeding this solution to the solvent-extraction circuit which uses a tertiary amine to capture the uranium oxide. The tertiary amine loads with uranium oxide and then adjusts the pH with ammonium hydroxide. This reaction makes a solution which strips the uranium oxide from the organic solution. The company also purchased new equipment to remove 3.8 million yards of overburden from the Sagebrush 3 and Tablestakes 1 pits on the southeast edge of the Sagebrush group.

The Petrotomics Co. mill remained in operation even though it was not participating in the AEC stretchout program. The recovered uranium oxide was stockpiled for future sale to private consumers. The company closed its uranium mine in December after mining the remaining 1966 allocation. The company also purchased a number of adjacent claims from Gas Hills Uranium Co. in the Shirley basin.

Table 11.—Mine production of uranium ore, by counties [1]

County	1964				1965			
	Number of operations	Ore (short tons)	U_3O_8 contained (pounds)	F.o.b. mine value [2]	Number of operations	Ore (short tons)	U_3O_8 contained (pounds)	F.o.b. mine value [2]
Albany	1	W	W	W	-----	-----	-----	-----
Big Horn	1	322	2,995	$13,105	2	W	W	W
Campbell	2	W	W	W	-----	-----	-----	-----
Carbon	6	r 159,772	r 852,306	r 2,877,166	8	253,001	1,299,583	$5,212,721
Converse	7	r 64,052	r 193,938	r 640,149	9	28,340	109,845	419,009
Crook	6	93,188	379,927	1,509,459	5	92,355	385,571	1,548,714
Fremont	40	r 859,421	r 4,443,458	r 18,232,641	37	663,940	2,734,743	10,478,514
Johnson	1	W	W	W	-----	-----	-----	-----
Natrona	5	W	W	W	4	W	W	W
Sweetwater	1	W	W	W	1	W	W	W
Undistributed	-----	r 6,999	r 17,697	r 48,013	-----	10,540	30,883	99,436
Total	70	r 1,183,754	r 5,890,321	r 23,320,533	66	1,048,176	4,560,625	17,758,394

r Revised, final figures supersede those shown in Volume I. W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] Receipts at mills based on data supplied to the Bureau of Mines by AEC.

[2] F.o.b. mine value; base price, grade premiums, and exploration allowances. Calculated according to AEC Circular 5, revised, price schedule.

Utah Construction & Mining Co. began stripping 450,000 cubic yards of waste from the Rex group, acquired in a 170-claim package from Gas Hills Uranium Co. The Riverton Uranium group was also included in the 170-claim package.

Several companies and individuals were searching for new uranium deposits throughout the State. Claim staking and some exploration drilling were conducted. The major companies were seeking uranium deposits at depths of 800 to 1,500 feet; one hole was drilled to 3,000 feet.

Vanadium.—The quantity of vanadium recovered was 6 percent greater than that of 1964. The vanadium was recovered as a byproduct of uranium ores processed in the mill of Mines Development, Inc., at Edgemont, S. Dak.

REVIEW BY COUNTIES

Albany.—Production of cement rock, gypsum, limestone, and sandstone by Monolith Portland Midwest Co. at Laramie totaled approximately half of the total value of mineral production of Albany County. The Idealite Co., a division of Ideal Cement Co., lightweight aggregate facilities adjacent to the cement plant were closed.

Value of crude oil production declined 9 percent. Quealy Dome and Rex Lake fields production decreased by about 7,500 bar-

Table 12.—Value of mineral production in Wyoming, by counties

County	1964	1965	Minerals produced in 1965 in order of value
Albany	$7,490,242	$6,139,715	Cement, petroleum, sand and gravel, stone, iron ore, gypsum, feldspar.
Big Horn	28,848,801	25,770,587	Petroleum, clays, natural gas, sand and gravel, stone, lime, uranium ore.
Campbell	18,358,563	22,038,639	Petroleum, coal, natural gas, LP gases, natural gasoline, sand and gravel.
Carbon	r 14,620,108	16,388,541	Petroleum, uranium ore, coal, natural gas, sand and gravel, LP gases, stone, copper, silver, vanadium, gold.
Converse	r 16,343,904	16,520,258	Petroleum, coal, uranium ore, LP gases, natural gas, natural gasoline, sand and gravel, vanadium, stone.
Crook	25,892,100	27,697,287	Petroleum, clays, uranium ore, vanadium, natural gas, sand and gravel, stone.
Fremont	r 78,497,345	67,799,836	Petroleum, iron ore, uranium ore, natural gas, natural gasoline, sand and gravel, LP gases, stone, beryllium concentrate.
Goshen	W	240,478	Lime, sand and gravel, petroleum, stone.
Hot Springs	55,486,702	46,579,263	Petroleum, natural gas, coal, natural gasoline, sand and gravel.
Johnson	20,414,205	20,963,000	Petroleum, clays, natural gas, natural gasoline, LP gases, sand and gravel.
Laramie	3,329,505	3,479,968	Stone, petroleum, sand and gravel, natural gas.
Lincoln	8,992,077	8,104,433	Natural gasoline, coal, phosphate rock, LP gases, sand and gravel, petroleum.
Natrona	r 43,881,204	46,913,507	Petroleum, natural gas, sand and gravel, LP gases, clays, natural gasoline, uranium ore, sodium sulfate.
Niobrara	2,607,000	2,832,916	Petroleum, stone, sand and gravel, natural gas, LP gases.
Park	81,067,981	85,347,899	Petroleum, natural gas, LP gases, gypsum, sand and gravel, natural gasoline, stone.
Platte	3,633,432	W	Iron ore, stone, sand and gravel.
Sheridan	2,898,235	2,898,731	Petroleum, coal, sand and gravel, stone, clays.
Sublette	22,899,140	22,423,870	Petroleum, natural gas, sand and gravel, LP gases, stone.
Sweetwater	47,337,255	52,125,089	Sodium carbonate, petroleum, natural gas, sand and gravel, coal, LP gases, natural gasoline, uranium ore.
Teton	W	W	Sand and gravel, stone, gold.
Uinta	1,201,743	1,212,508	Natural gas, sand and gravel, clays, natural gasoline.
Washakie	8,536,812	6,864,809	Petroleum, natural gas, LP gases, sand and gravel, lime.
Weston	11,952,831	12,051,195	Petroleum, clays, natural gas, LP gases, sand and gravel.
Yellowstone National Park	W	28,610	Stone.
Undistributed [1]	966,945	4,131,314	
Total	r 500,256,000	498,552,000	

r Revised. W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W.

rels; however, production at Little Laramie and Herrick fields increased. J. W. Gibson, Denver, Colo., reworked an old well in the Big Hollow field to reestablish production from the Muddy sandstone (Cretaceous); the field had been shut in for several years.

Sand and gravel output, from five commercial and four Government-and-contractor operations, increased. The University of Wyoming mined 713 tons of dimension sandstone as part of a planned production of 5,000 tons from its old sandstone quarry 9 miles east of Laramie. The sandstone was to be used in an $18 million building program on the campus. Iron ore production by Plicoflex, Inc., from Iron Mountain and Peterson, Anderson & Knisely from the Shanton deposits decreased substantially.

Big Horn.—Crude petroleum accounted for 80 percent, $20.6 million, of the value of mineral production in the county; however, value of petroleum production was 14 percent less than in 1964. Although the Garland field continued as the largest of the 17 producing oilfields in the county, output declined by 371,000 barrels to 3.9 million barrels. The Byron-Garland gasfield was again the principal gasfield with production of nearly 4.3 billion cubic feet.

Wyo-Ben Products Co. substantially increased its production of bentonite, and Magnet Cove Barium Corp. also increased its bentonite production. Output of miscellaneous clay—for building brick, heavy clay pipe, and tile products—by Lovell Clay Products Co. decreased. Sand and gravel production, at two commercial and two Government-and-contractor operations, declined 164,000 tons; Taggart Construction Co. produced granite under contract for the Federal Bureau of Public Roads. The Great Western Sugar Co. processed and used 25 percent less lime at its beet-sugar refinery at Lovell.

Campbell.—Except for $4,000, mineral fuels accounted for all of the value of mineral production in the county; crude petroleum accounted for 95 percent of the total value. Production of petroleum increased 22 percent, whereas natural gas production decreased 10 percent. The county again had 10 discoveries; 9 were new fields. In initial production, the Northwest Basin discovery was the most significant; the Union Texas Petroleum Corp. No. 2 Government-Bishop Land, sec 9, T 47 N, R 60 W, was completed for 656 barrels of oil per day from the Minnelusa formation (Pennsylvanian) at a depth of 9,900 to 9,930 feet.

A slight increase, less than 1 percent, in coal production by Wyodak Resources Development Corp. was recorded. Sand and gravel output was reported from one Government-and-contractor operation.

Carbon.—Crude petroleum, valued at $8.3 million, 51 percent of the total value of mineral production, was the leading commodity, followed by uranium ore and coal. Petroleum production declined 239,000 barrels, 7 percent. However, natural gas production increased 86 percent because of recent discoveries and building of pipeline outlets. The Barrel Springs field was a significant gas discovery; the discovery well yielded nearly 5 million cubic feet of gas per day from 10,701 to 10,710 feet. In 1965, McCulloch Oil Co. of California reported that a major oil discovery was completed in late December 1964. Completion of the No. 2 Bence-Federal, sec 22, T 19 N, R 89 W, opened the Espy field with initial production of 1,089 barrels of oil per day. In the same field, a later well found gas in a new pay horizon.

Uranium ore production increased over that of 1964. Output from five mines, compared with four in 1964, was by Utah Construction & Mining Co. and Petrotomics Co. in the Shirley basin; Basins Engineering Co., Inc., in the Washakie basin; and Joe Wentz in the Poison basin. One joint venture in the Shirley basin also reported small production. Coal production by Rosebud Coal Sales Co. and Monolith Portland Midwest Co. was 6 percent below the county total in 1964. Hanna Basin Construction & Coal Co. closed its coal operations.

Sand and gravel production from eight commercial and seven Government-and-contractor operations increased 116 percent. Stone production was only 2 percent of 1964 output. Gold, silver, and copper were produced from the Bonrite property by Uraninite Corp. Silver and copper were produced by Manson Mines, Ltd., from the Copper Range property.

Converse.—Mineral fuels accounted for most of the total value of mineral production; crude petroleum was the leading

commodity, valued at $11.3 million, followed by coal, uranium ore, and LP gases. South Glenrock and Big Muddy oilfields again were ranked first and second, respectively, in production.

Coal production by Pacific Power & Light Co. (Dave Johnston Strip) and Best Coal Co. (Antelope Strip) increased 25 percent.

Uranium ore output from nine operations, compared with seven in 1964, decreased 56 percent. B & H Mines, Inc., Mrak Mining Co., Susquehanna-Western, Inc., and Western Nuclear, Inc., operated in the Dry Fork area. Western Nuclear, Inc., continued to operate the Spook concentrator. Because of decreased uranium ore output, vanadium production decreased substantially.

Three commercial and five Government-and-contractor operations increased sand and gravel production 269 percent. Ivestor Construction Co., a contractor for the Federal Bureau of Reclamation, produced granite for riprap.

Crook.—Petroleum production in the county was valued at nearly $20 million, an increase of $2.9 million, or 17 percent. Among five discoveries, four were new fields. Davis Oil Co., No. 2 Allen, was completed for 224 barrels of oil per day from the Minnelusa formation (Pennsylvanian) to open the Little Mo field. Anschutz Oil Co., Inc., and Cooperative Refinery Association, No. 1 Government-Amax-Mobil, discovered the Ammo field with initial production of 221 barrels of oil per day from the Muddy formation (Cretaceous). West Moorcroft, Coyote Creek, and Donkey Creek fields continued as the principal producing fields.

Bentonite production decreased 9 percent. Producers were ADM, American Colloid Co., Baroid, and IMC.

Operations by Homestake Mining Co., Susquehanna-Western, Inc., and Balboa Mining & Development Co. decreased uranium ore output by 1 percent. The production from the Hulett area was processed by Mines Development, Inc., at Edgemont, S.Dak. The quantity of vanadium oxide recovered from the uranium ores was 32 percent higher than that of 1964.

Sand and gravel production by one commercial and one Government-and-contractor operation decreased 35 percent. Crushed stone output also decreased substantially.

Fremont.—Among the mineral commodities, petroleum was ranked first in value at $27.1 million, a decrease of 12 percent. The county was ranked third in gas and fourth in oil production in the State. Four oilfields yielded over a million barrels of oil each, Beaver Creek 2.7 million, Winkleman 2.4 million, Steamboat Butte 2 million, and Big Sand Draw 1.2 million. The principal gasfields were Beaver Creek 16.6 billion cubic feet (the State's second largest), Riverton Dome 9.9 billion, Frenchie Draw 3.9 billion, Pavillion 3.5 billion, and Big Sand Draw 3.3 billion.

The East Riverton field, a deep discovery of major importance, was one of four gas discoveries in Fremont County. The discovery well, Continental Oil Co., No. 1 Tribal, found gas in the Frontier, Muddy, and Lakota formations (all Cretaceous) at depths from 9,770 to 11,258 feet; combined initial production from the three horizons was 23 million cubic feet per day. By yearend, the new field had produced 580 million cubic feet of gas.

Iron ore production by USS increased 9 percent. The increase was mainly accounted for by the beneficiating plant reaching and surpassing the rated 1.3 million tons

Table 13.—Uranium operators in Fremont County in 1965

Operator	Locality	Type of mine
Atlas Corp., Atlas Mineral Division	Gas Hills	Underground.
Continental Uranium Company of Wyoming	Crooks Gap	Do.
Federal-Gas Hills Partners	Gas Hills	Open pit.
Green Mountain Uranium Corp	Crooks Gap	Underground.
P. C. Mining Corp	Gas Hills	Open pit.
Peters Mining Co	----do	Do.
Union Carbide Corp., Gas Hills Operations	----do	Open pit and underground.
Utah Construction & Mining Co., Lucky Mc Operation	----do	Do.
J. M. Wade	----do	Open pit.
Western Nuclear, Inc	----do	Open pit and underground.

of iron ore agglomerates 1 year ahead of schedule.

The county led the State in uranium ore output, accounting for 63 percent of the total uranium ore production; production, however, decreased 23 percent.

The Western Nuclear, Inc., Split Rock mill started solvent extraction of U_3O_8 to increase the recovery rate and raise the product purity from 88 to 96 percent U_3O_8. The company awarded a contract to Centennial Development Co., Eureka, Utah, to sink an 800-foot, three-compartment shaft on the Golden Goose property. This operation was part of a $1.5 million, 18-month development plan to obtain 1,200 tons of ore daily by January 1967. Production from the Day Loma pit was to be phased out as development of the Golden Goose progressed.

Production of sand and gravel from eight operations, compared with seven in 1964, increased fifteenfold.

Stone output, increasing substantially, was used for irrigation projects in the Midvale Irrigation District.

One operator produced a small quantity of beryllium concentrate.

Goshen.—Mineral production value was less than that of 1964. Holly Sugar Co. used 33 percent less lime in its Torrington beet sugar refinery. Sand and gravel production for road construction decreased. Wallace Minerals produced 170 tons of stone for use in fertilizer. Shut in during 1964, the Torrington oilfield yielded nearly 8,000 barrels of oil in 1965. Three unsuccessful exploratory wells were drilled in the county.

Hot Springs.—As in 1964, the county was ranked second in oil production with an output of 18.5 million barrels, a decrease of 15 percent. However, petroleum accounted for 99 percent of the value of mineral production. The Wyoming State Board of Equalization reported oil production from 18 fields, 1 less than in 1964. The 18 fields included 4 which yielded more than 1 million barrels of oil: Hamilton Dome 7.8 million (fourth largest in the State), Grass Creek 5.4 million, Little Buffalo Basin 1.9 million, and Murphy Dome 1.5 million. Eleven unsuccessful exploratory wells were drilled; of 14 development wells completed, 10 were oil wells.

A decrease in coal production by Roncco Coal Co. and T–K Coal Co. was not offset by increased production by Dusky Diamond Coal Co.; coal output decreased less than 1 percent. Sand and gravel production, from one commercial and one Government-and-contractor operation, increased 106 percent.

Johnson.—Value of crude petroleum produced accounted for 92 percent of the value of total mineral production. Quantity and value of petroleum were higher than in 1964, 4 and 3 percent, respectively. Natural gas and natural gas liquids decreased in quantity and value. Oil production was from 10 fields, and natural gas was produced from 5. The leading oilfield was Sussex with 4.2 million barrels, followed by Meadow Creek 825,000 barrels, and North Fork 727,000 barrels.

Johnson County was the site of the most significant oil discovery in the Rocky Mountain area, the Shell Oil Co. Reno field. In addition to large oil reserves, the field had the deepest production from the Pennsylvanian formations in the Rocky Mountain area and the deepest production in the Powder River basin.

Black Hills Bentonite Co. began producing from its new deposit near Barnum. The company's new 600-ton-per-day mill was put on stream in January; the old 300-ton-per-day mill at Moorcroft was phased out. The new mill, almost completely dust free, was operated from a central control panel by two men per shift. Operators controlled the feed and discharge of the ore bin using television cameras.

Sand and gravel output by four commercial and five Government-and-contractor operations decreased 74 percent.

Laramie.—Morrison-Knudsen Co., Inc., under contract to Union Pacific Railroad Co., mined, crushed, and screened granite for ballast and riprap. The Great Western Sugar Co. produced limestone for sugar refining, railroad ballast, road construction, and flux. Teton Construction Co. mined, crushed, and screened granite for road construction. Peter Kiewit Sons' Co. produced, crushed, and screened limestone for road construction.

Total output of petroleum, ranked second in value, was 513,000 barrels from six fields, an increase of 29 percent. The increase mainly resulted from greater output in two of the fields; Golden Prairie yielded

an additional 83,500 barrels to total 113,400 barrels; South Pine Bluffs had an increase of 24,500 barrels to 71,900.

Wycon Chemical Co., a division of Colorado Oil & Gas Corp., a subsidiary of CIG, awarded a $3.5 million contract to Chemical Construction Co., New York, for new urea-manufacturing facilities at its Cheyenne complex, to be completed by November 1966. Rated production was to be 44,000 tons per year of urea.

The combined sand and gravel output, from four commercial and six Government-and-contractor operations, was 18 percent less than in 1964.

Lincoln.—Mineral fuels comprised most of the value of mineral production. Natural gas liquids, extracted from natural gas from the Big Piney-La Barge area, constituted 55 percent of the value. The Opal gas plant of El Paso Natural Gas Co. produced 79.2 million gallons of natural gas liquids.

Coal output from two open pits operated by The Kemmerer Coal Co. increased 1 percent; the county was ranked second in coal production.

Phosphate rock output, from an open pit operated by San Francisco Chemical Co., decreased 9 percent. The company completed a new augmented three reactor Fluosolids plant in July for production of calcines from ore mined in Utah.

Output of sand and gravel by one commercial and five Government-and-contractor operations decreased 38 percent.

Natrona.—Mineral fuels accounted for 96 percent of the total value of mineral output. Crude oil, valued at $42.4 million, was 90 percent of the total, and natural gas production, valued at $1.6 million, accounted for 3 percent. Crude oil and natural gas output increased in value 7 and 16 percent, respectively. Petroleum production was reported from 39 fields and gas from 9 fields; the principal field was Salt Creek, second largest oilfield in the State, with an oil output of 12 million barrels and a gas production of 7.9 billion cubic feet.

When the Kansas-Nebraska Natural Gas Co. gas processing plant at Casper was completed on December 8, Natrona County had three such plants with a combined throughput capacity of 118.5 million cubic feet of gas per day; output capacity was 157,600 gallons of liquids per day.

The county was the site of 19 percent of all wells drilled in the State and of 24 percent of the development wells. Of the 26 exploratory wells, one discovered the River Bend field with oil production from the Phosphoria formation (Permian).

Sand and gravel output, from five commercial and two Government-and-contractor operations, decreased 5 percent or 62,000 tons.

Bentonite output, processed by Benton Clay Co., Inc., at Casper, was less than that of 1964. The bentonite came from mines near Midwest. Uranium ore production, by Union Carbide Corp., Mining and Metals Division, from three operations and by Joe Wentz from one operation, was 50 percent more. Sodium sulfate was harvested by William E. Pratt Co. from a saline deposit near Natrona.

Niobrara.—Crude oil, natural gas, and LP gases accounted for 93 percent of the value of mineral production in the county. Fourteen oilfields reported oil and gas production. Petroleum production increased 5 percent. The Marathon Oil Co. natural gas plant at the Lance Creek field had a 10-percent increase in production, to 468,000 gallons of LP gases.

Big Horn Construction Co., under contract to the Wyoming Highway Department, mined, crushed, and screened limestone for road construction. Sand and gravel output by one commercial and one Government-and-contractor operation increased 19 percent.

Park.—Mineral fuels accounted for nearly all of the county mineral production value. Petroleum, valued at $81.2 million, was the largest contributor; the county was ranked first in the State in oil production. Petroleum was produced from 26 fields, 4 of which had production of over 1 million barrels: Elk Basin (the State's largest oilfield) 18.5 million, Oregon Basin 7.9 million, Frannie 1.6 million, and Pitchfork 1.1 million. Natural gas, valued at $1.8 million, came from 11 fields; the largest was Elk Basin with output of 8 billion cubic feet, followed by Oregon Basin with 3.9 billion, and Heart Mountain with 2.3 billion. The county had five gas-processing plants which yielded 31.4 million gallons of natural gas liquids valued at $1.4 million.

At yearend, Pan American Petroleum Corp. was installing fieldwide automatic-

processing facilities in the Elk Basin field. The system, when completed in the spring of 1966, was to increase daily production by about 250 barrels per day.

Texaco Inc. discovered a new gas pay zone in the Silver Tip field; the discovery well had an initial production test of 2.7 million cubic feet of gas per day from the Lance formation (Tertiary).

Kern County Land Co. sold its gas plants at Elk Basin and Garland fields and its sulfur plant at Garland to Phillip T. Sharples, Denver, Colo., and Purvin & Gertz, Dallas, Tex.

Output of gypsum by Big Horn Gypsum Co. increased 20 percent. Sand and gravel production, from seven commercial and four Government-and-contractor operations, increased 33 percent. Cave Construction Co., under contract to the National Park Service, processed basalt for concrete and road metal.

Platte.—Iron ore output from the Sunrise mine of CF&I increased 16 percent as a result of the first full year of capacity operation of the new beneficiation plant.

Stone output from five operations, compared with four in 1964, decreased substantially. Guernsey Stone Co., a subsidiary of Peter Kiewit Sons' Co., produced crushed and broken limestone for road construction, railroad ballast, and riprap; some dimension limestone was also produced. Crown, Inc., under contract to the Federal Bureau of Reclamation, produced crushed and broken limestone for riprap. Basins Engineering Co., Wyoming Marble & Dolomite Co., Inc., and Rocky Mountain Aggregates, Inc., produced limestone for construction and decorative uses. Wilson Bros., Inc., produced sand and gravel for building construction.

Sheridan.—Mineral fuels accounted for the greater portion of the value of mineral production. Crude oil from the Ash Creek field, 221,000 barrels, and the South Ash Creek field, 243,000 barrels, was slightly less than in 1964. One development well was drilled in the county.

Coal production from strip mines operated by Big Horn Coal Co. and Welch Coal Co. decreased 82,000 tons. Output of sand and gravel from nine operations, compared with five in 1964, increased by 363,000 tons.

Tongue River Stone Co. produced miscellaneous stone for railroad ballast and road construction. J. D. Pelesky Construction Co. produced crushed and broken granite for roadstone. Cave Construction Co., under contract to the U.S. Army Corps of Engineers, produced miscellaneous stone for riprap. The Federal Forest Service used crushed and broken granite as riprap. Sheridan Block, Brick & Tile Co. slightly increased clay production, used for brickmaking.

Sublette.—Petroleum, natural gas, and LP gases comprised 99 percent of the mineral production value of the county. Crude oil output was 4.5 million barrels valued at $11.3 million; natural gas production was 80.2 billion cubic feet valued at $10.9 million. The county was ranked first in the State in gas production. Three of the principal gasfields in the State were in Sublette County: Greater La Barge (largest in the State) with output of 20.8 billion cubic feet, Tip Top with 15.4 billion, and Big Piney with 14.4 billion. Although petroleum production was only slightly below the level of 1964, gas production declined 18 percent. The gas plant of Chevron Oil Co., at Birch Creek field, produced 516,000 gallons of LP gases, 21 percent less than in the previous year.

Output of sand and gravel from three operations, one more than in 1964, increased by 76,000 tons. Sunset Rock Quarry, Inc., produced dimension sandstone for rough construction. Peter Kiewit Sons' Co., contractor for the Federal Bureau of Public Roads, produced miscellaneous stone for riprap.

Sweetwater.—The county was ranked second in State gas production with an output of 49 billion cubic feet, 11 percent higher than in 1964. Crude oil output was 5 percent lower, with 7.2 million barrels valued at $18 million. Natural gas production was reported from 25 fields, and oil from 21. The gasfields included four with production of over 5 billion cubic feet: Canyon Creek with 8.8 billion, Patrick Draw with 8.1 billion, Tablerock with 7.1 billion, and Patrick Draw-Arch Unit with 6.2 billion. Three oilfields each yielded more than 1 million barrels of oil: Lost Soldier 4 million, Patrick Draw 1.6 million, and Arch Unit 1.3 million. The Patrick Draw gas plant, owned by Union Pacific Railroad Co., and the Bairoil plant, owned by Sinclair Oil and Gas Co., pro-

duced 14.1 million gallons of natural gas liquids.

Two new-pay discoveries were made in the county: Mountain Fuel Supply Co. found gas in the Wasatch formation (Tertiary) with its No. 7 Unit in the Pioneer gasfield which had previously produced from the Mesaverde formation (Cretaceous); U.S. Natural Gas Corp. established Dakota formation (Cretaceous) gas production in its Black Butte Creek Unit which had produced from the Morrison formation (Jurassic). A ¾-mile intended confirmation to the latter discovery was unsuccessful.

Output of sodium carbonate increased 21 percent to supply completed additional facilities of FMC and Stauffer Chemical. FMC announced plans to increase facilities to produce 1.25 million tons by late 1967. Stauffer Chemical announced multimillion-dollar expansion plans to increase production to 875,000 tons of ore by fall 1966. The Solvay Process production shaft was completed to 1,626 feet, and exploration was begun on the trona deposits at 1,560 feet. Construction also was begun on the Solvay Process 500,000-ton-per-year processing facilities, planned to be on stream by fall 1966. TGS completed exploration drilling on its leases west of FMC. Phillips Petroleum Co. successfully bid $97.59 per acre for 2,516 acres 14 miles northwest of Green River and began exploration drilling. Duval Corp. was doing exploration drilling on land leased from Kern County Land Co. Church & Dwight Co. announced plans to construct processing facilities at Green River for manufacturing bicarbonate of soda and other products.

Sand and gravel production from three commercial and five Government-and-contractor operations, compared with four commercial operations in 1964, increased over 1 million tons.

Coal output by Gunn-Quealy Coal Co. and Edwin L. Swanson Bros. increased 15 percent. Fremont Uranium Corp. increased output of uranium ore.

Teton.—Production of sand and gravel from 10 operations, compared with 5 in 1964, decreased 12 percent. Utah-Idaho Sugar Co. increased output of mined and crushed limestone from the Fox Creek quarry; the limestone was used in beet sugar refineries in Idaho. Cave Construction Co. and Hartwell Excavation Co. mined, crushed, and screened basalt under contract with the Federal Forest Service for road construction in Yellowstone National Park.

Less than 5 ounces of gold was obtained from a small placer operation on Spread Creek.

Uinta.—Petroleum, natural gas, and natural gasoline production accounted for more than 75 percent of the value of total mineral production in the county. That part of the Church Buttes field within the county was the source of production; no output was reported from the Aspen, Spring Creek, or Sulfur Creek fields. The Mountain Fuel Supply Co. gas plant in the Church Buttes field produced 589,000 gallons of natural gasoline.

Sand and gravel output from five operations increased eightfold. An increase of 10 percent in clay production was recorded. Interstate Brick Co. manufactured building brick in a Utah plant from clay mined near Evanston. Interpace mined fire clay in Wyoming for manufacturing building brick at its Salt Lake City, Utah, plant.

Washakie.—Production of petroleum, natural gas, and LP gases comprised 90 percent of the mineral production value. Although crude oil output declined by 500,000 barrels, 26 percent, to 1.45 million barrels, it was the most valuable mineral commodity. The principal oilfield, Cottonwood Creek, yielded nearly 869,000 barrels, followed, in order of production, by Hidden Dome, Worland, and Slick Creek fields. Natural gas production decreased 13 percent to 13.8 billion cubic feet; 98 percent was from the Worland field. The Cottonwood Creek gas plant of Pan American Petroleum Corp. was shut down throughout the year. Operations were continued at the Pure Oil Co. plant at Worland; however, ownership was assumed by Union Oil Company of California when that company purchased Pure. Production was 16.8 million gallons of LP gases, 11 percent below that of 1964. TGS produced elemental sulfur from the hydrogen sulfide-bearing gas at Worland field.

A 5-percent increase was recorded for sand and gravel production produced by one commercial and four Government-and-contractor operations. Holly Sugar Co. processed lime for use in beet sugar refining at Worland.

Weston.—Mineral fuels accounted for most of the mineral output value in the county. Crude oil, valued at $9.1 million, led the mineral commodities; production was 7,000 barrels less than during the previous year. Oil production was reported from 21 fields in the county, principally from Fiddler Creek with 1.7 million barrels, Osage with 689,000, Clareton with 205,000, and Mush Creek with 166,000 barrels. The 31 exploratory wells resulted in 1 new field discovery, the Finn field, which yielded a small quantity of oil from the Wall Creek sand (Cretaceous); a later well completed in the field pumped 250 barrels of oil per day from the Newcastle formation (Cretaceous). The GGG Corp. gas plant at Clareton field was shut down leaving the Lonetree plant of N. C. Ginther as the only natural gas plant in the county; output of natural gas liquids was 2.4 million gallons. The Sioux Oil Co. refinery at Newcastle processed crude oil from fields in the general area.

Production of bentonite by American Colloid Co., ADM, and Baroid increased 33,500 tons valued at $285,000, accounting for 23 percent of the mineral production value. Sand and gravel output from two operations, the same number as in 1964, increased 31,000 tons.

Yellowstone National Park.—The National Park Service produced basalt and granite for use in road construction. R. S. Studer & Sons and Cave Construction Co. processed miscellaneous stone for use as riprap for the Federal Bureau of Public Roads.

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